ISSN 2220-3141 (online)

World Journal of

Critical Care Medicine

World J Crit Care Med 2023 June 9; 12(3): 92-187

Published by Baishideng Publishing Group Inc

WJCCM World Journal of Critical Care Medicine

Contents

Quarterly Volume 12 Number 3 June 9, 2023

REVIEW

MINIREVIEWS

ORIGINAL ARTICLE

Case Control Study

Observational Study

World Journal of Critical Care Medicine

Quarterly Volume 12 Number 3 June 9, 2023

Contents

ABOUT COVER

AIMS AND SCOPE

The primary aim of the *World Journal of Critical Care Medicine* (*WJCCM*, *World J Crit Care Med*) is to provide scholars and readers from various fields of critical care medicine with a platform to publish high-quality basic and clinical research articles and communicate their research findings online.

WJCCM mainly publishes articles reporting research results and findings obtained in the field of critical care medicine and covering a wide range of topics including acute kidney failure, acute respiratory distress syndrome and mechanical ventilation, application of bronchofiberscopy in critically ill patients, cardiopulmonary cerebral resuscitation, coagulant dysfunction, continuous renal replacement therapy, fluid resuscitation and tissue perfusion, hemodynamic monitoring and circulatory support, ICU management and treatment control, sedation and analgesia, severe infection, *etc*.

INDEXING/ABSTRACTING

The *WJCCM* is now abstracted and indexed in PubMed, PubMed Central, Reference Citation Analysis, China National Knowledge Infrastructure, China Science and Technology Journal Database, and Superstar Journals Database.

RESPONSIBLE EDITORS FOR THIS ISSUE

Production Editor: *Yi-Xuan Cai*; **Production Department Director:** *Xu Guo*; **Editorial Office Director:** *Li-Li Wang*.

NAME OF JOURNAL
World Journal of Critical Care Medicine

ISSN
ISSN 2220-3141 (online)

LAUNCH DATE
February 4, 2012

FREQUENCY
Quarterly

EDITORS-IN-CHIEF
Hua-Dong Wang

EDITORIAL BOARD MEMBERS
https://www.wjgnet.com/2220-3141/editorialboard.htm

PUBLICATION DATE
June 9, 2023

INSTRUCTIONS TO AUTHORS
https://www.wjgnet.com/bpg/gerinfo/204

GUIDELINES FOR ETHICS DOCUMENTS
https://www.wjgnet.com/bpg/GerInfo/287

GUIDELINES FOR NON-NATIVE SPEAKERS OF ENGLISH
https://www.wjgnet.com/bpg/gerinfo/240

PUBLICATION ETHICS
https://www.wjgnet.com/bpg/GerInfo/288

PUBLICATION MISCONDUCT
https://www.wjgnet.com/bpg/gerinfo/208

ARTICLE PROCESSING CHARGE
https://www.wjgnet.com/bpg/gerinfo/242

STEPS FOR SUBMITTING MANUSCRIPTS
https://www.wjgnet.com/bpg/GerInfo/239

ONLINE SUBMISSION
https://www.f6publishing.com

E-mail: bpgoffice@wjgnet.com https://www.wjgnet.com

World Journal of Critical Care Medicine

Submit a Manuscript: https://www.f6publishing.com

World J Crit Care Med 2023 June 9; 12(3): 176-187

DOI: 10.5492/wjccm.v12.i3.176

ISSN 2220-3141 (online)

ORIGINAL ARTICLE

Observational Study

Knowledge and awareness of infection control practices among nursing professionals: A cross-sectional survey from South Asia and the Middle East

Kanwalpreet Sodhi, Gunjan Chanchalani, Muktanjali Arya, Gentle S Shrestha, Juhi N Chandwani, Manender Kumar, Monika G Kansal, Mohammad Ashrafuzzaman, Anushka D Mudalige, Ashraf Al Tayar, Bassam Mansour, Hasan M Saeed, Madiha Hashmi, Mitul Das, Nehad N Al Shirawi, Ranjan Mathias, Wagih O Ahmed, Amandeep Sharma, Diptimala Agarwal, Prashant Nasa

Specialty type: Critical care medicine

Provenance and peer review: Invited article; Externally peer reviewed.

Peer-review model: Single blind

Peer-review report's scientific quality classification

Grade A (Excellent): 0
Grade B (Very good): B, B
Grade C (Good): C
Grade D (Fair): 0
Grade E (Poor): 0

P-Reviewer: Bittner EA, United States; Marano L, Italy; Roilides E, Greece

Received: April 14, 2023
Peer-review started: April 14, 2023
First decision: May 9, 2023
Revised: May 15, 2023
Accepted: May 31, 2023
Article in press: May 31, 2023
Published online: June 9, 2023

Kanwalpreet Sodhi, Department of Critical Care, Deep Hospital, Ludhiana 141001, Punjab, India

Gunjan Chanchalani, Critical Care Medicine, Somaiya Hospital and Research Centre, Mumbai 400001, Maharashtra, India

Muktanjali Arya, Department of Microbiology and Infection Control, Deep Hospital, Ludhiana 141001, India

Gentle S Shrestha, Department of Critical Care Medicine, Tribhuvan University Teaching Hospital, Kathmandu 44600, Nepal

Juhi N Chandwani, Anaesthesia and Intensive Care Unit, Royal Hospital, Muscat 112, Oman

Manender Kumar, Department of Cardiac Anaesthesia, Fortis Hospital, Ludhiana 141002, Punjab, India

Monika G Kansal, Intensive Care Medicine, Ng Teng Fong General Hospital, Singapore 609606, Singapore

Mohammad Ashrafuzzaman, Intensive Care Unit, Bangabandhu Sheikh Mujib Medical University, Dhaka 1000, Bangladesh

Anushka D Mudalige, Intensive Care Unit, Colombo North Teaching Hospital, Ragama 11010, Sri Lanka

Ashraf Al Tayar, Intensive Care Unit and Respiratory Therapy Department, Security Forces Hospital, Damman 34223, Saudi Arabia

Bassam Mansour, Pulmonary and Critical Care Division, Zahraa Hospital-University Medical Center, Beirut 1007, Lebanon

Bassam Mansour, Pulmonary Division, Faculty of Medical Sciences, Lebanese University, Beirut 1007, Lebanon

Hasan M Saeed, Department of Critical Care, Salmaniyah Medical Complex, Manama 323, Bahrain

Madiha Hashmi, Department of Critical Care Medicine, Ziauddin University, Karachi 75530, Pakistan

Mitul Das, Anaesthesia and Critical Care, Swasti Hospital, Rangia 781354, India

Nehad N Al Shirawi, Department of Critical Care Medicine, Al Fujairah Hospital, Fujairah 0000, United Arab Emirates

Ranjan Mathias, Department of Anesthesia and Intensive Care, Hamad Medical Corporation, Doha 974, Qatar

Wagih O Ahmed, Intensive Care Unit, Sulaiman Al Habib Medical Group, Buraidah 52211, Saudi Arabia

Amandeep Sharma, Department of Nursing, Deep Hospital, Ludhiana 141001, India

Diptimala Agarwal, Anesthesia and Intensive Care, Shantived Institute of Medical Sciences, Agra 282007, India

Prashant Nasa, Department of Critical Care Medicine, NMC Specialty Hospital, Dubai 7832, United Arab Emirates

Prashant Nasa, Internal Medicine, College of Medicine and Health Sciences, Al Ain 15551, Abu Dhabi, United Arab Emirates

Corresponding author: Prashant Nasa, MD, Chief Physician, Department of Critical Care Medicine, NMC Specialty Hospital, Amman Street, Dubai 7832, United Arab Emirates. dr.prashantnasa@hotmail.com

Abstract

BACKGROUND

The proficiency of nursing professionals in the infection prevention and control (IPC) practices is a core component of the strategy to mitigate the challenge of healthcare associated infections.

AIM

To test knowledge of nurses working in intensive care units (ICU) in South Asia and Middle East countries on IPC practices.

METHODS

An online self-assessment questionnaire based on various aspects of IPC practices was conducted among nurses over three weeks.

RESULTS

A total of 1333 nurses from 13 countries completed the survey. The average score was 72.8% and 36% of nurses were proficient (mean score > 80%). 43% and 68.3% of respondents were from government and teaching hospitals, respectively. 79.2% of respondents worked in < 25 bedded ICUs and 46.5% in closed ICUs. Statistically, a significant association was found between the knowledge and expertise of nurses, the country's per-capita income, type of hospitals, accreditation and teaching status of hospitals and type of ICUs. Working in high- and upper-middle-income countries (β = 4.89, 95%CI: 3.55 to 6.22) was positively associated, and the teaching status of the hospital (β = -4.58, 95%CI: -6.81 to -2.36) was negatively associated with the knowledge score among respondents.

CONCLUSION

There is considerable variation in knowledge among nurses working in ICU. Factors like income status of countries, public *vs* private and teaching status of hospitals and experience are independently associated with nurses' knowledge of IPC practices.

Key Words: Knowledge; Attitude; Policy compliance; Infection control; Infection control practices; Nurses

Core Tip: The knowledge testing on infection prevention and control (IPC) practices among intensive care unit nurses in South Asia and the Middle East showed considerable variation. The higher economic status of the country and working experience were independently associated with better knowledge among respondents. Working in public or teaching hospital were inversely associated with knowledge of IPC practices. There is an urgent need for education and awareness among nurses regarding IPC practices, especially in lower-middle-income countries.

Citation: Sodhi K, Chanchalani G, Arya M, Shrestha GS, Chandwani JN, Kumar M, Kansal MG, Ashrafuzzaman M, Mudalige AD, Al Tayar A, Mansour B, Saeed HM, Hashmi M, Das M, Al Shirawi NN, Mathias R, Ahmed WO, Sharma A, Agarwal D, Nasa P. Knowledge and awareness of infection control practices among nursing professionals: A cross-sectional survey from South Asia and the Middle East. *World J Crit Care Med* 2023; 12(3): 176-187

URL: https://www.wjgnet.com/2220-3141/full/v12/i3/176.htm

DOI: https://dx.doi.org/10.5492/wjccm.v12.i3.176

INTRODUCTION

Healthcare-associated infections (HAI) pose a considerable threat to the patients who are admitted in hospitals, especially in intensive care units (ICU). According to the surveillance report published by the International Nosocomial Infection Control Consortium, despite appreciable efforts on prevention and control of HAI, the Device-Associated (DA)-HAI rates in the ICUs of developing countries are higher compared to the developed nations[1]. Though the device utilization rate is similar, the DA-HAI rates of the ICUs in the developing countries remain higher than the ones belonging to the Center for Disease Control and Prevention- National Healthcare and Safety Network[1,2]. Hence, a robust infection prevention and control (IPC) program involving multi-disciplinary stakeholders is essential to mitigate the threat of HAI[3]. However, the compliance with IPC practices has been a critical implication on the implementation of the IPC program. Nurses have frequent and direct contact with the patients due to which, their knowledge and awareness about the IPC practices are integral[4]. On the other hand, the nurses are also at-risk of self-infection when providing care to critically ill patients[5]. Several factors may affect the compliance with IPC practices, prominent of which are knowledge, education and training, and the experience of nurses[6]. The lack of knowledge among health care workers (HCWs) about the IPC practices or the occurrence of discrepancies when applying this knowledge in bedside has been linked to worsening healthcare delivery outcomes, especially in case of developing countries[6-8]. Recently, the global experts have recommended that the ICU nurses should be a part of the surveillance team that monitor adherence of IPC practices[9].

The countries in South Asia and the Middle East regions constitute one-third of the global population. In spite of such common neighborhoods and centuries of cultural and political exchange, these countries exhibit vast differences in terms of income, availability of the resources and healthcare dynamics[10].

Though studies have been conducted to evaluate the knowledge of the nurses from individual nations, the authors were unable to find any literature that compares the knowledge of the nurses across the South Asian and Middle Eastern nations[8,11,12]. So, the current study is aimed to analyse the knowledge of ICU nurses on various aspects of IPC practices across the countries in South Asia and the Middle East.

MATERIALS AND METHODS

The study was conducted over three weeks, from April 20 to May 10, 2022. An online-based, cross-sectional survey was conducted using a multiple-choice questionnaire to evaluate the knowledge of nurses on various aspects of the IPC program. A 20-member steering committee comprising of critical care physicians, infection control professionals, microbiologist and the nursing administrator was involved in framing the questionnaire and its pilot run. The questionnaire was examined, revised and validated internally among the steering committee. Internal consistency among the questionnaire items using Cronbach's alpha (α) was found to be 0.90, which was considered within the acceptable range. The study was approved by the Ethics Committee (DHEC-2057/2022) of the institute, where the principal investigator (Kanwalpreet Sodhi) is affiliated and is exempted from other participating hospitals.

The final questionnaire has two portions in which the first portion covered the aspects like country name, profile of the hospital such as the type of setup, hospital accreditation and their teaching status, the type, size and the operating model of the ICU, and the nurses' demographic data including their years of clinical experience. The operating model of the ICU had three options such as "Open ICU" in

which the patients are admitted under the care of a non-intensivist physician, with the intensivists providing their expertise consultation when required, "Closed ICU" in which the patients are admitted under an intensivist-led team, and is held responsible for the primary care, and "Semi-closed ICU" in which the intensivist-led team provides direct patient care in collaboration with the non-intensivist physicians with shared decision making[13]. The second portion of the questionnaire consisted of 25 single best response types, *i.e.*, multiple choice questions (MCQ) on different aspects of the IPC practices, categorized under five sections such as the general aspects of infection control, standard precautions, transmission-based precautions, care bundles, and severe acute respiratory syndrome coronavirus 2 transmission (Appendix). Each section had five MCQs, and respondents can score one mark for a correct response. The answers to the MCQs were decided *a priori* by the steering committee members (Kanwalpreet Sodhi, Muktanjali Arya Amandeep Sharma, Prashant Nasa). The knowledge level was categorized based on the mean overall score, secured by the participants, *i.e.*, more than 81% score as proficient, 61%-80% as above average, 41%-60% as average and less than 40% as poor knowledge (Table 1).

The survey was conducted using a web link circulated by the steering committee members of the respective participant countries. The study included around 4-5 tertiary care hospitals from each country. The questionnaire was distributed to the nurses who work full-time in ICUs, and they were asked to fill it anonymously and voluntarily. The nurse trainees were excluded from the study. The consent for participation in the study and the publication of the results was obtained from the respondents at the beginning of the online questionnaire. The STROBE checklist was used for reporting the results of this cross-sectional survey.

Statistical analysis

The data was described in terms of frequencies (number of cases) and relative frequencies (percentages) as appropriate. In order to compare the categorical data, the chi-square (χ^2) test was used. Both univariate and multivariate linear regression analyses were conducted to compare the covariates. A probability value (P value) less than 0.05 was considered to be statistically significant. The outcome variable for the linear regression analysis was the total score secured from the questionnaire and no continuous data sets were present. Collinearity was checked for each predictor variable whereas non-linear regression underwent the same analysis and yielded the same conclusions. (Appendix) Those variables obtaining a P value < 0.05 in the univariate analysis, were included in the multivariate linear regression analyses. The beta coefficient and the confidence intervals were used to present of the multivariate linear regression analysis. All the statistical calculations were done using (Statistical Package for the Social Science) SPSS version 21 (SPSS Inc., Chicago, IL, United States) statistical program for Microsoft Windows.

RESULTS

The questionnaire was filled out by 1376 nurses across 13 countries. Out of the total responses, 43 were excluded from the final analysis (11 with negative consent for participation, and 32 had missing information). The data from 1333 respondents (nurses) was considered for the study (Figure 1).

The demographic profile of the respondents' hospitals and the ICUs is provided in Table 2. For analysis, the countries of the respondents were divided according to the World Bank income classification criteria into high-income countries (HIC) (such as Bahrain, the United Arab Emirates, Oman, Qatar, Saudi Arabia, and Singapore); upper-middle-income countries (UMIC) (*i.e.*, Lebanon); and lower-middle-income countries (LMIC) (such as Bangladesh, Bhutan, India, Sri Lanka, Nepal, and Pakistan). Most of the respondents belong to HIC (608, 45.6%) and LMIC (656, 49.2%). The respondents had varying level of experience, with 232 (17.4%) nurses having less than two years of experience and 396 (29.7%) nurses with more than ten years of experience. Among the responding nurses, 524 (39%) worked in corporate or private hospitals, whereas 570(43%) were in public hospitals. Most of the respondents worked in a hospital, accredited either by an international agency like Joint Commission International (606, 45.5%), or a national level agency (442, 33.2%). Further, majority of the respondents (1056, 79.2%) were working in less than 25-bedded ICUs and 607 (45%) were in mixed medical and surgical ICUs. In terms of the operational model of ICU, 620 (46.5%) respondents were working in closed ICUs and nearly equal proportion (27%) were in open and semi-closed ICUs. Further most of the respondents (911, 68.3%) worked in teaching hospitals.

The average score of the respondents was 72.8% (Figure 2). In terms of knowledge level categories, 480 (36%) respondents were categorized as proficient, and 472 (35.4%) had above-average knowledge. Only 11% of the respondents with less than two years of experience, were found to be proficient, compared to 34% respondents who had 5-10 years of experience. The knowledge of 32% of nurses with > 10 years of experience was above average, compared to 18% nurses with < 2 years of experience (Table 1). A statistically significant difference was found between the respondents on knowledge testing based on the working experience of the nurses (P = 0.001). Further, there was also statistically significant difference in the knowledge of the nurses based on World Bank income status (P = 0.001). The

Table 1 Demographic profile of the respondents and scores achieved by the level of knowledge

	Number of respondents (%)		Number of respondents (%)
World Bank income classification		**Working experience (yr)**	
High-income countries	608 (45.6)	< 2 yr	232 (17.4)
Upper middle-income countries	69 (5.2)	2-5 yr	354 (26.6)
Lower middle-income countries	656 (49.2)	5-10 yr	351 (26.3)
		> 10 yr	396 (29.7)
Score attained by level of knowledge			
Proficient (81%-100%)	480 (36)	**Type of ICU**	
Above average (61%-80%)	472 (35.4)	Medical and Surgical ICU	607 (45.5)
Average (41%-60%)	296 (22.2)	Medical ICU	408 (30.6)
Below average (≤ 40%)	85 (6.4)	Others	318 (23.9)
Type of hospital		**Size of ICU (number of beds)**	
Corporate/private	524 (39)	< 25 bedded	1056 (79.2)
Medical college/university hospital	239 (18)	25-100 bedded	251 (18.8)
Public/government	570 (43)	> 100 bedded	26 (2.0)
Hospital accreditation		**Operating model of ICU**	
International	606 (45.5)	Closed ICU	620 (46.5)
National	442 (33.2)	Open ICU	355 (26.6)
None	285 (21.4)	Semi-closed ICU	358 (26.9)
Teaching status			
Non-teaching	422 (31.7)		
Teaching	911 (68.3)		

ICU: Intensive care unit.

performance of the respondents working in HIC and UMIC was found to be better than the LMIC. Further, 237 (38.9%) and 30 (43.5%) respondents from the HIC and UMIC, respectively, were found to be proficient, compared to 213 (32.4%) respondents from LMIC.

The difference in the knowledge of the respondents, based on the type of hospital was found to be statistically significant (P = 0.001). A more significant proportion of the nurses, working in corporate/private hospitals (231, 44.1%) and medical college/university hospitals (85, 35.6%) was found to be proficient than those working in public hospitals (164, 28.8%). There was also a statistically significant difference found in the knowledge of the nurses based on the accreditation status and teaching status of the hospital (P = 0.001).

In terms of the ICU setup, a difference was found in the knowledge of responding nurses for the type (P = 0.004) and size (P = 0.007) of the ICU. However, no significant difference was found in the knowledge of the respondents based on the operating model of ICU (P = 0.453) (Table 2).

In terms of multivariate analysis, the income status of the country (P < 0.001), type of the hospital (P < 0.001), teaching status (P < 0.001) and the experience of the nurses (P = 0.001) showed an independent association with a difference in knowledge among the nurses. Working in HIC and UMIC was found to be strongly associated with the high knowledge score secured by respondents (β = 4.89, 95%CI: 3.55 to 6.22). The teaching status of the hospital was inversely associated with the knowledge score secured by the respondents (β = -4.58, 95%CI: -6.81 to -2.36) (Table 3).

DISCUSSION

The cross-sectional survey results, on knowledge testing of the nurses working in 13 countries of South Asia and the Middle East, showed a considerable variation. About 3/4th of the respondents secured above average or proficient scores. Some of the factors like the higher economic status of the country and working experience were found to be independently associated with better knowledge among the

Table 2 Comparison of nurses' knowledge based on their experience and the demographic profile of the hospital and intensive care unit, *n* (%)

	Knowledge level categories				χ^2 value	*P* value
	Below average	Average	Above average	Proficient		
Working experience (yr)						
< 2 yr	24 (28.2)	69 (23.3%)	86 (18.2%)	53 (11%)	57.09	0.001[a]
2-5 yr	29 (34.1%)	84 (28.4%)	109 (23.1%)	132 (27.5%)		
5-10 yr	15 (17.6%)	48 (16.2%)	125 (26.5%)	163 (34.0%)		
> 10 yr	17 (20%)	95 (32.1%)	152 (32.2%)	132 (27.5%)		
World bank income classification						
High-income countries	14 (2)	119 (19.6)	238 (39.1)	237 (38.9)	46.47	0.001[a]
Lower-middle-income countries	68 (10.4)	164 (25)	211 (32.2)	213 (32.4)		
Upper-middle-income countries	3 (4.3)	13 (18.8)	23 (33.3)	30 (43.5)		
Type of hospital						
Corporate/private	42 (8)	98 (18.7)	153 (29.2)	231 (44.1)	60.53	0.001[a]
Medical college/university hospital	26 (10.9)	56 (23.4)	72 (30.1)	85 (35.6)		
Public/government	17 (2.9)	142 (24.9)	247 (43.3)	164 (28.8)		
Hospital accreditation						
International	30 (4.9)	120 (19.8)	220 (36.3)	236 (38.9)	30.56	0.001[a]
National	42 (9.5)	122 (27.6)	153 (34.6)	125 (28.3)		
None	13 (4.6)	54 (18.9)	99 (34.7)	119 (41.7)		
Teaching status						
Non-teaching	18 (4.2)	70 (16.6)	149 (35.3)	185 (43.8)	23.61	0.001[a]
Teaching	67 (7.3)	226 (24.8)	323 (35.5)	295 (32.4)		
Operating model of ICU						
Closed ICU	46 (7.4)	146 (23.5)	215 (34.7)	213 (34.4)	5.74	0.45
Open ICU	18 (5.1)	81 (22.8)	122 (34.4)	134 (37.7)		
Semi-closed ICU	21 (5.9)	69 (19.3)	135 (37.7)	133 (37.1)		
Type of ICU						
Medical-surgical ICU	30 (4.9)	113 (18.6)	221 (36.4)	243 (40)	19.39	0.004[a]
Medical ICU	30 (7.4)	98 (24)	134 (32.8)	146 (35.8)		
Other	25 (7.9)	85 (26.7)	117 (36.8)	91 (28.3)		
Size of ICU (number of beds)						
< 25	61 (5.8)	231 (21.9)	390 (36.9)	374 (35.4)	17.27	0.008[a]
25-100	18 (7.2)	59 (23.5)	77 (30.7)	97 (38.6)		
> 100	6 (23.1)	6 (23.1)	5 (19.2)	9 (34.6)		

[a]*P* value < 0.05 is significant.
ICU: Intensive care unit.

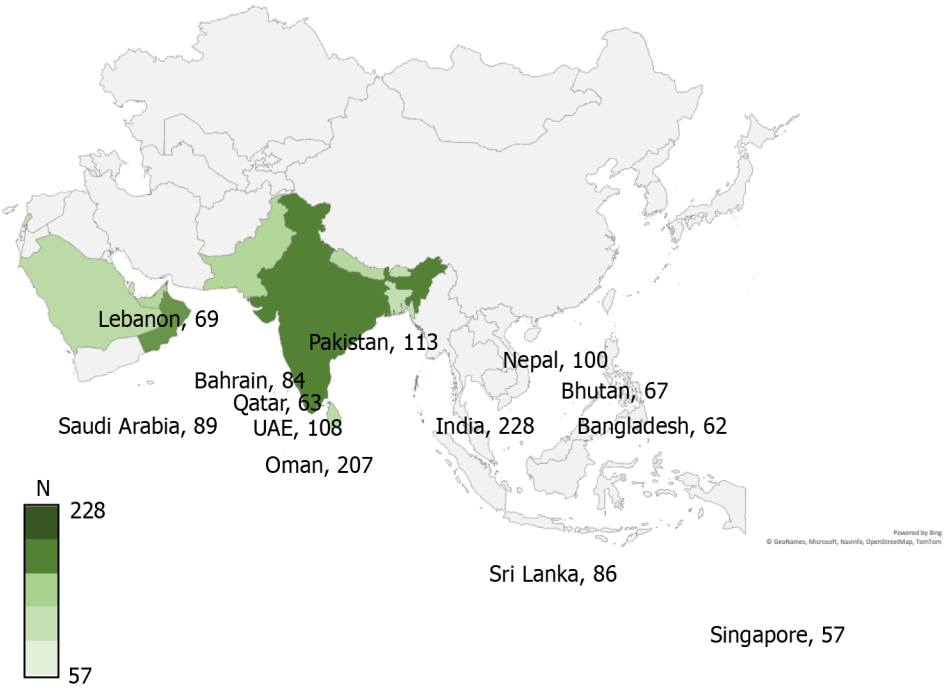
respondents. On the other hand, working in teaching or public hospitals was inversely associated with the knowledge level of IPC practices than the private and university hospitals.

In general, the ICUs show the highest prevalence of HAIs in a hospital setting. This may adversely affect the patients' clinical outcomes like length of stay in the hospital and ICU, quality of life after discharge, and mortality[14,15]. Nurses are the first and the foremost formidable line of defense against the HAIs. Hence their training, and awareness levels, knowledge, and compliance for the IPC practices are crucial in preventing the HAIs. The regional studies conducted earlier found gaps in the knowledge

Table 3 Multivariate analysis of demographic variables of respondents

Variables	Beta coefficient	*P* value	95%CI	
			Lower bound	Upper bound
Type of hospital	-3.76	< 0.001[a]	-5.03	-2.49
Hospital accreditation	0.89	0.24	-0.59	2.36
Teaching status	-4.58	< 0.001[a]	-6.81	-2.36
World bank income classification	4.89	< 0.001[a]	3.55	6.22
Type of ICU	-1.04	0.13	-2.40	0.32
Size of ICU	-2.01	0.07	-4.21	0.19
Working experience	1.71	0.001[a]	0.70	2.71

[a]$P < 0.05$ is significant.
CI: Confidence Interval, ICU: Intensive care unit.



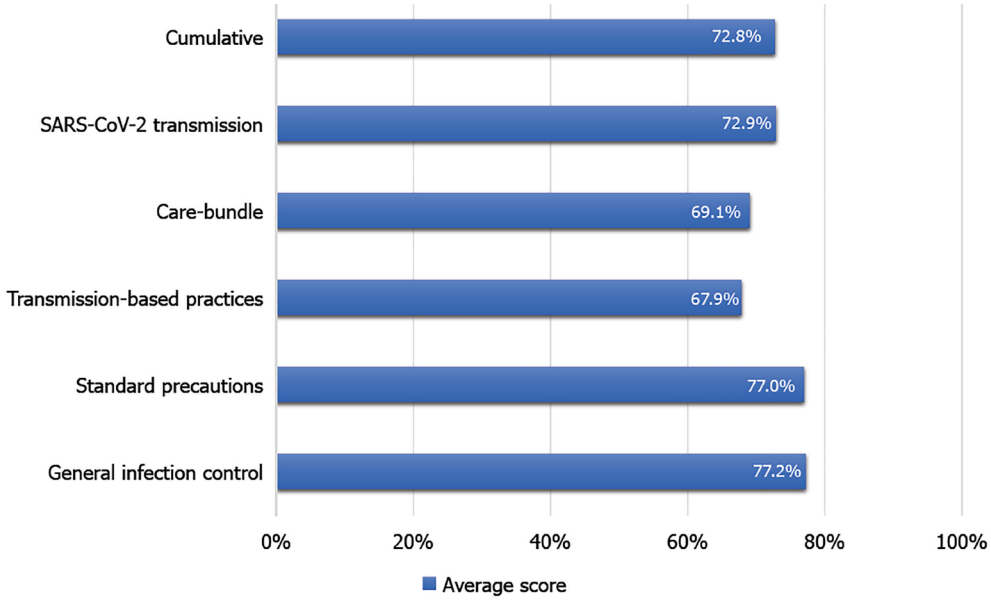
DOI: 10.5492/wjccm.v12.i3.176

Figure 1 Country-wise representation of the respondents of the survey. N: Number of respondents.

of HCWs upon the IPC practices, whereas training was found to be independently associated with better knowledge[16,17]. The literature showed a positive correlation between knowledge and better compliance with IPC practices among the HCWs[18,19].

Among five sections, the performance of the respondents was found to be worst in the section in transmission-based precautions. This reflects the knowledge deficiency of the nurses in understanding the microbiology aspect of IPC among nurses, which can be a focal point for future training programs. A systematic review of 30 studies also identified few gaps in the knowledge of HCWs among different IPC areas, such as vaccinations for HCWs, modes of transmission of infectious diseases, and the risk of infection from needle-stick and sharps injuries[6].

A recent review found that the structure and the skills of the ICU nurses vary according to the patient population, and availability of the resources, and treatments[20]. The current study found a strong association between the economic status of the countries (either UMIC or HIC *vs* LMIC) and better knowledge among the nurses. This finding infers about the impact caused by better resources, training, and surveillance opportunities on IPC practices in HIC or UMIC compared to LMIC. However, this finding is worrisome since the burden of HAIs is considerably higher in LMICs[21]. A recent global survey conducted by the World Health Organization on core components of the IPC programme and its



DOI: 10.5492/wjccm.v12.i3.176

Figure 2 Section-wise average score of the respondents in the questionnaire. SARS-CoV-2: Severe acute respiratory syndrome coronavirus 2.

implementation in healthcare facilities also highlighted the existence of critical gaps in LMIC and low-income countries[22]. The core components involving the workload, staffing, bed occupancy, education and training were scored the lowest in the survey.

The respondents working in private hospitals had significantly better knowledge about the IPC compared to their counterparts working in public hospitals. Though no direct studies compare different hospital settings on IPC practices, a few single-center studies have shown sound knowledge of the nurses working in private hospitals[23]. This can be attributed to resource constraints in terms of equipment, medications and the availability of the trained HCWs in public hospitals compared to private hospitals[24]. The current study finding with regards to teaching status of the hospital being negatively associated with knowledge of the nurses, is surprising. However, this can be explained by the fact that most of the teaching hospitals are public hospitals in UMIC and LMIC countries. Few studies conducted with the small number of samples in these countries from the region also found a deficiency in the knowledge among nurses working in teaching hospitals[25-27]. This suggests that education and training on IPC should be incorporated into medical teaching.

In the current study, a statistically significant difference was found in the knowledge of respondents based on their hospital accreditation status. Patient safety remains the centerpiece of hospital quality accreditation programs. Periodic training of the HCWs on various hospital-based policies, including IPC, is a core component of patient safety. In the current study, it is surprising to find the deficiency in knowledge of among the respondents working in hospitals with a national-level accreditation compared to their counterparts in international accreditation. However, the accreditation status was found to be not independently associated with better knowledge. This may reflect a difference in the standards of accreditation among the participating hospitals.

The working experience of the nurses was another factor, independently associated with a better knowledge. Since experience is the best teacher, it is expected that the knowledge of the nurses gets enhanced with increasing number of years of practice along with periodic trainings. In our previous multi-center study conducted in India, the working experience had a significant association with better knowledge among nurses[28]. Another single-center study from Saudi Arabia also found that the age (> 34 years), training and experience (> 6 years) were a predictor of good knowledge[17].

Strengths and limitations

The current study is a first-of-its-kind in this domain since the study conducted simultaneous knowledge testing of more than 1300 critical care nurses on IPC practices from 13 Asian countries. The survey intends to provide a snapshot of the knowledge of nursing professionals in terms of IPC practices, working in countries with a close cultural, social, and economic exchange. Besides testing the knowledge of the nurses on different aspects of IPC practices, the current study also tried to compare the knowledge based on a few factors such as the economic status of the country, working experience of the respondents; the type, accreditation, and the teaching status of the hospital, in which the respondents are working; and the type, size, and the operating model of ICUs by the respondents. The survey was participated by ICU nurses from large public and private hospitals with varying levels of accreditation and ICU setup.

The current study has a few limitations. Non-random convenience sampling method was followed for the study to obtain the data from only a set of selected hospitals from each participating nation. So, this data may not represent any individual country on the whole. We did make an effort to make the study population representative of nurses within respective countries with inclusion of public, corporate or university hospitals; teaching and non-teaching hospitals; and accredited as well as non-accredited hospitals, but still, this might not be an absolute representation. The number of entries received from each country varied from 57 to 228 which may have caused some statistical bias. The questionnaire did not include all the components of IPC as the intention was to evaluate only the knowledge of nurses working in the ICU. The questionnaire was made available to the study participants only in English and was not translated in their local language, due to concerns regarding accuracy and the misinterpretation of the questions. There is a potential for bias because of the gap in understanding the questions by the nurses due to language barrier. The knowledge testing of the IPC practices does not reflect the actual compliance with IPC practices and might not correlate with this self-answered knowledge evaluation. We did not capture the age, gender, qualification, and method of training rendered to the respondents, as these factors may have explained the variation in knowledge. Since the survey was an open-book and without any time restriction, the respondents might have answered the questions after taking external help, thus bringing a possible bias.

CONCLUSION

The current cross-sectional survey on testing the knowledge of nursing professionals on IPC practices from 13 Asian countries found a considerable variation. The higher economic status of the country and working experience were found to be independently associated with a better knowledge among the respondents. Working in public or teaching hospitals were found to be inversely associated with better knowledge about the IPC practices. There is an urgent need for periodic training and audits on the IPC practices of HCWs working in ICUs, especially in LMICs.

ARTICLE HIGHLIGHTS

Research background

Healthcare-associated infections (HAI) pose a significant threat to patients in hospitals, particularly in intensive care units (ICU). Despite efforts to prevent and control HAI, rates of device-associated (DA)-HAI in ICUs of developing countries remain higher than those in developed nations. Compliance with infection prevention and control (IPC) practices is crucial, and nurses play a key role due to their frequent contact with patients.

Research motivation

The lack of knowledge and awareness among healthcare workers about IPC practices, as well as discrepancies in applying this knowledge, have been linked to poor healthcare outcomes, especially in developing countries. ICU nurses' knowledge and awareness are integral to an effective IPC program. However, there is a lack of literature comparing the knowledge of ICU nurses across South Asian and Middle Eastern countries.

Research objectives

The current study aims to analyse the knowledge of ICU nurses regarding various aspects of IPC practices across countries in South Asia and the Middle East.

Research methods

The study conducted an online-based, cross-sectional survey using a multiple-choice questionnaire. The questionnaire was developed and validated by a 20-member steering committee comprising critical care physicians, infection control professionals, microbiologists, and nursing administrators. The survey was distributed to full-time ICU nurses in participating hospitals. The data were analysed using descriptive statistics, chi-square tests, and linear regression.

Research results

A total of 1333 nurses from 13 countries participated in the study. The average knowledge score was 72.8%, with 71.4% of respondents categorized as having above-average or proficient knowledge. Factors such as higher country income status, private hospital setting, and greater nursing experience were associated with better knowledge. Teaching hospitals and public hospitals showed lower knowledge levels.

Research conclusions

The study revealed significant variation in knowledge levels among ICU nurses across South Asian and Middle Eastern countries. Factors such as country income status, hospital type, teaching status, and nursing experience were associated with knowledge differences. These findings highlight the need for targeted interventions and training programs to improve IPC knowledge and practices, particularly in public and teaching hospitals.

Research perspectives

Future research should focus on developing comprehensive training programs and policies to enhance IPC knowledge and compliance among ICU nurses in South Asian and Middle Eastern countries. Comparative studies between different hospital settings and income groups can provide valuable insights into the factors influencing IPC practices and outcomes. Additionally, exploring the impact of improved IPC knowledge on healthcare delivery outcomes can further strengthen the evidence base for effective infection control strategies.

FOOTNOTES

Author contributions: Nasa P, Sodhi K, Arya M, Chanchalani G participated in the acquisition, and interpretation of the data and contributed equally to this work; Sodhi K designed the research and drafted the initial manuscript; Sodhi K and Nasa P, analyzed the data; Nasa P, Arya M, Chanchalani G, Shrestha G, Chandwani J, Kumar M, Kansal MG, Ashrafuzzaman M, Mudalige AD, Al Tayar A, Mansour B, Saeed HM, Hashmi M, Das M, Al Shirawi NN, Mathias R, Ahmed WO, Sharma A, Agarwal D performed the research, were involved in the recruitment of participants from their respective countries, revised the article critically for important intellectual content.

Institutional review board statement: The study was approved by the Ethics Committee (DHEC-2057/2022) of the institute of the principal investigator (KS) and exempted from other participating hospitals, as only healthcare professionals participated in the survey.

Informed consent statement: All study participants, provided informed written consent prior to study enrolment.

Conflict-of-interest statement: GPC reports receiving honorarium for advisory and consultancy services from Pneumocare Health Pvt Ltd. PN reports speaker honorarium from Tabuk Pharmaceuticals and MSD Pharmaceuticals. All other authors declare no competing interest in relation to the contents of this manuscript.

Data sharing statement: No additional data are available.

STROBE statement: The authors have read the STROBE Statement—checklist of items, and the manuscript was prepared and revised according to the STROBE Statement—checklist of items.

Country/Territory of origin: United Arab Emirates

ORCID number: Kanwalpreet Sodhi 0000-0002-7377-9225; Gunjan Chanchalani 0000-0001-8429-8526; Muktanjali Arya 0000-0002-4925-2220; Gentle S Shrestha 0000-0003-0385-2340; Juhi N Chandwani 0000-0001-6946-9075; Manender Kumar 0000-0002-2448-3057; Monika G Kansal 0000-0002-6228-3398.; Mohammad Ashrafuzzaman 0000-0002-3040-5418; Anushka D Mudalige 0000-0002-5264-1585; Ashraf Al Tayar 0000-0002-2897-7417; Bassam Mansour 0000-0003-1548-6210; Hasan M Saeed 0000-0003-4442-4318; Madiha Hashmi 0000-0002-7332-0692; Mitul Das 0009-0005-8801-3109; Nehad N Al Shirawi 0000-0002-2091-6564; Ranjan Mathias 0000-0002-3577-7317; Wagih O Ahmed 0009-0000-9221-6105; Amandeep Sharma 0009-0008-7505-3234; Diptimala Agarwal 0000-0003-1948-4060; Prashant Nasa 0000 0003 1948 4060.

S-Editor: Ma YJ
L-Editor: A
P-Editor: Ma YJ

REFERENCES

1 **Rosenthal VD**, Bat-Erdene I, Gupta D, Belkebir S, Rajhans P, Zand F, Myatra SN, Afeef M, Tanzi VL, Muralidharan S, Gurskis V, Al-Abdely HM, El-Kholy A, AlKhawaja SAA, Sen S, Mehta Y, Rai V, Hung NV, Sayed AF, Guerrero-Toapanta FM, Elahi N, Morfin-Otero MDR, Somabutr S, De-Carvalho BM, Magdarao MS, Velinova VA, Quesada-Mora

AM, Anguseva T, Ikram A, Aguilar-de-Moros D, Duszynska W, Mejia N, Horhat FG, Belskiy V, Mioljevic V, Di-Silvestre G, Furova K, Gamar-Elanbya MO, Gupta U, Abidi K, Raka L, Guo X, Luque-Torres MT, Jayatilleke K, Ben-Jaballah N, Gikas A, Sandoval-Castillo HR, Trotter A, Valderrama-Beltrán SL, Leblebicioglu H; International Nosocomial Infection Control Consortium. International Nosocomial Infection Control Consortium (INICC) report, data summary of 45 countries for 2012-2017: Device-associated module. *Am J Infect Control* 2020; **48**: 423-432 [PMID: 31676155 DOI: 10.1016/j.ajic.2019.08.023]

2 **Jahani-Sherafat S**, Razaghi M, Rosenthal VD, Tajeddin E, Seyedjavadi S, Rashidan M, Alebouyeh M, Rostampour M, Haghi A, Sayarbayat M, Farazmandian S, Yarmohammadi T, Arshadi FK, Mansouri N, Sarbazi MR, Vilar M, Zali MR. Device-associated infection rates and bacterial resistance in six academic teaching hospitals of Iran: Findings from the International Nocosomial Infection Control Consortium (INICC). *J Infect Public Health* 2015; **8**: 553-561 [PMID: 26027477 DOI: 10.1016/j.jiph.2015.04.028]

3 **Marano L**, Carbone L, Poto GE, Calomino N, Neri A, Piagnerelli R, Fontani A, Verre L, Savelli V, Roviello F, Marrelli D. Antimicrobial Prophylaxis Reduces the Rate of Surgical Site Infection in Upper Gastrointestinal Surgery: A Systematic Review. *Antibiotics (Basel)* 2022; **11** [PMID: 35203832 DOI: 10.3390/antibiotics11020230]

4 **Stewart S**, Robertson C, Pan J, Kennedy S, Dancer S, Haahr L, Manoukian S, Mason H, Kavanagh K, Cook B, Reilly J. Epidemiology of healthcare-associated infection reported from a hospital-wide incidence study: considerations for infection prevention and control planning. *J Hosp Infect* 2021; **114**: 10-22 [PMID: 34301392 DOI: 10.1016/j.jhin.2021.03.031]

5 **Nasa P**, Modi P, Setubal G, Puspha A, Upadhyay S, Talal SH. Demographic and risk characteristics of healthcare workers infected with SARS-CoV-2 from two tertiary care hospitals in the United Arab Emirates. *World J Virol* 2023; **12**: 122-131 [PMID: 37033144 DOI: 10.5501/wjv.v12.i2.122]

6 **Alhumaid S**, Al Mutair A, Al Alawi Z, Alsuliman M, Ahmed GY, Rabaan AA, Al-Tawfiq JA, Al-Omari A. Knowledge of infection prevention and control among healthcare workers and factors influencing compliance: a systematic review. *Antimicrob Resist Infect Control* 2021; **10**: 86 [PMID: 34082822 DOI: 10.1186/s13756-021-00957-0]

7 **Allegranzi B**, Bagheri Nejad S, Combescure C, Graafmans W, Attar H, Donaldson L, Pittet D. Burden of endemic health-care-associated infection in developing countries: systematic review and meta-analysis. *Lancet* 2011; **377**: 228-241 [PMID: 21146207 DOI: 10.1016/S0140-6736(10)61458-4]

8 **Das R**, Saha AK, Barua PK, Borua JP, Akhter N, Hossain A. Knowledge and practices regarding infection control among nurses in secondary level hospital. *Asian J Med Biol Res* 2020; **6**: 731-737 [DOI: 10.3329/ajmbr.v6i4.51240]

9 **Nasa P**, Azoulay E, Chakrabarti A, Divatia JV, Jain R, Rodrigues C, Rosenthal VD, Alhazzani W, Arabi YM, Bakker J, Bassetti M, De Waele J, Dimopoulos G, Du B, Einav S, Evans L, Finfer S, Guérin C, Hammond NE, Jaber S, Kleinpell RM, Koh Y, Kollef M, Levy MM, Machado FR, Mancebo J, Martin-Loeches I, Mer M, Niederman MS, Pelosi P, Perner A, Peter JV, Phua J, Piquilloud L, Pletz MW, Rhodes A, Schultz MJ, Singer M, Timsit JF, Venkatesh B, Vincent JL, Welte T, Myatra SN. Infection control in the intensive care unit: expert consensus statements for SARS-CoV-2 using a Delphi method. *Lancet Infect Dis* 2022; **22**: e74-e87 [PMID: 34774188 DOI: 10.1016/S1473-3099(21)00626-5]

10 **Chanchalani G**, Arora N, Nasa P, Sodhi K, Bahrani MJA, Tayar AA, Hashmi M, Jaiswal V, Kantor S, Lopa AJ, Mansour B, Mudalige AD, Nadeem R, Shrestha GS, Taha AR, Türkoğlu M, Weeratunga D. Visiting and Communication Policy in Intensive Care Units during COVID-19 Pandemic: A Cross-sectional Survey from South Asia and the Middle East. *Indian J Crit Care Med* 2022; **26**: 268-275 [PMID: 35519910 DOI: 10.5005/jp-journals-10071-24091]

11 **Alojaimy RS**, Nakamura K, Al-Sobaihi S, Tashiro Y, Watanabe N, Seino K. Infection prevention and control standards and associated factors: Case study of the level of knowledge and practices among nurses in a Saudi Arabian hospital. *J Prev Med Hyg* 2021; 62: E501-E507 [PMID: 34604592 DOI: 10.15167/2421-4248/jpmh2021.62.2.1957]

12 **Abed Alah M**, Abdeen S, Selim N, Hamdani D, Radwan E, Sharaf N, Al-Katheeri H, Bougmiza I. Knowledge and Perceived Effectiveness of Infection Prevention and Control Measures Among Health Care Workers During the COVID-19 Pandemic: A National Survey. *J Nurs Care Qual* 2022; **37**: E23-E30 [PMID: 34935733 DOI: 10.1097/NCQ.0000000000000615]

13 **Chowdhury D**, Duggal AK. Intensive care unit models: Do you want them to be open or closed? A critical review. *Neurol India* 2017; **65**: 39-45 [PMID: 28084236 DOI: 10.4103/0028-3886.198205]

14 **European Centre for Disease Prevention and Control**. Healthcare-associated infections in intensive care units - Annual Epidemiological Report for 2017. [accessed 10 January 2023]. Available from: https://www.ecdc.europa.eu/en/publications-data/healthcare-associated-infections-intensive-care-units-annual-epidemiological-1/

15 **World Health Organization**. Report on the burden of endemic health care-associated infection worldwide. 2011. [cited 2016 May 04]. Available from: https://apps.who.int/iris/bitstream/handle/10665/80135/9789241501507_eng.pdf/

16 **Tamang N**, Rai P, Dhungana S, Sherchan B, Shah B, Pyakurel P, Rai S. COVID-19: a National Survey on perceived level of knowledge, attitude and practice among frontline healthcare Workers in Nepal. *BMC Public Health* 2020; **20**: 1905 [PMID: 33317486 DOI: 10.1186/s12889-020-10025-8]

17 **Abalkhail A**, Al Imam MH, Elmosaad YM, Jaber MF, Hosis KA, Alhumaydhi FA, Alslamah T, Alamer A, Mahmud I. Knowledge, Attitude and Practice of Standard Infection Control Precautions among Health-Care Workers in a University Hospital in Qassim, Saudi Arabia: A Cross-Sectional Survey. *Int J Environ Res Public Health* 2021; **18**: 11831 [PMID: 34831585 DOI: 10.3390/ijerph182211831]

18 **Thu T**, Anh N, Chau N, Hung N. Knowledge, attitude and practices regarding standard and isolation precautions among Vietnamese health care workers: a multicenter cross-sectional survey. *Intern Med* 2012; **2**: 115 [DOI: 10.4172/2165-8048.1000115]

19 **Wisniewski MF**, Kim S, Trick WE, Welbel SF, Weinstein RA; Chicago Antimicrobial Resistance Project. Effect of education on hand hygiene beliefs and practices: a 5-year program. *Infect Control Hosp Epidemiol* 2007; **28**: 88-91 [PMID: 17230394 DOI: 10.1086/510792]

20 **Macey A**, O'Reilly G, Williams G, Cameron P. Critical care nursing role in low and lower middle-income settings: a scoping review. *BMJ Open* 2022; **12**: e055585 [PMID: 34983772 DOI: 10.1136/bmjopen-2021-055585]

21 **World Health Organization**. Report on the Burden of Endemic Health Care-Associated Infection Worldwide. 2011.

Available from: https://www.who.int/publications/i/item/report-on-the-burden-of-endemic-health-care-associated-infection-worldwide

22 **Tomczyk S**, Twyman A, de Kraker MEA, Coutinho Rehse AP, Tartari E, Toledo JP, Cassini A, Pittet D, Allegranzi B. The first WHO global survey on infection prevention and control in health-care facilities. *Lancet Infect Dis* 2022; **22**: 845-856 [PMID: 35202599 DOI: 10.1016/S1473-3099(21)00809-4]

23 **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: 269-275 [PMID: 23806701 DOI: 10.1016/j.jiph.2013.02.004]

24 **Basu S**, Andrews J, Kishore S, Panjabi R, Stuckler D. Comparative performance of private and public healthcare systems in low- and middle-income countries: a systematic review. *PLoS Med* 2012; **9**: e1001244 [PMID: 22723748 DOI: 10.1371/journal.pmed.1001244]

25 **Al-Rawajfah OM**. Infection control practices among intensive care unit registered nurses: a Jordanian national study. *Nurs Crit Care* 2016; **21**: e20-e27 [PMID: 24450751 DOI: 10.1111/nicc.12078]

26 **Acharya AS**, Khandekar J, Sharma A, Tilak HR, Kataria A. Awareness and practices of standard precautions for infection control among nurses in a tertiary care hospital. *Nurs J India* 2013; **104**: 275-279 [PMID: 24974532]

27 **Dhedhi NA**, Ashraf H, Jiwani A. Knowledge of standard precautions among healthcare professionals at a Teaching Hospital in Karachi, Pakistan. *J Family Med Prim Care* 2021; 10: 249-253 [PMID: 34017735 DOI: 10.4103/jfmpc.jfmpc_1622_20]

28 **Sodhi K**, Arya M, Chanchalani G, Sinha V, Dominic Savio R, Ak AK, Ahmed A, Jagiasi B, Agarwal D, Jagathkar G, Khasne R, Sahasrabudhe SS, Jha SK, Sahoo TK, Mittal V, Hr H, Bansal S, Agarwal C, Kumar M. Comparison of knowledge and awareness of infection control practices among nurses in India: A cross-sectional survey. *Am J Infect Control* 2022; **50**: 1368-1373 [PMID: 35181374 DOI: 10.1016/j.ajic.2022.02.014]

Published by **Baishideng Publishing Group Inc**
7041 Koll Center Parkway, Suite 160, Pleasanton, CA 94566, USA
Telephone: +1-925-3991568
E-mail: bpgoffice@wjgnet.com
Help Desk: https://www.f6publishing.com/helpdesk
https://www.wjgnet.com