ABSTRACT

Aims and objectives: To assess nurses' knowledge on pressure ulcer (PU) prevention and treatment in Jordan, and the frequency of and factors influencing nurses' implementation of PU prevention and treatment interventions.

Background: Highly educated and experienced nurses can provide effective PU care; however, previous studies highlighted poor knowledge and implementation of PU care.

Design: A correlational study examining nurses' knowledge of PU prevention and frequency of PU preventive actions in Jordanian hospitals.

Methods: Participants were 377nurses and 318 patients from 11 hospitals. Data were collected to quantify the frequency of nurses' implementation of pressure ulcer prevention and treatment interventions for patients suffering from PUs and/or at risk of PU development using a self-reported cross-sectional survey and prospective 8-hour observation

Results: For observed PU prevention while type of hospital and number of beds in units were significant it is not known without further work if this is replicable. For observed PU treatment, linear regression analysis revealed significant negative beta values for more than 50 beds in clinical unit (β=-2.49).

Conclusion: The study addressed new factors, facilitating the provision of prevention and treatment strategies to PU development, including type of clinical institution and number of beds in clinical unit.

Relevance to clinical practice: There is a need to develop training programmes to improve insufficient nurses' knowledge and, thus, clinical practices on PU prevention and treatment. These programmes would assist both junior and senior nurses and other key stakeholders (e.g. hospital managers, policy-makers, and educators) to improve the performance of PU services, thus, minimising patient suffering.

Keywords: Pressure ulcer, knowledge, pressure ulcer prevention, pressure ulcer treatment, Jordan

INTRODUCTION

Pressure ulcers (PUs) are a major health problem, resulting in reduced quality of life (1)and demanding resources from healthcare systems worldwide (2).PUs are seen as an outcome of poor-quality nursing care(3); they are largely preventable (4) and clinical guidelines are available to assist clinicians. In 2017, Anthony et al. reported that there were 854 grade 2–4 PUs in a single year (2015) in Greater Glasgow and Clyde (an area of Scotland with a population of 1.2 million), of which 48.4% were assessed as avoidable (5).PU rates continue to increase significantly (6)in some regions, but not in all. For example, in Germany, total prevalence fell from 12.5% in 2002to 5.0%in2008, probably due to more effective PU prevention strategies (7). Differences in PU prevalence among countries may be attributed to differences in the risk levels and/or use of different prevention strategies. Halfens et al. (8) compared PU prevalence among Austrian, Swiss, and Dutch hospitals. The PU rate was highest among Dutch hospitals which was

probably not due to different risk scores as when only at risk patients were considered the rate remained higher. Preventive measures differed among the countries and this may be the explanation for differing rates.

Nurses 'knowledge about PU prevention and treatment

Nurses' knowledge about PU prevention and treatment is a prerequisite to undertake effective prevention and therapeutic interventions of PU and its complications, which can lead to mortality if not treated effectively.

Numerous studies on nurses' knowledge about PU management revealed contradictory findings. Nurses' knowledge about PU prevention is a significant predictor of implementing PU prevention in practice(9). In 2006, Pancorbo-Hidalgo et al. identified that about 65% of nurses implemented PU prevention interventions (10).Aslan and Giersbergen (11) confirmed that almost 59% of Turkish nurses implemented PU knowledge in clinical practice.

Several studies have shown inadequate knowledge about PU prevention and treatment, though Demarré et al.(12) revealed that knowledge was not a significant independent predictor for applyingPU prevention toat-risk nursing-home residents. Further, a Jordanian study revealed that 73% of nurses had inadequate PU knowledge and skills, leading to ineffective prevention and implementation plans (13).Saleh et al. (14) showed that, although nurses had adequate PU knowledge, their prevention measures were insufficient. Thus, there is a gap between theory and practice

Several factors influencing knowledge about PU prevention and treatment indicated conflicting findings. For example, despite nurses with bachelor degrees having better knowledge on PU prevention, this was not associated with providing PU prevention (15). One study revealed that highly educated nurses demonstrated less knowledge than those with baccalaureate degrees (16).Additionally, nurses working in orthopaedic, trauma, and emergency departments lacked knowledge about PU prevention, classification, and management (17–18).

Factors influencing nurses' implementation of PU management

Moore and Price (19) confirmed that well-educated nurses, having received additional formal training on skin and PU risk assessment, were aware that early actions would reduce the likelihood of PU occurrence. Insufficient documentation and training may have impeded their ability to provide effective preventive care-plans. Both factors have been repeatedly recognised as important for effective nursing (20).

Number of unit beds also affects PU prevention and practices. For instance, crowding is a common problem in Greek hospitals (21).In Jordan, however, the number of unit beds was not associated with implementing PU prevention and treatment interventions (9).

Nurses' characteristics such as gender, age, and experience may influence implementing PU prevention and treatment. There are findings such as that male nurses showed better knowledge on PU prevention (13) that remain to be replicated or substantiated. The literature confirmed no associations with nurses' knowledge and implementation of PU care (9, 11).Although having more than 10 years' experience was significantly associated with PU

prevention knowledge, work experience was not influential in practising better PU prevention (15).

International PU prevention guidelines recommend using an established risk assessment scale (RAS) (6). The purpose of a RAS (e.g. the Braden scale) is to guide nurses' clinical judgement (10) to expand the clinical effectiveness of PU prevention (e.g. incidence reduction). The predictive capability of nurses' clinical judgement can be augmented by access to structured PU risk assessment activities (22).This might be expected to improve nurses' clinical effectiveness of PU prevention. RASs, along with advanced PU prevention measures, have been employed recently in Jordan hospitals, which may explain nurses' lack of PU prevention (9).

What is most needed is to explore factors influencing PU care, to determine the level of knowledge and observe its implementation in clinical practice (19).Thus, the present study was developed to assess nurses' knowledge and practice of PU prevention and treatment in Jordan and to observe factors associated with PU care in clinical practice.

MATERIALS AND METHODS

Aims

This study aimed to assess:

- Nurses' knowledge of pressure ulcer prevention and treatment
- Frequency of observed implementation of pressure ulcer prevention and treatment in clinical practice

- Factors influencing nurses' implementation of pressure ulcer prevention and treatment interventions

Study design

This is a correlational study examining nurses' knowledge of PU prevention and frequency of PU preventive actions in Jordanian hospitals.

First, a self-reported cross-sectional survey was undertaken to assess nurses' knowledge of PU prevention and treatment. Next, a prospective 8-hour observation quantified the frequency of nurses'PU prevention and treatment interventions for patients suffering from, or at risk of PUs.

Sample and setting

Inclusion criteria were hospitals in Jordan with 200 or more beds and medical-surgical, and critical care units. Eleven hospitals (6 government, 2 university, 1 military, and 2 private) met the inclusion criteria (23)

From these, a list of all units with potential PU patients, including medical-surgical, and critical care units was obtained from the nursing directors. Three clinical units per hospital were randomly selected (33 in total). All selected units implemented the Braden RAS as a requirement for hospital accreditation (24).

Nurses working in the selected units were surveyed. The sample consisted of registered nurses with baccalaureate and/or 3-year diploma, and associate degree nurses (2-year diploma). All participants were involved in direct patient assessment and PU prevention and treatment.

Senior nurses were excluded. Observed patients were adults (18 years and older), and having at least a mild risk of developing a pressure ulcer- Braden score ≤17. We also included any patient suffering from PU grade 1–4according to EPUAP-NPUAP guidelines (25), who had been admitted to critical care or medical-surgical unit for at least 24 hours, regardless of their Braden score.

Power calculation

A power analysis using G*power (26) gave a required sample size of128 for an independent groups *t*-test. This figure used power=0.80, α=0.05(2-tailed) and effect size=0.5 (medium effect). A sample of 377 nurses and 318 patients was achieved.

Measures

Nurse demographics and professional characteristics

Nurses ' characteristics included gender, age, education, having postgraduate education, experience, hospital type, type of clinical unit number of unit beds, knowledge about PU, having PU training, using PU RAS and PU classification system involvement in PU research, and whether they agree with EPUAP-NPUAP's (25)definition of PU.

Patients' demographics

Observed patients' characteristics included gender, age, hospital type, length of stay, previous hospitalisation, medical diagnosis, and level of PU risk using the Braden scale.

Nurses 'knowledge and implementation of PU prevention and treatment

In the first part of the study a questionnaire collected data about Jordanian nurses' knowledge and practice of PU prevention and treatment, based on previous works (9, 21, 27) and EPUAP-NPUAP's PU prevention and treatment recommendations(6, 25). An initial 60-item questionnaire was subjected to validation by researchers and expert nurses (n=10), assessing comprehensiveness, clarity, avoidance of ambiguity, and content validity. This involved circulating the draft items until there was consensus on content, order, and wording. The questionnaire contained the following subscales:

- PU prevention: 16interventions considered effective/ineffective according to EPUAP-NPUAP (6, 25) guidelines and expert panel.
- PU treatment: 29 interventions considered effective/ineffective according to EPUAP-NPUAP (6, 25) guidelines and expert panel.

For each intervention, participants were asked to indicate its degree of appropriateness according to their knowledge (yes=1/no=0). Eleven items were reverse-coded (Appendix 1). The total knowledge index scores were reached by adding positive responses in both subscales.Cronbach's alpha reliability was as follows: total instrument=0.61, prevention knowledge subscale=0.47,treatment knowledge subscale=0.62, observed prevention subscale=0.61, and observed treatment subscale=0.71.

The questionnaire was piloted using a sample of 40 nurses after gaining ethical approval. Thirty-two questionnaires were received. Afterwards, some items were reworded for clarity and

the questionnaire was revised to combine similar items and remove misleading or repeated items. The pilot sample was excluded from the main study.

Observed PU prevention and treatment

In the second part of the study, the items assessing nurses' knowledge in the first part were used to formulate an observational checklist to measure nurses' implementation of prevention and treatment interventions in clinical practice. For each item, the observer assessed nurses' performance assisting patients with and/or at risk of PU as follows: always=2, sometimes=1, never=0.

The Braden scale was used to determine the risk of PU occurrence (cut-off score ≤17). EPUAP-NPUAP's classification system (6, 25) was applied to distinguish those patients with PU. These checklists were assessed through an inter-rater reliability index. Two trained nurses assessed the performance of one nurse caring for a patient with grade 3PU. These nurses showed an almost 0.90 intra-class correlation coefficient in scoring checklist items and were in agreement with the researchers' (Tissue Viability Nurse Specialist) assessment.

Ethical considerations

Ethical approval was sought and granted by the Research and Ethics Committee at the School of Nursing, The University of Jordan, and the Research and Ethics Committee of each participating hospital. Participation was voluntary. The anonymity and confidentiality of both nurse and

patient participants were ensured by assigning identification numbers to participants, restricted to the research team. The questionnaire contained detailed information about the study's objectives, and returned questionnaires implied consent.

Written consent was obtained from patients involved in the observation. Patient participants could choose to leave the study at any time, or they could refuse participation and/or inspection for PU development.

Data collection

Survey of knowledge

A detailed explanation of the study was presented to senior nurses at participating hospitals. A list of available nurses was prepared by selected hospitals one day before data collection. Questionnaires were distributed to nurses by the researchers via departmental managers and charge nurses. Each questionnaire had a covering letter explaining the study, its aims, and how to complete and return the form. Self-completed questionnaires were returned in a sealed envelope to the researchers.

Observation

When the self-reported questionnaires were collected from participants, observational checklists were used to measure nurses' implementation of PU prevention and treatment interventions. The observation procedure was implemented in nursing units that had completed the survey. The 8-hour prospective observation of nurses' performance with patients showed that flexibility, consistency, and adequacy of PU prevention and treatment interventions were applied in clinical settings. Each nurse participant was observed separately. Observation followed an arranged plan

with unannounced visits to participating units. To reduce observational bias, 10 nurses were trained for two weeks on the EPUAP-NPUAP (6, 25) grading system, Braden scale for PU risk assessment, EPUAP guidelines for PU prevention and treatment, and using the observational checklists. Trained nurses reviewed patients' medical records to document patients' demographic data and identify eligibility.

Observed nurses who performed care with patients were aware of the observers' presence but not their specific tasks (28).

Data analysis

Items that were not practice-recommended were reverse-coded (Appendix 1). Total scores were computed for prevention knowledge, treatment knowledge, observed PU prevention, and observed PU treatment. Dependent variables were observed PU prevention and observed PU treatment (both normalised 0–100). Independent variables were type of clinical unit (medical-surgical or critical care), institution, number of beds in ward/unit, years of experience, basic education, higher education (yes/no),length of time since last attended PU training session, involvementin PU research (yes/no),knowledge sources about PU, using RAS(yes/no),agreement with definition of PU,PU grading (yes/no), and demographics (gender, age).Also, knowledge of prevention/treatment was calculated (normalised 0–100).

Univariate inferential tests were used to determine variables that may influence observed PU prevention/treatment (dependent variables).Both were roughly normally distributed by visual inspection using histograms. Finally, linear regression analysis was employed to show associations of independent variables found to be significant under univariate analysis, on observed implementation of PU prevention and PU treatment. Additionally, knowledge of

prevention was added as a covariate for observed PU prevention, and knowledge of treatment was added as a covariate for observed PU treatment. Significant results were examined at α=0.05 (2-tailed) probability, and the beta showed the strength of the relationship between the dependent and independent variables.

RESULTS

Descriptive statistics

Of 460 questionnaires distributed, 377 were returned (Response rate=81.9%). In addition, of 360 eligible patients, 318 were observed for PU prevention and treatment intervention (Response rate=88.3%). Demographic data of nurse participants are presented in Table 1 and observed patients' characteristics are presented in Table 2.Knowledge sources about PU were largely from formal education or in-service education. Most nurses (89.9%, n=339) were not involved in research activities on pressure ulcers. Only 34.2% stated using RAS. About 90% of participants (n=335) agreed on the definition of PU and 49.6% acknowledged using the EPUAP-NPUAP classification system. Regarding observed patients, about 168 (52.8%) were aged ≥60 years and most (89.9%, n=286)had previous hospitalisation. Half had a short length of stay, for 1–3 days (52.5%, n=167), and218 (68.6%) had mild to moderate risk of PU development. Sixty-six percent and 79% of nurse participants disagreed with using 'doughnuts' and 'massage', respectively, yet 32% said they always use'doughnuts'to prevent pressure ulcers.

The knowledge and observed implementation scores are shown in Tables 3 and 4. Table 5showsknowledge and implementation indices of PU prevention and treatment. Results showed

less than satisfactory knowledge on PU prevention and treatment (74.5% and 72.6%respectively, where we would hope to have at least 80%) and very inadequate implementation of PU prevention and treatment (49.2% and 44.9%, respectively).

Univariate analysis

Institution was significantly associated with observed prevention and treatment interventions (p=0.001), with the military hospital having higher implementation than governmental, university, or private hospitals in both cases. Type of clinical unit, namely critical care, was significant for observed prevention (p=0.007), but not significant for observed treatment. Gender was not significant for either implementations, nor were experience, age, basic education, knowledge sources, last attended PU training, involvement in PU research, agreement with PU definition or PU classification. Higher education was significant for implementing treatment (p=0.005), but was not significant for prevention. Using RAS was significant for treatment (p=0.031), with higher implementation for those employing a RAS. Number of beds was significant for both prevention and treatment (p=0.001 and p=0.018), with units having fewer beds experiencing higher implementation than larger units in both cases.

Regression analysis

Linear regression used observed prevention as the dependent variable. Independent variables included institution, type of clinical unit, number of beds in unit, and knowledge about PU prevention, all were significant under univariate analysis. All categorical independent variables

were dummy coded, except for knowledge of prevention. This gave significant negative beta values for the type of institution (university and private hospitals) and significant positive association for the number of beds in unit (10–20 beds) (Table 6).

For observed treatment (Table 7), linear regression used observed treatment as dependent and independent variables were those significant under univariate analysis-institution, higher education, using RAS, number of beds in unit, and knowledge about PU treatment. All independent variables were dummy coded, except for treatment knowledge. This gave significant negative beta values for institution (governmental and private hospitals) and also for number of beds in unit (>50 beds).

DISCUSSION

The present study assessed nurses' knowledge and practice of PU prevention and treatment in Jordan and explored factors associated with PU care in clinical practice.

Pressure ulcer care was better in the military hospitals, but with only one military hospital included it is difficult to interpret this result – it may just be that the particular military hospital has high standards not generalizable to other military hospitals.

The number of beds in clinical units was only significant for prevention interventions for units with 10-20 beds, neither more nor fewer were significant (though 31-40 beds approaches significance) and it is possible this result is not replicable. For treatment interventions only beds >50 was significant. A previous study found no such relation with bed size (9).This may be attributable to limited nursing resources in clinical units with more beds (and far more beds than would be typical in most countries). .

Nurses have less than adequate knowledge of PU prevention and very inadequate implementation of PU care. There is a need to increase pressure ulcer training both in nurse education and continuing education after graduation.

Our study revealed that more educated nurses did not provide better PU treatment. However, highly educated nurses were aware that undertaking early actions would reduce the likelihood of PU (19). Training and documentation are recognised as being essential for providing PU care (20).A consideration is the mismatch between supply and demand for highly educated nursing services(19).Additionally, anecdotal evidence suggests that more educated nurses undertake less hands-on care. Poor knowledge of managing PU complications by highly educated nurses was evident compared with those holding a baccalaureate degree (16). Additionally, highly educated nurses may have insufficient clinical experience; in Jordan, many degree-level nurses continue with postgraduate education at the expense of clinical experience.

We suggest that the recent use of RASs (the Braden scale) and clinical employability of PU definition and PU staging in Jordan may orient nurses to organise clinically effective PU prevention plans. Most nurses agreed with the latest definition of PU and that using structured RAS was significant for PU treatment. But no predictive value was evident regarding their impact on undertaking effective PU prevention and treatment. A higher Braden score may increase use of PU prevention and treatment activities, though there is no evidence that using such scales reduces pressure ulcer incidence. In addition, the validity and reliability of frequently used RASs for PU are questionable due to limited evidence regarding their usefulness (22). However, the predictive capability of nurses' clinical judgement can be augmented through

access to structured PU risk assessment activities. Besides, the usefulness of a structured RAS has no clinical significance once the PU has developed (29).

Our study found no influence of nurses' demographics (e.g. age, gender) on their likelihood of undertaking PU care activities. The literature suggests that neither demographics nor experience influence PU care (30).

Limitations to the study

The observed data on nurses' knowledge were self-reported. The observation approach was applied to at-risk patients and the PU interventions were examined. Yet, the unplanned observations were exclusive of the prevention and treatment care provided—not all PU interventions provided to at-risk patients could be observed. Further, the 8-hourobservation interval may have missed observing changes on patients' skin and PU interventions.

The questionnaire and its content validity have not been tested other than by its piloting and the team of experts, respectively. Also, familiarity of ward nurses with the investigator may have biased their use of PU management interventions.

CONCLUSIONS

PU treatment is less good in units with >50 beds which leads one to consider that work load, occupancy rate, availability of resources, and nurse–patient ratios essential to plan effective PU care may be different in these units. Additional investigation is required to shed light on the

theory–practice gap, perhaps through an experimental approach, to improve the transformation of knowledge into practice.

Relevance to clinical practice

Significant gaps of knowledge were identified on skin assessments, risk assessment procedures, and management strategies regarding nurses' views towards PU care policies. Therefore, there is a clear need to develop training programmes to improve the clinical utility of nurses' knowledge regarding PU prevention and treatment. These training programmes would assist both junior and senior nurses (e.g. nurse managers) and other key stakeholders (e.g. hospital managers, policy-makers, and educators) to improve PU prevention and treatment services, thus minimising patients' suffering. One form of training would be to arrange courses regarding the effective management of PU and its complications. At ward level, senior nurses would update junior staff, while promoting best practice. Another form would be to introduce a simulation-based training system for different stages of PU management, such as debridement of a deep ulcer.

Regular updates on best practice should be shared among ward staff and newcomers to ensure excellent standards are maintained, reducing the theory–practice gap and the time-lag between research findings and implementation. Consequently, the well-being of patients and their families would improve, and there would be long-term cost-savings for healthcare organisations due to reduced patients' stays.

This study's practice implications move beyond the specific nursing specialty (i.e. PU management) and are applicable to other specialties. In palliative care, it is imperative to provide

lifelong training to nurses to bridge the theory–practice gap and well-recognised strategies address this issue (e.g. use of a nurse-link) (31).Similar activities help to improve the translation of knowledge into practice in other specialties (e.g. paediatric nursing) and geographical areas (e.g. Pakistan) (32).

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Appendix 1 Description of the reverse-coded items used in the analysis

Prevention interventions
Item no. 13: Use skin barrier creams to protect reddened skin
Item no.14: Use alcohol solution on the skin.
Item no.15: Use donuts-type devices to relieve pressure on areas at risk.
Item no. 16: Massage reddened areas and/or bony prominences is helpful in pressure ulcer prevention.
Treatment interventions
Item no. 22: Using antiseptics frequently to clean PrU wounds (e.g. iodine providing, H2O2, chlorohexidine).
Item no. 23: Dry dressing used on a PrU such as dry gauze or iodine soaked gauze.
Item no. 24: Change dressing on daily basis regardless of the condition of the wound-bed and findings of wound assessment.
Item no. 25: Use topical antibiotics on PrU with signs of infection
Item no. 27: Use alternative methods in PrU treatment such as (honey, heat, or other preparations)
Item no. 28: Leave the necrotic (dead) tissues) with no debridement on ulcers without signs of infection
Item no. 29: Use the same type of dressing for all ulcers.

Source: Original items as adapted from the tool (Saleh *et al.* 2013)

Table 1 Nurse Participant's characteristics (N=377)

		N	%
Institution	Governmental	133	35.3
	University	86	22.8
	Private	66	17.5
	Military	92	24.4
Unit	Medical-surgical	175	46.4
	Critical care	202	53.6
Unit Beds M =22 SD=14 R=5-64	Less than 10	101	26.8
	10-20	102	27.1
	21-30	53	14.1
	31-40	94	24.9
	41-50	3	0.8
	More than 50	16	4.2
Experience in Years	Less than 1 year	78	20.7
	1-4	140	37.1
	5-10	103	27.3
	11-15	32	8.5
	16-20	14	3.7
	More than 20 years	10	2.7
Gender	Male	189	50.1
	Female	188	49.9
Age (years) M =27.4 SD=4.5 R=21-50	21-26	207	54.9
	27-32	125	33.2
	33-38	31	8.2
	39-44	12	3.2
	45-50	2	0.5
Basic Education	BsC	329	87.3
	Diploma 3 years	32	8.5
	Associate Degree 2 years	15	4.0
Higher education	Yes	63	16.7
	No	314	83.3
Source of knowledge	University Degree	178	47.2
	In service education	43	11.4

	Conference attendance Product Promotion Degree plus in service education	4 24 128	1.1 6.4 34.0
Last attended PU training	Less than one year ago 1-2 years More than 2 years Never attended	113 57 70 136	30.0 15.1 18.6 36.1
Using RAS	Yes No	129 248	34.2 65.8
Involved in PU research	Yes No	38 339	10.1 89.9
Agreement with PU definition	Disagree Agree	42 335	11.1 88.9
Availability PU classification (Grading)	Yes No	187 190	49.6 50.4

M=Mean, SD=Std. Deviation, R (Range)=Min-Max

Table 2 Observed patient's characteristics (N=318)

Patient's Characteristics		n (%)
Institution	Governmental	126(39.6%)
	University	80 (25.1%)
	Private	31(9.7%)
	Military	81 (25.5%)
Gender	Male	204 (64.1%)
	Female	114 (35.8%)
Age (in years)	18-39	69 (21.7%)
	40-59	81(25.5%)
	60-69	82(25.7%)
	70-79	64 (20.1%)
	80-89	18 (5.7%)
	≥ 90	4 (1.2%)
Length of stay	1 day-3 Days	167 (52.5%)
	4 days -6 days	83(26.1%)
	1 week – 29 days	49 (15.4%)
	1 month-6 months	19(5.9%)
	> 6 Months	0 (0.0%)
Previous hospitalization	Yes	286 (89.9%)
	No	32 (10.1%)
Diagnosis	Medical-surgical	197 (61.9%)

	Critically ill	121 (38.01%)
Level of PU risk using Braden scale	≤ 9 (Severe risk) 10-12 (High risk) 13-14 (Moderate risk) 15-17 (Mild risk)	57 (17.9%) 43(13.5%) 61 (19.2%) 157(49.3%)

Table 3Assessed level of prevention knowledge and the actual preventive care provided,

PU prevention knowledge and implementation		Prevention knowledge		Prevention Implementation		
		Yes (%)	No (%)	Never (%)	Sometimes (%)	Always (%)
1.	Assess pressure ulcer usingrisk assessment scale suchas The Braden scale	71.1	28.9	24.9	54.4	20.7
2.	Inspect and document skincondition on daily basis(basically areas at risk andbony prominences such as the Sacrum) for dryness, cracking, erythema(redness), maceration, Fragility, heat andinduration.	90.2	9.8	3.7	92.8	3.5
3.	Avoid excessive friction(rubbing) and/or friction over bony prominencesin patient's movements	88.1	11.9	5.0	94.2	0.8
4.	Avoid excessive moisturedue to incontinence, perspiration, wounddrainage and maintainskin clean and dry.	90.5	9.5	0.8	97.9	1.3
5.	Assess, support and maintain nutritionallycompromised patients.For example, the needfor NGT feeding andserum Albumin level.	85.9	14.1	22.3	77.2	0.5
6.	Maintain patient's activity(outside the bed) andmobility (within the bed)according to patient'shealth condition	92.3	7.7	21.2	76.4	2.4

7.	Reposition those patientsat risk frequently and onregular basis (if it is safeto do so)	92.8	7.2	0.0	87.0	13.0
8.	Use pillows, foam wedges to relief pressure over bonyprominences such as knees,or heels	91.5	8.5	1.9	95.8	2.3
9.	Use principles of safemanual handling duringtransfer and/or positioningof the patient	90.5	9.5	0.0	97.8	2.2
10.	For those patients seatedon chair, they should notexceed 2 h out of the bed	80.1	19.9	5.9	72.3	21.8
11.	Encourage patients toreposition themselves andredistribute weight every15 min (if this possible)	81.2	16.2	13.0	49.9	37.1
12.	Educate nurses and/orcare givers the principlesof pressure ulcerprevention	88.1	11.9	10.1	88.5	1.4
13.	*Use skin barrier creams to protect reddened skin	13.3	86.7	2.4	91.0	6.6
14.	*Use alcohol solution onthe skin	55.4	44.6	37.6	62.4	0.0
15.	*Use donuts-type devices to relieve pressure on areasat risk	34.0	66.0	15.6	52.5	31.9
16.	*Massage reddened areas and/or bony prominences is helpful in pressureulcer prevention	21.0	79.0	10.1	86.2	3.7

* Reverse-coded items

Table 4Assessed level of knowledge of implementation and the actual treatment implemented

PU treatment knowledge and implementation		Treatment knowledge		PU Treatment Implementation		
		Yes (%)	No (%)	Never (%)	Sometimes (%)	Always (%)
1.	Existence of appropriatepressure ulcer definition	82.5	17.5	6.1	81.4	12.5
2.	Using valid classificationsystem that define pressureulcer into four stages(grades)	70.0	30.0	7.5	85.7	6.8

3.	Full assessment anddocumentation of apressure ulcer included(location, size, grade,wound bed, exudates,pain, surrounding skin, and undermining) ondaily orweekly basis	84.9	15.1	1.6	92.8	5.6
4.	Re evaluate a pressureulcer as the patient'scondition deteriorates	85.9	14.1	4.2	93.4	2.4
5.	Performing completephysical examination forthose patients who arenewly developed pressureulcer	82.8	17.2	11.7	84.1	4.2
6.	Assess and manage nutritional needs ofpatients who developedor at risk of pressure ulcer development suchas food ingestion	84.1	15.9	3.7	94.4	1.9
7.	Assess for and managepain related to pressureulcer development	89.7	10.3	1.9	98.1	0.0
8.	Educate nurses and caregivers on pressure ulcermanagement	85.9	14.1	1.9	95.8	2.3
9.	Manual repositioning ofthe patient of at least 3 h	83.3	16.7	8.8	91.2	0.0
10.	Using special devices inpatient's repositioning suchas sliding sheet, slidingboard and/or hoist	68.2	31.8	10.1	58.4	31.5
11.	Assess patient's bed orchair for safety, mobility,and comfortability	88.3	11.7	1.6	96.0	2.4
12.	Avoid positioning of thepatient on a developedpressure ulcer	63.7	36.3	22.8	77.2	0.0
13.	Apply pressure ulcerrelief, reduction, orredistribution devices suchalternating air mattress(bed), low air loss system,foam overlays, gel pads,and/or air fluidized beds	81.4	18.6	2.1	91.2	6.7
14.	Debridement (removal of dead tissues) of necrotictissues using surgical(scalpel), enzymaticagents, and/or hydrocolloid hydrogeldressings	84.1	15.9	1.9	93.9	4.2
15.	Clean a pressure ulcerusing normal saline 0.9%solution	89.9	10.1	2.1	97.3	0.6
16.	Cover a pressure ulcerwith moist primarydressings such ashydrocolloids	76.4	23.6	20.7	77.4	1.9
17.	Wound dressing protocolplanned and supervised byTissue Viability NurseSpecialist (TVNS)	67.4	32.6	39.6	33.2	27.2
18.	Assess for signs andsymptoms of pressure ulcerwound infection such	89.1	10.9	3.2	96.8	0.0

	aspurulent discharge, odor,pathology findings, and/orosteomyelitis					
19.	Apply aseptic technique(hand washing, steriledressing) in caring thosepatients who are havinginfected pressure ulcer orwith signs and symptoms of osteomyelitis	91.8	8.2	1.6	98.4	0.0
20.	Collaborate with healthcare professionals toprovide adjunctivetherapies relevant topressure ulcer care such as electrotherapy, hyperbaricoxygenation, or laser therapy	60.5	39.5	30.9	43.4	25.7
21.	Obtain Tissue culture forinfected pressure ulcer	83.2	16.8	26.6	57.8	15.6
22.	*Using antisepticsfrequently to cleanpressure ulcer wound suchas iodine povidine, H2O2,chlorohexidine	27.6	72.4	38.0	62	0.0
23.	*Dry dressing used ona pressure ulcer such as drygauze or iodine soakedgauze	22.5	77.5	30.9	69.1	0.0
24.	*Change dressing on dailybasis regardless thecondition of the wound bedand findings of wound assessment	24.4	75.6	7.8	92.2	0.0
25.	*Use topical antibiotics onpressure ulcer with signs ofinfection	10.1	89.9	18.6	81.4	0.0
26.	Antibiotics are prescribedaccording to the results of swab culture in an infectedpressure ulcer	88.1	11.9	2.2	96.8	1.0
27.	*Use alternative methods in pressure ulcer treatmentsuch as (honey, heat, orother preparations)	57.5	42.5	55.3	22.3	22.4
28.	*Leave the necrotic(dead) tissues with nodebridement on ulcerswithout signs of infection	43.2	56.8	62.8	37.2	0.0
29.	*Use the same type ofdressing for all ulcers	36.9	63.1	38.8	61.2	0.0

* Reverse-coded items

Table 5 Nurses' knowledge index and implementation index of PU prevention and treatment

Index	M	SD	Min - Max	Percentiles		
				25th	50th	75th
Knowledge of PU Prevention	74.5	11.1	31-100	68.7	75.0	81.2
Knowledge of PU treatment	72.6	11.0	38-93	65.5	75.8	79.3
Observed implementation of PU prevention	49.2	8.1	34-78	43.7	50.0	56.2
Observed implementation of PU treatment	44.9	6.9	29-64	41.3	43.1	48.2

M=Mean, SD=Std. Deviation

Table 6 Regression analysis of observed PU prevention interventions (obtained from linear regression using enter method)

	B	Std. Error	Standardized Beta	t	P Value*
(Constant)	54.3	3.30		16.4	<0.001*
Knowledge of PU prevention	-0.01	0.04	-0.02	-0.36	0.711
University Hospital	-4.37	1.32	-0.23	-3.31	0.001*
Private Hospital	-3.67	1.48	-0.17	-2.57	0.011*
Military Hospital	0.34	1.44	0.01	0.23	0.812
Critical Care unit	-1.21	1.33	-0.07	-0.91	0.362
Number of unit beds					
< 10	1.8	1.55	0.10	1.17	0.240
10-20	3.7	1.33	0.21	2.77	0.006*
21-30	2.9	1.59	0.12	1.83	0.06
41-50	0.93	4.60	0.13	0.202	0.84
> 50	2.0	2.29	0.05	0.874	0.38

*Regression analysis of PU observed prevention intervention final model produced at a = 0.05, F = 3.65, P< 0.001, R^2 =0.32.

Table 7Regression analysis of observed PU treatment interventions (obtained from linear regression using enter method)

	B	Std. Error	Standardized Beta	t	P Value*
(Constant)	44.12	2.66		16.57	< 0.001
Knowledge of PU treatment	0.029	0.034	0.045	0.84	0.39
GovernmentalHospital	- 7.24	1.009	- 0.493	-7.19	< 0.001*
University Hospital	-2.28	1.25	-0.190	-1.899	0.059
Private Hospital	-8.51	1.399	-0.422	-6.08	< 0.001*
Having higher education	0.34	1.006	0.018	0.339	0.735
Using RAS	0.41	0.88	0.027	0.46	0.645
Number of unit beds					
< 10	1.33	1.01	0.084	1.31	0.19
21-30	0.38	1.26	0.019	0.30	0.76
31-40	-1.63	1.09	-0.103	-1.49	0.13
41-50	-0.30	3.78	-0.004	-0.07	0.93
> 50	-5.00	2.04	-0.147	-2.49	0.013*

*Regression analysis of observed PU treatment intervention final model produced at a = 0.05, F = 8.801, P< 0.001, R^2 =0.508.

Declaration of interest: No conflict of interest for any of the authors

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