Knowledge, perceptions and practices of healthcare workers regarding the use of respiratory protection equipment at Iran hospitals

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Abstract

Background: Using appropriate respiratory protection equipment (RPE) is very important to protect healthcare workers (HCWs) against respiratory hazards. The aim of this study was to identify the level of knowledge, perceptions and practices of HCWs on using RPE.

Methods: This cross-sectional study was conducted with 284 employees of educational hospitals affiliated to Shiraz University of Medical Sciences. The study's instrument was a self-made questionnaire that comprised four components: demographic inquiries and questions designed to assess the knowledge, perceptions and practice of HCWs regarding RPE. Collected data were analysed using SPSS software version 21.

Results: Average scores of knowledge, perceptions and practice of HCWs on using RPE were $66.50\% \pm 11.93\%$, $80.32\% \pm 10.05\%$ and $70.12\% \pm 20.51\%$, respectively. A significant association was observed between knowledge and age, job experience, history of using respirator, marital status and risk of respiratory hazards in the workplace and perceptions with age and education and practice with education.

Conclusion: Studied HCWs had positive perceptions and moderate level of knowledge and practice about the use of RPE. Full implementation of respiratory protection program in the hospitals would be helpful to improve the knowledge, perceptions and practices of HCWs regarding RPE.

Keywords

Knowledge, perceptions, practice, respiratory protection equipment

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Introduction

Healthcare workers (HCWs) are at high risk of various respiratory hazards including chemical agents, e.g. cleaning and disinfectant materials, anaesthetic and cytotoxic drugs, and biological agents, e.g. blood pathogens including hepatitis B and C, human immunodeficiency viruses and respiratory pathogens such as influenza, tuberculosis, diphtheria and chickenpox (European Commission, 2010; Sepkowitz, 1996; Stein et al., 2003). One way to protect HCWs against respiratory hazards in healthcare centres is by the effective use of respiratory protection equipment (RPE) (CDC, 2005; OSHA, 2004). Surgical masks and N95 respirators are the two most prevalent RPE used in

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hospitals (Coia et al., 2013; College of Respiratory Therapists of Ontario, 2011). Surgical masks protect HCWs from inhalation of infected droplets and microorganisms transmitted through the mouth and nose (College of Respiratory Therapists of Ontario, 2011), whereas N95 respirators protect HCWs against airborne pollutants. N95 respirators provide better protection than surgical masks (MacIntyre et al., 2011, 2013; World Health Organization, 2004); however, they can cause breathing resistance, heat, moisture and discomfort for users (Li et al., 2005). Numerous studies have shown that HCWs generally comply poorly with RPE regulations (Evanhoff et al., 1999; Gershon et al., 1995; Honarbakhsh et al., 2017; Kelen et al., 1990; Madan et al., 2001; Nickell et al., 2004). Reasons for HCWs not using RPE includes not having RPE readily available or not knowing that a patient has transmittable disease (De Perio et al., 2012; Honarbakhsh et al., 2017; Wise et al., 2011). Other factors that appear to influence RPE practices are individual's perceptions and knowledge (Khalilzadeh et al., 2013).

The aim of this study was to investigate the level of knowledge, perceptions and practice among Iranian HCWs on using RPE.

Methods

Investigation design

This cross-sectional study was conducted on 284 HCWs (physicians, nurses and janitors) in six hospitals affiliated to Shiraz University of Medical Sciences. HCWs were selected by simple random sampling.

The study protocol was approved by the Shiraz University of Medical Sciences ethics committee.

Questionnaire design

A questionnaire based on the Occupational Safety and Health Administration (OSHA) Respiratory Protection Program standard requirements (OSHA, 2017) was developed and used to collect data regarding HCWs RPE knowledge, perceptions and practices. Five Occupational Health and Safety experts (OHS) and five HCWs assessed the validity of the questionnaires. The reliability of the questionnaires was checked by Cronbach's alpha ($\alpha = 0.860$, 0.899 and 0.870 , respectively, for knowledge, perceptions and practice dimensions).

The questionnaire consisted of four components including: demographic, knowledge (22 items), perceptions (eight items) and practice (seven items). Knowledge items were categorised as true (score 2), false (score 0) or don't know (score 1). Perceptions items were scored using a Likert-scale, which ranged from 1 (completely disagree) to 5 (completely agree). Practice items also were categorised as yes (score 1) and no (score 0). All negatively worded responses were scored reversely.

To calculate the percentage of participant's response in each section, obtained scores from items were added and divided to the maximum attainable scores (44, 40 and 7 for knowledge, perceptions and practices, respectively). The final score for each section was classified into four categories: very poor (0–25%); poor (26–50%); moderate (51–75%); and good (76–100%).

Statistical analysis

Descriptive statistics such as percentage, average and standard deviation (median and interquartile range for non-normal distribution data) were used. T-test and ANOVA were used to assess the relationship between level of knowledge, perceptions and practices with the studied variables. Pearson correlation coefficient was used to assess the relationship between knowledge, perceptions and practice. Analyses were conducted using the SPSS software, version 21 and a two-sided P value of 0.05 was used for all statistical procedures.

Results

As shown in Table 1, HCWs spent an average of 3 h per day using RPE and had seven years of experience using RPE, on average. This table also shows that most of the participants believed that risk of respiratory hazards at their workplace was moderate to high. The most commonly used RPE were surgical masks and N95 respirators.

Average scores of knowledge, perceptions and practice of HCWs on using RPE were calculated at $66.50\% \pm 11.93$, $80.32\% \pm 10.05$ and $70.12\% \pm 20.51$, respectively. The majority of HCWs had moderate knowledge and practice (68.7% and 48.9%, respectively) and good perceptions (71.8%) regarding the use of RPE (Figure 1).

The results of Pearson correlation coefficient showed a weak correlation between knowledge and perceptions ($r = 0.245$, $P < 0.001$), knowledge and practice ($r = 0.240$, $P < 0.001$), and practice and perceptions ($r = 0.241$, $P < 0.001$).

In Table 2, the relationship between the studied variables with knowledge, perceptions and practice of HCWs on using RPE is presented. The average score of knowledge and perceptions had a significant relationship with age. The average score of knowledge had relationship with job experience and history of using RPE ($P < 0.05$). Married individuals had significantly higher knowledge than the single individuals ($P < 0.05$). The average score of perceptions and practice in non-collegiate individuals was significantly higher than collegiate education individuals ($P < 0.05$). The average score of knowledge and perceptions in workplace with high and moderate risk of respiratory hazards was significantly greater than the low-risk environment ($P < 0.05$).

The frequency of detailed responses of hospital staff to knowledge, perceptions and practice questions has been shown in Appendix 1 (Tables 3–5).

Table 1. Summary statistics.

Age (years)	Mean $\pm$ SD	31.63 $\pm$ 8.27
	Range	20–58
Job experience (years)	Mean $\pm$ SD	7.78 $\pm$ 7.09
	Range	1–28
History of using RPE (years)	Mean $\pm$ SD	7.02 $\pm$ 6.61
	Range	1–27
Duration of using RPE (h/day)	Mean $\pm$ SD	3.12 $\pm$ 2.46
	Range	1–12
Sex	Male	108 (38%)
	Female	176 (62%)
Marital status	Single	113 (39.8%)
	Married	171 (60.2%)
Education	Non-collegiate (non-academic)	87 (30.6%)
	Collegiate (academic)	197 (69.4%)
Job	Physician	16 (5.6%)
	Nurse	166 (58.5%)
	Janitor*	102 (35.9%)
Perceived risk of respiratory hazards in the workplace	Low	39 (13.7%)
	Moderate	111 (39.1%)
	High	134 (47.2%)
Type of RPE†	Surgical mask	227 (79.9%)
	N95	11 (3.9%)
	Chemical cartridge	2 (0.7%)
	PAPR	1 (0.4%)
	Surgical N95	41 (14.4%)
	Surgical N95 and chemical cartridge respirator	1 (0.4%)
	Surgical and chemical cartridge respirator	1 (0.4%)
Type of hospital	General	138 (48.6%)
	Specialty‡	146 (51.4%)

*A janitor performs basic housekeeping, janitorial, maintenance and cleaning duties in the hospitals.

†All types of RPE except PAPR and chemical cartridges respirator were disposable.

‡Hospital that provides a limited range of services (e.g. orthopaedic surgery, ophthalmology or obstetrics).
RPE, respiratory protection equipment; PAPR, Powered Air-Purifying Respirator; SD, standard deviation.

Discussion

The aim of this study was to investigate the level of knowledge, perceptions and practice of Iranian HCWs on using RPE. The results indicated that most of the studied HCWs had good level of perceptions and moderate level of knowledge and practice regarding the use of RPE.

Knowledge can be improved through measures such as training, while attitude could shape and influence behaviour (Hughes et al., 2005; Khalilzadeh et al., 2013). The right knowledge along with the right attitude can eventually

lead to promotion of practice and healthy behaviour (Achal, 2001). In this study, HCWs did not have enough knowledge about how to select and use an appropriate RPE and the limitations of N95 respirators to protect them against hazardous drugs and chemical vapours. Also, the knowledge of individuals about effectiveness of surgical masks against biological agents in comparison to N95 respirators was very weak. Moreover, the knowledge of individuals towards Powered Air-Purifying Respirator (PAPR) was at a moderate level. These respirators are usually used for the employees who have facial hair or who cannot

Figure 1. Frequency distribution of knowledge, perceptions and practices of HCWs regarding the use of RPE (n = 284).

effectively fit the respirator on their face and also for employees who are involved in the decontamination process or primary care of biological and chemical emergencies (California Department of Public Health, Occupational Health Branch, 2012). Therefore, it is necessary to promote the knowledge of studied HCWs about the use and limitation of these RPE.

Studied HCWs had a moderate level of practice on using RPE. The main weakness in this regard was related to not conducting the medical evaluation and seal check before using RPE.

A weak significant relationship was found between knowledge and practice regarding the use of RPE. This finding is in contrast with Truong's study, which showed that the level of knowledge and attitude regarding the use of RPE was low, while all the respondents had moderate to high practice (Truong et al., 2009). It seems that there are

Table 2. The relationship between the studied variables (demographic and non-demographic variables) with knowledge, perceptions and practice of HCWs regarding the use of RPE (n = 284).

Parameter		Knowledge	P value	Perceptions	P value	Practice	P value
Age (years)*	< 35	65.26 ± 11.43	0.008†	79.53 ± 9.02	0.045†	68.89 ± 19.85	0.129
	≥ 35	69.33 ± 12.62		82.12 ± 11.91		72.90 ± 21.78	
Job experience (years)*	< 10	65.28 ± 11.43	0.005†	79.63 ± 9.53	0.060	69.90 ± 19.99	0.772
	≥ 10	69.75 ± 12.70		82.14 ± 11.17		70.69 ± 21.95	
Experience of using the RPE (years)*	< 10	65.50 ± 11.40	0.012†	79.72 ± 9.49	0.073	70.09 ± 19.77	0.976
	≥ 10	69.63 ± 13.07		82.21 ± 11.49		70.18 ± 22.81	
Sex*	Male	66.45 ± 12.04	0.953	79.72 ± 11.50	0.429	68.91 ± 21.11	0.439
	Female	66.54 ± 11.90		80.69 ± 9.06		70.86 ± 20.16	
Marital status*	Single	64.80 ± 10.53	0.050†	79.66 ± 9.87	0.371	68.77 ± 20.69	0.369
	Married	67.63 ± 12.68		80.76 ± 10.17		71.01 ± 20.40	
Education*	Non-collegiate (academic)	66.77 ± 11.40	0.806	82.50 ± 10.20	0.015†	77.66 ± 19.32	< 0.001†
	Collegiate (academic)	66.39 ± 12.19		79.36 ± 9.85		66.78 ± 20.18	
Job	Physician	29.18 ± 5.58	0.916	33.12 ± 2.30	0.145	4.68 ± 0.94	< 0.001†
	Nurse	29.37 ± 5.55		31.74 ± 3.88		4.57 ± 1.48	
	Janitor	29.09 ± 4.72		32.59 ± 4.37		5.48 ± 1.24	
Type of hospital*	General	65.25 ± 10.96	0.084	79.69 ± 9.46	0.302	68.63 ± 19.89	0.236
	Specialty	67.69 ± 12.71		80.92 ± 10.57		71.52 ± 21.05	
Perceived risk of respiratory hazards in the workplace‡	Low	61.24 ± 13.20	0.007†	79.35 ± 13.13	0.202	67.76 ± 23.10	0.637
	Moderate	68.20 ± 11.61		79.30 ± 10.47		71.29 ± 19.02	
	High	66.63 ± 11.46		81.45 ± 8.51		69.82 ± 20.99	

*T-test.

†Significant relationship.

‡ANOVA test.

likely other more important factors than knowledge, which if targeted in a respiratory protection program (RPP) may lead to behaviour change. However, in none of the studied hospitals had a RPP been fully implemented.

The knowledge of HCWs on using RPE in older participants and individuals with higher job experience was greater. These findings are consistent with other studies (Jahangiri et al., 2013; Monazzam et al., 2009; Mortazavi et al., 2011; Nour et al., 2015; Sanaei Nasab et al., 2009). This could be attributed to the fact that these individuals with higher age and job experience received more training on the job safety and health issues and had a better understanding of workplace hazards.

In this study, interestingly, individuals with non-collegiate education had higher level of perceptions and practice compared with individuals with collegiate education (nurses and physicians). This is may be because that lower educated HCWs are more exposed to high-risk respiratory hazards due to their job responsibility. Moreover, these HCWs may be more likely to comply with the health and safety regulation due to low job security.

According to the results of this study, married individuals had significantly higher knowledge than single individuals, possibly because married individuals were older (34.49 years versus 27.17 years) and old individuals (≥ 35 years) had significantly higher knowledge than young counterparts (< 35 years) (Table 2).

There were some limitations to our study. The study sample was limited to governmental hospitals affiliated by Shiraz University of Medical Sciences, Shiraz, Iran, and the results may not be generalisable to other countries. Moreover, the study is based on self-report, which may be susceptible to self-presentation bias. Nonetheless, the present results can provide important evidence for promoting training on respiratory protection for HCWs. Further studies with more representative samples are needed.

Conclusion

Proper practices are a key factor in respiratory protection of HCWs against their workplace respiratory hazards. The good level of HCWs' perceptions and their moderate level of knowledge about the use of RPE were not sufficient to provide a good level of practice. It seems that knowledge and perceptions alone are insufficient to maintain the proper practices. Therefore, full implementation of RPP in the hospitals would be helpful to improve the knowledge, perceptions and practices of HCWs regarding RPE.

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Appendix I

Table 3. Frequency of participants response to questions related to knowledge about RPE (n = 284).

Statement	True	Don't know	False
Having facial hair (beard) or acne has negative influence in protective performance of respirator.	130 (45.8)	76 (26.8)	78 (27.5)
Surgical and N95 respirators should be discarded after usage.	188 (66.2)	28 (9.9)	68 (23.9)
Each person should wear a respirator that fit on his/her face dimensions.	97 (34.2)	34 (12)	153 (53.9)
N95 respirators are suitable protection against gases and vapours from the chemicals.	102 (35.9)	55 (19.4)	127 (44.7)
Surgical masks are as effective as N95 respirator against biological agents.	184 (64.8)	52 (18.3)	48 (16.9)
Surgical masks or N95 respirators cannot be stored to be reused.	187 (65.8)	37 (13)	60 (21.1)
I know how to correctly don and doff the respirators (adjust respirators on face, grab the bands in doffing)	236 (83.1)	32 (11.3)	16 (5.6)
Before using respirators for the first time, it is necessary to be medically evaluated.	198 (69.7)	41 (14.4)	45 (15.8)
Seal check shall be performed before each time of wearing N95 respirators.	153 (53.9)	84 (29.6)	47 (16.5)
After each contact with infectious patients, N95 respirator should be replaced.	173 (60.9)	44 (15.5)	67 (23.6)
In case hands contact the outer surface of the respirator, hands should be washed immediately to prevent the transmission of the infection.	213 (75)	33 (11.6)	38 (13.4)
For people with chronic respiratory diseases, heart diseases or medical conditions, N95 respirator equipped with expiratory valve is recommended.	121 (42.6)	116 (40.8)	47 (16.5)
Surgical masks must be replaced after visiting each patient.	209 (73.6)	26 (9.2)	49 (17.3)
For first exposure with unknown diseases, Powered Air-Purifying Respirator (PAPR) must be used.	127 (44.7)	127 (44.7)	30 (10.6)
N95 respirators with expiratory valves should not be used in the operating or sterile room.	115 (40.5)	126 (44.4)	43 (15.1)
In the operating rooms, surgical N95 respirators should be used.	97 (34.2)	111 (39.1)	76 (26.8)
PAPR is suitable respirator for people with facial hair (beard).	91 (32)	160 (56.3)	33 (11.6)
For decontamination and maintenance, PAPR is recommended to be worn.	83 (29.2)	171 (60.2)	30 (10.6)
To deal with patients with seasonal flu and tuberculosis, N95 or PAPR respirators must be used.	191 (67.3)	69 (24.3)	24 (8.5)
N95 respirators are not effective protection against hazardous drugs (chemotherapy, hormone).	121 (42.6)	88 (31)	75 (26.4)
To deal with the Severe Acute Respiratory Syndrome (SARS) patients, N95 or PAPR respirators are efficient.	163 (57.4)	98 (34.5)	23 (8.1)
For protection against infectious aerosols, produced during intubation or bronchoscopy, N95 or PAPR respirators should be used.	121 (42.6)	103 (36.3)	60 (21.1)

Table 4. Frequency of participants response to questions related to perceptions about the RPE (n = 284).

Statement	Completely agree	Agree	No idea	Disagree	Completely disagree
I think that HCWs are aware of the respiratory contaminations of their jobs.	42 (14.8)	77 (27.1)	37 (13)	101 (35.6)	27 (9.5)
I think that the hospital staff should be examined for their respiratory system at least once a year.	163 (57.4)	95 (33.5)	15 (5.3)	7 (2.5)	4 (1.4)
Hospital staff should be trained about how to use RPE.	163 (57.4)	95 (33.5)	15 (5.3)	7 (2.5)	4 (1.4)
I think the staff should not have contact with suspected patients and respiratory pollutants, without using respirator.	195 (68.7)	70 (24.6)	10 (3.5)	4 (1.4)	5 (1.8)
I think using respirator alone (without ventilation and biological hoods) is not enough to protect against the respiratory pollutants in hospitals.	122 (43)	104 (36.6)	38 (13.4)	14 (4.9)	6 (2.1)
I think complete fit respirator on the user's face is very important on its performance.	142 (50)	118 (41.5)	15 (5.3)	6 (2.1)	3 (1.1)
I think respiratory pollutants in hospitals are not so dangerous in order to wear respirators.	79 (27.8)	108 (38)	34 (12)	33 (11.6)	30 (10.6)
I think short contact with suspected infectious patients using surgical mask is not dangerous.	65 (22.9)	128 (45.1)	21 (7.4)	38 (13.4)	32 (11.3)

Table 5. Frequency of participants response to questions related to practice using the RPE (n = 284).

Statement	Yes	No
Do you usually have facial hair (beard) when using a respirator?	89 (31.3)	195 (68.7)
Do you use the bands when doffing the respirator?	229 (80.6)	55 (19.4)
Do you adjust the nose clip when donning the respirator?	262 (92.3)	22 (7.7)
Do you perform the seal check (test to ensure the completely fit of respirator on face) when wearing the N95 respirators?	163 (57.4)	121 (42.6)
Do you wash your hands after contact with outer surface of the respirator?	210 (73.9)	74 (26.1)
Have you received medical evaluation before using the respirator for the first time?	101 (35.6)	183 (64.4)
Do you discard the N95 and surgical mask after each use?	234 (82.4)	50 (17.6)