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## Major Article

## Improving knowledge and compliance with infection control Standard Precautions among undergraduate nursing students in Jordan



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**Key Words:**  
Professional practice  
Adherence

**Introduction:** The recent emergence and reemergence of infectious diseases have made the knowledge and practice of standard infection control precautions in developing countries more important than ever. However, schools of nursing in Jordan do not have a prescribed curriculum in Standard Precautions.

**Purpose:** To test the effectiveness of using an online education module and a learning contract on knowledge and compliance with infection control Standard Precautions among undergraduate nursing students in Jordan.

**Methods:** A sample of 256 undergraduate nursing students participated in an online education module in infection control Standard Precautions. A pretest–posttest design tested effectiveness using an online questionnaire (Questionnaires for Knowledge and Compliance with Standard Precautions) before and after the online instruction.

**Results:** Initially, subjects reported low levels of knowledge and compliance with Standard Precaution practices and relatively few (15.2%) had high scores. Compliance with Standard Precautions was somewhat better (27%). Significant differences in the mean scores of knowledge and compliance between pretest and posttest were found.

**Conclusion:** Online instruction offers a consistent and effective method to include Standard Precautions into nursing education. Organizations that oversee nursing in Jordan have the option to strengthen all nursing curricula by mandating a standardized infection control curricula across all schools of nursing.

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It has been estimated that the risk of health care-associated infection (HAI) is 2–20 times higher in developing countries compared with developed countries.<sup>1</sup> HAI refers to infections acquired in hospitals, clinics, and where health care providers are susceptible to infections.<sup>2</sup> HAIs cost thousands of lives each year, yet most infections can be prevented with inexpensive Standard Precaution (SP) practices such as hand hygiene and wearing gloves.<sup>3</sup> According to the World Health Organization, the practice of SPs includes the basic principles of infection control such as handwashing and using personal protective equipment such as gloves, masks, gowns, and eyewear to prevent contact with potentially infectious materials, as well as safe handling of sharps.<sup>4</sup>

Experts at the Centers for Disease Control and Prevention have reported that the recent occurrence of highly infectious diseases like severe acute respiratory syndrome, Middle-East respiratory

syndrome, and Ebola virus disease have made the knowledge, practice, and enforcement of SPs more important than ever.<sup>5</sup> For example, the rapid spread of severe acute respiratory syndrome and Ebola virus disease transmitted by travelers illustrated how quickly diseases can enter health care systems and communities.<sup>6</sup>

Exposure to infectious material can be minimized by strict compliance with SPs.<sup>7</sup> Strict compliance with safety rules must be taught and reinforced as the educational cornerstone of providing basic care and preventing the spread of disease. Thus, nursing students must be prepared to demonstrate professional accountability in infection control and adhere to standards of safe practice.<sup>8,9</sup>

Nurses represent the largest labor group in health care and they have the greatest degree of contact with patients.<sup>10</sup> In addition, nursing students are at even greater risk of contamination and sharps injuries during clinical training precisely because they are inexperienced. Especially during early clinical training, nursing students commonly have contact with body fluids such as saliva, sputum, urine, feces, and blood as they learn to provide basic patient care and obtain laboratory specimens.<sup>11</sup> The issue of undergraduate education in shaping attitudes and teaching infection control

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knowledge among health care professionals in developing countries is important.

The adherence to SPs in most developing countries remains either ineffective or nonexistent. Research has shown the obvious: lack of knowledge is the major reason for nonadherence to SPs.<sup>12</sup> Developing countries yield some alarming statistics: 39.3% of injections are given with syringes or needles that were reused without sterilization. Conversely, others have found good levels of knowledge and compliance with hand hygiene, a centerpiece of SPs, among nursing students who received various types of hand hygiene instruction and were reassessed frequently.<sup>13</sup> Among nursing students in Hong Kong, predictors for SPs compliance included knowledge of SPs, perceived barriers, adequacy of training, management support, and influence of nursing staff.<sup>14</sup>

In Jordanian nursing schools, infection control and SPs in a coherent instructional form are missing from the curriculum.<sup>15</sup> For example, Jordanian nursing students were found to have insufficient knowledge regarding SPs.<sup>16</sup> Although the students who were surveyed reported positive attitudes and compliance regarding infection control practices, the level of knowledge was under 50%.<sup>16</sup>

Although Jordan has a population of only 9.46 million,<sup>17</sup> it has a robust university system that graduates approximately 1,651 nursing students per year.<sup>18</sup> The scientific, medical, and nursing programs in Jordan provide instruction in English using English-language textbooks and journals. The Jordanian medical system is modeled after the Western medical system and operates using a primary care framework. Jordan's major export is its university graduates in nursing, medicine, and the sciences. Nursing graduates can easily emigrate for work due to the acute imbalance between the large numbers of nursing graduates and underemployment nationally. Nursing graduates become expatriate workers, mostly in Middle Eastern countries, but also in the United Kingdom and the United States. Thus, insufficient and ineffective instruction in infection control and SPs has international implications.

Jordanian nursing students have been found to have insufficient knowledge regarding SPs.<sup>16</sup> To improve compliance, it is important to recognize undergraduate nursing students' level of knowledge and compliance with SPs and to identify the strengths and weaknesses of their education. Many studies have been performed in relation to professional health care workers' knowledge of and compliance with SPs, yet few studies have involved undergraduate nursing students. Findings from this study will provide input for universities developing curricula and the clinical placement facilities where students obtain their experience.

## METHODS

To address infection control, it is important to recognize an undergraduate nursing students' level of knowledge and compliance with SPs and to identify the strengths and weaknesses of their education. This study was designed to assess knowledge and compliance with SPs and to test the efficacy of online instruction in SP training among university nursing students. The online teaching method allowed participants opportunities to save, exit, and re-enter the program at will and to engage in multiple self-assessment activities. Findings from this study will provide baseline and instructional effectiveness data regarding infection control and SPs to advocate for systematically adding these curricula in national nursing programs in Jordan.

### Research objectives

1. Describe the demographic characteristics of the sample (ie, gender, prior attendance in an infection control course, and year of study).

2. Identify and compare the subjects' knowledge levels (ie, high, moderate, or inadequate) of SPs before and after online instruction.
3. Assess the effectiveness of online instruction on the levels of knowledge of SPs of undergraduate nursing students.
4. Identify the undergraduate nursing students' level of self-reported compliance with SPs (ie, high, average, low, and very low).
5. Assess the effectiveness of a one-time exposure to online instruction to increase compliance with SPs.

### Design and sample

The research design was a pretest–posttest educational intervention method (Fig 1). This design provided baseline and instructional effectiveness data of an online intervention. In preparation for sampling, we selected an  $\alpha$  of 0.05 and a medium effect size, yielding a minimum sample size of 256 participants for data analyses with a power equal to 0.80.<sup>19</sup> Subjects included undergraduate nursing students in Jordan who were aged at least 18 years. Students were recruited via e-mail; they were in years 2, 3, and 4 of their 4-year bachelor's degree in nursing program. These groups were selected because they would have sufficient clinical experience to be able to report on SPs. Students from other universities and graduate nursing students were excluded from the study.

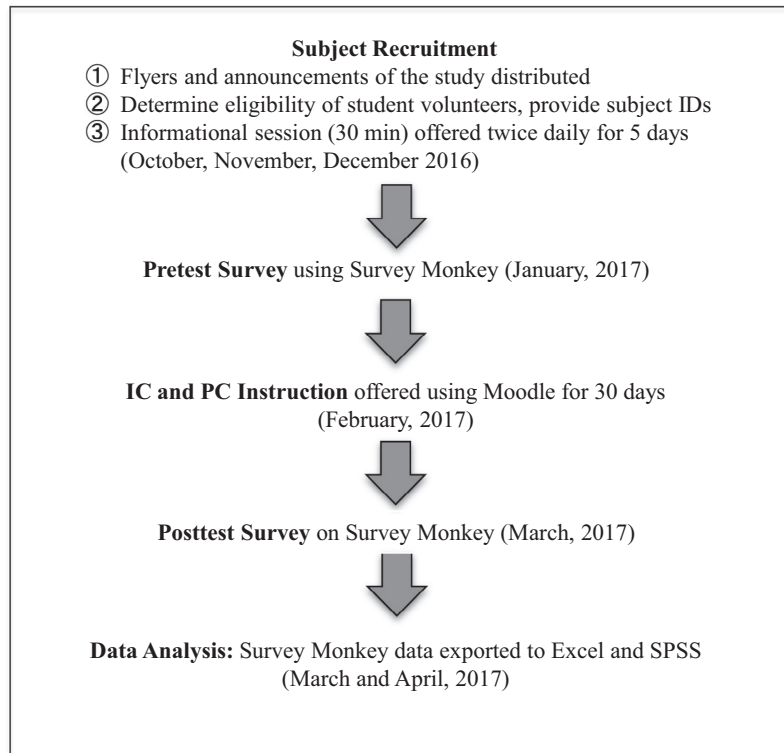
### Ethical considerations

Before executing the study, the design was reviewed and approved by the Protection of Human Subjects Committee at the investigator's university. Participants were informed that they could choose to refuse to participate or could withdraw from the study at any time before completion of the study. They were also assured that participation or nonparticipation in the study would in no way jeopardize their academic record and were informed that the findings would be reported in the form of aggregate data. Confidentiality of all information was maintained throughout the study using coded identifiers. For security purposes, the survey data were maintained on a password-protected computer and any hard copies of data were kept in a locked cabinet in a locked office. Only the investigator had access to the data or data files.

### Instruments

The survey used in this study was an adapted version of the Questionnaires for Knowledge and Compliance with Standard Precautions instrument. The survey items ask about the knowledge of and compliance with the use of personal protective equipment, disposal of sharp objects and other biological wastes, decontamination of spills and used articles, and prevention of cross-infection. The instrument validity was been estimated at 0.98, reliability = 0.87, and Cronbach's  $\alpha$  = 0.93. The instrument was scored according to the guidelines provided by Lou et al.<sup>20</sup>

This questionnaire was converted to an online survey.<sup>21</sup> The first section addressed subject demographics, including gender, year in the nursing program, and prior attendance at infection control seminars. The balance of the survey addressed knowledge of SPs and compliance with SPs using the questionnaire mentioned above. To assess the participants' knowledge, the survey included 20 items, with possible responses of "yes," "no," or "unknown." "Yes" answers were given a value of 1 point, and "no" or "unknown" received 0 points; the maximum possible score was 20. The higher the subject's score, the greater his or her knowledge about SPs. For example: "The main goal to implement Standard Precautions is to protect the medical staff" the correct "Standard Precaution is only applicable



**Fig 1.** Study design and methods. IC, infection control; ID, identification; PC, xxxxx. Survey Monkey ([www.surveymonkey.com](http://www.surveymonkey.com)). Excel (Microsoft Inc, Redmond, WA). SPSS (version 22; IBM-SPSS Inc, Armonk, NY).

for the patient with the confirmed diagnosis of infection or in the latent period of infection.” The knowledge items were summed for each subject, and then the score was converted into a percentage by multiplying the score by 5. Based on the percentage of correct answers in these sections, the levels of knowledge were classified according to the following criteria: if the score was >75%, participants were considered to have a high level of knowledge; if the score was 50%-75%, they were considered to have a moderate level of knowledge; and if the score was <50%, they were considered to have an inadequate level of knowledge.

The last portion of the survey included 20 compliance items with a scale of 0-4 points (0 = never, 1 = seldom, 2 = sometimes, 3 = usually, and 4 = always) yielding a total score range of 0-80. In determining the level of compliance, the following scale of mean scores was used: high compliance = 61-80, average compliance = 41-60, low compliance = 21-40, and very low compliance = 0-20. The higher the mean score, the better that person carries out SPs.

#### *Preliminary instrument testing*

An expert panel of 4 English-speaking Jordanian nurses with doctorate degrees participated in the prepilot work to review the study instrument. The nurses were asked to identify ambiguous information and to comment on the ease of reading and presentation. This was done because the primary language of Jordanian students is Arabic. Afterward, a pilot study was carried out to assess the feasibility of the study in terms of acceptability to participants, and to ascertain the clarity and readability of the instrument before beginning the full online study. Minimal changes in wording were made based on participants' responses. The pilot sample included 10% of the estimated sample size ( $n = 26$ ) to test the study feasibility and the reliability and validity of the instrument. The

findings from the pilot sample yielded Cronbach's  $\alpha = 0.82$  for knowledge and  $\alpha = 0.86$  for compliance.

#### *Data collection*

The procedure for data collection was as follows: flyers and announcements were prepared to encourage students to participate, students interested in the training sent an e-mail message to the principal investigator indicating that he/she would like to participate in the study, and the principle investigator determined whether the student met the inclusion criteria for the study.

The current study was conducted in 3 phases. In phase 1, an information session was conducted for approximately 30 minutes twice daily in a university conference room over 5 days. The presentation included the study purpose, method, required time commitment, potential risks/benefits, and contact information for the investigator. Following the presentation, each volunteer was given a randomized personal study identification number to maintain confidentiality and allow comparison of data by subject. The recruitment process ended with each volunteer developing a learning contract with the primary investigator. The structure of the learning contract contained the following questions: What are you going to learn? (objectives); How are you going to learn it? (resources and strategies); and, When do you plan to complete the task? Each student volunteer was asked to describe in writing his/her processes to meet the objectives.

Finally, the principle investigator also gave each volunteer instructions on how to access the online survey<sup>21</sup> to complete the pretest instrument. The introductory page explained that the questionnaire was voluntary and would take about 20 minutes to complete. Each participant was instructed to put his or her study number on the survey, but not a name.

Standard Infection Control Precaution Practices:	
Module Content	
<b>Module 1:</b> Emerging Diseases	<ul style="list-style-type: none"> <li>• Categories of Priority Pathogens</li> <li>• Ebola (Category A Pathogen)</li> <li>• Influenza (Category C Pathogen)</li> </ul>
<b>Module 2:</b> Policies and Procedures of Standard Infection Control Precaution Practices	<ul style="list-style-type: none"> <li>• Isolation Procedures &amp; Precautions</li> </ul>
<b>Module 3:</b> Care of Patients with Known Infections	<ul style="list-style-type: none"> <li>• Patient care practices for preventing device and procedure-associated infections</li> </ul>
<b>Module 4:</b> Post-Exposure Procedures	<ul style="list-style-type: none"> <li>• Risks of HIV, Hepatitis B, and Hepatitis C infection after accidental occupational exposures</li> <li>• Post-exposure prophylaxis (PEP)</li> </ul>
<b>Module 5:</b> General Standard Infection Control Precaution Practices	<ul style="list-style-type: none"> <li>• Hand Hygiene</li> <li>• Personal protective equipment (PPE)</li> <li>• Transmission-Based Precautions</li> </ul>
<b>Module 6:</b> Documentation & Reporting Requirements of Injuries and Exposure	<ul style="list-style-type: none"> <li>• Occupational injury and illness reporting requirements</li> </ul>

Fig 2. The infection control/PC curriculum.

In phase 2, the infection control and SP instruction was delivered using an online teaching/learning platform<sup>22</sup> that has been adopted by many Jordanian universities. This program allows instructors to develop teaching options such as quizzes, word matches, video clips, and assignment submission; video files and links; multiple-choice quizzes; an instant messaging service for intraclass communication; and other self-assessment tools. The infection control curriculum was organized into 6 modules (Fig 2) and was developed by the primary investigator who is a content expert in infection control. The main topics were emerging infectious diseases, policies and procedures regarding SPs, care of patients with known infections, postexposure procedures, general SPs, and documentation and reporting requirements of injuries and exposure. The instruction was offered for 30 days to give students a flexible time frame in which to complete the lesson. The posttest part of the study, phase 3, essentially repeated the pretest measure, including the assessment of knowledge and compliance regarding SPs measures.

#### Data analyses

For the statistical analysis, the data were imported to SPSS version 22 (IBM-SPSS Inc, Armonk, NY). The dataset was reviewed for input accuracy and checked for out-of-range values. Frequencies and percentages were derived for categorical variables. All significance values were set at  $P < .05$  and included 2-sided analysis.

For levels of knowledge (high, moderate, and inadequate), frequencies and percentages were derived. A paired-samples  $t$  test was used to compare group means at pretest and posttest. To evaluate subjects' compliance with SPs, frequencies and percentages were derived for 4 levels of compliance for pretest and posttest measures. Paired parametric  $t$  tests were used to compare the mean

number of correct answers in both the pretest and posttest within the levels of compliance.

## RESULTS

After excluding incomplete surveys, the final sample was 256. Demographic characteristics of the sample are presented in Table 1; women constituted a majority of participants (53.1%;  $n = 136$ ). Few students (7.8%) had ever attended infection control courses outside the nursing curriculum. Table 2 shows that a majority of participants (57%) scored their pretest knowledge as inadequate, with about one-quarter (27.7%) rating their knowledge as moderate, and only one-sixth (15.2%) rating their knowledge as high. At posttest, almost one-half of subjects (45.7%) rated their knowledge as high, with nearly one-third (32%) rating their knowledge as moderate, and less than one-quarter (22.3%) rating their knowledge as inadequate. Table 2 shows that a majority reported poor pretest compliance (ie, low [39.5%] and very low [27%]). Just one-third had better pretest compliance scores; that is, average (14.1%) and high (19.5%) ratings. The posttest reports of compliance improved considerably, with high reaching 36.7%, average reaching 46.8%, low reaching 14.5%, and only 2% reporting very low compliance. Significant improvement in both knowledge and compliance scores was seen when comparing pretest versus posttest means (Table 3).

Table 4 A paired-samples  $t$  test indicated that the knowledge scores were significantly higher at posttest than at pretest. These results suggest a statistically significant improvement in the

Table 1  
Sample demographic characteristics (N = 256)

Characteristic	Men	Women
Year of study		
2	46 (38)	34 (25)
3	29 (24)	54 (40)
4	45 (38)	48 (35)
Total	120 (46.9)	136 (53.1)
Previous infection control course		
Yes	17 (14)	3 (2)
No	103 (86)	133 (98)
Total	120	136

NOTE. Values are presented as n (%).

Table 2  
Knowledge and compliance with standard precautions (N = 256)

	Score	Pretest	Posttest
Knowledge			
High	15-20	39 (15.2)	133 (52)
Moderate	10-14	71 (27.8)	98 (38.3)
Inadequate	0-9	146 (57)	25 (9.7)
Compliance			
High	61-80	50 (19.5)	111 (43.4)
Average	41-60	36 (14.1)	130 (50.8)
Low	21-40	101 (39.5)	15 (5.8)
Very low	0-20	69 (27)	0

NOTE. Values are presented as n (%).

Table 3  
Means and standard deviations (SD) of scores for knowledge and compliance: Pretest and posttest

	Mean	SD
Knowledge score		
Pretest	8.003	6.93
Posttest	15.14	4.27
Compliance score		
Pretest	37.22	19.27
Posttest	59.96	11.42

**Table 4**One-sample paired *t* test: Comparing pretest versus posttest scores of knowledge and compliance

Score	<i>t</i> Value	Significance (2-tailed)	Mean difference	95% Confidence interval	
				Lower	Upper
Pre/posttest knowledge	14.04	0.00*	7.13	6.13	8.13
Pre/posttest compliance	16.60	0.00*	22.74	20.04	25.44

\**P* < .01.

undergraduate nurses' knowledge following the educational intervention. The paired-samples *t* test indicated that posttest compliance scores were also significantly higher than pretest measures.

## DISCUSSION

In the current study, nearly half of study subjects were male nursing students (*n* = 120; 46.9%). This is not an unusual finding in Jordan because men are admitted at the same rate as women. Jordan's national universities are free to citizens and admit students based on a high school exit exam, the Tawjihi (General Secondary Education Certificate Examination). Regardless of a student's personal career preference, those with the highest Tawjihi scores are sequentially admitted into academic career programs in order of social standing and earning potential (ie, medical school, engineering, and other sciences). Nursing ranks just above agriculture, which ranks last. There are so many men with high exam scores that they could fill all of the admission slots in nursing, which is identified as a career for women. However, due to the strict prohibitions in Islamic cultures on men providing direct care for women, rules were set in place to admit equal numbers of men and women to national nursing schools.

Female subjects were more likely to report higher knowledge of and compliance with SPs at posttest than men. In contrast, a recent study of nursing students in Australia found no association between self-reported compliance with SP practices based on gender or age. However, that particular sample was more than 90% women, which likely influenced these findings.<sup>23</sup> In studies of health care workers in the United States, it was found that compliance with universal precautions was low but higher among women (25%) than men (19%).<sup>24</sup> Further, an extensive review of studies reported that being a man was a risk factor for low compliance with hand hygiene.<sup>25</sup> On the other hand, 1 study reported that male and female health care workers washed their hands equally often.<sup>26</sup>

### Pretest knowledge and compliance with SPs

As expected, the results of the current study show that a majority of students had low levels of SP knowledge at pretest. The poor measure of PC knowledge is a reflection of the absence of systematic SP training in the Jordanian nursing curriculum. This is not an unusual finding in developing countries that provide regular instruction in PC, medical students in Venezuela also lacked adequate knowledge of SPs.<sup>27</sup> A study from Israel provides insight to the issue of PC knowledge; those authors<sup>28</sup> found that nursing students' knowledge level with PCs was influenced by their instructors during formal training.

Low pretest measures of SP compliance were an expected finding in this study. Jordanian nursing programs have large classes and have high faculty-to-student ratios. This means that during instruction, faculty members are seldom able to provide role modeling or adequately monitor students during performance of SPs. In addition, clinical experiences occur in settings with insufficient resources (eg,

masks, gloves, sinks, water, and paper hand towels) when numerous students are present at 1 site. Role modeling by faculty and onsite clinical faculty (selected health care workers) is important, and others have reported that the hand hygiene practices of mentors influence the hand hygiene practices of students.<sup>29</sup>

### Posttest outcomes after online education

The results showed a significant improvement in undergraduate nurses' knowledge and compliance within the month after the educational intervention. Although the education component was entirely online and no mentors were involved, the short-term implications are good for the instructional methodology. In this case, the subjects were volunteers who had to undergo redundant testing and be self-directed learners on top of their official studies. The students were not required to participate as part of their curriculum but apparently valued the opportunity to master this content that would protect their patients as well as themselves.

It is noteworthy that compliance with SPs was higher among students in the latter years of the nursing program. This finding is consistent with a recent study among Jordanian nursing students.<sup>16</sup> In contrast, other researchers have found that intent to comply was negatively influenced during the senior year of nursing education by increased workload and clinical responsibility as well as the effect of the theory-practice gap.<sup>28</sup> This disparity between the principles taught in academic programs and workplace practices is a common stressor for novice health care professionals. For example, in a large sample of Chinese nurses (*N* = 1,444) only half could correctly identify each and every SP measure.<sup>20</sup>

### Limitations

Several limitations of this study should be noted. First, the use of a volunteer sample can result in systematic biases inherent to nonprobability samples. Also, the short time frame between instruction and posttesting for compliance may not have adequately reflected their behavior over time. In addition, the use of self-report for compliance with SPs is typically influenced by social conformity. These subjects may have already had better knowledge of SPs or stronger beliefs about its importance than those who chose not to participate. Lastly, these findings cannot be generalized to all nursing students in Jordan.

## CONCLUSIONS

This small study demonstrates that knowledge and compliance of SPs among undergraduate nursing students can be improved by instruction provided online. However, the absence of a rigorous curriculum will always impede progress toward reducing and preventing HAIs and has a negative effect on nursing practice. Organizations that oversee nursing programs in developing countries are themselves developing and reaching higher goals. These findings offer proof-of-concept for the utility of a freestanding online curriculum for infection control that could be mandated to nursing programs and as continuing education for nurses in practice. Thus, infection control is not just an issue of individual practice, it is also relevant to policy at national levels. A coherent policy to mandate infection control training by the nursing profession can evoke a trickle-down effect on other professions, health care agencies, as well as national and international health care outcomes.

### Recommendations for future studies

Ideally, outcome studies of infection control and SP adoption after repeated application of the online instruction module by all nursing

students in Jordan would yield informative, data-driven practical outcomes. An extension of our study of nursing students would be to conduct a study among nurses at agencies where students have clinical experiences. Such a study could assess the agencies' infection control outcomes as well as changes in behavior among the nurses who collaborate with students. Because others have described the dissonance between theory and practice, we hypothesize that change can begin from the bottom up: from novice to expert. In developing countries, where physical resources are limited, educated professionals can override habitual poor practice. Research is best used as a tool for positive change.

## References

- Pittet D, Allegranzi B, Storr J, Donaldson L. "Clean care is safer care": the global patient safety challenge 2005-2006. *Int J Infect Dis* 2006;10:419-24. doi:10.1016/j.ijid.2006.06.001.
- Glance LG, Stone PW, Mukamel DB, Dick AW. Increases in mortality, length of stay, and cost associated with hospital-acquired infections in trauma patients. *Arch Surg* 2011;146:794-801. doi:10.1001/archsurg.2011.41.
- Wasswa P, Nalwadda CK, Buregyeya E, Gitta SN, Anguzu P, Nuwaha F. Implementation of infection control in health facilities in Arua district, Uganda: a cross-sectional study. *BMC Infect Dis* 2015;15:268. doi:10.1186/s12879-015-0999-4.
- World Health Organization; 2004. Practical Guidelines for Infection Control in Health Care Facilities. Available at [http://www.wpro.who.int/publications/docs/practical\\_guidelines\\_infection\\_control.pdf](http://www.wpro.who.int/publications/docs/practical_guidelines_infection_control.pdf). Accessed May 15, 2016.
- Adams DA, Thomas KR, Jajosky RA, Foster L, Sharp P, Onweh DH, et al. Summary of notifiable infectious diseases and conditions—United States, 2014. *MMWR Morb Mortal Wkly Rep* 2016;63:1-152. doi:10.15585/mmwr.mm6354a1.
- Shaw K. The 2003 SARS outbreak and its impact on infection control practices. *Public Health* 2006;120:8-14. doi:10.1016/j.puhe.2005.10.002.
- Siegel JD. Controversies in isolation and general infection control practices in pediatrics. *Semin Pediatr Infect Dis* 2002;13:48-54.
- Amoran O, Onwube O. Infection control and practice of standard precautions among healthcare workers in northern Nigeria. *J Glob Infect Dis* 2013;5:156-63. doi:10.4103/0974-777x.122010.
- White N, Clark D, Lewis R, Robson W. The introduction of "Safety science" into an undergraduate nursing programme at a large university in the United Kingdom. *Int J Nurs Educ Scholarsh* 2016;13:doi:10.1515/ijnes-2015-0007.
- Cole M. Exploring the hand hygiene competence of student nurses: a case of flawed self assessment. *Nurse Educ Today* 2009;29:380-8. doi:10.1016/j.nedt.2008.10.010.
- Tavolacci MP, Ladner J, Bailly L, Merle V, Pitrou I, Czernichow P. Prevention of nosocomial infection and standard precautions: knowledge and source of information among healthcare students. *Infect Control Hosp Epidemiol* 2008;29:642-7. doi:10.1086/588683.
- Sax H, Perneger T, Hugonnet S, Herrault P, Chraïti MN, Pittet D. Knowledge of standard and isolation precautions in a large teaching hospital. *Infect Control Hosp Epidemiol* 2005;26:298-304. doi:10.1086/502543.
- Nasirudeen AM, Koh JW, Lau AL, Li W, Lim LS, Ow CY. Hand hygiene knowledge and practices of nursing students in Singapore. *Am J Infect Control* 2012;40:e241-3. doi:10.1016/j.ajic.2012.02.026.
- Cheung K, Chan CK, Chang MY, Chu PH, Fung WF, Kwan KC, et al. Predictors for compliance of standard precautions among nursing students. *Am J Infect Control* 2015;43:729-34. <http://dx.doi.org/10.1016/j.ajic.2015.03.007>
- Al-Rawajfah OM, Tubaishat A. Nursing students' knowledge and practices of Standard Precautions: a Jordanian web-based survey. *Nurse Educ Today* 2015;35:1175-80. <http://dx.doi.org/10.1016/j.nedt.2015.05.011>
- Darawad MW, Al-Hussami M. Jordanian nursing students' knowledge of, attitudes towards, and compliance with infection control precautions. *Nurse Educ Today* 2013;33:580-3. doi:10.1016/j.nedt.2012.06.009.
- World Bank; 2016. World Development Indicators, Country Profile: Jordan (September 1, 2017). Available at [http://databank.worldbank.org/data/Views/Reports/ReportWidgetCustom.aspx?Report\\_Name=CountryProfile&id=b450fd57&tbar=y&dd=y&inf=n&zm=n&country=JOR](http://databank.worldbank.org/data/Views/Reports/ReportWidgetCustom.aspx?Report_Name=CountryProfile&id=b450fd57&tbar=y&dd=y&inf=n&zm=n&country=JOR). Accessed May 26, 2016.
- Jordanian Nursing Council; 2014. Jordanian Nursing Council. Available at: <http://jnc.gov.jo/en/Pages/default.aspx>. Accessed May 26, 2016.
- Cohen J. *Statistical power analysis for the behavioral sciences*. 2nd ed. Hillsdale, NJ.: Erlbaum; 1988.
- Luo Y, He GP, Zhou JW, Luo Y. Factors impacting compliance with standard precautions in nursing, China. *Int J Infect Dis* 2010;14:e1106-14. doi:10.1016/j.ijid.2009.03.037.
- SurveyMonkey.com. San Mateo, California, USA; 2015.
- Moodle.com. Perth, Australia; 2014.
- Mitchell BG, Say R, Wells A, Wilson F, Cloete L, Matheson L. Australian graduating nurses' knowledge, intentions and beliefs on infection prevention and control: a cross-sectional study. *BMC Nurs* 2014;13:43. doi:10.1186/s12912-014-0043-9.
- Gershon RR, Vlahov D, Felknor SA, Vesley D, Johnson PC, Delclos GL, et al. Compliance with universal precautions among health care workers at three regional hospitals. *Am J Infect Control* 1995;23:225-36.
- Pittet D. Improving adherence to hand hygiene practice: a multidisciplinary approach. *Emerg Infect Dis* 2001;7:234-40. doi:10.3201/eid0702.700234.
- Kirkland KB, Weinstein JM. Adverse effects of contact isolation. *Lancet* 1999;354:1177-8. doi:10.1016/s0140-6736(99)04196-3.
- Monsalve-Arteaga LC, Martinez-Balzano CD, Carvajal-De Carvajal AC. Medical students' knowledge and attitudes towards standard precautions. *J Hosp Infect* 2007;65:371-2. doi:10.1016/j.jhin.2006.11.009.
- Livshiz-Riven I, Nativ R, Borer A, Kanat-Maymon Y, Anson O. Nursing students' intentions to comply with Standard Precautions: an exploratory prospective cohort study. *Am J Infect Control* 2014;42:744-9. doi:10.1016/j.ajic.2014.04.002.
- Snow M, White GL Jr, Alder SC, Stanford JB. Mentor's hand hygiene practices influence student's hand hygiene rates. *Am J Infect Control* 2006;34:18-24. doi:10.1016/j.ajic.2005.05.009.