Nursing Students' Knowledge on Pressure Injuries Following a Blended-Learning Unit: A Quasi-experimental Study

Paul Bobbink, MScN; Géraldine Gschwind, MScN; Lucie Charbonneau, MSc; Carole Guex, BScN; Laurent Chabal, BScN, ETN; and Sebastian Probst, DClinPrac, MNS, RN

ABSTRACT

OBJECTIVE: To assess first-year bachelor's degree in nursing students' knowledge about pressure injury (PI) etiology, classification, prevention, and management following blended learning and clinical practice.

METHODS: A quasi-experimental design was used. Nursing students' PI knowledge was measured using the French version of the Pressure Ulcer Knowledge Assessment Tool (PUKAT) at three time points: baseline (before a blended-learning unit, consisting of 2 hours of e-learning and 3 hours of practical workshop), after the blended-learning unit, and after clinical practice.

RESULTS: A total of 21 students participated over the three time points. At baseline, the mean percentage of correct answers on the PUKAT was 45.8%. This score increased to 59.2% following the blended-learning unit and 65% after completing the clinical practice ($F_{2,58} = 19.08$; $P = .00$). Over the three time points, students scored highest on knowledge of risk assessment and lowest on knowledge of prevention.

CONCLUSIONS: Blended-learning units combining e-learning and practical workshops are valuable tools to increase students' knowledge about PIs. The PUKAT enables the evaluation of changes in students' knowledge following a teaching unit on PIs. However, more research is needed to assess the long-term evolution of knowledge and the impact of this teaching on clinical practice.

KEYWORDS: blended learning, clinical practice, e-learning, knowledge, nurse education, nursing students, practical workshop, pressure injury, pressure ulcer, PUKAT

INTRODUCTION

The incidence of pressure injuries (PIs) is high, with approximately 3 million cases worldwide.[1] The overall PI prevalence is estimated to be 12.8% in hospitalized adult patients[2] and varies by setting, with prevalence rates as high as 27% in neonates,[3] 12% to 18% among ICU patients,[4] 13.1% in patients admitted to palliative home care settings,[5] and 3.9%[6] to 8.9%[7] among patients in acute care settings.

Pressure injuries can cause pain, odor, and disability, reducing quality of life[8] and extending the length of hospital stay by an average of 4 days[9] in an adult population and 14 days[3] in a pediatric population. By increasing the need for care resources, PIs represent a major economic burden for healthcare systems worldwide. The annual US expenditure for hospital-acquired PIs is estimated to be $26.8 billion.[10] Data from Australia report annual PI-related healthcare costs in public hospitals of $9.11 billion.[11] These costs are predicted to rise dramatically in the upcoming years due to the aging population and growing incidence of obesity.

Although PI prevention is a multidisciplinary responsibility, nurses play a pivotal role because they offer 24-hour patient care[12] and PI prevention is a key indicator of nursing standards.[13] It is important that nurses have the appropriate knowledge and skills to prevent and treat PIs. Evidence demonstrates that nurses' knowledge and skills vary between different PI prevention domains, such as identifying prevention protocols,[14] classifying and assessing PI risk, and planning preventive activities.[15,16]

Low levels of PI knowledge are reported not only among nurses but also among nursing students.[17–20] It

may be that nursing students do not receive sufficient education on PIs during their undergraduate curriculum.[21] Different instruments have been used to measure PI knowledge and skills.[22] Assessments of nurses' and nursing students' PI knowledge using the Pressure Ulcer Knowledge Assessment Tool (PUKAT) have obtained a mean score range between 39.7% and 58.5%, which is described as insufficient.[17,18,23–26] The lowest scores primarily related to PI prevention,[17,18,24] whereas the highest score was generally nutrition knowledge.[17,23] Only one study found the highest score for the "risk assessment" theme.[24]

Knowledge deficits can be improved by specific training programs.[27] It is important to support knowledge development for nursing students with an adapted curriculum[21] and using specific educational methods.[17,25] Both nurses and nursing students must be trained in PI prevention and management. Evidence demonstrates an increase in nurses' knowledge of PI prevention and treatment following PI trainings.[28–30]

To address this fact, the chair of wound care of the Geneva School of Health Sciences, HES-SO University of Applied Sciences and Arts of Western Switzerland, developed a blended-learning unit that combined e-learning and a practical workshop to improve first-year bachelor's degree in nursing students' PI knowledge and skills. This scenario was developed to align with the learning outcomes provided by the level 5 curricula for nurses of the European Wound Management Association.[31] This study evaluates bachelor's degree in nursing students' baseline PI knowledge and the evolution of their knowledge over time following a blended-learning unit and clinical practice.

METHODS
Using a quasi-experimental design, the authors collected data over three time points between October 2021 and February 2022.

Participant Recruitment and Study Setting
All 220 nursing students from the first semester of a French-speaking University of Applied Sciences and Arts of Western Switzerland were invited to participate. The researchers provided oral information about the project in class as well as via an online forum. Students were invited to fulfill the questionnaire at the three time points. Participation was voluntary, and the assessment had no impact on their course.

Bachelor's Degree in Nursing Curricula
In Western Switzerland, the bachelor's degree in nursing content is prescribed by the same educational framework, which defines the minimum content.[32] The bachelor's degree in nursing is a 3-year program, representing a workload of 180 European Credits Transfer Accumulation System, of which 60 are allocated to clinical practice. In the University of Applied Sciences and Arts of Western Switzerland, the chair of wound care implemented a specific approach to wound care education over a period of 3 years, including education on PIs, skin tears, diabetic foot and leg ulcers, and malignant fungating wounds.[33]

Participants' Education Background
Bachelor's degree in nursing students arriving at the University of Applied Sciences and Arts have a heterogeneous background from their previous training. Because of regulations, most students access the first-year bachelor's degree in nursing after a preparatory year. This preparatory year contains 2 hours of theoretical courses on PIs and 8 hours of workshops. During the workshops, the students practice positioning to prevent PIs, clinical examination of the skin, and how to hydrate the skin to prevent dryness. During this year, they also have two 14-week clinical experiences: one in a professional environment and one in a healthcare environment. Other students directly access the first-year bachelor's degree in nursing after completing healthcare/nurse assistant courses or specific equivalencies.

Pedagogical Scenario
A blended-learning unit with a flipped classroom approach was developed to promote a theoretical and practical approach to learning. Learning outcomes of the e-learning and workshops are described in Table 1. All students began with an e-learning lesson based on recent literature and the latest consensus document, which covered PI classification,[34] prevention, and treatment and highlighted specificities of PIs related to medical devices. This interactive unit was designed using Articulate Storyline and reviewed by nurses with a Certificate of Advanced Studies in wound care for content validity. The e-learning unit included text where important information was highlighted and pictures to illustrate PI classification and specific positions to prevent PIs. Integrated videos explained specific aspects of PI prevention. Students could access the e-learning unit at any time and had 2 hours to complete it.

After the e-learning was complete, the researchers divided students into 22 subgroups with 10 students each. A workshop design was used to implement the theory into practice. Each 4-hour workshop was tutored by a wound care nurse specialist with a certificate of advanced studies in wound care. To ensure equity between groups, wound care nurse specialists received a paper tutorial and a 15-minute explanation about the workshop's pedagogical intentions. During the workshop, students could practice on high-fidelity wound care models with all stages of PIs on the basis of a clinical situation.

Table 1. LEARNING OUTCOMES FOR EACH EDUCATION MODALITY

E-Learning	Workshop
- Explain the pathophysiology of PI	- List and define the different categories of PI
- Identify PI categories	- Orally transmit the wound assessment and classify the PI using professional terminology
- Differentiate IAD from PI	- Practice a PI dressing (categories 1 and 2) while respecting the quality-of-care criteria and relationship with the patient
- List the risk factors for PI	- Use the evaluation tools linked to a clinical vignette
- Assess the patient's risk	- Transfer the knowledge acquired during the theoretical courses concerning PI and IAD
- Propose preventive and therapeutic measures according to the person's needs and environment	- Explain to the patient the risk factors for PI and recommendations for good practice
- Propose ways of educating people and their entourage on the principles of prevention and PI management	

Abbreviations: IAD, incontinence-associated dermatitis; PI, pressure injury.

Following the theoretical part of the bachelor's degree, nursing students participate in a 6-week clinical practice (internship) in different settings, such as hospital units, home care, or nursing homes. To support learning, students can ask questions at any time in a specific forum where both students and lecturers can respond.

Data Collection

All data were collected using the Moodle learning platform (Cyberlearn) via online surveys. Data were collected at three time points: at baseline before the blended-learning unit (T0), after the blended-learning unit (T1), and after 6 weeks of clinical practice (T2). Figure 1 provides an overview of data collection.

Sociodemographic questionnaire. At baseline, students completed a sociodemographic questionnaire that included questions about age, highest academic level achieved, years of professional experience in health, and setting of professional experience. Students had the option not to answer these questions.

The PUKAT. At all three time points, students completed the PUKAT 2.0[35] to measure their PI knowledge. The PUKAT is a valid and reliable tool to measure knowledge about PIs[22] that is appropriate for use with nursing students.[36] It contains 25 questions across six

themes: (1) etiology, (2) classification and observation, (3) risk assessment, (4) nutrition, (5) prevention of PI, and (6) specific patient groups. The PUKAT 2.0 has satisfactory psychometric properties;[35] the level of difficulty (0.12–0.91), discrimination index (0.02–0.34), quality of the response alternatives (0.01–0.70), and test-retest procedure (0.69) are good.[35]

The English version of the PUKAT 2.0 was translated and culturally adapted to Swiss French using a translation and a back-translation process.[37] Two bachelor's degree nurses working as assistant lecturers at the university independently translated the PUKAT from English to Swiss French. Outputs were compared and clarified if needed. Then, two independent nurses provided a back-translation. Differences were highlighted and discussed, and consensus was reached between wound care experts and a dietitian. Because there were only slight differences, no pilot test was needed. The translated questionnaire was used with all students.

Data Analysis

Data were extracted from the learning platform, cleaned, and anonymized prior to statistical analysis using Stata 16 (StataCorp). Data were analyzed using descriptive statistics. The researchers included data only from participants

Figure 1. TIMELINE OF DATA COLLECTION
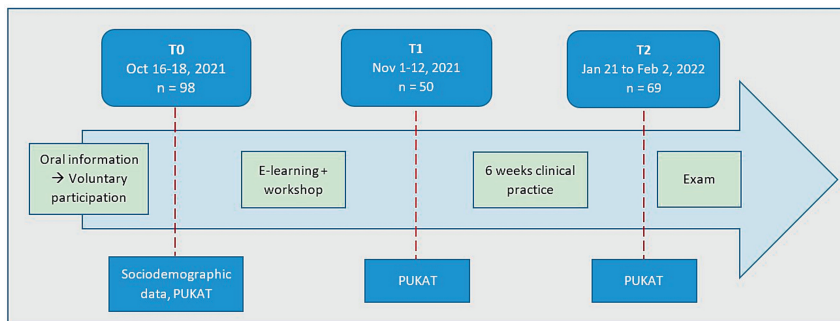
who responded at all three time points. Differences in scores among the three time points were identified using an analysis of variance test, and t tests were used to compare scores before and after the blended learning (T0-T1), before the blended learning and after clinical practice (T0-T2), and after the blended learning and after clinical practice (T1-T2). Effect size was calculated with Cohen d adapted to paired data when the t test showed significant differences ($P < .05$).

Ethics

This study was approved by the director of the University of Applied Sciences and Arts Western Switzerland, Geneva, and dean of the nursing faculty. The researchers followed principles defined in the Declaration of Helsinki, as well as national guidelines for research. Participation was entirely voluntary and had no impact on student evaluation. The return of a completed questionnaire indicated consent to participate. Because this study did not involve treatment or personal data and data were anonymized prior to analysis, no ethical approval was required according to the Human Research Act (HRA)[38] and the Research Ethics Committee (2022-00891).

RESULTS

General Demographic Characteristics

Of a total of 220 enrolled first-year nursing students, 21 students responded at all three time points, resulting in a participation rate of 9.5%.

The mean age of the participants was 25.4 (SD, 7.5) years (range, 19–47 years), and the highest academic degree reported was a master's degree in another discipline. One participant indicated not having any clinical experience; the majority (n = 12) had 1 or more years of professional experience in different healthcare settings before the start of the bachelor's degree in nursing program. The clinical practice locations varied, but no participants had previous experience on a surgical or medical unit. Table 2 provides an overview of participants' academic achievement and previous clinical experiences.

Changes in PUKAT Scores Over Time

At all three time points, students scored lowest on prevention knowledge (34.5%, 49.4%, and 52.4% at T0, T1, and T2, respectively) and highest on risk assessment (64.5%, 81%, and 83.5% at T0, T1, and T2, respectively). Table 3 outlines the percentage of correct answers over the total scores and themes. The results per item are available in the Supplemental Table (http://links.lww.com/NSW/A167).

At baseline (T0), only two students (9.5%) selected the correct answer for why a ring cushion (donut) should not be used for PI prevention, and one student (4.8%) knew the importance of not securing the blanket under

Table 2. ACADEMIC AND CLINICAL EXPERIENCE OF PARTICIPANTS, N = 21

Characteristic	n (%)
Highest academic level attained	
High school	3 (14.28)
Nurse assistant with a federal diploma in vocational education and training	4 (19.05)
Federal vocational baccalaureate	10 (47.62)
Bachelor's	2 (9.52)
Master's or PhD	1 (4.76)
Other	1 (4.76)
Duration of professional health experience, y	
None	1 (4.76)
<1	8 (38.10)
1–2	4 (19.05)
3–4	4 (19.05)
≥5	4 (19.05)
Setting of professional experience	
Home care	4 (19.05)
Nursing home	7 (33.33)
Pediatrics/maternity	3 (14.29)
Readaptation	3 (14.29)
Outpatient clinic	1 (4.76)
Other	3 (14.29)

the mattress. In contrast, 16 students (76.2%) correctly selected the appropriate positioning protocol.

After completion of the blended-learning unit (T1), four students (19.1%) indicated the correct use of bed linen, and five (23.8%) knew why a ring cushion should not be used for PI prevention.

After the 6 weeks of clinical practice (T2), the item with the fewest correct answers was the proper use of the blanket, with only two students (9.5%) answering correctly. Although students scored highest on risk assessment (83.5%), they also scored well on nutrition (82.7%).

Total PUKAT scores increased from 45.8% correct at baseline to 59.2% after the blended-learning unit and 65% after clinical practice ($F_{2,58} = 19.08$; $P = .00$). This increase was statistically significant before and after the blended-learning unit (T0-T1; 95% CI, −4.89 to −1.81; $P = .00$) and before the blended-learning unit and after clinical practice (T0-T2; 95% CI, −6.64 to −3.26; $P = .00$), with respective Cohen d effect sizes of −1.02 and −1.37. The increase in mean score between T1 and T2 was not significant (95% CI, −3.49 to 0.29; $P = .09$). Figure 2 illustrates the evolution of total scores over time.

DISCUSSION

This project highlights the difficulties in obtaining longitudinal student participation. The response rate over the

Table 3. PUKAT TOTAL SCORES AND SPECIFIC THEME SCORES

Variables	T0				T1				T2			
	n (MD)	Mean (SD)	Range	Correct Answers, %	n (MD)	Mean (SD)	Range	Correct Answers, %	n	Mean (SD)	Range	Correct Answers, %
Total score	20 (1)	11.45 (2.09)	7–15	45.8	20 (1)	14.8 (3.47)	10–21	59.2	21	16.24 (3.51)	11–25	65
Theme												
Etiology	21	2.52 (1.17)	0–5	42	21	3.09 (1.18)	1–5	51.5	21	3.52 (1.40)	0–6	58.7
Classification and observation	20 (1)	2.25 (0.91)	0–4	56.3	20 (1)	2.6 (0.94)	1–4	65	21	2.81 (0.87)	1–4	70.3
Risk assessment	21	1.29 (0.56)	0–2	64.5	21	1.62 (0.59)	0–2	81	21	1.67 (0.48)	1–2	83.5
Nutrition	21	1.52 (0.93)	0–3	50.7	21	2.19 (0.81)	1–3	73	21	2.48 (0.75)	1–3	82.7
PI prevention	21	2.76 (1.51)	0–6	34.5	21	3.95 (1.75)	1–8	49.4	21	4.19 (1.81)	0–8	52.4
Specific patient	21	1.19 (0.51)	0–2	59.5	21	1.38 (0.50)	1–2	69	21	1.57 (0.51)	1–2	78.5

Abbreviation: MD, missing data; PI, pressure injury; PUKAT, Pressure Ulcer Knowledge Assessment Tool.

three time points was low (9.5%), even though students received a precontact and a reminder e-mail at each measuring point, as recommended in the literature.[39] However, despite the small sample size, the results show a statistically significant increase in students' PI knowledge after participation in a blended-learning unit and clinical practice. These results align with an integrative review suggesting that e-learning and face-to-face teaching could enhance clinical skills[40] and research noting that well-structured and well-designed blended learning can impact students' success.[41,42] Regarding PI knowledge specifically, the literature confirms that an intervention combining face-to-face and virtual training improves nurses' knowledge.[43]

The finding that students had insufficient PI knowledge measured at baseline (T0) before the blended-learning unit was not surprising because participants started their nursing education 1 month prior to this study. The knowledge score after conducting the blended-learning unit and the clinical practice reached 65%, which is higher than the recommended knowledge score of 60%.[17,18,24,44] However, these results could be influenced by reusing the same questionnaire at all three time points.[45]

The results highlight the challenges with developing knowledge about PI prevention and support previous research about nursing students[17,18,23–26] and nurses,[46,47] indicating that knowledge about prevention is insufficient. The authors determined that PI prevention was probably not sufficiently highlighted during the blended-learning unit. For example, students did not practice the use of ring cushions or sheets, which could explain their low scores on the related PUKAT questions.

The theme of risk assessment obtained the highest percentage of correct answers over the three time points. These numbers are confirmed in another study using the same measurement tool (PUKAT 2.0).[24] During the workshop, risk assessment tools were discussed to highlight similarities and discrepancies, which could

support knowledge evolution and explain students' good understanding of the available tools.

According to Beeckman et al,[36] the PUKAT could be used in undergraduate nursing education to identify low-scoring themes and items. This was also the case using the French translation. Identifying the themes with the lowest scores will help the department improve the blended-learning unit and adapt the current curricula to meet students' education needs. Future workshops will include a stronger focus on PI etiology and prevention and will clarify the difference between incontinence-associated dermatitis and PIs.

Strengths and Limitations

To the authors' knowledge, this is the first study to follow nursing students over three time points to evaluate knowledge evolution after a blended-learning unit and clinical practice. The use of a standardized tool enhances the validity of the results and helps improve future teaching modalities by obtaining real-world data. One limitation of this research is that there was no psychometric validation of

Figure 2. PUKAT SCORE EVOLUTION OVER TIME
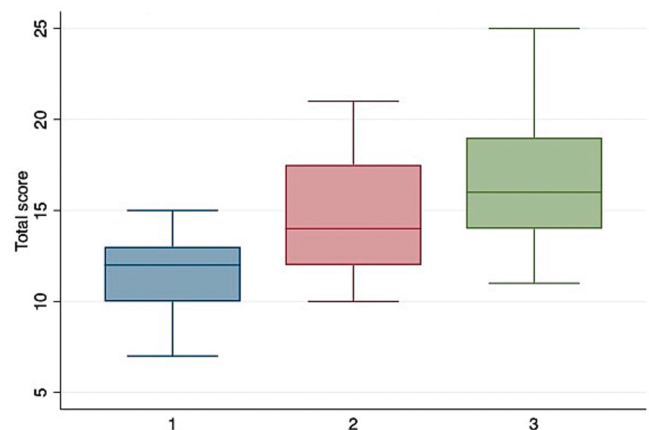
Abbreviation: PUKAT, Pressure Ulcer Knowledge Assessment Tool.

the French version of the PUKAT 2.0. In addition, this quasi-experimental study did not include a control group. The low response rate may be because students could complete the survey at home after receiving a reminder, potentially introducing a participation bias. However, a statistical comparison between groups and the respondents at each time point supports the validity of the findings.

CONCLUSIONS

This research found that nursing student knowledge about PIs increased after a blended-learning unit in combination with clinical practice. Students exhibited a low level of knowledge about PI prevention over the time points. Therefore, the nursing curriculum needs to be updated to include more information about PI prevention, which could influence the quality of care provided to patients across settings. Further research is needed to evaluate the long-term retention of knowledge and how bachelor's degree in nursing students will use it in clinical practice. ●

REFERENCES

1. Zhang X, Zhu N, Li Z, Xie X, Liu T, Ouyang G. The global burden of decubitus ulcers from 1990 to 2019. Sci Rep 2021;11(1):21750.
2. Li Z, Lin F, Thalib L, Chaboyer W. Global prevalence and incidence of pressure injuries in hospitalised adult patients: a systematic review and meta-analysis. Int J Nurs Stud 2020;105:103546.
3. Triantafyllou C, Chorianopoulou E, Kourkouni E, Zaoutis TE, Kourlaba G. Prevalence, incidence, length of stay and cost of healthcare-acquired pressure ulcers in pediatric populations: a systematic review and meta-analysis. Int J Nurs Stud 2021;115:103843.
4. Chaboyer WP, Thalib L, Harbeck EL, et al. Incidence and prevalence of pressure injuries in adult intensive care patients: a systematic review and meta-analysis. Crit Care Med 2018;46(11):e1074-81.
5. Artico M, Dante A, D'Angelo D, et al. Prevalence, incidence and associated factors of pressure ulcers in home palliative care patients: a retrospective chart review. Palliat Med 2018;32(1):299-307.
6. Association nationale pour le développement de la qualité dans les hôpitaux et les cliniques. Chutes et escarres, médicine somatique aiguë adultes. Rapport comparatif national 2019. 2019. https://www.anq.ch/wp-content/uploads/2020/09/ANQaigu_Chutes_Escarres_Adultes_Rapport-comparatif-national_2019.pdf. Last accessed September 12, 2023.
7. VanGilder CA, Cox J, Edsberg LE, Koloms K. Pressure injury prevalence in acute care hospitals with unit-specific analysis: results from the International Pressure Ulcer Prevalence (IPUP) Survey database. J Wound Ostomy Continence Nurs 2021;48(6):492-503.
8. Gorecki C, Brown JM, Nelson EA, et al. Impact of pressure ulcers on quality of life in older patients: a systematic review. J Am Geriatr Soc 2009;57(7):1175-83.
9. Graves N, Birrell F, Whitby M. Effect of pressure ulcers on length of hospital stay. Infect Control Hosp Epidemiol 2005;26(3):293-7.
10. Padula WV, Delarmente BA. The national cost of hospital-acquired pressure injuries in the United States. Int Wound J 2019;16(3):634-40.
11. Nghiem S, Campbell J, Walker RM, Byrnes J, Chaboyer W. Pressure injuries in Australian public hospitals: a cost of illness study. Int J Nurs Stud 2022;130:104191.
12. Li Z, Marshall AP, Lin F, Ding Y, Chaboyer W. Knowledge of pressure injury in medical and surgical nurses in a tertiary level hospital: a cross-sectional study. J Tissue Viability 2022;31(1):24-9.
13. Van den Heede K, Sermeus W, Diya L, et al. Nurse staffing and patient outcomes in Belgian acute hospitals: cross-sectional analysis of administrative data. Int J Nurs Stud 2009;46(7):928-39.
14. Kim JY, Lee YJ. A study on the nursing knowledge, attitude, and performance towards pressure ulcer prevention among nurses in Korea long-term care facilities. Int Wound J 2019;16 Suppl 1(Suppl 1):29-35.
15. Porter-Armstrong AP, Moore ZE, Bradbury I, McDonough S. Education of healthcare professionals for preventing pressure ulcers. Cochrane Database Syst Rev 2018;5(5):CD011620.
16. Parisod H, Holopainen A, Koivunen M, Puukka P, Haavisto E. Factors determining nurses' knowledge of evidence-based pressure ulcer prevention practices in Finland: a correlational cross-sectional study. Scand J Caring Sci 2022;36(1):150-61.
17. Usher K, Woods C, Brown J, et al. Australian nursing students' knowledge and attitudes towards pressure injury prevention: a cross-sectional study. Int J Nurs Stud 2018;81:14-20.
18. Simonetti V, Comparcini D, Flacco ME, Di Giovanni P, Cicolini G. Nursing students' knowledge and attitude on pressure ulcer prevention evidence-based guidelines: a multicenter cross-sectional study. Nurse Educ Today 2015;35(4):573-9.
19. Beeckman D, Schoonhoven L, Boucque H, van Maele G, Defloor T. Pressure ulcers: e-learning to improve classification by nurses and nursing students. J Clin Nurs 2008;17(13):1697-707.
20. Gunningberg L, Martensson G, Mamhidir AG, Florin J, Muntlin Athlin A, Baath C. Pressure ulcer knowledge of registered nurses, assistant nurses and student nurses: a descriptive, comparative multicentre study in Sweden. Int Wound J 2015;12(4):462-8.
21. Xiong S-Q, Sang M, Huang Y-Q, Wang H-P, Jin2 C-D. The competence of nursing students to prevent pressure injury—a scoping review. TMR Integr Nurs 2020;4(2):38-44.
22. Kielo E, Suhonen R, Ylonen M, Viljamaa J, Wahlroos N, Stolt M. A systematic and psychometric review of tests measuring nurses' wound care knowledge. Int Wound J 2020;17(5):1209-24.
23. Gunningberg L, Pöder U, Carli C. Facilitating student nurses' learning by real time feedback of positioning to avoid pressure ulcers—evaluation of clinical simulation. J Nurs Educ Pract 2015;6:1.
24. Cukljek S, Rezic S, Ficko SL, Hosnjak AM, Smrekar M, Ljubas A. Croatian nurses' and nursing students' knowledge about pressure injury prevention. J Tissue Viability 2022;31(3):453-8.
25. Kara H, Arikan F, Kahyaoglu A. Student nurse knowledge of and attitudes toward pressure injury prevention: how sufficient is undergraduate education? Adv Skin Wound Care 2021;34(9):473-80.
26. Cullen Gill E, Moore Z. An exploration of fourth-year undergraduate nurses' knowledge of and attitude towards pressure ulcer prevention. J Wound Care 2013;22(11):618-9, 620, 622, passim.
27. Kim G, Park M, Kim K. The effect of pressure injury training for nurses: a systematic review and meta-analysis. Adv Skin Wound Care 2020;33(3):1-11.
28. Jiang L, Li L, Lommel L. Nurses' knowledge, attitudes, and behaviours related to pressure injury prevention: a large-scale cross-sectional survey in mainland China. J Clin Nurs 2020;29(17-18):3311-24.
29. Aydin AK, Karadag A, Gul S, Avsar P, Baykara ZG. Nurses' knowledge and practices related to pressure injury: a cross-sectional study. J Wound Ostomy Continence Nurs 2019;46(2):117-23.
30. Wu J, Wang B, Zhu L, Jia X. Nurses' knowledge on pressure ulcer prevention: an updated systematic review and meta-analysis based on the Pressure Ulcer Knowledge Assessment Tool. Front Public Health 2022;10:964680.
31. Pokorna A, Holloway S, Strohal R, Verheyen-Cronau I. Wound curriculum for nurses. J Wound Care 2017;26(Suppl12):S1-27.
32. Haute Ecole Spécialisée de Suisse occidentale (HES-SO) University of Applied Sciences of Western Switzerland. Plan d'études cadre bachelor 2012—Filière de formation en soins infirmiers de la haute école spécialisée de suisse occidentale. 2012. https://www.hes-so.ch/data/documents/plan-etudes-bachelor-soins-infirmiers-878.pdf. Last accessed September 18, 2023.
33. Bobbink P, Teixeira CM, Charbonneau L, Chabal L, Guex C, Probst S. E-learning and blended-learning program in wound care for undergraduate nursing students. J Nurs Educ 2022;61(1):53-7.
34. European Pressure Ulcer Advisory Panel (EPUAP) NPIAPN, Pan Pacific Pressure Injury Alliance (PPPIA). Prevention and Treatment of Pressure Ulcers /Injuries. The International Guideline. 2019.
35. Manderlier B, van Damme N, Vanderwee K, Verhaeghe S, van Hecke A, Beeckman D. Development and psychometric validation of PUKAT 2.0, a knowledge assessment tool for pressure ulcer prevention. Int Wound J 2017;14(6):1041-51.
36. Beeckman D, Vanderwee K, Demarre L, Paquay L, van Hecke A, Defloor T. Pressure ulcer prevention: development and psychometric validation of a knowledge assessment instrument. Int J Nurs Stud 2010;47(4):399-410.
37. Maneesriwongul W, Dixon JK. Instrument translation process: a methods review. J Adv Nurs 2004;48(2):175-86.
38. Swiss Confederation. Federal Act on Research Involving Human Beings. Vol 810.30; 2011. https://fedlex.data.admin.ch/filestore/fedlex.data.admin.ch/eli/cc/2013/617/20210526/en/pdf-a/fedlex-data-admin-ch-eli-cc-2013-617-20210526-en-pdf-a.pdf. Last accessed September 18, 2023.
39. Wu M-J, Zhao K, Fils-Aime F. Response rates of online surveys in published research: a meta-analysis. Comput Human Behavior Rep 2022;7:100206.
40. McDonald EW, Boulton JL, Davis JL. E-learning and nursing assessment skills and knowledge—an integrative review. Nurse Educ Today 2018;66:166-74.
41. Jowsey T, Foster G, Cooper-Ioelu P, Jacobs S. Blended learning via distance in pre-registration nursing education: a scoping review. Nurse Educ Pract 2020;44:102775.
42. Saiz-Manzanares MC, Escolar-Llamazares MC, Arnaiz Gonzalez A. Effectiveness of blended learning in nursing education. Int J Environ Res Public Health 2020;17(5):1589.
43. Karimian M, Khalighi E, Salimi E, Borji M, Tarjoman A, Mahmoudi Y. The effect of educational intervention on the knowledge and attitude of intensive care nurses in the prevention of pressure ulcers. Int J Risk Safety Med 2020;31:89-95.
44. Beeckman D, Defloor T, Schoonhoven L, Vanderwee K. Knowledge and attitudes of nurses on pressure ulcer prevention: a cross-sectional multicenter study in Belgian hospitals. Worldviews Evid Based Nurs 2011;8(3):166-76.
45. Höhne JK. New insights on respondents' recall ability and memory effects when repeatedly measuring political efficacy. Qual Quant 2022;56:2549-66.
46. Gress Halasz B, Beresova A, Tkacova L, Magurova D, Lizakova L. Nurses' knowledge and attitudes towards prevention of pressure ulcers. Int J Environ Res Public Health 2021;18(4):1705.
47. Dalvand S, Ebadi A, Gheshlagh RG. Nurses' knowledge on pressure injury prevention: a systematic review and meta-analysis based on the Pressure Ulcer Knowledge Assessment Tool. Clin Cosmet Investig Dermatol 2018;11:613-20.