



Published in final edited form as:

Nurse Educ Today. 2017 June ; 53: 19–25. doi:10.1016/j.nedt.2017.02.021.

Reported hours of infection education received positively associated with student nurses' ability to comply with infection prevention practices: Results from a nationwide survey[★]

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1. Introduction

Healthcare-associated infections remain a major patient safety concern, causing significant patient mortality, morbidity and healthcare costs, despite being largely preventable (Umscheid et al., 2011). Nurses are critical in preventing healthcare-associated infections, with nursing-driven procedures, including nurse initiated urinary catheter removal protocols resulting in sustained reductions in catheter-associated urinary tract infections (Meddings et al., 2014; Parry et al., 2013). While numerous studies continue to highlight the important role nurses play in infection prevention, only a handful of studies have examined the infection prevention education that nurses receive prior to entering the workforce (Celik and Kocasli, 2008; Darawad and Al-Hussami, 2013; Hinkin and Cutter, 2014). These studies have assessed certain infection prevention areas, e.g. hand hygiene, personal protective equipment, and isolation precautions, yet, have overlooked the importance of student nurses' ability to insert and maintain invasive devices properly. The proper insertion and maintenance of invasive devices (e.g. urinary catheters) is becoming increasingly important especially as device-associated healthcare-associated infections comprise the vast majority of healthcare-associated infections (Umscheid et al., 2011) and as studies have found poor

[★]This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

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device insertion and maintenance technique in hospital settings (Fakih et al., 2012; Manojlovich et al., 2016; Stone et al., 2014).

The relationship between the duration of infection prevention education received and student nurses' self-reported knowledge, attitudes, and practices is unknown. Schools of nursing commonly integrate infection prevention education throughout students' course curriculum and do not provide a dedicated infection prevention course (Al-Hussami and Darawad, 2013). This 'integrative' educational approach may result in variation in the hours of infection prevention education that student nurses receive, and impact student nurses' knowledge, attitudes, and practices.

Given these identified gaps, the aim of this study was to examine the relationship between the hours of infection prevention education received and student nurses' knowledge, attitudes, and practices in hand hygiene, personal protective equipment, isolation precautions, and aseptic technique. We used student nurse self-report to quantify the hours of infection prevention education received because we were interested in student nurses' perceptions of the time their program dedicated to infection prevention content.

2. Methods

2.1. Sample

We surveyed a national sample of student nurses from February 10 to March 10, 2016. Student nurses were identified through their membership in the National Student Nurses Association (NSNA), a nonprofit organization that promotes the development of students enrolled in associate, baccalaureate, diploma, and graduate nursing programs in the US (National Student Nurses Association, 2016). All NSNA student members with active email addresses ($N=52,063$) were invited to participate in the anonymous, web-based survey.

2.2. Survey Instrument Development and Testing

A team of nurses with expertise in pedagogy, infection prevention, and survey design developed the survey after reviewing the literature on student nurse infection prevention education. The survey included 45 Likert-scale questions and was separated into five sections: 1) overall impressions and experiences of course curriculum related to infection prevention and control; 2) hand hygiene; 3) personal protective equipment; 4) isolation precautions; and 5) aseptic technique. We selected these infection prevention areas as respondents were likely to have been exposed to these concepts in the classroom and clinical setting, and because these practices are essential to the prevention of healthcare-associated infection (Collins, 2008). Respondents were asked to assess the time, quality, and location of education (clinical setting, classroom, simulation) they had received in these infection prevention areas and how difficult it was to carry out these practices when busy. We also asked respondents to comment on statements using free-text: 1) I have witnessed poor practices related to infection prevention and control in my clinical rotations; and 2) I feel comfortable speaking up when I see poor practices related to infection prevention and control in my clinical rotations. A convenience sample of nurses ($N=6$) who were enrolled in a variety of nursing degree programs piloted the survey prior to formal use, confirmed that

survey questions were clear and not burdensome, and reported that the survey took approximately 10–15 min to complete. Columbia University Medical Center's institutional review board approved this study.

2.3. Survey Administration

Surveys were distributed electronically by NSNA to student members using a commercial survey software package (SurveyMonkey, <https://www.surveymonkey.com/>). Weekly study email reminders were also sent to encourage participation.

2.4. Data Analysis

We first explored survey responses using descriptive statistics. Using separate logistic regression models, we then examined the factors associated with respondents' reporting that it was difficult for them to carry out a specified infection prevention practice when busy (hand hygiene, personal protective equipment, isolation precautions, and aseptic technique). Included in this multivariate logistic regression model were: 1) the hours of education the respondent reported to have received in a particular infection prevention area; 2) the setting where the respondent reported to have received the majority of infection prevention education (i.e. lecture, simulation, clinical); and 3) the respondent's current program of study (i.e. bachelors, associates/diploma, or master's direct entry). Factors associated with respondents' confidence in inserting and maintaining invasive devices using aseptic technique were also assessed.

Free-text survey responses were analyzed using a directed and conventional content analysis (Hsieh and Shannon, 2005). We used a directed content analysis to categorize the types of infection prevention breaches that student nurses had observed in their clinical setting, in which two researchers assigned predefined codes to survey data. Predefined codes were based upon a previous study in which researchers identified common infection control hazards reported by student nurses (Geller et al., 2010). We performed a separate conventional content analysis to categorize the factors that student nurses had considered when deciding to confront the poor infection prevention practices witnessed in clinical rotations. In using this method, two researchers reviewed survey responses and generated codes based on the information reviewed (Hsieh and Shannon, 2005).

3. Results

A total of 3678 students responded for a response rate of 7%. Among respondents, 3353 (91%) were female, 2489 (67%) were enrolled in a baccalaureate program, and 2427 (66%) were 29 years of age or less, detailed in Table 1.

3.1. Overall Impressions and Experiences of Course Curriculum Related to Infection Prevention and Control

The vast majority (98%) of respondents agreed that nurses play an important role in preventing the spread of infections in healthcare settings and that infection prevention practices help protect them from contracting infections. While 98% of respondents reported that their nursing program emphasizes the importance of infection prevention, 1324 students

(38%) believed that additional infection prevention education is needed in their nursing program.

The largest proportion of respondents reported receiving 1–3 h of education in hand hygiene, personal protective equipment, and isolation precautions, and receiving 4–8 h of education in aseptic technique, Fig. 1. The setting of education varied, with the largest proportion of respondents (44%) reporting that they received most of their education in isolation precaution in lecture and 63% of respondents reporting that they received most of their education in aseptic technique in simulation, Fig. 2. We describe findings related to each infection prevention area below.

3.2. Hand Hygiene

Nearly 98% of respondents agreed that they: 1) know when and how to perform hand hygiene when caring for patients; 2) believe that hand hygiene is effective in preventing the spread of infections; and 3) believe that their nursing program emphasizes the importance of hand hygiene when taking care of patients.

When asked where respondents had received the most of their hand hygiene education in their nursing program, 46% reported the simulation lab, 33% reported in lecture, and 20% reported in the clinical setting. The hours of education spent in their program on hand hygiene were reported as: less than 1 h (10%), 1–3 h (45%), 4–8 h (22%), and >8 h (22%). A total of 676 (19%) of respondents reported that they often found it difficult to perform hand hygiene when busy.

3.3. Personal Protective Equipment

Nearly 97% of respondents reported that they know when and how to use different types of personal protective equipment, and that they believe their nursing education emphasizes the importance of personal protective equipment.

Respondents reported receiving most of their education on personal protective equipment in the simulation lab (47%), clinical setting (27%), and lecture (26%). The hours of education received on personal protective equipment were reported as: less than one hour (12%), 1–3 h (49%), 4–8 h (24%), and >8 h (14%). A total of 727 (21%) of respondents reported that they often find it difficult to use personal protective equipment when busy.

3.4. Isolation Precautions

Nearly 97% of respondents agreed that they: 1) know why different types of isolation precautions are used; 2) know how to follow isolation precautions; and 3) believe that their nursing education emphasizes the importance of isolation precautions.

When asked where respondents had received the most of their education in isolation precautions in their nursing program, 43% reported in lecture, 29% reported in simulation lab, and 28% reported in the clinical setting. The hours of education spent in their program on isolation precautions were reported as: less than 1 h (17%), 1–3 h (49%), 4–8 h (23%), and >8 h (12%). A total of 639 (18%) of respondents reported that they often found it difficult to follow isolation precautions when busy.

3.5. Aseptic Technique

Nearly 99% of respondents agreed that they understand the meaning of aseptic technique and believe that the aseptic placement and maintenance of invasive devices are effective in preventing the spread of infections. Respondents reported receiving most of their education on aseptic technique in the simulation lab (63%), lecture (21%), and the clinical setting (15%). The hours of education spent in their program on aseptic technique were reported as: less than 1 h (7%), 1–3 h (32%), 4–8 h (34%), and >8 h (27%).

Approximately 12% of respondents reported not feeling confident in their ability to insert and maintain invasive devices using aseptic technique and 16% reported that they often found it difficult to insert and maintain invasive devices using aseptic technique when busy.

3.6. Regression Results

Multivariate regression results of factors associated with respondents agreeing that it is difficult for them to carry out hand hygiene, personal protective equipment, isolation precautions, and aseptic technique when busy are detailed in Table 2. The hours of infection prevention education received was significantly associated with respondents agreeing that it was difficult for them to carry out all infection prevention practices when busy (hand hygiene, personal protective equipment, isolation precautions, and aseptic technique). Specifically, respondents that received less than 1 h of education in infection prevention practices were significantly more likely to report difficulty in carrying out infection prevention practices when busy than those who received more education, $p < 0.0001$, Table 2.

The setting of education was only statistically significant when evaluating the relationship between education setting and student nurses' reported confidence in inserting and maintaining invasive devices using aseptic technique. Specifically, respondents who received most of their aseptic technique training in simulation or in the clinical setting were more likely to report feeling confident in their ability to insert and maintain devices than those who received the majority of education in lecture ($p = 0.003$), Table 3.

3.7. Concordance Between Classroom and Clinical Experiences

While 89% of respondents reported that there is agreement between what they are taught in school and what they observe in clinical rotations, 51% of respondents noted that they had witnessed poor practices related to infection prevention and control in their clinical placement. A total of 1691 respondents submitted free-text responses in response to the statement, "*I Have Witnessed Poor Practices Related to Infection Prevention and Control in my Clinical Rotations.*" These witnessed breaches included observations in categories of personal protective equipment, environmental or equipment contamination, aseptic technique, and hand hygiene. Regarding personal protective equipment, respondents noted the improper use of personal protective equipment among hospital staff, particularly around isolation precautions. Respondents also noted a lack of accessible personal protective equipment supplies, which contributed to poor compliance. Regarding environmental and equipment contamination, respondents noted poor environmental and equipment hygiene in the clinical setting. Regarding aseptic technique, respondents noted breaks in sterile

technique in a range of patient care procedures, from indwelling catheter insertion to accessing intravenous lines. Respondents also witnessed staff not performing hand hygiene before or after direct contact with a patient or patient environment, and a lack of hand hygiene supplies, which they suggested contributed to poor hand hygiene compliance. These categories of witnessed breaches and representative quotes are presented in Table 4.

Among respondents that observed poor infection prevention practices in their clinical setting, 70% felt comfortable speaking up when they witnessed non-compliance. A total of 812 respondents submitted free-text responses in response to the following statement, *“I feel comfortable speaking up when I see poor practices related to infection prevention and control in my clinical rotations.”* Content analysis revealed four themes. The first theme, *“history of speaking-up, but concerns not taken seriously”* emerged from respondents indicating that they had addressed poor infection prevention practices in the past, but that these concerns would not be taken seriously. Respondents also indicated that they fear not being taken seriously if they were to address non-compliance. The second theme, *“willingness to speak-up”*, emerged from respondents indicating that they would address poor infection prevention practices indirectly, e.g. by asking a relevant and timely question to hospital staff or by providing hospital staff with necessary supplies. The third theme, *“difficulty speaking up”*, emerged from a reported reluctance to speak-up when observing poor infection prevention practices in their clinical setting for fear that they would disrespect or undermine nurses, would appear rude or as a “know-it-all”, or because they felt less experienced than those that had been working in the clinical setting. While these respondents reported that they did not feel comfortable raising their concerns to hospital staff, they commonly reported that they shared their concerns with their clinical instructor. The final theme, *“fear of retaliation”* emerged from respondents expressing discomfort speaking up for fear of personal retaliation or repercussion from those they are training alongside in the clinical setting (nurses, nursing assistants, MDs), as well as repercussions to the relationship between the clinical setting and academic institution. These themes regarding student comfort speaking up when witnessing poor infection prevention compliance and representative quotes are presented in Table 5.

4. Discussion

In analyzing survey results from a national sample of student nurses in the US, we found that the overwhelming majority of respondents reported understanding when, why, and how to use infection prevention practices, and the importance of these practices among nurses. These findings contrast with previous studies that have found inconsistent infection prevention knowledge among student nurses (Celik and Kocasli, 2008; Darawad and Al-Hussami, 2013; Hinkin and Cutter, 2014). This variation may result from the variety of instruments that researchers have used to evaluate student nurse knowledge, or may indicate cultural differences, with previous studies being conducted in the United Kingdom, Thailand, Taiwan, Jordan, and the US.

Despite the majority of respondents believing that their nursing education emphasized the importance of infection prevention, nearly two-fifths of respondents believed additional education in infection prevention and control is needed in their nursing program. One of the

greatest opportunities for improvement identified in this study is a need for better alignment between the infection prevention education that student nurses are taught in the classroom and observe in the clinical setting. Consistent with published reports, we found that student nurses were knowledgeable and cognizant of infection prevention concepts as evidenced by their ability to identify and provide instances of non-compliance in the hospital. Studies consistently show that student nurses observe discordance in infection prevention expectations and behaviors between the classroom and patient-care setting (Cox et al., 2014; Geller et al., 2010; Gould and Drey, 2013). Geller et al. (2010) analyzed 3492 comments related to hazards and near-misses reported by student nurses during clinical rotations and found that nearly one-quarter of comments were infection related. Student nurses reported that they had observed staff non-compliance to isolation precautions, aseptic technique, hand hygiene, environmental contamination, etc., which is similar to our analysis of free text comments. Hospitals often employ “secret-shoppers” who monitor staff compliance to infection prevention practices as a quality assurance measure. The experiences and insight of student nurses may supplement such existing methods to monitor compliance and may be used to help improve infection prevention practices in hospitals.

In contrast to a recent literature review that concluded there is a lack of rigorous evidence to show that infection prevention education improves infection prevention compliance (Ward, 2011), we found that the hours of infection prevention education received was significantly associated with student nurses’ self-reported ability to comply with infection prevention practices. This is likely due to an increased understanding of infection prevention concepts and awareness of how infection prevention practices may be correctly performed. Cox et al. (2014) explored the knowledge and practices of nurse graduates through in-depth interviews and found that participants believed infection prevention education and peer-role modeling played a substantial role in early nurse graduates’ infection prevention behaviors. In discussing peer-role modeling, the authors described that when poor infection prevention practices are repeatedly witnessed, individuals become desensitized to infection prevention behaviors and subsequently begin to model observed practices. In finding that the quantity of infection prevention education received is associated with infection prevention compliance, our study adds to the growing body of the literature that has identified that infection prevention behaviors are complex (Yanke et al., 2014). While researchers have shown that infection prevention behaviors are contingent on a host of factors, e.g. the environment, availability and ease of equipment and products (Carter et al., 2016, 2015), we found that student nurse education and witnessing sub-optimal infection prevention practices may also play important roles.

Simulation is used to supplement didactic training (Goldrick, 1990) and may be an effective substitute for clinical hours (Hayden et al., 2014). We found that simulation training may pose additional benefits compared to lecture-alone, with respondents that had received most of their aseptic technique education in simulation displaying significantly higher levels of confidence in aseptic technique. In contrast to lecture-based learning, which is conducted in a pure education environment and does not include hands-on training, and in contrast to clinical-based learning, which co-occurs with patient care activities that are often subject to time constraints, simulation mimics patient care scenarios in a controlled clinical environment that is paced according to the needs of the learner (Goldrick, 1990). Prior

studies have shown that aseptic technique compliance during device insertion and maintenance are sub-optimal and can be improved through staff education and real-time feedback (Fakih et al., 2012; Manojlovich et al., 2016), inherent to simulation training. Our findings lend support to the use of simulation as a principal method of educating student nurses in aseptic technique.

4.1. Limitations

This study has several limitations. First, the survey was sent only to members of NSNA with active email addresses. These individuals may be more likely to have an orientation and interest in policy and practice issues facing the nursing profession. Secondly, the response rate, as is common in such surveys, was quite low. Hence, the data are subject to non-response and selection bias. Because the survey was anonymous, we cannot compare responders with non-responders, but the demographic characteristics of responders were similar to NSNA membership. While it is not possible to estimate the direction of any bias associated with these limitations, there are still clear implications of the findings for nursing education. Last, the survey relied on self-report; additional studies are needed to objectively determine the optimal number of hours that schools of nursing should dedicate to infection prevention education, and to correlate the infection prevention education taught with student nurse infection prevention practices.

4.2. Conclusion

Hours of infection prevention education received among student nurses was significantly associated with student nurses' self-reported ability to comply with infection prevention practices. Additional studies are needed to objectively quantify the hours of infection prevention education provided through student nurses' course curriculum. Better alignment is needed between the infection prevention practices taught in the classroom setting and the infection prevention practices observed in patient care settings. Student nurse observations and experiences of infection prevention practices may be used to complement existing methods used in hospitals to prevent healthcare-associated infections.

References

- Al-Hussami M, Darawad M. Compliance of nursing students with infection prevention precautions: effectiveness of a teaching program. *Am J Infect Control*. 2013; 41(4):332–336. <http://dx.doi.org/10.1016/j.ajic.2012.03.029>. [PubMed: 23036481]
- Carter EJ, Pallin DJ, Mandel L, Sinnette C, JD S. A qualitative study of factors facilitating clinical nurse engagement in emergency department catheter-associated urinary tract infection prevention. *J Nurs Adm*. 2016
- Carter, EJ., Wyer, P., Giglio, J., Jia, H., Nelson, G., Kauari, VE., Larson, EL. Environmental factors and their association with emergency department hand hygiene compliance: an observational study. *BMJ Qual Saf*. 2015. <http://dx.doi.org/10.1136/bmjqs-2015-004081>
- Celik S, Kocasli S. Hygienic hand washing among nursing students in Turkey. *Appl Nurs Res*. 2008; 21(4):207–211. <http://dx.doi.org/10.1016/j.apnr.2006.12.001>. [PubMed: 18995162]
- Collins AS. Preventing Health Care–Associated Infections. 2008
- Cox, JL., Simpson, MD., Letts, W., Cavanagh, HM. Putting it into practice: infection control professionals' perspectives on early career nursing graduates' microbiology and infection control knowledge and practice; *Contemp Nurse*. 2014. p. 5395-5408. <http://dx.doi.org/10.5172/conu.2014.5395>

- Darawad MW, Al-Hussami M. Jordanian nursing students' knowledge of, attitudes towards, and compliance with infection control precautions. *Nurse Educ Today*. 2013; 33(6):580–583. <http://dx.doi.org/10.1016/j.nedt.2012.06.009>. [PubMed: 22789874]
- Fakih MG, Jones K, Rey JE, Berriel-Cass D, Kalinicheva T, Szpunar S, Saravolatz LD. Sustained improvements in peripheral venous catheter care in non-intensive care units: a quasi-experimental controlled study of education and feedback. *Infect Control Hosp Epidemiol*. 2012; 33(5):449–455. <http://dx.doi.org/10.1086/665322>. [PubMed: 22476270]
- Geller NF, Bakken S, Currie LM, Schnall R, Larson EL. Infection control hazards and near misses reported by nursing students. *Am J Infect Control*. 2010; 38(10):811–816. <http://dx.doi.org/10.1016/j.ajic.2010.06.001>. [PubMed: 20621394]
- Goldrick BB. Infection control programmed instruction: an alternative to classroom instruction in baccalaureate nursing education. *J Nurs Educ*. 1990; 29(1):20–25. [PubMed: 2153777]
- Gould D, Drey N. Student nurses' experiences of infection prevention and control during clinical placements. *Am J Infect Control*. 2013; 41(9):760–763. <http://dx.doi.org/10.1016/j.ajic.2013.01.025>. [PubMed: 23993761]
- Hinkin J, Cutter J. How do university education and clinical experience influence pre-registration nursing students' infection control practice? A descriptive, cross sectional survey *Nurse Educ Today*. 2014; 34(2):196–201. <http://dx.doi.org/10.1016/j.nedt.2013.09.005>. [PubMed: 24090618]
- Hsieh HF, Shannon SE. Three approaches to qualitative content analysis. *Qual Health Res*. 2005; 15(9):1277–1288. <http://dx.doi.org/10.1177/1049732305276687>. [PubMed: 16204405]
- Hayden JK, Smiley RA, Alexander M, Kardong-Edgren S, Jeffries PR. The NCSBN national simulation study: a longitudinal, randomized, controlled study replacing clinical hours with simulation in prelicensure nursing education. *J Nurs Regul*. 2014; 5(2, Supplement):S3–S40. [http://dx.doi.org/10.1016/S2155-8256\(15\)30062-4](http://dx.doi.org/10.1016/S2155-8256(15)30062-4).
- Manojlovich M, Saint S, Meddings J, Ratz D, Havey R, Bickmann J, Krein SL. Indwelling urinary catheter insertion practices in the emergency department: an observational study. *Infect Control Hosp Epidemiol*. 2016; 37(1):117–119. <http://dx.doi.org/10.1017/ice.2015.238>. [PubMed: 26434781]
- Meddings J, Rogers MA, Krein SL, Fakih MG, Olmsted RN, Saint S. Reducing unnecessary urinary catheter use and other strategies to prevent catheter-associated urinary tract infection: an integrative review. *BMJ Qual Saf*. 2014; 23(4):277–289. <http://dx.doi.org/10.1136/bmjqs-2012-001774>.
- National Student Nurses Association. About Us. 2016. Retrieved from. <http://www.nсна.org/AboutUs.aspx>
- Parry MF, Grant B, Sestovic M. Successful reduction in catheter-associated urinary tract infections: focus on nurse-directed catheter removal. *Am J Infect Control*. 2013; 41(12):1178–1181. <http://dx.doi.org/10.1016/j.ajic.2013.03.296>. [PubMed: 23768439]
- Stone PW, Pogorzelska-Maziarz M, Herzig CT, Weiner LM, Furuya EY, Dick A, Larson E. State of infection prevention in US hospitals enrolled in the National Health and Safety Network. *Am J Infect Control*. 2014; 42(2):94–99. <http://dx.doi.org/10.1016/j.ajic.2013.10.003>. [PubMed: 24485365]
- Umscheid C, Mitchell MD, Doshi J, Agarwal R, Williams K, Brennan P. Estimating the proportion of healthcare-associated infections that are reasonably preventable and the related mortality and costs. *Infect Control Hosp Epidemiol*. 2011; 32(2):101–114. [PubMed: 21460463]
- Ward DJ. The role of education in the prevention and control of infection: a review of the literature. *Nurse Educ Today*. 2011; 31(1):9–17. <http://dx.doi.org/10.1016/j.nedt.2010.03.007>. [PubMed: 20409621]
- Yanke E, Carayon P, Safdar N. Translating evidence into practice using a systems engineering framework for infection prevention. *Infect Control Hosp Epidemiol*. 2014; 35(9):1176–1182. <http://dx.doi.org/10.1086/677638>. [PubMed: 25111927]

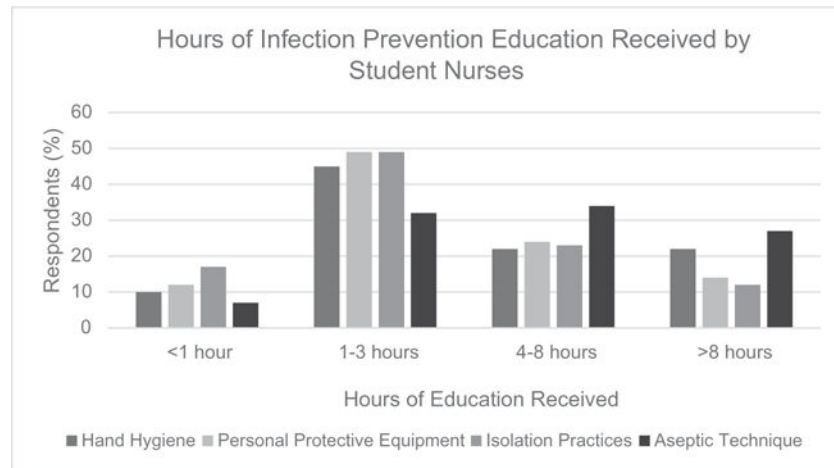


Fig. 1.
Hours of infection prevention education received by student nurses.

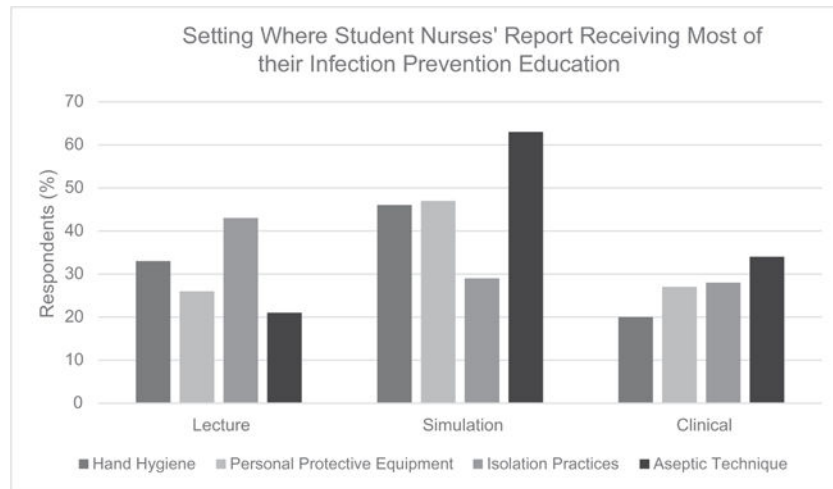


Fig. 2.
Setting where student nurses' report receiving most of their infection prevention education.

Table 1

Respondent characteristics.

Age	N (%)
<22	879 (24)
22–29	1548 (42)
30–39	755 (21)
40–49	372 (10)
50+	124 (4)
Gender	
Female	3353 (91)
Ethnicity	
Caucasian	2438 (67)
Hispanic or Latino	379 (10)
Asian	314 (9)
Black or African American	301 (8)
Other	208 (6)
Graduation year	
2015	164 (4)
2016	1813 (49)
2017	1204 (33)
2018	349 (9)
2019	134 (4)
Current program	
Diploma/Associates	1163 (31)
Bachelors	2489 (67)
Pre-licensure Master's Degree	48 (1)

Table 2

Regression Results.

Modeling agreement to “I often find it difficult to perform hand hygiene when I am busy.”			
Covariates	Point Estimate	CI	p-Value
Hours of education			<0.001
<1 h	1.355	1.043, 1.760	
1–3 h	Ref	Ref	
4–8 h	0.745	0.597, 0.930	
>8 h	0.563	0.441, 0.720	
Education setting			0.385
Lecture	<i>NS</i>	<i>NS</i>	
Simulation	<i>NS</i>	<i>NS</i>	
Clinical	<i>NS</i>	<i>NS</i>	
Program of study			0.032
Associate/diploma	0.803	0.664, 0.970	
Bachelors	Ref	Ref	
Masters	1.461	0.760, 2.808	
Modeling agreement to “I often find it difficult to use personal protective equipment when I am busy.”			
Hours of education			<0.001
<1 h	1.472	1.158, 1.871	
1–3 h	Ref	Ref	
4–8 h	0.886	0.722, 1.088	
>8 h	0.496	0.370, 0.665	
Education setting			0.142
Lecture	<i>NS</i>	<i>NS</i>	
Simulation	<i>NS</i>	<i>NS</i>	
Clinical	<i>NS</i>	<i>NS</i>	
Program of study			0.759
Associate/diploma	<i>NS</i>	<i>NS</i>	
Bachelors	<i>NS</i>	<i>NS</i>	
Modeling agreement to “I often find it difficult to follow isolation precautions when I am busy.”			
Hours of education			<0.001
<1 h	1.310	1.036, 1.656	
1–3 h	Ref	Ref	
4–8 h	0.793	0.632, 0.996	
>8 h	0.525	0.375, 0.734	
Education setting			0.372
Lecture	<i>NS</i>	<i>NS</i>	
Simulation	<i>NS</i>	<i>NS</i>	
Clinical	<i>NS</i>	<i>NS</i>	
Program of study			0.580
Associate/diploma	<i>NS</i>	<i>NS</i>	

Modeling agreement to “ <i>I often find it difficult to perform hand hygiene when I am busy.</i> ”			
Covariates	Point Estimate	CI	p-Value
Bachelors	<i>NS</i>	<i>NS</i>	
Modeling agreement to “ <i>I often find it difficult to insert and maintain invasive devices using aseptic technique when I am busy.</i> ”			
Hours of education			<0.0001
<1 h	1.633	1.181, 2.258	
1–3 h	Ref	Ref	
4–8 h	0.731	0.585, 0.913	
>8 h	0.531	0.412, 0.686	
Education setting			0.481
Lecture	<i>NS</i>	<i>NS</i>	
Simulation	<i>NS</i>	<i>NS</i>	
Clinical	<i>NS</i>	<i>NS</i>	
Program of study			0.096
Associate/diploma	<i>NS</i>	<i>NS</i>	
Bachelors	<i>NS</i>	<i>NS</i>	
Masters	<i>NS</i>	<i>NS</i>	

Table 3

Regression results.

Modeling agreement to “I am confident in my ability to insert and maintain invasive devices using aseptic technique.”			
Covariates	Point estimate	CI	p-Value
Hours of education			<0.001
<1 h	0.271	0.199, 0.371	
1–3 h	Ref	Ref	
4–8 h	2.111	1.604, 2.780	
>8 h	3.035	2.174, 4.237	
Education setting			0.003
Lecture	Ref	Ref	
Simulation	1.333	1.035, 1.718	
Clinical	1.907	1.035, 1.718	
Program of study			0.034
Associate/diploma	1.347	1.048 1.731	
Bachelors	Ref	Ref	
Masters	0.671	0.299, 1.506	

Table 4

Witnessed infection prevention breaches and representative quotes.

Type of breach witnessed	Representative quote
Personal Protective Equipment	<p><i>"Contact/droplet precautions are not consistently followed due to a lack of PPE, laziness, and inefficiency"</i></p> <p><i>"I had a nurse who didn't adhere to the isolation practices required for the flu virus with one of her patients. She walked in without any protection."</i></p> <p><i>"A nurse changing sheets of a c diff patient with no gloves no gown."</i></p> <p><i>"At times, I have seen nurses...not wear PPE when needed."</i></p> <p><i>"I have observed nurses remove gloves during venipuncture to assess the veins easily"</i></p>
Environmental or equipment contamination	<p><i>"Emergency rooms do not clean beds adequately and nursing staff may use a cloth to wipe – with or without gloves."</i></p> <p><i>"Contact precaution patients' rooms... nurses, lab techs, and doctors may not...wipe off equipment when coming out of the room."</i></p> <p><i>"At some hospitals, I have witnessed little things, such as the glucometer not being wiped down from room to room."</i></p> <p><i>"I have seen shortcuts. Dirty linens on the floor, then picked up and carried to the hamper. Dirty wash clothes placed on the counter. Small things like this add up."</i></p>
Aseptic technique	<p><i>"Breaking sterile technique during catheter insertion."</i></p> <p><i>"A nurse didn't scrub the hub on an IV."</i></p> <p><i>"I witnessed a nurse insert a Foley catheter with almost complete disregard for sterile technique."</i></p> <p><i>"I watched an IV inserted on a toddler with no prior hand washing or gloves."</i></p> <p><i>"I have witnessed other nurses skipping over important steps in their skills to save time such as scrubbing an IV hub or not using sterile technique to change a catheter or clean a trach."</i></p>
Hand hygiene	<p><i>"Already after only 12 h of clinical time, I have seen nurses and CAN's go a whole shift without washing their hands."</i></p> <p><i>"During my med-surg clinical we witnessed medical professional enter rooms without pumping in, and in some cases "faking" pumping in (put their hand underneath and not actually passing the pump)."</i></p> <p><i>"At clinicals the nursing home had no hand sanitizer pumps and no gloves"</i></p> <p><i>"I have had floor nurses say that "Students wash their hands too much." I have also witnessed nurses providing care without performing hand hygiene."</i></p>

Table 5

Student reactions towards addressing poor infection prevention compliance.

Theme	Representative quote
History of speaking-up, but concerns not taken seriously	<p><i>"I speak up some, but I am usually dismissed."</i></p> <p><i>"As a student nurse, it can be intimidating to voice to a primary nurse that they are practicing poorly for fear that there may be repercussions. When I do speak up, it is not uncommon for my concerns to be brushed aside or reasoned away with rationalization for why the poor practices were necessary."</i></p> <p><i>"As a student, physicians and other providers don't take my opinion seriously"</i></p>
Willingness to speak-up	<p><i>"If I directly saw a break in aseptic technique I would simply say, 'let me get you another catheter'"</i></p> <p><i>"As a student, I feel I have a balance to keep between providing safe care and respecting healthcare professionals who work at each facility. This bothers me, but seems to be part of the territory. If there is something more serious, I will not hesitate to speak up for the sake of a patient. However, as a "germ freak", I will likely be loud about this issue when I graduate. While I will still respect everyone, I will not worry about keeping the balance I mentioned when it comes to infection prevention."</i></p>
Difficulty speaking up	<p><i>"As a student nurse I don't feel comfortable addressing those issues because I'm not licensed. I would rather bring up the issue to the clinical instructor and let her address it."</i></p> <p><i>"As a student nurse, I don't feel comfortable speaking up with things of the sort. It's already hard enough when seasoned nurses don't always like having student nurses around"</i></p>
Fear of retaliation	<p><i>"I do not feel comfortable speaking up to whoever is doing the poor performances because the thought of retaliation. I do speak up to the clinical professor when observed."</i></p> <p><i>"As a student, I am not comfortable speaking up because the one time I did, it set me up for conflict between me and the nurses at each additional clinical day I went to. I was subjected to attitude and an unwillingness to answer any questions I had to further my learning. And when the clinical instructor personally knows the nurses on the floor, it makes it that much harder to feel comfortable saying anything."</i></p> <p><i>"In the area where I live there is only one major hospital. The relationship between the management of the hospital and the faculty of the school already seems strained. I fear retaliation if I cause an issue that puts further strain on this relationship."</i></p> <p><i>"At times I am afraid to speak up because I'm afraid it might affect my grade or potential for hire."</i></p>