Original article

Knowledge, attitudes, practices, and barriers related to health information security among undergraduate nursing students

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Abstract

Background: Health information security is a fundamental principle of healthcare practice. However, nursing students remain at risk of breaching patient confidentiality due to limitations in knowledge, skills, and the clinical learning environment.

Objectives: This study aimed to assess nursing students' knowledge, attitudes, and practices regarding health information security, identify associated factors, and explore barriers to health information security practices.

Materials and Methods: A mixed-methods study was conducted at Da Nang University of Medical Technology and Pharmacy from November 2025 to March 2026. The quantitative phase employed a cross-sectional design involving 267 nursing students. The qualitative phase included in-depth interviews with 12 purposively selected nursing students to further explain the quantitative findings. Quantitative data were analyzed using descriptive statistics and multiple linear regression, while qualitative data were analyzed using thematic analysis.

Results: The mean scores for knowledge, attitudes, and practices regarding health information security were 1.69 ± 0.24, 3.75 ± 0.70, and 3.31 ± 0.87, respectively. Knowledge and practice scores were significantly associated with selected academic and clinical factors ($p < 0.05$), whereas the overall regression model for attitudes was not statistically significant ($p = 0.133$). Qualitative findings identified three major categories of barriers to health information security practices: individual, organizational, and system-related barriers.

Conclusion: Nursing students had higher mean scores for knowledge and attitudes toward health information security than for health information security practices. Strengthening practice-oriented education, improving confidentiality guidelines, and enhancing supervision during clinical training are essential to improve nursing students' competency in protecting health information security.

Keywords: *health information security; knowledge; attitude; practice; nursing students.*

1. INTRODUCTION

Against the backdrop of global digital health transformation, protecting personal health information has become an urgent challenge for modern healthcare systems worldwide [1]. The rapid expansion of electronic health records, artificial intelligence (AI)-enabled health monitoring devices, and cloud-based data storage has brought substantial benefits to healthcare delivery, but has also created new security vulnerabilities [1]. In Vietnam, the Government and the Ministry of Health have issued strategic policies, including Decision No. 4888/QD-BYT (2019) and Decision No. 5316/QD-BYT (2020), to promote smart healthcare and comprehensive digital transformation [2, 3]. More recently, the Ministry of Health issued Circular No. 13/2025/TT-BYT, providing guidance on the implementation of electronic medical records (EMRs) and requiring hospitals to implement EMRs by September 30, 2025 [4]. By 2030, Vietnam aims to have 100% of healthcare facilities implement electronic medical records, further increasing the volume and accessibility of electronically stored health information [5]. These developments underscore the increasing importance of health information security within digitally enabled healthcare environments. In this study, health information security refers to the protection of patients' health information from unauthorized access, disclosure, use, or sharing, including appropriate management of medical records, information access, communication, and electronic health information systems.

Nursing students are an important component of the future healthcare workforce and are frequently exposed to sensitive patient information during clinical training [6]. Their access to medical records, clinical documentation, electronic systems, and personal digital devices creates opportunities for

both appropriate and inappropriate handling of patient information. International evidence suggests that nursing students may demonstrate positive attitudes toward patient confidentiality and health information security while still having gaps in their practical knowledge and behaviors related to health information security [6]. The use of personal smartphones during clinical placements, for example, may create potential risks when students access educational materials, communicate with others, or handle patient-related information [7]. In addition, unclear procedures, technological constraints, and insufficiently defined supervisory responsibilities may make it difficult for students to consistently apply health information security requirements in clinical settings [6].

The increasing implementation of EMRs in Vietnam further highlights the relevance of this issue to nursing education. By March 2025, 142 healthcare facilities across 29 provinces and cities had reported using EMRs [8]. At the same time, the healthcare sector operates within a broader cybersecurity environment characterized by increasing threats to information systems [8]. Although national regulations provide an increasingly comprehensive framework for protecting health information and managing EMRs, these regulatory developments do not necessarily indicate that nursing students have adequate knowledge, appropriate attitudes, or consistent practices related to health information security.

In Vietnam, evidence specifically examining health information security among undergraduate nursing students remains limited. Existing nursing education places considerable emphasis on professional ethics, patient confidentiality, and responsible clinical practice; however, less is known about whether students can translate these principles into specific health information security behaviors during clinical placements [9, 10]. Moreover, limited evidence is available on factors associated with students' health information security knowledge, attitudes, and practices, as well as the individual, organizational, and system-level barriers that may influence these practices [11]. This represents an important research gap because identifying only the level of knowledge or attitudes may not fully explain why appropriate practices are or are not adopted in clinical settings.

A mixed-methods approach is therefore appropriate for examining this issue. Quantitative assessment can identify levels of knowledge, attitudes, and practices and their associated factors, while qualitative exploration can provide deeper insights into individual, organizational, and system-level barriers. Integrating these findings can clarify the gap between students' knowledge and attitudes and their practices and inform practice-oriented education, institutional guidance, and clinical supervision. Accordingly, this study was conducted to:

1. To describe the knowledge, attitudes, and practices regarding health information security among nursing students.

2. To identify factors associated with nursing students' knowledge, attitudes, and practices regarding health information security.

3. To explore barriers to health information security practices among nursing students.

2. PARTICIPANTS AND METHODS

2.1. Study Participants

The study participants were full-time third- and fourth-year undergraduate nursing students at the Da Nang University of Medical Technology and Pharmacy, Vietnam, who had received clinical training. The nursing program includes four specialized tracks: General Nursing, Dental Nursing, Anesthesia and Critical Care Nursing, and Midwifery.

Inclusion criteria

+ Phase 1 – Quantitative study: Undergraduate students enrolled in the nursing education program at the University, including students in General Nursing, Dental Nursing, Anesthesia and Critical Care Nursing, and Midwifery, who had participated in clinical placements, been directly involved in patient care activities, and been exposed to patient health information in healthcare settings.

+ Phase 2 – Qualitative study: Participants were purposively selected from students who had participated in Phase 1. Eligible students had relatively higher or lower practice scores, were able to clearly articulate and share their perspectives, and voluntarily agreed to participate in the interviews.

Exclusion criterion: Students who declined to participate in the study.

2.2. Study Period and Setting

The study was conducted from July 2025 to April 2026 at the Da Nang University of Medical Technology and Pharmacy, Vietnam, with data collected from November 2025 to March 2026. The nursing curriculum combines theoretical instruction with substantial clinical training in affiliated hospitals, where students have regular contact with patients, medical records, and health information. Health information security is primarily addressed within courses on law and healthcare organization (2 credits) and medical psychology and professional

ethics (1 credit), rather than as a dedicated course.

2.3. Study Design and Sample Size

A sequential explanatory mixed-methods design (QUAN to QUAL) was employed, with the qualitative phase used to further explain the quantitative findings.

Phase 1: The required sample size was calculated using G*Power version 3.1.9.4 for linear multiple regression analysis (fixed model, R^2 deviation from zero). Assuming a small-to-moderate effect size ($f^2 = 0.08$), a significance level of $\alpha = 0.05$, statistical power of 80%, and 19 theoretically relevant predictor variables, the minimum required sample size was approximately 250 students. A total of 267 students were recruited and included in the final analysis. Convenience sampling was used.

Phase 2: Following preliminary quantitative analysis, purposive sampling was used to deliberately select participants with contrasting levels of practice, an approach that can enhance the breadth of perspectives relevant to the research question [12]. Because no previous qualitative study was available to guide the selection of contrasting practice levels, a threshold of 3.5 on the five-point Likert scale was pragmatically selected by the research team as a threshold representing a relatively higher level of practice. Students with practice scores ≥ 3.5 (n = 7) and < 3.5 (n = 5) were therefore purposively selected to capture contrasting perspectives. This threshold was not intended as an established psychometric or clinical cut-off, but solely as a sampling criterion for the qualitative phase. Semi-structured in-depth interviews were conducted from March 12 to March 21, 2026, lasting 25 – 35 minutes each, audio-recorded with consent, transcribed verbatim, and de-identified. Data were analyzed using inductive thematic analysis in NVivo. Two researchers independently coded the transcripts, compared and discussed coding differences, and reached consensus; related codes were grouped into subthemes and themes. Interviews continued until information saturation, defined as no substantively new codes or themes emerging from subsequent interviews. Quantitative and qualitative findings were integrated at the interpretation stage, with qualitative themes used to explain and contextualize quantitative findings, particularly those related to medical law and ethics, personal electronic device use, clinical supervision, and health information security practices.

2.4. Study Instruments

Data were collected using a questionnaire comprising six parts:

Part 1: Sociodemographic and academic characteristics. This section collected information on sex, age, academic program, year of study, and grade point average (GPA).

Part 2: Exposure to health information during clinical placements. This section assessed students' access to patient health information during clinical practice, their understanding of relevant legal and medical ethical requirements, their habits and purposes of using personal electronic devices during clinical placements, and the guidance and supervision provided by clinical instructors and healthcare professionals regarding health information security.

Part 3: Knowledge of health information security. Students' knowledge was assessed using the instrument developed by Karasneh et al. (2021) [13]. The original instrument was developed and administered among physicians to assess knowledge related to patient confidentiality and data sharing [13]. In the present study, the knowledge items were applied to undergraduate nursing students because their content was relevant to health information security in clinical practice. The instrument consists of seven multiple-choice questions, each with three response options ("Yes," "No," and "Don't know"). Each correct response was assigned 2 points, whereas an incorrect or "Don't know" response was assigned 1 point, as specified in the scoring procedure of the original instrument [12]. Thus, the scoring system was intended to distinguish correct responses from incorrect/uncertain responses while retaining a minimum score of 1 per item. Higher mean scores indicated better knowledge. The original instrument demonstrated good internal consistency (Cronbach's $\alpha = 0.83$) [13]. In a study by Alqahtani et al. (2024) among health sciences students, including 127 nursing students, the seven-item knowledge scale demonstrated acceptable internal consistency, with a Cronbach's alpha of 0.76 [6].

Part 4: Attitudes toward health information security. Attitudes were assessed using the scale developed by Song et al. [14], and subsequently adapted by Kim and Lim. [15]. The scale consists of 23 items across three subscales: attitudes toward communication behaviors (9 items), attitudes toward record confidentiality and information sharing (11 items), and attitudes toward access control of health information (3 items). Items were rated on a 5-point Likert scale ranging from 1 ("Strongly disagree") to 5 ("Strongly agree"). Higher mean scores indicated more positive attitudes toward protecting health information. The original instrument demonstrated excellent reliability (Cronbach's $\alpha = 0.94$) [14], while

the adapted version reported by Kim and Lim yielded a Cronbach's α of 0.875 [15].

Part 5: Health information security practices. Students' practices were assessed using the instrument developed by Kim and Lim (2017) [15]. The original instrument consists of 23 items across three subscales: communication practices (9 items), record confidentiality and information-sharing practices (11 items), and health information access-control practices (3 items). Items are rated on a 5-point Likert scale ranging from 1 ("Never") to 5 ("Always"). With permission from the original author, several items were linguistically adapted for the Vietnamese context, and one item was removed following expert review because of its contextual appropriateness. The final Vietnamese version comprised 22 items. Higher mean scores indicated better health information security practices. Following adaptation, the 22-item version demonstrated high internal consistency in the pilot sample (Cronbach's α = 0.915).

Part 6: Barriers to health information security. This section was used for the qualitative component of the study. The interview guide focused on three main domains of barriers: individual-level barriers, organizational barriers, and system-level barriers. Before use, the interview guide was refined through expert consultation involving nursing faculty members and nurse managers and was pilot tested with a small group of students to ensure clarity and contextual appropriateness.

After obtaining permission from the original authors, the quantitative instruments were translated into Vietnamese using the forward–backward translation procedure described by Cha et al. (2007) [16]. Content validity was assessed by five nursing experts, all of whom held a master's or doctoral degree in nursing and had more than five years of professional experience. The experts evaluated the relevance and semantic clarity of each item using a four-point rating scale. I-CVI and S-CVI were calculated. Based on expert feedback, several items were revised for wording and contextual appropriateness in Vietnam, and one item from the practice scale was removed, reducing the scale from 23 to 22 items. The I-CVI values ranged from 0.80 to 1.00 across the items, while the S-CVI values were 0.92 for the knowledge scale, 0.95 for the attitude scale, and 0.94 for the practice scale. The revised Vietnamese instruments were subsequently pilot-tested in 30 nursing students to assess internal consistency. Cronbach's alpha coefficients were 0.967 for the knowledge scale, 0.947 for the attitude scale, and 0.915 for the practice scale, indicating high internal consistency.

2.5. Data Collection

For the quantitative component, questionnaires were administered directly to students after informed consent was obtained. For the qualitative component, selected students participated in semi-structured interviews, which were audio-recorded with consent and transcribed verbatim.

2.6. Data Analysis

Quantitative data were analyzed using SPSS version 20.0. The distributions of knowledge, attitude, and practice scores were assessed and found to deviate from normality. Accordingly, the Mann–Whitney U test, Kruskal–Wallis test, and Spearman's rank correlation were used to examine associations, with statistical significance set at $p < 0.05$.

All collected participant characteristics were examined in bivariate analyses. Variables with $p < 0.20$, together with theoretically important variables identified from previous literature, were considered for inclusion in multiple linear regression models. Regression assumptions, including linearity, normality and homoscedasticity of residuals, independence, and multicollinearity, were assessed; VIF values were used to assess multicollinearity. Regression coefficients (B), 95% confidence intervals (CIs), p-values, R^2, and adjusted R^2 were reported.

For the qualitative component, interview data were transcribed and analyzed using thematic analysis with the support of NVivo software. Two researchers independently coded the transcripts and discussed discrepancies to reach consensus. Data collection continued until no substantively new codes or themes emerged.

Quantitative and qualitative findings were integrated at the interpretation stage, with qualitative themes used to explain, complement, or contextualize the quantitative findings, particularly the factors and barriers related to health information security practices.

2.7. Ethical Considerations

The study was approved by the Biomedical Research Ethics Committee of the University of Medical Technology and Pharmacy at Da Nang under Decision No. 05/CT-HĐĐĐ, dated November 11, 2025, before the study was initiated. All participants provided informed consent before participation.

3. RESULTS

3.1. General characteristics

Among the 267 students who participated in the study, the mean age was 20.54 years (SD = 0.82; range, 19 - 24 years), and 88.8% were female. Of the participants, 58.0% were enrolled in the general nursing program, and 61.8% had a "good" academic performance classification.

3.2. Access to health information during clinical placements

Table 1. Access to health information during clinical placements among nursing students (n = 267)

	Contents	Number (n)	Percentage (%)
Knowledge of medical law and ethics	Never	9	3.4
	Have heard about them but have limited understanding	82	30.7
	Have studied them but do not clearly remember the content	77	28.8
	Understand them well and can apply them	80	30.0
	Have a very good understanding and have applied them	19	7.1
Frequency of using personal electronic devices during clinical placements	Never	24	9.0
	Occasionally	145	54.3
	Once or twice a week	21	7.9
	Almost every day	52	19.5
	Always when needed	25	9.4
Purposes of using personal electronic devices during clinical placements*	Searching for educational materials	160	59.9
	Taking notes on medical records	48	18.0
	Taking photographs of imaging/laboratory results	35	13.1
	Sending patient information to others	45	16.9
Guidance from clinical instructors/healthcare professionals on health information security	Never	3	1.1
	Rarely	15	5.6
	Occasionally	26	9.7
	Frequently	104	39.0
	Always, with specific reminders	119	44.6
Supervision by clinical instructors/healthcare professionals regarding health information security	No supervision	10	3.7
	Indirect supervision without reminders	41	15.4
	Direct supervision, with reminders when mistakes occur	122	45.7
	Close supervision with specific guidance	94	35.2

Multiple responses were permitted for the purposes of using personal electronic devices during clinical placements; therefore, the percentages do not necessarily sum to 100%.

Comments: As shown in Table 1, 30.7% of students had heard about health information security but did not have a clear understanding of the topic. Regarding the use of personal electronic devices during clinical placements, the most common frequency was "occasionally" (54.3%), with 59.9% of students reporting that they used personal electronic devices to search for educational materials. Overall, 44.6% of students reported always receiving guidance from clinical instructors or healthcare professionals with specific reminders, while 45.7% reported receiving direct supervision with reminders when mistakes occurred.

3.3. Knowledge, attitudes, and practices regarding health information security among nursing students

Table 2. Knowledge, attitudes, and practices regarding health information security among nursing students (n = 267)

Contents	Mean; SD	Range
Knowledge	1.69 ± 0.24	1 – 2
Attitudes	3.75 ± 0.70	1 – 5
Attitudes toward communication behaviors	3.62 ± 0.79	1 – 5
Attitudes toward record confidentiality and information sharing	3.83 ± 0.74	1 – 5
Attitudes toward health information access control	3.79 ± 0.84	1 – 5
Practices	3.31 ± 0.87	1 – 5
Practices regarding communication behaviors	3.58 ± 0.82	1 – 5
Practices regarding record confidentiality and information sharing	3.27 ± 0.99	1 – 5
Practices regarding health information access control	3.07 ± 1.23	1 – 5

As shown in Table 2, the overall mean knowledge score regarding health information security was 1.69 ± 0.24. The overall mean attitude score was 3.75 ± 0.70, with the highest mean score observed for attitudes toward record confidentiality and information sharing (3.83 ± 0.74). The overall mean practice score was 3.31 ± 0.87. Among the practice domains, communication practices had the highest mean score (3.58 ± 0.82).

3.4. Multivariable linear regression analysis of factors associated with knowledge, attitudes, and practices regarding health information security

Table 3. Multiple linear regression analysis of factors associated with knowledge, attitudes, and practices regarding health information security

Model summary

Model	R^2	Adjusted R^2	F-test, p	VIF
Model 1	0.231	0.172	F = 3.910; p < 0.001	1.115 – 4.723
Model 2	0.092	0.026	F = 1.397; p = 0.133	1.113 – 4.622
Model 3	0.211	0.160	F = 4.168; p < 0.001	1.088 – 4.558

B = unstandardized regression coefficient; CI = 95% confidence interval; ref. = reference category; – = not included in the model. Multiple linear regression using the Enter method. Candidate variables were selected based on theoretical relevance and previous evidence. VIF = variance inflation factor.

Multivariable regression analysis showed that higher knowledge scores were significantly associated with enrollment in Dental Nursing and Anesthesia and Critical Care Nursing, being a fourth-year student, greater knowledge of medical law and ethics, and not taking photographs of patient-related data. In contrast, using personal electronic devices almost every day was significantly associated with lower knowledge scores (R^2 = 0.231, p < 0.001). For attitudes, although several individual coefficients reached statistical significance, the overall regression model was not statistically significant (R^2 = 0.092, adjusted R^2 = 0.026, p = 0.133). Therefore, the statistically significant individual coefficients should be interpreted cautiously and should not be considered definitive independent factors associated with attitudes. Higher practice scores were significantly associated with enrollment in Dental Nursing and Midwifery, using personal electronic devices for educational purposes, not taking photographs of patient-related data, and receiving supervision during clinical placements. The overall model was statistically significant (R^2 = 0.211, p < 0.001). VIF values ranged from 1.088 to 4.723, indicating no substantial multicollinearity among the predictors.

3.5. Barriers to health information security practices among nursing students

Twelve nursing students participated in the qualitative interviews, including 7 students with high practice scores and 5 students with low practice scores. The participants represented different academic years and nursing programs. The characteristics of the qualitative participants are presented in Table 4.

Table 4. Characteristics of nursing students participating in the interview phase

Characteristic	High-practice group (n = 7)	Low-practice group (n = 5)	Total (n = 12)
Female, n (%)	6 (85.7)	4 (80.0)	10 (83.3)
Age, mean ± SD	21.0 ± 0.6	20.4 ± 0.5	20.8 ± 0.6
Third year, n (%)	2 (28.6)	4 (80.0)	6 (50.0)
Fourth year, n (%)	5 (71.4)	1 (20.0)	6 (50.0)
General Nursing, n (%)	4 (57.1)	3 (60.0)	7 (58.3)
Other nursing programs, n (%)	3 (42.9)	2 (40.0)	5 (41.7)
Practice score, mean ± SD	4.18 ± 0.24	2.14 ± 0.32	3.33 ± 1.08

Thematic analysis identified three overarching categories of barriers to health information security practices: (1) individual barriers related to knowledge, skills, and attitudes; (2) organizational barriers related to regulations, supervision, and training; and (3) system-level barriers related to the clinical environment and infrastructure.

Individual barriers: knowledge, skills, and attitudes. Students described their understanding of health information security as largely general and theoretical. Although they recognized the importance of not disclosing patient information, some were uncertain about what information could appropriately be discussed or shared in specific clinical situations. One student stated: *"I understand that confidentiality means not disclosing the patient's information to others, but sometimes I am not sure what information can be discussed with my classmates." (Student 03).* Another student explained: *"At university, we learned about medical ethics, but it was mainly theoretical. During clinical placements, we were rarely given specific guidance on how to handle individual situations." (Student 10)*

Students also reported difficulties in communicating with patients and family members while maintaining confidentiality. For example, one student noted: *"Sometimes family members ask very detailed questions about the patient's condition, and I don't know how to respond appropriately." (Student 07)* This uncertainty was accompanied by varying perceptions of the sensitivity of patient information. Some students considered sharing information with classmates acceptable when it was perceived as being for educational purposes. As one student stated: *"Some students think that it is okay to tell their classmates because they are also studying in the health sciences." (Student 12)*

Organizational barriers: regulations, supervision, and clinical education. Participants reported that health information security requirements were not always communicated clearly before or during clinical placements. They also described variation in the frequency and specificity of supervision and reminders provided by clinical instructors and healthcare professionals. Students perceived that confidentiality was often addressed through general reminders rather than situation-specific guidance. One student commented: *"Before starting clinical placements, we were only given a general reminder that we had to keep patient information confidential." (Student 05)*. Another stated: *"I am not sure whether the hospital has specific regulations about using patient information." (Student 14)*

Variation in clinical supervision was also identified as a barrier. Students reported that when direct supervision or reminders were limited, they tended to focus more on completing clinical tasks and relied on their own judgment regarding information security. One student explained: *"When there is no direct supervision, students tend to focus more on clinical skills." (Student 11*) Participants also perceived that health information security received less emphasis than technical aspects of patient care during clinical training. One student stated: *"During clinical practice, we learn a lot about nursing procedures, while information security is rarely discussed." (Student 02)*

System-level barriers: clinical environment and infrastructure**.** Participants identified characteristics of the clinical environment that could make appropriate health information security practices difficult to maintain. These included crowded patient-care areas, limited private spaces for communication, and insufficiently clear guidance regarding access to medical records. One student explained:*"There are often many people in the patient room, so it is very difficult to have a private conversation with a patient." (Student 11)* Another noted: *"In the examination area, it is often very crowded, making it difficult to maintain privacy when*

discussing information." (Student 14)

Students also described difficulties related to access to medical records. Although they were allowed to access patient records for learning purposes, guidance regarding appropriate handling of information was not always provided. Importantly, one participant described the use of personal electronic devices to photograph patient information during clinical placements: *"During night shifts or afternoon sessions, some students take pictures of patient information in the medical record for studying. They may not think about confidentiality, and sometimes the staff only tell us to take a picture, look at it, and delete it afterward." (Student 12)* This account provides important qualitative context for the quantitative finding that 13.1% of students reported taking photographs of imaging or laboratory results and that not taking photographs was associated with higher knowledge and practice scores.

Overall, the qualitative findings complemented the quantitative results by providing contextual explanations for factors associated with health information security practices, particularly clinical supervision, knowledge of medical law and ethics, and personal electronic device use. The findings highlighted how individual, organizational, and system-level barriers may contribute to the gap between students' knowledge and their reported practices.

4. DISCUSSION

The findings showed that mean knowledge score was 1.69 ± 0.24, the mean attitude score was 3.75 ± 0.70, and the mean practice score was 3.31 ± 0.87. The discrepancy between knowledge, attitudes, and practices suggests that understanding health information security principles alone may not be sufficient to translate them into appropriate behaviors in clinical settings. The qualitative findings provide further insight into this gap. Students described health information security as being learned mainly at a theoretical level, while uncertainty about specific situations, limited practical guidance, and variation in clinical supervision made it difficult to consistently apply these principles. Thus, strengthening experiential and practice-oriented learning may be important for translating students' awareness and attitudes into safer behaviors. This finding is consistent with Farah et al. (2022) [17], who reported that although students demonstrated good awareness, they experienced difficulties applying confidentiality principles in practice. The attitudes toward record confidentiality and information sharing were also consistent with the findings of Alqahtani et al. (2024) [6]. However, the lower scores for communication-related attitudes suggest that this remains an area requiring greater attention in nursing education, consistent with the observations of Kim and Lim (2017) [15].

Multivariable regression analysis identified several factors associated with knowledge and practice scores, while the overall attitude model was not statistically significant. Students in Dental Nursing and Anesthesia and Critical Care Nursing had lower knowledge scores than those in General Nursing, whereas students in Midwifery had higher practice scores. This pattern may be related to differences in clinical exposure and involvement in patient care activities, although causal explanations cannot be established from the cross-sectional design. These findings are consistent with Alqahtani (2024) and Park and Woo (2021) [6],[11]. Notably, students who reported a higher level of understanding of medical law and ethics had higher knowledge scores and more positive attitudes toward health information security. This finding highlights the potential importance of integrating legal and ethical content into nursing curricula. This is consistent with the recommendations of the WHO (2021) [18]. However, self-reported understanding of medical law and ethics and positive attitudes alone may not be sufficient to improve practice in the absence of adequate support from the educational and clinical environments.

The association between personal electronic device use and health information security outcomes was not consistent across knowledge and practice. Using personal electronic devices almost every day was associated with lower knowledge scores, whereas using such devices once or twice a week or almost every day was associated with higher practice scores. Notably, 13.1% of students reported taking photographs of imaging or laboratory results during clinical placements. Not taking such photographs was independently associated with higher knowledge and practice scores, suggesting that photographing patient-related results may be an important area for targeted education and supervision on health information security. The qualitative findings may help explain this behavior, as students described using personal devices in clinical settings while receiving limited guidance on how to manage patient-related information in specific situations. This finding differs, to some extent, from that of Tran et al. (2014)

[7], but may reflect the evolving context of digital transformation and the increasingly widespread use of smartphones in clinical education. These findings suggest that the implications of personal device use may depend on its purpose and the way devices are used rather than on frequency alone. Because of the cross-sectional design, these associations should not be interpreted causally.

The role of clinical supervision was also evident in this study. Students who received more frequent supervision and specific guidance were more likely to report positive attitudes and better health information security practices. The qualitative findings provided further insight into this association: students described receiving general reminders about confidentiality but limited situation-specific guidance on how to manage patient information during clinical practice. Some students also reported that, in the absence of direct supervision, they tended to prioritize completing clinical tasks and rely on their own judgment. These findings suggest that the value of supervision may depend not only on its presence but also on its frequency, specificity, and relevance to situations encountered in clinical practice. This finding is consistent with Keshavarzi et al. (2022) [19], who emphasized the importance of supervision and regular feedback in shaping professional behaviors.

The qualitative findings further indicated that barriers to health information security practices existed at three levels: individual, organizational, and system levels. At the individual level, students reported limited skills in applying their knowledge and managing communication situations involving confidentiality. At the organizational level, the lack of specific guidance and insufficient integration of health information security content into clinical education made it difficult for students to apply their knowledge in practice. At the system level, crowded clinical environments, limited privacy, and insufficiently clear guidance on access to medical records created additional challenges. Importantly, these barriers appeared to interact rather than operate independently. For example, limited individual understanding could become more problematic when students received only general guidance and were practicing in crowded clinical environments with limited privacy. This is consistent with the WHO (2021) [18], which emphasizes that health information security should be approached as a system-wide responsibility rather than solely as an individual responsibility.

Based on these findings, educational institutions should strengthen the integration of health information security content throughout clinical education through simulation-based scenarios, case-based learning, and direct feedback in clinical settings. Clinical placement sites should also establish standardized procedures for the use of personal electronic devices, strengthen supervision, and improve conditions that support patient privacy during care. These strategies may help narrow the gap between knowledge, attitudes, and practices and enhance students' health information security competencies before entering professional practice.

Limitations

This study has several limitations. First, the single-institution setting and convenience sampling may limit the representativeness and generalizability of the findings. Second, self-administered questionnaires may have introduced recall and social desirability bias, while adaptation of the practice instrument, including removal of one item, may have introduced measurement bias despite assessment of content validity and internal consistency. Third, the cross-sectional design precludes causal inference. Finally, the regression models explained only part of the variance in knowledge and practice (R^2 = 0.231 and 0.211, respectively), and the attitude model was not significant (R^2 = 0.092, p = 0.133), suggesting that other relevant factors were not captured. The qualitative sample was also limited to one university, which may have restricted the diversity of barriers identified.

5. CONCLUSION

The mean scores for knowledge and attitudes toward health information security were higher than the mean score for health information security practices among nursing students. Several factors were associated with knowledge and practice scores, particularly self-reported understanding of medical law and ethics, personal electronic device use, and supervision during clinical placements, whereas the overall attitude model was not statistically significant. The qualitative findings identified three main categories of barriers to health information security practices: individual, organizational, and system-level barriers. These findings highlight the importance of practice-oriented education, clear and standardized guidance, and enhanced clinical supervision to strengthen nursing students' health information security competencies.

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