Shiraz E-Med J. 2022 February; 23(2):e117459. doi: 10.5812/semj.117459.

Published online 2021 October 23. **Research Article**

Knowledge, Attitudes, and Practice Toward Isolation Precautions Amongst Nurses and Auxiliary Nurses in Nemazee Hospital, Shiraz, Iran

Mina Danaei [1], Mary-Louise McLaws [2], Zahra Shayan [3], Mohsen Momeni [4], Shiva Aminnia [5], Yasaman Yaghout [5], Farideh Fereidoni [5], Gary Groot [6], Ardalan Askarian [7] and Mehrdad Askarian [8, 9, *]

[1] Social Determinants of Health Research Center, Institute for Futures Studies in Health, Kerman University of Medical Sciences, Kerman, Iran
[2] School of Public Health and Community Medicine, UNSW Australia, NSW, Australia
[3] Department of Biostatistics, School of Medicine, Shiraz University of Medical Sciences, Shiraz, Iran
[4] Neuroscience Research Center, Institute of Neuropharmacology, Kerman University of Medical Sciences, Kerman, Iran
[5] Student Research Committee, Shiraz University of Medical Sciences, Shiraz, Iran
[6] Department of Community Health and Epidemiology, College of Medicine, University of Saskatchewan, Saskatoon, Canada
[7] College of Arts & Science, University of Saskatchewan, Saskatoon, Canada
[8] Department of Community Medicine, School of Medicine, Shiraz University of Medical Sciences, Shiraz, Iran
[9] Health Behavior Science Research Center, Shiraz University of Medical Sciences, Shiraz, Iran

[*] *Corresponding author*: Department of Community Medicine, School of Medicine, Shiraz University of Medical Sciences, Shiraz, Iran. Email: askariam@sums.ac.ir

Received 2021 June 29; **Revised** 2021 July 29; **Accepted** 2021 August 21.

Abstract

Background: Understanding the factors influencing nurses' compliance with infection prevention strategies can assist in reducing occupational infections.
Objectives: We surveyed nurses and auxiliary nurses in Shiraz, Iran, to evaluate their knowledge, attitudes, and practice (KAP) towards isolation precautions (IP).
Methods: A cross-sectional study was conducted in a teaching hospital in Shiraz, Iran, in 2019. A five-part self-administered questionnaire was used, addressing demographics and infection prevention knowledge; nine items on KAP towards standard precautions, five items on droplet precautions, six items about airborne precautions, and eight items about contact precautions. The independent sample *t*-test and Pearson correlation were performed.
Results: The mean score of practice was lower than that of knowledge and attitude in all IP domains. Droplet precautions acquired lower KAP scores than other domains. There were significant positive correlations between KAP scores in all IP domains in nurses ($P < 0.001$) and auxiliary nurses, except for the correlation between knowledge and practice in terms of standard precautions ($P = 0.099$). In nurses, age significantly correlated with knowledge towards airborne precautions ($P < 0.001$) and with attitude regarding droplet precautions ($P = 0.003$). Nurses had significantly higher scores regarding knowledge ($P = 0.037$) and attitude ($P = 0.009$) towards standard precautions than auxiliary nurses. The persons who had previous training sessions presented a higher score of the practice dimension for droplet ($P = 0.001$), airborne ($P = 0.011$), and contact ($P = 0.004$) precautions.
Conclusions: This study revealed a gap in Nemazee hospital nurses' KAP towards IPs. Those responsible for infection prevention and control programs in Shiraz University of Medical Sciences must address this poor practice of nurses towards patient safety.

Keywords: Airborne, Contact, Droplet, Standard, Precautions

1. Background

Infection containment in hospitals is a global challenge to prevent morbidity and mortality in patients and healthcare workers (HCWs) (1). Over recent decades, hospitals have faced challenges regarding the prevention of the spread of Middle East Respiratory Syndrome Coronavirus (MERS-CoV) and Severe Acute Respiratory Syndrome Coronavirus (SARS-CoV) amongst HCWs and patients (2, 3). In 2020, the coronavirus disease (COVID-19) pandemic further highlighted these challenges, especially in the prevention of novel and reemerging infections (4). A systematic review reported that until May 8, 2020, nearly 152,888 COVID-19 infections and 1413 deaths occurred among HCWs (5).

The World Health Organization (WHO) developed a wide range of infection prevention and control guidelines to control the transmission of infectious diseases in hos-

pitals, including environmental and administrative control measures, such as using personal protective equipment (PPE) and observing hand hygiene, to prevent infection transmission (6).

A systematic review indicated that in most studies, nurses had acceptable knowledge and attitude towards infection control, but their practice was poor, and they did not obey infection control guidelines perfectly (7). The compliance of HCWs with these guidelines may be influenced by their knowledge, attitudes, and practice (KAP) towards isolation precautions, as well as time, resources, and experience (8, 9). The understanding of the factors influencing HCWs' compliance with infection prevention and control measures can help improve their adherence; for example, to wear PPE to reduce environmentally acquired deadly infections. We here surveyed nurses' knowledge, attitudes, and practice towards infection control isolation precautions (IPs) in Shiraz, Iran.

2. Methods

This cross-sectional study was conducted on 676 nurses and auxiliary nurses working at the Nemazee hospital of Shiraz (the biggest teaching hospital in Southern Iran) between May 22 and July 23, 2019 (ie, nearly six months prior to the COVID-19 outbreak). The respective ethical approval codes were obtained from the ethical committee of Shiraz University of Medical Sciences (IR.sums.med.rec.1399.252, IR.sums.med.rec.1398.315, and IR.sums.med.rec.1399.277). All the nurses and auxiliary nurses who gave oral informed consent were included in the study. The investigators referred to the Nemazee Hospital during different work shifts and described the importance and aims of the survey for nurses and auxiliary nurses. A self-administered questionnaire was distributed among nurses and auxiliary nurses. The investigators responded to participants' all questions and gathered completed questionnaires immediately. It took about 15 minutes to complete each questionnaire.

A five-part self-administered questionnaire was designed: (1) part 1 examined demographics, including age, gender, occupation (nurse/auxiliary nurse), and prior participation in infection prevention training; and (2) parts 2, 3, 4, and 5 included nine, five, six, and eight items regarding knowledge, attitude, and practice (KAP) towards standard, droplet, airborne, and contact precautions, respectively. Responses to the items of the knowledge dimension were categorized as correct (score = 1) or incorrect/don't know (score = 0), delivering the maximum knowledge scores of nine, five, six, and eight for the standard, droplet, airborne, and contact precaution domains, respectively.

Attitude items were scored on a Likert scale (1-5) ranging from unimportant, low importance, important, moderately important, and extremely important. So, the maximum score was 45 for standard precautions (i.e., nine items), 25 for droplet precautions (i.e., five items), 30 for airborne precautions (i.e., six items), and 40 for contact precautions (i.e., eight items).

The options of practice items ranged from never, seldom, sometimes, often, and always, which were scored as always = 1 and all other answers = 0. The maximum practice score was, therefore, nine for nine-item standard precautions, five for five-item droplet precautions, six for six-item airborne precautions, and eight for eight-item contact precautions. The validity and reliability of this questionnaire were assessed in previous studies (9-11). In this study, Cronbach's alpha for the knowledge, attitude, and practice dimensions and the whole questionnaire were 0.84, 0.81, 0.80, and 0.84, respectively

All scores were rounded up at the 0.5 level. The independent sample *t*-test was used to compare differences in the mean scores of KAP between the study groups. Analyses were performed in SPSS IBM statistics software for Windows version 20.0 (IBM Corp., New York, USA) at the significance level of 0.05.

3. Results

Among 734 nurses and auxiliary nurses working in Namazee hospital, 676 completed the questionnaire (i.e., the response rate: 92%). The majority of the participants were females (87%, 589/679) and nursing staff (92%, 624/679). The mean $\pm$ SD of the participants' age was 29.72 $\pm$ 6.2 years. Nearly 73.2% (495/676) of the participants had already passed training programs on standard precautions. The mean scores of knowledge, attitude, and practice were high for all the four precaution domains (Table 1).

Regarding the standard precaution domain, less than three-quarter of the participants failed to observe the following practices before and after patient care: hand hygiene, glove use, wearing goggles, wearing a gown, and not bending needles after use (Table 2). Less than three-quarter of the participants correctly responded to the items of the droplet precaution dimension, including the need for an isolation room, the 1.5-meter distancing rule, and the need for patients to wear a face mask during transportation. The items needing attention in the airborne precaution domains were the requirement for negative air pressure rooms, wearing a face mask prior to entering the patient's room, staff vaccination, and patients' need for wearing face masks during transportation. Regarding the contact precaution domains, the items needing improvement included single room, hand hygiene, gown use, no-

Table 1. Participants' Scores of KAP Regarding Infection Prevention and Control Precautions

Precautions	Knowledge		Attitude		Practice	
	Mean ± SD	Range [a]	Mean ± SD	Range [a]	Mean ± SD	Range [a]
Standard	8.11 ± 1.34	0 - 9	37.56 ± 4.81	9 - 45	5.55 ± 2.56	0 - 9
Droplet	3.72 ± 0.81	0 - 5	19.92 ± 2.29	5 - 25	2.99 ± 1.42	0 - 5
Airborne	4.77 ± 1.03	0 - 6	24.74 ± 3.14	6 - 30	3.69 ± 1.80	0 - 6
Contact	6.88 ± 1.42	0 - 8	34.21 ± 4.69	8 - 40	5.34 ± 2.59	0 - 8

[a] Possible range: Minimum and maximum possible scores.

tifying wards about the patients requiring contact precautions, dedicated equipment and cleaning them, and gloving safety issues.

There were significant positive correlations between knowledge, attitude, and practice in all IP domains in nurses ($P < 0.001$) and auxiliary nurses, except for the correlation between knowledge and practice in standard precautions ($P = 0.099$). Among nurses, age significantly correlated with knowledge in airborne precautions ($P < 0.001$) and with attitude in droplet precautions ($P = 0.003$) (Table 3).

Regarding KAP scores, nurses had significantly better knowledge ($P = 0.037$) and attitude ($P = 0.009$) scores in standard precautions compared to auxiliary nurses. Women had significantly better attitude and practice scores in all IP domains ($P < 0.05$) and better knowledge scores in all IP domains but droplet ($P = 0.320$) and contact ($P = 0.138$) precautions compared to men. The participants taking part in previous training sessions delivered higher knowledge scores in standard ($P = 0.003$), droplet ($P = 0.002$), airborne ($P < 0.001$), and contact ($P < 0.001$) precautions, higher attitude scores in standard ($P < 0.001$), and contact ($P < 0.001$) precautions, and higher practice scores in droplet ($P = 0.001$), airborne ($P = 0.011$), and contact ($P = 0.004$) precautions (Table 4).

4. Discussion

Healthcare workers, individually and collectively, must have a high level of understanding and compliance with the guidelines developed to protect themselves, their team, and patients from acquiring a communicable disease (12). The understanding and practice of precautions by all HCWs in non-pandemic conditions are pivotal to develop an enduring safety habit that will transfer safely to the pandemic time, such as COVID-19 (13).

Our current knowledge suggests that COVID-19 is transmitted directly via droplets or indirectly by contact with opportunistic airborne spread in poorly ventilated spaces (13). To protect both HCWs and patients, the WHO (13) recommended contact precautions, while the Center for Disease Control (14) recommended airborne precautions. The majority (75% or more) of our participants were equipped with adequate knowledge to protect themselves. Comparing the scores of different precaution domains showed that the participants scored lower in the practice dimension compared to the knowledge or attitude across all the four precaution domains. The exception was the low proportion of participants with sound knowledge, attitudes, and practice around physical distancing, BCG vaccine, and inappropriate double-gloving with kitchen gloves for protection. Previously, Shirazi healthcare workers were found to score sub-optimally for compliance with contact, standard, and isolation precautions (9-11). Over years, training programs (lectures, workshops, etc.) have been provided for all new staff; however, these classes seem to have had a non-significant impact. In a study in 2012, hand hygiene performance and mask use were poor among HCWs in an Iranian ICU, with low practice scores for these two precautions (15). Earlier in 2010, 1500 nurses in China were found to have poor compliance with standard precautions (16). In 2015, HCWs' compliance with standard precautions was low in Brazil (69%) and Hong Kong (57%) (17). We noticed that the majority of our HCWs had good knowledge and attitudes but poor practice, which was similar to the results of a study on nurses in the USA (18) where 94% of American nurses had appropriate knowledge about standard precautions, yet only 62% actually adhered to these precautions (18). Similarly, 90% of HCWs in Jordan scored good at knowledge about isolation precautions, while only 65% of them complied with the precautions, which was also the case in Pakistan. In another study, only 56% of 2000 nurses and physicians, working at a teaching hospital in Switzerland who had adequate knowledge about correct precautions also had acceptable practice about it. (19-21). Nurses and midwives in Yazd, Iran, were reported to have a moderate level of knowledge and attitude, yet their level of practice was low (22). Also, 70% of Vietnamese HCWs demonstrated adequate knowledge and attitude, while only 46% of them applied that knowledge in practice (23).

Table 2. Proportion of Participants with Correct Knowledge, Attitudes, and Practice [a]

Questions	Correct Knowledge	Correct Attitude	Correct Practice
Standard precautions			
Washing hands before and after patient care	617 (91.3)	654 (96.7)	433 (64.1)
Washing hands before and after using gloves	541 (80.0)	633 (93.6)	358 (53.0)
Washing hands after unwanted contact with blood, body fluids, excretions, and contaminated items	663 (98.1)	663 (98.1)	552 (81.7)
Wearing gloves before touching mucous membranes and non-intact skin	658 (97.3)	664 (98.2)	506 (74.9)
Wearing goggles to protect mucous membranes of the eyes during procedures that are likely to generate splashes or sprays of blood and body fluids	617 (91.3)	648 (95.9)	362 (53.6)
Washing hands with betadine after contact with patients during the procedures and activities that are likely to generate splashes or sprays of blood and body fluids	559 (82.7)	323 (47.8)	356 (52.7)
Wearing a surgical mask to protect nose and mouth during the procedures and activities that are likely to generate splashes or sprays of blood and body fluids	623 (92.2)	625 (92.5)	419 (62.0)
Bending needles before disposal	569 (84.2)	287 (42.5)	357 (52.8)
Wearing a gown during the procedures that are likely to generate splashes or sprays of blood and body fluids	636 (94.1)	644 (95.3)	409 (60.5)
Droplet precautions			
Patients with a droplet spreading disease should be isolated in a private room.	625 (92.5)	660 (97.6)	496 (73.4)
Patients with a droplet spreading disease should be kept apart at a distance of at least 150 cm.	81 (12.0)	66 (9.8)	74 (10.9)
Patients with a droplet spreading disease should wear a face mask during transport	607 (89.8)	656 (97.0)	475 (70.3)
Masks should be worn when a subject is within a 90-cm distance from a patient under droplet precaution care.	575 (85.1)	637 (94.2)	454 (67.2)
Hospital wards should be notified prior to the admission of a patient needing droplet precaution.	630 (93.2)	639 (94.5)	524 (77.5)
Airborne precautions			
Patients with an airborne transmissible disease should be isolated in a private room with a negative pressure.	604 (89.3)	646 (95.6)	433 (64.1)
The door of the room of a patient with an airborne transmissible disease should always be closed.	626 (92.6)	654 (96.7)	477 (70.6)
Wearing a mask is necessary when entering the room of patients with chickenpox or measles.	599 (88.6)	645 (95.4)	472 (69.8)
All healthcare workers should be vaccinated with the B.C.G vaccine.	182 (26.9)	123 (18.2)	114 (16.9)
Wards should be notified prior to the admission of a patient requiring airborne precautions.	603 (89.2)	637 (94.2)	503 (74.4)
The patients requiring airborne precautions should wear a surgical mask during transportation.	613 (90.7)	648 (95.9)	501 (74.1)
Contact precautions			
The patients needing contact precautions should be kept in a private room.	573 (84.8)	644 (95.3)	478 (70.7)
Wearing gloves on entry and removing them before leaving the room is necessary for the patients needing contact precautions.	643 (95.1)	660 (97.6)	509 (75.3)
It is necessary to disinfect hands on the removal of gloves when caring for the patients needing contact precautions.	603 (89.2)	640 (94.7)	490 (72.5)
It is necessary to wear a gown on entry to the room of the patients needing contact precautions.	634 (93.8)	644 (95.3)	487 (72.0)
Wards should be notified upon the admission of the patient needing contact precautions.	602 (89.1)	642 (95.0)	489 (72.3)
It is necessary to dedicate noncritical patient care equipment to the patients needing contact precautions.	606 (89.6)	642 (95.0)	502 (74.3)
It is necessary to clean and disinfect all common equipment shared with the patients needing contact precautions.	591 (87.4)	621 (91.9)	446 (66)
Double gloving with plastic kitchen gloves used at the hospital will give the same protection as latex gloves.	399 (59.0)	421 (62.3)	214 (31.7)

[a] Values are expressed as No. (%).

Table 3. The Correlation of Knowledge, Attitude, and Practice with the Age of Nurses and Auxiliary Nurses

Isolation Precautions	Nurse						Auxiliary Nurse					
	Knowledge		Attitude		Practice		Knowledge		Attitude		Practice	
	r	P-Value	r	P-Value	r	P-Value	r	P-Value	r	P-Value	r	P-Value
Standard												
Knowledge	-	-	0.488	< 0.001	0.318	< 0.001	-	-	0.578	< 0.001	0.232	0.099
Attitude	0.488	< 0.001	-	-	0.487	< 0.001	0.578	< 0.001	-	-	0.397	0.004
Practice	0.318	< 0.001	0.487	< 0.001	-	-	0.232	0.099	0.397	0.004	-	-
Age	0.031	0.436	0.012	0.763	0.071	0.076	0.008	0.956	0.189	0.179	0.015	0.917
Droplet												
Knowledge	-	-	0.461	< 0.001	0.377	< 0.001	-	-	0.425	0.002	0.329	0.017
Attitude	0.461	< 0.001	-	-	0.595	< 0.001	0.425	0.002	-	-	0.296	0.033
Practice	0.377	< 0.001	0.595	< 0.001	-	-	0.329	0.017	0.296	0.033	-	-
Age	0.062	0.123	0.117	0.003	0.046	0.256	0.079	0.579	0.054	0.704	0.020	0.891
Airborne												
Knowledge	-	-	0.529	< 0.001	0.430	< 0.001	-	-	0.313	0.024	0.345	0.012
Attitude	0.529	< 0.001	-	-	0.612	< 0.001	0.313	0.024	-	-	0.555	< 0.001
Practice	0.430	< 0.001	0.612	< 0.001	-	-	0.345	0.012	0.555	< 0.001	-	-
Age	0.147	< 0.001	0.064	0.108	0.057	0.158	0.102	0.470	0.082	0.566	0.008	0.954
Contact												
Knowledge	-	-	0.582	< 0.001	0.494	< 0.001	-	-	0.679	< 0.001	0.546	< 0.001
Attitude	0.582	< 0.001	-	-	0.609	< 0.001	0.679	< 0.001	-	-	0.575	< 0.001
Practice	0.494	< 0.001	0.609	< 0.001	-	-	0.546	< 0.001	0.575	< 0.001	-	-
Age	0.033	0.410	0.000	0.996	0.047	0.240	0.080	0.573	0.127	0.369	0.122	0.390

There was a positive linear correlation between our participants' knowledge and practice in the most domains of IPs, which was similar to the findings of other studies (9-11, 23, 24). As a whole, better knowledge and attitude could positively affect practice; however, these parameters are not the only predictors (25). Hospital managers should identify various factors affecting nurses' compliance with isolation precautions and implement effective intervention programs to improve their performance.

Evaluating the association between demographic characteristics and KAP scores showed that in some IP domains, nurses had better knowledge than auxiliary nurses, but there were no significant differences between nurses and auxiliary nurses regarding attitude and practice. Women had better KAP scores than men in almost all IP domains, and taking part in training sessions predicted a higher level of knowledge in all and better attitudes and practice in most IP domains.

Similar to the results of this study, participation in training sessions (21, 26, 27), gender (22, 25), and job (24, 28) were reported to be significantly associated with KAP scores. The results of some studies, however, did not show significant differences in KAP scores considering participation in training sessions (19) and gender (15, 16). Holding effective training courses and using new training methods can improve nurses' KAP scores. Men and practical nurses should be given priority to participate in such training programs.

Nurses are at the front line of COVID-19 management, and their health is very important. This study tried to describe the status of infection control practices in one of the biggest hospitals in Iran. The results of this study were based on self-reporting. Therefore, the participants may have reported their practice better than their actual compliance. Observing nurses' compliance in future studies can help estimate nurses' practice more accurately.

4.1. Conclusions

Compliance with IPs is not adequate among nurses and auxiliary nurses in Nemazee hospital. Our study highlighted a gap between knowledge, attitude, and practice

Table 4. Comparing KAP Scores Between Participants According to Their Occupation, Gender, and Previous Training

Variables	Isolation Precautions			
	Standard	Droplet	Airborne	Contact
Knowledge Score (Mean ± SD)				
Occupation				
Nurse	8.14 ± 1.32	3.72 ± 0.84	4.77 ± 1.03	6.89 ± 1.45
Practical	7.65 ± 1.6	3.75 ± 0.7	4.80 ± 0.9	6.71 ± 0.4
P-value	0.037	0.817	0.806	0.376
Gender				
Man	7.56 ± 1.71	3.64 ± 0.68	4.51 ± 1.27	6.59 ± 1.94
Woman	8.19 ± 1.2	3.73 ± 0.8	4.81 ± 0.9	6.92 ± 1.3
P-value	0.002	0.320	0.039	0.138
Previous training				
Yes	8.23 ± 1.02	3.78 ± 0.75	4.87 ± 0.98	7.07 ± 1.15
No	7.78 ± 1.9	3.54 ± 0.9	4.49 ± 1.2	6.33 ± 1.9
P-value	0.003	0.002	< 0.001	< 0.001
Attitude Score (Mean ± SD)				
Occupation				
Nurse	37.70 ± 4.71	19.90 ± 2.23	24.79 ± 3.17	34.20 ± 4.72
Practical	35.90 ± 5.04	20.1 ± 2.27	24.17 ± 0.3.23	34.42 ± 3.97
P-value	0.009	0.519	0.174	0.744
Gender				
Man	35.27 ± 5.13	19.31 ± 2.54	23.73 ± 3.35	32.87 ± 6.16
Woman	37.90 ± 4.68	20.01 ± 2.29	24.89 ± 3.14	34.41 ± 4.43
P-value	< 0.001	0.007	0.001	0.025
Previous training				
Yes	38.10 ± 4.42	20.02 ± 2.15	24.88 ± 2.93	34.67 ± 4.16
No	36.09 ± 5.42	19.65 ± 2.66	24.35 ± 3.57	32.96 ± 5.72
P-value	< 0.001	0.092	0.079	< 0.001
Practice Score (Mean ± SD)				
Occupation				
Nurse	5.60 ± 2.51	2.99 ± 1.45	3.70 ± 1.76	5.3 ± 2.64
Practical	4.94 ± 2.65	3.00 ± 1.34	3.61 ± 1.87	5.44 ± 2. 38
P-value	0.075	0.969	0.730	0.785
Gender				
Man	4.91 ± 2.73	2.68 ± 1.36	3.22 ± 1.92	4.63 ± 2.76
Woman	5.64 ± 2.51	3.0 ± 1.43	3.76 ± 1.72	5.45 ± 2.55
P-value	0.014	0.033	0.009	0.006
Previous training				
Yes	5.59 ± 2.58	3.10 ± 1.34	3.81 ± 1.73	5.52 ± 2.52
No	5.41 ± 2.63	2.68 ± 1.54	3.38 ± 1.98	4.85 ± 2.76
P-value	0.425	0.001	0.011	0.004

of nurses in one of the biggest hospitals in Iran. Those responsible for infection prevention and control programs in our hospital must address the poor practice of nurses and auxiliary nurses to warrant the safety of individuals, health care teams and workers, and patients.

Footnotes

Authors' Contribution: Mina Danaei, data analysis, writing, and final approval of the manuscript; Mary-Louise McLaws, writing and final approval of the manuscript; Zahra Shayan, data analysis and final approval of the manuscript; Mohsen Momeni, data analysis, writing, and final approval of the manuscript; Shiva Aminnia, Yasaman Yaghout, and Farideh Fereidoni, data collection and final approval of the manuscript; Gary Groot and Ardalan Askarian, writing and final approval of the manuscript; Mehrdad Askarian, study design, writing and final approval of the manuscript.

Conflict of Interests: We have no conflict of interest to disclose.

Ethical Approval: Ethical approval codes were obtained from the ethical committee of Shiraz University of Medical Sciences (IR.sums.med.rec.1399.252, IR.sums.med.rec.398.315, IR.sums.med.rec.1399.277).

Funding/Support: The present study was extracted from the theses written by Shiva Aminnia, Yasaman Yaghout, and Farideh Fereidoni in partial fulfillment for acquiring certification for a medical doctorate and supported by the grant numbers of 22907, 20254, and 22716. The authors thank the vice chancellor of Shiraz University of Medical Sciences for providing grants for these projects.

Informed Consent: All nurses and auxiliary nurses gave oral informed consent before being included in the study.

References

1. Harrod M, Petersen L, Weston LE, Gregory L, Mayer J, Samore MH, et al. Understanding workflow and personal protective equipment challenges across different healthcare personnel roles. *Clin Infect Dis*. 2019;**69**(Suppl 3):S185–91. doi: 10.1093/cid/ciz527. [PubMed: 31517971].
2. Chen X, Chughtai AA, Dyda A, MacIntyre CR. Comparative epidemiology of Middle East respiratory syndrome coronavirus (MERS-CoV) in Saudi Arabia and South Korea. *Emerg Microbes Infect*. 2017;**6**(6). e51. doi: 10.1038/emi.2017.40. [PubMed: 28588290]. [PubMed Central: PMC5520315].
3. JAMA. From the centers for disease control and prevention. Update: outbreak of severe acute respiratory syndrome–worldwide. *JAMA*. 2003;**289**(15):1918–20. doi: 10.1001/jama.289.15.1918. [PubMed: 12697782].
4. Livingston E, Desai A, Berkwits M. Sourcing personal protective equipment during the COVID-19 pandemic. *JAMA*. 2020;**323**(19):1912–4. doi: 10.1001/jama.2020.5317. [PubMed: 32221579].
5. Bandyopadhyay S, Baticulon RE, Kadhum M, Alser M, Ojuka DK, Badereddin Y, et al. Sourcing Personal Protective Equipment during the COVID-19 Pandemic. *JAMA*. 2020;**323**(19):1912–4. doi: 10.1101/2020.06.04.20119594.
6. World Health Organization. *Guidelines on core components of infection prevention and control programmes at the national and acute health care facility level*. Geneva, Switzerland: World Health Organization; 2016.
7. Nasiri A, Balouchi A, Rezaie-Keikhaie K, Bouya S, Sheyback M, Rawajfah OA. Knowledge, attitude, practice, and clinical recommendation toward infection control and prevention standards among nurses: A systematic review. *Am J Infect Control*. 2019;**47**(7):827–33. doi: 10.1016/j.ajic.2018.11.022. [PubMed: 30612817].
8. Harrod M, Weston LE, Gregory L, Petersen L, Mayer J, Drews FA, et al. A qualitative study of factors affecting personal protective equipment use among health care personnel. *Am J Infect Control*. 2020;**48**(4):410–5. doi: 10.1016/j.ajic.2019.08.031. [PubMed: 31610895].
9. Askarian M, Memish ZA, Khan AA. Knowledge, practice, and attitude among Iranian nurses, midwives, and students regarding standard isolation precautions. *Infect Control Hosp Epidemiol*. 2007;**28**(2):241–4. doi: 10.1086/510868. [PubMed: 17265414].
10. Askarian M, Mirzaei K, Mundy LM, McLaws ML. Assessment of knowledge, attitudes, and practices regarding isolation precautions among Iranian healthcare workers. *Infect Control Hosp Epidemiol*. 2005;**26**(1):105–8. doi: 10.1086/502495. [PubMed: 15693417].
11. Askarian M, Shiraly R, McLaws ML. Knowledge, attitudes, and practices of contact precautions among Iranian nurses. *Am J Infect Control*. 2005;**33**(8):486–8. doi: 10.1016/j.ajic.2005.06.001. [PubMed: 16216666].
12. Wu Z, McGoogan JM. Characteristics of and important lessons from the Coronavirus disease 2019 (COVID-19) outbreak in China: Summary of a report of 72314 cases from the Chinese center for disease control and prevention. *JAMA*. 2020;**323**(13):1239–42. doi: 10.1001/jama.2020.2648. [PubMed: 32091533].
13. World Health Organization. *Rational use of personal protective equipment (PPE)for Coronavirus disease (COVID-19): Interim guidance*. Geneva, Switzerlad: World Health Organization; 2020.
14. Centers for Disease Control Prevention. *Interim infection prevention and control recommendations for healthcare personnel during the Coronavirus disease 2019 (COVID-19) pandemic*. Atlanta, Georgia: Centers for Disease Control Prevention; 2020. Available from: https://www.cdc.gov/coronavirus/2019-ncov/hcp/infection-control-recommendations.html.
15. Tajabadi A, Parsaeimehr Z, Kashani E. Evaluation of compliance with standard precautions by ICU nurses of Sabzevar hospitals. *S J Nurs Midwifery Paramedical Fac*. 2018;**4**(2):79–91. Persian.
16. Luo Y, He GP, Zhou JW, Luo Y. Factors impacting compliance with standard precautions in nursing, China. *Int J Infect Dis*. 2010;**14**(12):e1106–14. doi: 10.1016/j.ijid.2009.03.037. [PubMed: 21071254].
17. Pereira FM, Lam SC, Chan JH, Malaguti-Toffano SE, Gir E. Difference in compliance with Standard Precautions by nursing staff in Brazil versus Hong Kong. *Am J Infect Control*. 2015;**43**(7):769–72. doi: 10.1016/j.ajic.2015.03.021. [PubMed: 25934059].
18. Hessels AJ, Genovese-Schek V, Agarwal M, Wurmser T, Larson EL. Relationship between patient safety climate and adherence to standard precautions. *Am J Infect Control*. 2016;**44**(10):1128–32. doi: 10.1016/j.ajic.2016.03.060. [PubMed: 27318523]. [PubMed Central: PMC5048506].
19. Suliman M, Aloush S, Aljezawi M, AlBashtawy M. Knowledge and practices of isolation precautions among nurses in Jordan. *Am J Infect Control*. 2018;**46**(6):680–4. doi: 10.1016/j.ajic.2017.09.023. [PubMed: 29103636]. [PubMed Central: PMC7132704].
20. Faryad S, Inayat MS, Afzal M, Hussain M. Knowledge, attitude and practice of standard isolation precautions among registered nurses of allied hospital Faisalabad. *Int J Sci Eng Res*. 2018;**9**(5):461–84.
21. Sax H, Perneger T, Hugonnet S, Herrault P, Chraiti MN, Pittet D. Knowledge of standard and isolation precautions in a large teaching hospital. *Infect Control Hosp Epidemiol*. 2005;**26**(3):298–304. doi: 10.1086/502543. [PubMed: 15796284].

22. Mohammadzadeh M, Behnaz F, Parsa S. Knowledge, practice and attitude towards standard isolation precautions in nurses, auxiliary nurses and midwives of Shahid Sadoughi hospital Yazd, Iran. *Int J Infect Control*. 2013;**9**(1). doi: 10.3396/ijic.v9i1.005.13.
23. Anh Thu T. Knowledge, attitude and practices regarding standard and isolation precautions among Vietnamese health care workers: a multicenter cross-sectional survey. *Open J Intern Med*. 2012;**2**(4). doi: 10.4172/2165-8048.1000115.
24. Jain M, Sawla L, Mathur A, Nihlani T, Ayair U, Prabu D, et al. Knowledge, attitude and practice towards droplet and airborne isolation precautions amongs dental health care professionals in India. *Med Oral Patol Oral Cir Bucal*. 2010;**15**(6):e957–61. doi: 10.4317/medoral.15.e957. [PubMed: 20526247].
25. Barikani A, Afaghi A. Knowledge, attitude and practice towards standard isolation precautions among Iranian medical students. *Glob J Health Sci*. 2012;**4**(2). doi: 10.5539/gjhs.v4n2p142.
26. 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**(1):16–22. doi: 10.1177/1757177414558957. [PubMed: 28989394]. [PubMed Central: PMC5074133].
27. Abdel-Rasoul GM, Al Bahnasy RA, Mohamed OA, Abdel-Aziz AM, Mourad WS, Youssef MF. Effect of an educational health program on the knowledge, attitudes and practices of healthcare workers with respect to nosocomial infections in the National Liver Institute, Egypt. *Menoufia Med J*. 2016;**29**(4):984.
28. Ataei B, Askarian M, Javadi A, Khorvash F, Babak A, Pozveh ZA, et al. Knowledge, attitude and practice of surgeons and surgical residents in disciplines standard precautions. *J Isfahan Med Sch*. 2011;**28**(115).