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State of the Science Review

Knowledge, attitude, practice, and clinical recommendation toward infection control and prevention standards among nurses: A systematic review

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Key Words:
Control infection
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Systematic review
Health Knowledge

Background: The purpose of this study was to systematically review the literature to describe nurses' knowledge and practice of and attitude toward infection control and prevention standards.
Methods: In the present systematic review, 4 electronic databases were searched from the inception of databases through March 2018. Quality of included studies was assessed using the Hoy tool.
Results: Eighteen studies conducted on 4,577 employed nurses and nursing students entered the final stage. Results indicated that nurses in most studies had adequate knowledge (n = 10, 40%-90%) and positive attitude (n = 4, 37%-100%). However, most studies reflected average and poor nursing practices with regard to adherence to infection control and prevention standards. The most frequent recommendations proposed for improving nurses' knowledge, attitude, and practice included periodic training via scientific conferences and relevant practical courses (n = 12), combining up-to-date theoretical and practical programs (n = 6), and training at the beginning of hospital employment (n = 4).
Conclusions: The results of the present study indicate that although nurses in most studies had adequate knowledge of and positive attitude toward health care–associated infections, because of average and poor practices, they need systematic and integrated implementation of the presented recommendations.
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Today, the growing increase in health care–associated infections (HAIs) is considered one of the most important challenges facing health care systems worldwide.[1] HAIs, previously known as "nosocomial" or "hospital" infections, refer to infections that occur 48 hours after admission to a hospital.[2] According to statistics by the World Health Organization, the global prevalence of HAIs is 15%.[3] The prevalence of HAIs in Europe is 6%,[4] and in developing countries as well as East Mediterranean countries, prevalence has been estimated at 5.7%-19.1%.[5] Over 80% of HAIs involve the urinary tract, surgical wounds, respiratory system, and bloodstream.[5] HAIs cause delayed patient improvement, lengthened hospitalization (eg, more than 4 days in urinary tract infections and up to 1 month in bloodstream infections), increased health care costs for patients and health care systems, and increased suffering of patients' families as a result of following up the complications attributable to HAIs.[6,7] Considering the importance, cost, and prevalence of HAIs at different and wards of hospitals, the World Health Organization and the Centers for Disease Control and Prevention have proposed 2 approaches to controlling infections: standard precautions and transmission-based precautions.[6,8,9] Standard precautions refer to the basic principles of controlling infections to protect health care team members against HAIs. These precautions include handwashing, protective barriers (gloves, masks, guns, and eye protection), managing sharp objects, and managing patient-associated care instruments. Indeed, they are the

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minimum requirements for fulfilling health care safety in any ward irrespective of the type and intensity of disease. Transmission-based precautions are used when the standard precautions are inadequate for controlling infections.[8,10,11]

Nurses, as the largest group constituting the health care team, have the greatest contact with patients and are at higher risk of developing HAIs.[12] Poor knowledge is one of the most important causes of high HAI prevalence worldwide.[5,12,13] Individual studies suggest different levels of knowledge among nurses regarding standard precautions, including poor,[14] average,[15] and adequate. Studies have also suggested that suitable knowledge and attitude can be important factors in good infection control and prevention practices.[16-18] However, no study has thus far been conducted in an integrated way, with a systematic review approach. Accurately determining level of knowledge, attitude, and practice can help health care policymakers better plan for improving nurses' knowledge and practice. Considering the importance of these components in controlling HAIs to reduce costs incurred by the health care system, this study has been conducted with the aim of investigating nurses' knowledge and practice of and attitude toward infection control and prevention standards.

METHODS

Eligibility criteria

The methods adopted for this systematic review are consistent with the guidelines detailed on the Preferred Reporting Items for Systematic Reviews and Meta-Analyses checklist.[19] Inclusion criteria were the following: (1) studies investigated knowledge and practice of and attitude toward infection control and prevention standards, (2) study designs were cross-sectional, (3) studies had been performed on nurses or nursing students, (4) studies had been published in English, and (5) method of data collection was self-report or observation. Exclusion criteria were the following: (1) studies conducted on populations other than nurses or a combination of populations, (2) studies that were letters to editors or review studies, and (3) studies with high risk of bias (low quality) based on the Hoy tool.

Search strategy

Searches were conducted by 2 independent researchers following consultation with a health sciences librarian, who assisted in development of overall search strategy and identification of key Medical Subject Headings search terms and free terms according to the Peer Review of Electronic Search Strategies standard.[20] Key words used for electronic database searches are listed in Table 1. Four electronic databases were searched from launch through March 2018: PubMed, Web of Science, Scopus, and CINAHL. The PubMed search strategy was first finalized and then adapted for use in other identified databases. PROSPERO was also searched for ongoing or related recently completed systematic reviews.

Table 1
List of key words used in literature search

Participants	Infection control	Outcomes
"nurses"	"standard precautions"	"knowledge"
"nursing students"	"infection control"	"attitude"
	"Health care–associated infections"	"use"
	"hospital-acquired infection"	"practice"
	"nosocomial infections"	"KAP"
		"Knowledge"

Selection of studies and data extraction

Two researchers independently screened titles and abstracts for eligibility. The full text was then reviewed to confirm an eligibility criteria match. Requisite information extracted included basic information regarding general information (first author, year of publication, country, participants, sampling method, data collection method, instruments, risk of bias, target population, and age) and outcome measures (knowledge and practice of, attitude toward, and recommendations for infection control, HAIs, and standard precautions). Duplicate studies were then removed after comparing lists generated by the 2 researchers. Where there was a discrepancy between researchers with regard to inclusion of a study, discussions were held among the study authors to resolve concerns through consensus.

Quality assessment and abstraction

To assess the methodologic quality and risk of bias of each included observational study, the Hoy critical appraisal checklist was used.[21] This 10-item checklist evaluates study quality in 2 dimensions: external validity (items 1-4 assess target population, sampling frame, sampling method, and nonresponse bias minimal) and internal validity (items 5-9 assess different parts including data collection method, case definition, study instrument, and mode of data collection); item 10 assesses bias related to the analysis. Each study was evaluated for risk of bias by the 2 independent researchers, with disagreements resolved through consensus method.

RESULTS

Study selection

A total of 2,703 articles were retrieved from the initial search in different databases. After excluding duplicates, 2,053 studies were processed for further filtration. After applying the initial review of both title and abstract, 2,004 studies were excluded. The final list comprised 49 studies that had been checked against the eligibility criteria. The 2 researchers agreed to include 18 studies in the final review. Of the 31 excluded studies, 6 were review articles, 6 were focused on mixed populations, 2 were letters to editors, 2 did not have full text, 2 were qualitative studies, 8 were in a language other than English, and 5 did not meet quality requirements for inclusion in the study (Fig 1).

Study characteristics

Eighteen studies conducted on 4,577 employed nurses and nursing students entered the final stage. Most studies had been performed in Jordan (N = 5)[8,22-25] and Iran (n = 3).[15,26,27] Two studies had also been performed in India,[28,29] with 1 study being performed in other countries. Out of 16 studies, 12 had been done on nurses employed in hospitals[15,22,23,25-33] and 6 on nursing students.[6,8,18,24,34,35] The sampling method in most studies was convenience sampling (n = 12). The method of completing the questionnaires in most studies was self-report (n = 16). All studies had a high level of quality (low bias), and a list of summary studies is available in Table 2.

Used instruments

Except for 3 studies,[8,22,23] all others used nonstandardized instruments. The number of items used was not mentioned in 6 studies; in those studies that did mention this component, the number of instrument items was 20-43. The validity of the used instruments was not examined in 11 studies. The Cronbach α coefficient was 0.72-0.87 in the studies with standard instruments.

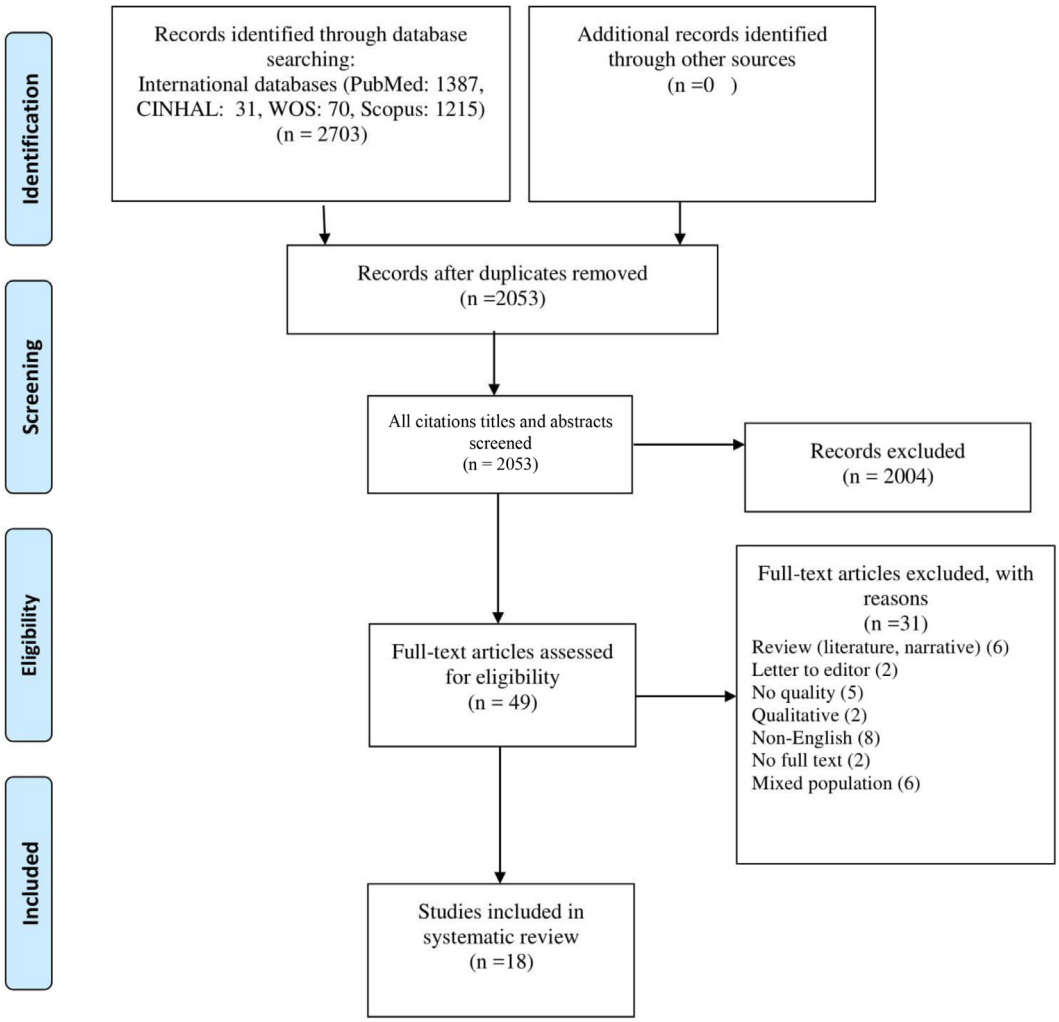

Fig 1. Study selection process. *WOS*, Web of Science.

Nurses' knowledge of infection control and prevention standards

Sixteen out of 18 of the included studies examined knowledge level. The level of knowledge in different studies had been mainly categorized as inadequate, average, and adequate. We mentioned the most common level of knowledge in each study. Out of the 16 studies, 10, 4, and 2 characterized knowledge level as "adequate," "inadequate," and "average," respectively. Out of the 10 studies that characterized level of knowledge as adequate, 9 reported adequate knowledge level (range, 40%-90%) in different studies. One study also reported level of knowledge as average (21.4%). In the group of 4 studies, the most common level of knowledge was characterized as inadequate (range, 43%-88%). In the 2 remaining studies, participants had mostly average knowledge. The overall results indicated that most participants had adequate knowledge regarding infection control and prevention standards (Table 2).

Nurses' attitude toward and practice of infection control and prevention standards

Out of the 18 studies, 5 examined nurses' attitudes regarding HAIs. In most studies (n = 4), nurses had a positive attitude toward infection control and prevention standards. The percentage of nurses with a positive attitude ranged in these studies from 37%-100%. The practice level of nurses was classified as good, average, and poor. Out of the 18 studies, 10 examined nurses' level of practice with respect to infection control and prevention standards; nurses in most of the studies (n = 4) had an average level of practice (Table 2).

Recommendations for improving nurses' knowledge and practice of and attitude toward infection control and prevention standards

Most of the studies presented recommendations for improving nurses' knowledge and practice of and attitude toward controlling infections. The most important recommendations—based on their frequency in different studies—were (1) periodic training in infection control and prevention standards via scientific conferences and relevant practical courses (n = 12), (2) combining up-to-date theoretical and practical programs for controlling HAIs (n = 6), and (3) training at the beginning of hospital employment (n = 4). It seems that one of the best approaches for enhancing nurses' knowledge involved developing a positive attitude toward infection control standards, teaching proper hospital clinical practice during student programs (including incorporating educational materials related to controlling infections into educational curricula and relevant practical courses in the hospital) and on hospital employment (including practical tests when entering the hospital and periodic relevant scientific and practical training courses at suitable time intervals), and developing relevant infrastructure for implementing policies and standards related to HAIs (Table 3).

Table 2
Study characteristics, knowledge, and practice of and attitude toward health care–acquired infection precautions and infection control among nurses

Study authors (year)	Outcome measures	Country	Study characteristics: participants, target population, sampling method, method of data collection, risk of bias	Instrumentation: type of tool, number of items, reliability	Knowledge level and mean (%)	Participants with positive attitude (%)	Compliance or practice and mean ± SD or n (%)
Abou El-Enein and El Mahdy (2011)[30]	Knowledge and attitude	Egypt	17, hospital nurses, census, direct observation and self-report, low	Nonstandardized, 20, NR	Adequate (47.1)	(100)	-
Al-Rawajfah (2016)[22]	Practice	Jordan	247; hospital nurses; stratified, cluster, random sampling; self-report; low	Standardized, 29, 0.83	-	-	122.6 ± 13.2
Al-Rawajfah et al (2013)[23]	Compliance	Jordan	889; hospital nurses; proportional multistage, probability sampling; self-report; low	Standardized, 29, 0.83	-	-	Good (65)
Al-Rawajfah and Tubaishat (2015)[8]	Knowledge and practice	Jordan	594, nursing students, census, self-report, low	Standardized, 43, 0.87	Adequate (79.9)	-	Good (84.3)
Brosio et al (2017)[6]	Knowledge	Italy	339, nursing students, census, self-report, low	Nonstandardized, NR, NR	(21.4)	-	-
Darawad and Al-Hussami (2013)[24]	Knowledge, attitude, and practice	Jordan	168, nursing students, convenience, self-report, low	Nonstandardized, 25, NR	Inadequate (49.6)	(89.8)	Average (75)
Gawad (2017)[31]	Knowledge	Yemen	196, hospital nurses, convenience, self-report, low	Nonstandardized, 25, NR	Inadequate (63.8)	-	-
Ghalya and Ibrahim (2014)[32]	Knowledge	Saudi Arabia	96, hospital nurses, convenience, self-report, low	Nonstandardized, NR, NR	Adequate (45.83)	-	-
Jahangir et al (2017)[33]	Knowledge	Pakistan	240, hospital nurses, convenience, self-report, low	Nonstandardized, 24, NR	(61)	-	-
Kalantarzadeh et al (2014)[26]	Knowledge and practice	Iran	224, hospital nurses, convenience, self-report, low	Nonstandardized, 40, 0.81	Average (41.09)	-	Average (75.8)
Mitchell et al (2014)[34]	Knowledge and attitude	Australia	349, graduating nurses, convenience, self-report, low	Nonstandardized, NR, NR	Adequate (59.8)	(60)	-
Poorkahkhaei et al (2016)[27]	Knowledge	Iran	100, hospital nurses, convenience, self-report, low	Nonstandardized, NR, NR	Adequate (40)	-	-
Rahiman et al (2018)[35]	Knowledge, attitude, and practice	South Africa	301, nursing students, convenience, self-report, low	Nonstandardized, NR, 0.72-0.75	Adequate (47.4)	(41.7)	Poor (37.3)
Sarani et al (2015)[15]	Knowledge, attitude, and practice	Iran	170, hospital nurses, simple random sampling, self-report, low	Nonstandardized, 36, NR	Inadequate (43)	(37)	Average (42)
Sodhi et al (2013)[28]	Knowledge	India	100, hospital nurses, convenience, self-report, low	Nonstandardized, 40, NR	Average (40)	-	-
Suliman et al (2018)[25]	Knowledge and practice	Jordan	247, hospital nurses, convenience, self-report, low	Nonstandardized, NR, 0.77-0.89	Adequate (90)	-	Good (65)
Taneja (2009)[29]	Knowledge and practice	India	100, hospital nurses, convenience, self-report, low	Researcher-made, 37, NR	Adequate (75.5)	-	Average (57.5)
Wu et al (2009)[18]	Knowledge and practice	Taiwan	200, nursing students, convenience, self-report, low	Researcher-made, 36, 0.82	Inadequate (88)	-	Poor (72)

NR, not reported.

Table 3
Recommendations for improving nurses' knowledge and practice of and attitude toward infection control and prevention standards

Recommendations	Study (year)																
	Abou El-Enein, N. Y and El Mahdy (2011)[30]	Al-Rawajfah et al (2013)[23]	Al-Rawajfah and Tubaishat (2015)[8]	Brosio et al (2017)[6]	Darawad and Al-Hussami (2013)[24]	Gawad (2017)[31]	Ghalya and Ibrahim (2014)[32]	Jahangir et al (2017)[33]	Kalantarzadeh et al (2014)[26]	Mitchell et al (2014)[34]	Poorkahkhaei et al (2016)[27]	Rahiman et al (2018)[35]	Sarani et al (2015)[15]	Sodhi et al (2013)[28]	Suliman et al (2018)[25]	Taneja (2009)[29]	Wu et al (2009)[18]
Suitable feedback to improve behaviors associated with controlling HAIs	✓																
Using and installing general protocols related to controlling HAIs	✓						✓							✓	✓		
Establishing a committee for controlling infection and updating information related to controlling infection by the committee members	✓																
Periodic training of nurses about HAIs via scientific conferences and relevant practical courses	✓		✓	✓	✓	✓	✓	✓			✓	✓		✓		✓	✓
Training nurses at the beginning of their employment in the hospital	✓						✓			✓						✓	
Developing required infrastructure and materials for implementing principles of controlling infection and standard precautions	✓	✓						✓							✓		
Combining up-to-date theoretical and practical programs to control HAIs			✓	✓			✓				✓	✓		✓			
Adding educational courses associated with controlling infection in academic curricula					✓												
Administering practical tests before entering the hospital							✓										
Creating a national information bank to investigate level of knowledge and performance regarding HAI protocols, with the aim of providing correct data for education									✓								
Developing national guidelines based on relevant universal guidelines		✓											✓				
Developing a suitable system to supervise proper implementation of principles of infection control in hospitals															✓		

DISCUSSION

To the authors' best knowledge, this is the first systematic review study conducted with the aim of investigating nurses' knowledge and practice of and attitude toward infection control and prevention standards. Eighteen studies conducted on 4,577 employed nurses and nursing students in 11 countries entered the final stage. Most of the instruments used in these studies were nonstandard and were designed based on reviews of past literature as well as experts' opinions. Most of the studies reported an adequate knowledge range (40%-90%) in nurses regarding infection control and prevention standards. No systematic review study was found involving other health care member teams. However, individual studies performed across different health care populations of dentistry students,[36] gynecologists (31.4%),[30] and medical staff (10%-75%)[14,37,38] indicated various levels of knowledge regarding infection control and prevention standards compared with nurses, which may be a result of both methodologic differences in the studies and the holding of more courses for nurses compared with other health care team members. The results of the present research suggest that most participants of these studies had a positive attitude toward infection control and prevention standards; as with the present study, other studies also show a positive attitude among other members of the health care team.[38] In the present study, nurses had a poor level of practice with respect to controlling HAIs. As with individual studies of medical teams, this suggests a poor general level of practice in the realm of infection control and prevention standards.[39]

One of the limitations of the present study was the researcher-made instruments for determining knowledge, attitude, and performance surrounding HAIs. Because of the diversity in the number of items, difference in the content of items and scoring of questionnaires, and not investigating the reliability and validity of instruments in some studies, it was not possible to perform a meta-analysis. Because complete data were not available for many studies, contact was made with the authors to acquire this information. Because of the low number of studies conducted in Western countries, we cannot extrapolate the results to these countries. Strengths of the present study include the following: (1) using a systematic review approach and writing the article based on a predefined protocol and the Preferred Reporting Items for Systematic Reviews and Meta-Analyses checklist as well as taking into account all possible dimensions of knowledge, attitude, practice, and recommendations based on published studies; (2) using a defined search strategy to search for articles, most of which were of good quality; and (3) using an established critical appraisal tool to evaluate studies.

CONCLUSIONS

This systematic review, which dealt with investigating nurses' knowledge and performance of and attitude toward infection control and prevention standards, suggests that in spite of adequate knowledge and a positive attitude, nurses unfortunately have a poor level of performance. Considering the vital role nurses play as one of the most important members of the health care team—and the member with maximum patient contact—it seems that more practical measures should be used to enhance their performance in clinical practice. Precise investigation regarding obstacles to and problems arising from not following standard precautions through descriptive studies can help better identify causes. Further, one of the most important challenges in hospitals is acknowledging the role played by HAIs in increasing health care system costs, which results in less attention to practical measures. Seminars and workshops related to the importance of infection control and prevention standards in the health care economy can also be helpful. Finally, launching a system to record HAIs in different wards according to standard protocols, instituting monthly reporting, and rewarding wards with the least number of HAI cases can also be helpful.

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References

1. Allegranzi B, Nejad SB, Combescure C, Graafmans W, Attar H, Donaldson L, et al. Burden of endemic health-care-associated infection in developing countries: systematic review and meta-analysis. Lancet 2011;377:228-41.
2. Bello AI, Asiedu EN, Adegoke BO, Quartey JN, Appiah-Kubi KO, Owusu-Ansah B. Nosocomial infections: knowledge and source of information among clinical health care students in Ghana. Int J Gen Med 2011;4:571.
3. Sydnor ER, Perl TM. Hospital epidemiology and infection control in acute-care settings. Clin Microbiol Rev 2011;24:141-73.
4. European Centre for Disease Prevention and Control. Point prevalence survey of healthcare-associated infections and antimicrobial use in European acute care hospitals, 2013. Stockholm (Sweden): ECDC; 2013.
5. Khan HA, Baig FK, Mehboob R. Nosocomial infections: epidemiology, prevention, control and surveillance. Asian Pac J Trop Biomed 2017;7:478-82.
6. Brosio F, Kuhdari P, Stefanati A, Sulcaj N, Lupi S, Guidi E, et al. Knowledge and behaviour of nursing students on the prevention of healthcare-associated infections. J Prev Med Hyg 2017;58:E99-104.
7. Heister T, Kaier K, Wolkewitz M. Estimating the burden of nosocomial infections: time dependency and cost clustering should be taken into account. Am J Infect Control 2017;45:94-5.
8. 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.
9. Foster TM, Lee MG, McGaw CD, Frankson MA. Knowledge and practice of occupational infection control among healthcare workers in Jamaica. West Indian Med J 2010;59:147-52.
10. Ocampo W, Geransar R, Clayden N, Jones J, de Grood J, Joffe M, et al. Environmental scan of infection prevention and control practices for containment of hospital-acquired infectious disease outbreaks in acute care hospital settings across Canada. Am J Infect Control 2017;45:1116-26.
11. World Health Organization. WHO guidelines on hand hygiene in health care. Available from: http://whqlibdocwhoint/publications/2009/9789241597906_engpdf. Accessed October 10, 2018.
12. Boev C, Xia Y. Nurse-physician collaboration and hospital-acquired infections in critical care. Crit Care Nurse 2015;35:66-72.
13. Ogoina D, Pondei K, Adetunji B, Chima G, Isichei C, Gidado S. Knowledge, attitude and practice of standard precautions of infection control by hospital workers in two tertiary hospitals in Nigeria. J Infect Prev 2015;16:16-22.
14. Atif ML, Brenet A, Hageaux S, Fave MH, Cochet C, Baticle E, et al. Awareness of standard precautions for 4439 healthcare professionals in 34 institutions in France. Med Mal Infect 2013;43:10-6.
15. Sarani H, Balouchi A, Masinaeinezhad N, Ebrahimitabas E. Knowledge, attitude and practice of nurses about standard precautions for hospital-acquired infection in teaching hospitals affiliated to Zabol University of Medical Sciences (2014). Glob J Health Sci 2015;8:193-8.
16. 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.
17. Tenna A, Stenehjem EA, Margoles L, Kacha E, Blumberg HM, Kempker RR. Infection control knowledge, attitudes, and practices among healthcare workers in Addis Ababa, Ethiopia. Infect Control Hosp Epidemiol 2013;34:1289-96.
18. Wu CJ, Gardner GE, Chang AM. Taiwanese nursing students' knowledge, application and confidence with standard and additional precautions in infection control. J Clin Nurs 2009;18:1105-12.
19. Moher D, Liberati A, Tetzlaff J, Altman DG. Preferred reporting items for systematic reviews and meta-analyses: the PRISMA statement. PLoS Med 2009;6:e1000097.
20. McGowan J, Sampson M, Salzwedel DM, Cogo E, Foerster V, Lefebvre C. PRESS peer review of electronic search strategies: 2015 guideline statement. J Clin Epidemiol 2016;75:40-6.
21. Hoy D, Brooks P, Woolf A, Blyth F, March L, Bain C, et al. Assessing risk of bias in prevalence studies: modification of an existing tool and evidence of interrater agreement. J Clin Epidemiol 2012;65:934-9.
22. Al-Rawajfah OM. Infection control practices among intensive care unit registered nurses: a Jordanian national study. Nurs Crit Care 2016;21:E20-7.
23. Al-Rawajfah OM, Hweidi IM, Alkhalaileh M, Khader YS, Alshboul SA. Compliance of Jordanian registered nurses with infection control guidelines: a national population-based study. Am J Infect Control 2013;41:1065-8.
24. 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.

25. Suliman M, Aloush S, Aljezawi M, AlBashtawy M. Knowledge and practices of isolation precautions among nurses in Jordan. Am J Infect Control 2018;46:680-4.
26. Kalantarzadeh M, Mohammadnejad E, Ehsani SR, Tamizi Z. Knowledge and practice of nurses about the control and prevention of nosocomial infections in emergency departments. Arch Clin Infect Dis 2014;9:e18278.
27. Poorkahkhaei M, Roshangar M, Vahedi A, Izadpanah H, Khodadoost M. Analyzing the awareness of nurses in relation to the prevention of hospital-acquired infections in Zahedan's teaching hospitals 2014. Intl J Pharm Technol 2016;8:18790-5.
28. Sodhi K, Shrivastava A, Arya M, Kumar M. Knowledge of infection control practices among intensive care nurses in a tertiary care hospital. J Infect Public Health 2013;6:269-75.
29. Taneja J. Evaluation of knowledge and practice amongst nursing staff toward infection control measures in a tertiary care hospital in India.. Can J Infect Control 2009;24:104-7.
30. Abou El-Enein NY, El Mahdy HM. Standard precautions: a KAP study among nurses in the dialysis unit in a university hospital in Alexandria, Egypt. J Egypt Public Health Assoc 2011;86:3-10.
31. Gawad A. Assessment of knowledge about standard precautions and nosocomial infection among nurses working in hospitals of Sana'a City, Yemen. Int J Car Sci 2017;10:169-75.
32. Ghalya MH, Ibrahim Y. Knowledge, attitudes and sources of information among nursing students toward infection control and standard precautions. Life Sci J 2014;11:249-60.
33. Jahangir M, Ali M, Riaz MS. Knowledge and practices of nurses regarding spread of nosocomial infection in government hospitals, Lahore. J Liaquat Univ Med Health Sci 2017;16:149-53.
34. 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.
35. Rahiman F, Chikte U, Hughes GD. Nursing students' knowledge, attitude and practices of infection prevention and control guidelines at a tertiary institution in the Western Cape: a cross-sectional study. Nurse Educ Today 2018;69:20-5.
36. Singh A, Purohit BM, Bhambal A, Saxena S, Singh A, Gupta A. Knowledge, attitudes, and practice regarding infection control measures among dental students in Central India. J Dent Educ 2011;75:421-7.
37. Díaz-Peña R, Irissont-Durán JA, de León JC. Level of knowledge of and capability for application of isolation precautions in a tertiary-level pediatric hospital. Gac Med Mex 2015;151:567-75.
38. Dramowski A, Whitelaw A, Cotton MF. Healthcare-associated infections in children: knowledge, attitudes and practice of paediatric healthcare providers at Tygerberg Hospital, Cape Town. Paediatr Int Child Health 2016;36:225-31.
39. Holla R, Kanchan T, Kumar N, Unnikrishnan B, Rekha T, Mithra P, et al. Perception and practices of standard precautions among health care professionals at tertiary care hospitals in coastal South India. Asian J Pharm Clin Res 2014;7:101-4.