

Assessment of compliance to standard precautions among surgeons in Zagazig University Hospitals, Egypt, using the Health Belief Model

Eman M. Mortada^a, Marwa M. Zalab^b

^aDepartments of Community Medicine

^bOccupational and Environmental Medicine, Faculty of Medicine, Zagazig University, Zagazig, Egypt

Correspondence to Eman M. Mortada, Department of Community Medicine, Faculty of Medicine, Zagazig University, Zagazig, Egypt
Tel: +20 109 686 5168,
e-mail: emanmortada@hotmail.com

Received 6 November 2013

Accepted 30 December 2013

Journal of the Arab Society for Medical Research 2014, 9:6–14

Background/aim

Although it is recommended that healthcare professionals should comply with the standard precautions to prevent acquiring blood-borne diseases (AIDS, hepatitis B and C), yet, they frequently do not comply with this recommendation. Understanding the reasons for compliance and noncompliance will help in designing educational programs for hospital staff and in determining a strategy for improving health behavior. The present study aimed to assess surgeons' compliance to standard precautions and determine surgeons' perceived beliefs affecting their compliance using the Health Belief Model.

Participants and methods

A cross-sectional study was carried out at surgical departments in Zagazig University Hospitals from December 2012 to May 2013. A questionnaire on various aspects of infection control and standard precautions practices was provided to 307 surgeons, with a response rate of 70%.

Results

Our findings indicated that 57.5% of the surgeons sampled in Zagazig University Hospitals were compliant with standard precautions. 59.8% of compliant surgeons had been exposed to at least one needle-stick injury in the previous 3 months, whereas slightly less than half of compliant surgeons (48.4%) had been exposed to splashes, with a highly significant difference compared with nonexposed surgeons. All Health Belief Model subscales were correlated directly with the surgeons' compliance, except perceived barriers.

Conclusion

There is adequate compliance with standard precautions among surgeons in Zagazig University Hospitals, especially female surgeons, with a high level of knowledge among compliant compared with noncompliant surgeons. All Health Belief Model subscales were correlated directly with the surgeons' compliance, except perceived barriers. Adequate training of surgeons, provision of infection prevention equipment, regular reporting, follow-up, and assessment of occupational exposures need to be introduced.

Keywords:

compliance and standard precautions, Health Belief Model, surgeons

J Arab Soc Med Res 9:6–14

© 2014 The Arab Society for Medical Research
1687-4293

Introduction

Healthcare workers (HCWs) are at an increased risk of occupationally acquired infections transmitted from both blood-borne pathogens (BBP), such as hepatitis B and C and HIV. Exposure to blood and body fluids is a major concern for HCWs; surgeons are especially at an increased risk of exposure to these pathogens during surgical procedures. Surgeons have been shown to have a four-fold to eight-fold higher incidence of exposure to patients' blood compared with internists [1]. Exposure can occur through a percutaneous injury and/or mucosa exposure (needle-stick or other sharps injury), a mucocutaneous occasion (splash of blood and body fluids into the eyes, nose, or mouth), or blood contact with damaged skin [2,3], and presents a major risk for the transmission of BBPs such as HIV, hepatitis B virus (HBV), and hepatitis C virus (HCV). The highly significant predictors for compliance of surgeons were

training on standard precautions, knowledge level, perceived severity, perceived barrier, and perceived cues to action [4].

'Standard precautions' aim to prevent the transmission of BBPs. The objective is to assume that patients are infected with BBPs, and ensuring that health staff minimizes the risk of exposure to infected body fluids [5]. The proper and consistent use of personal protective equipment (PPE) during operative/invasive procedures by members of surgical teams reduces the risk of acquiring blood-borne disease. Studies worldwide have shown that despite training on universal precautions, availability of PPE, and effective organizational safety climate, some surgical team members choose not to comply with regulations and recommendations related to exposure to pathogens. Compliance is the

extent to which certain behavior (e.g. following a physician's orders or implementing healthier lifestyles) is in accordance with the physicians' instructions or healthcare advice. To explain and understand the factors that influence an individual's compliance, which may consequently contribute toward the adoption of certain behavior, the most commonly used model is the Health Belief Model (HBM) [6,7]. HBM was originally developed by a group of psychologists in the 1950s; the model offers the ability to understand the different behaviors or attitudes that individuals may develop. It has been used widely and is considered one of the most useful models in healthcare prevention and promotion [8]. Finding the reasons for compliance and noncompliance with reporting needle-stick injuries (NSIs) will help in designing educational programs for hospital staff and in determining a strategy for improving health behavior [9].

According to the HBM, individuals are ready to take action if they believe that they are susceptible to a disease (perceived susceptibility), believe that a condition has serious consequences (perceived severity), believe that taking action will reduce their susceptibility to the condition (perceived benefits), understand that the costs of taking action (perceived barriers) are outweighed by the benefits, are exposed to factors that prompt action (cue to action), and are confident in their ability to perform that action successfully (self-efficacy). The model is based on the understanding that an individual will engage in a health-related action if the individual:

- (a) Believes that he or she can avoid a negative health condition (i.e. exposure to BBPs),
- (b) Has a positive expectation that he or she will avoid a negative health condition by taking a recommended action (i.e. wearing PPE to avoid exposure), and
- (c) Believes that he or she can successfully take a recommended health action [10].

The aim of this study was to provide the foundation for planning a program for prevention of BBPs among surgeons.

Objectives

The objectives of the study were as follows:

- (1) Assess the surgeons' compliance with standard precautions.
- (2) Determine the surgeons' perceived beliefs affecting their compliance using the HBM.

Participants and methods

Study design and setting

To fulfill our objectives, a cross-sectional study was carried out at surgical departments in Zagazig University Hospitals during the period from December 2012 to May 2013.

Target population and sampling

Surgeons in different surgical departments and surgical subspecialties were selected because they have the highest rates of exposure and are at an increased risk of exposure to HBV, HCV, and HIV while performing operative or invasive procedures. There are eight surgical departments; from these, only four departments were chosen randomly (general surgery, orthopedic, urology, and obstetrical and gynecologic departments). The target population for the study included all surgeons in the randomly chosen departments ($n = 410$). In total, 307 questionnaires were completed by consenting clinicians who agreed to participate in the study. After excluding incompletely filled questionnaires from the final analysis, only 287 were included in final analysis, yielding a 70.0% response rate (287/410).

Instrument used for data collection

A questionnaire [11,12] on various aspects of infection control and standard precaution practices was devised and modified after being tested on a sample of 25 surgeons to determine the acceptability and clarity of the questionnaire and to confirm its face validity. The internal consistency of each subscale was measured by Cronbach's α and it ranged from acceptable to desire. The final version included the following three parts:

Personal and job-related variables

Personal and job-related variables included sex, age, surgical specialty, recent qualification, years of experience in practice, and whether they had received training related to infection control and standard precautions. Also, questions addressed the history of HBV vaccination, including number of doses, and postvaccine serologic testing. In addition, the questionnaire specifically asked participants about exposures to sharps injuries, and splash of blood and body fluids during the previous 3 months. This 3-month time period was used to minimize recall bias.

Questions to assess compliance with standard precautions (desired behavior)

Compliance with standard precautions was determined using the modified standard precautions questionnaires. The items measured how often these surgeons followed specific recommended work practices, such as use

of protective barriers as (gloves, gowns, masks, and goggles), disposal of sharps, and needles. Response options included 'never', 'rarely', 'sometimes', 'often', and 'always' on a five-point Likert scale ranging from 1 to 5. In addition, three other questions assessed vaccination status. We also asked questions related to the reasons for noncompliance with standard precautions. Then, we classified the results of the scoring and the respondents were divided into two groups for the purpose of analysis using median as a cutoff point (less than median as noncompliant and more than median as compliant).

Health belief questionnaire

A health belief questionnaire included questions to assess:

- Knowledge of disease transmission and standard precautions (12 items): A correct answer was assigned a score of 1, whereas an incorrect answer was assigned a score of 0. The mean knowledge score was computed by adding the number of correct answers.
- Perceived susceptibility of infection and acquiring BBPs (one item) and perceived severity of consequences of exposure to blood and body fluids (one item). The response to perceived susceptibility and severity was on a scale of 1 (being none) to 5 (being very high).
- Perceived benefits of standard precautions (one item): 'to what extent do you believe that standard precautions practices protect against blood borne infections?' (very low = 1 to very high = 4).
- Perceived barriers to practice of standard precautions (seven items) (yes = 1, no = 0).
- Cue to action (five items) that motivates action to be taken (yes = 1, no = 0).
- Perceived self-efficiency (one item) 'are you confident in your ability to successfully practice

safe standard precautions at your workplace?' (not confident = 0, completely confident = 2).

Ethical consideration

Ethical permission to carry out the study was obtained from the hospital director before data collection. Participation in the study was voluntary and informed verbal consent was obtained before data collection. The questionnaires were strictly confidential and anonymous and each questionnaire was numerically coded.

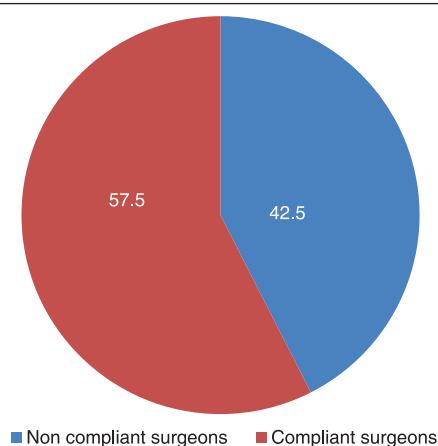
Statistical analysis

Data were analyzed using the statistical package for the social sciences (SPSS, version 19.0; SPSS Inc., Chicago, Illinois, USA) for Windows. Descriptive statistics such as frequency, percent, mean, and SD were determined. Analytical statistical tests such as χ^2 , analysis of variance, independent *t*-test, Mann-Whitney, and Kruskal-Wallis tests were used to compare continuous variables. Pearson's correlation coefficient was calculated to determine the associations between surgeons' compliance and HBM subscales. Logistic regression was used to assess predictors of compliance; the threshold of statistical significance was set at *P* value less than 0.05 (two-tailed).

Results

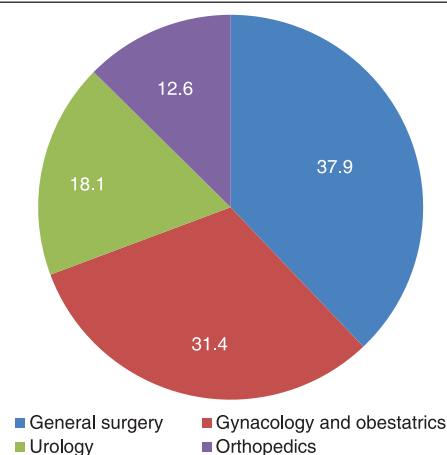
Of the 410 surgeons selected, 287 (70%) were included in the final analysis. Figure 1 shows the distribution of sampled surgeons according to their specialties; 37.9% were general surgeons, 31.4% were gynecologists and obstetricians, 18.1% were urologists, and 12.6% were working in the orthopedic department. Analysis of data showed that 57.5% of the sampled surgeons in Zagazig University Hospitals were compliant with standard precautions (Fig. 2). The mean

Figure 1



Distribution of the studied sample according to surgical specialty.

Figure 2



Compliance with standard precautions among sampled surgeons.

score of compliance among surgeons was 72.9 ± 7.3 . The mean score of overall knowledge level was 14.3 ± 3.5 . The Cronbach's α for internal consistency of knowledge items was 0.79 (Table 1).

Table 2 shows the relationship between the demographic characteristics of the surgeons at risk of blood-borne occupational exposures and their compliance with the standard precautions. It was found that 54.9% of female surgeons were highly compliant with standard precautions. Of the compliant surgeons, 46.7% were 35–44 years old and 42.6% worked in the general surgery department; 39.3% of highly compliant surgeons were lecturers in Zagazig University Hospitals and 55.7% had spent 10 or more years in their current occupation. Forty-nine (40.2%) surgeons who had received infection control training were highly significantly compliant with standard precautions ($P = 0.000$). More

than half of the compliant surgeons (59.8%) had been exposed to at least one NSI in the previous 3 months, whereas around half of the compliant surgeons (48.4%) had been exposed to splashes with a highly significant difference compared with nonexposed surgeons.

On analyzing the reasons for noncompliance with the standard precautions among surgeons, it was found that improper training had the most cumulative percentage, as shown in the Pareto chart in Fig. 3. On comparing the knowledge and beliefs scores of compliant and noncompliant surgeons, there were highly significant mean scores of awareness, perceived severity, and perceived barriers among compliant than among noncompliant surgeons (Table 3).

In terms of the relationship between subscales of HBM and personal characteristics of the sampled surgeons, it

Table 1 Mean, SD, and Cronbach's α for the Health Belief Model subscale

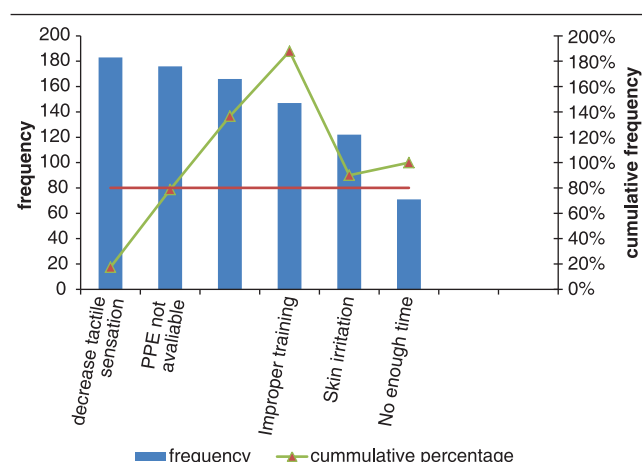
	Items	Minimum–maximum	Mean $\pm$ SD	Cronbach's α
Compliance	21	60–92	72.9 ± 7.3	0.84
Knowledge level	12	8–22	14.3 ± 3.5	0.79
Perceived susceptibility	1	2–5	4.06 ± 0.86	0.82
Perceived severity	1	2–5	4.2 ± 0.7	0.91
Perceived benefits	1	1–2	1.8 ± 0.37	0.88
Perceived barriers	7	4–7	5.9 ± 1.13	0.83
Perceived self-efficacy	1	0–2	1.17 ± 0.03	0.89
Cues to action	5	0–5	3.68 ± 1.4	0.87

Table 2 Personal and occupational characteristics of the studied sample according to their compliance with the standard precautions ($n = 287$)

Variables	Categories	Compliant [N (%)]	Noncompliant [N (%)]	χ^2
Sex	Male ($n = 178$)	55 (45.1)	123 (74.5)*	25.8
	Female ($n = 109$)	67 (54.9)	42 (25.5)	
Age groups (years)	<35 ($n = 60$)	22 (18.0)	38 (23.0)	1.62
	35–44 ($n = 131$)	57 (46.7)	74 (44.8)	
	45–54 ($n = 81$)	35 (28.7)	46 (27.9)	
	≥ 55 ($n = 15$)	8 (6.6)	7 (4.2)	
Surgical specialty	General surgery ($n = 109$)	52 (42.6)	57 (34.5)	5.25
	Gynecology and obstetrics ($n = 90$)	39 (32.0)	51 (30.9)	
	Urology ($n = 52$)	15 (12.3)	37 (22.4)	
	Orthopedic ($n = 36$)	16 (13.1)	20 (12.1)	
Job title	Resident ($n = 32$)	11 (9.0)	21 (12.7)	9.07
	Assistant lecturer ($n = 57$)	23 (18.9)	34 (20.6)	
	Lecturer ($n = 108$)	48 (39.3)	60 (36.4)*	
	Assistant professor ($n = 63$)	22 (18.0)	41 (24.8)	
	Professor ($n = 27$)	18 (14.8)	9 (5.5)	
Years of experience	<10 ($n = 128$)	54 (44.3)	74 (44.8)	0.01
	≥ 10 ($n = 159$)	68 (55.7)	91 (55.2)	
Infection control training	No ($n = 121$)	73 (59.8)	48 (29.1)	27.2
	Yes ($n = 166$)	49 (40.2)	117 (70.9)*	
Exposure to NSI	No ($n = 152$)	49 (40.0)	103 (62.4)*	13.9
	Yes ($n = 135$)	73 (59.8)	62 (37.6)	
Exposure to splashes	No ($n = 111$)	63 (51.6)	48 (29.1)	15.03
	Yes ($n = 176$)	59 (48.4)	117 (70.9)*	

NSI, needle-stick injury; *Significance difference at $P \leq 0.05$.

Figure 3



Pareto chart showing the reasons for noncompliance. PPE, personal protective equipment.

was found that there were significantly perceived benefits among male than female surgeons. Moreover, perceived self-efficacy and cues to action were also significant among surgeons younger than 35 years old. Perceived barriers and perceived self-efficacy were highly significant among gynecologists and urologists than other surgeons. Highly significant cues to action were found among residents than those with other job titles. Significantly perceived susceptibility was found among surgeons with less than 10 years' work experience. Significantly higher perceived susceptibility, perceived self-efficacy, and cues to action were found among surgeons who had received infection control training than those who had not. Perceived susceptibility, perceived severity, perceived barriers, and cues to action were significantly higher among surgeons exposed to NSI compared with nonexposed surgeons, whereas only perceived barriers, perceived self-efficacy were significantly higher among surgeons exposed to splashes (Table 4).

Table 5 shows the correlation between surgeons' compliance and HBM subscales. It is well evident that all HBM subscales were correlated directly with the surgeons' compliance, except perceived barriers. Knowledge of standard precautions, perceived susceptibility, and perceived severity was significantly correlated with compliance.

Discussion

To our knowledge, this is the first research study carried out in Zagazig University Hospitals among a group of surgeons investigating the issue of compliance with standard precautions to avoid occupational exposure to BBPs. The HBM has been used previously as a theoretical framework in many studies, and has

Table 3 Comparison of knowledge and beliefs scores among compliant and noncompliant surgeons

Variables	Noncompliant (mean $\pm$ SD)	Compliant (mean $\pm$ SD)	T-test
Knowledge level	12.8 $\pm$ 2.8	16.2 $\pm$ 3.4*	8.9
Perceived susceptibility	4.04 $\pm$ 0.6	4.07 $\pm$ 1.01	0.36
Perceived severity	4.06 $\pm$ 0.6	4.28 $\pm$ 0.78*	2.6
Perceived benefits	2.99 $\pm$ 0.9	3.14 $\pm$ 0.96	1.31
Perceived barriers	5.6 $\pm$ 0.99	6.07 $\pm$ 1.19*	3.01
Perceived self-efficacy	3.2 $\pm$ 1.4	3.9 $\pm$ 1.3*	4.3
Cues to action	1.15 $\pm$ 0.36	1.18 $\pm$ 0.76	0.45

*Significance difference from the noncompliant group at $P \leq 0.05$.

been successful in explaining a variety of human behaviors and attitudes, including compliance with universal precautions, the previous version of standard precautions. Therefore, the use of the HBM as a sound and useful theory improves the internal validity of this study and enables comparisons among similar studies. This study examined surgeons' compliance with standard precautions and determined surgeons' perceived beliefs affecting their compliance to avoid occupational exposure to BBPs. Using the HBM as a theoretical framework, this study focused on the factors that affect compliance either negatively (barriers), leading to noncompliance, or positively, leading to compliance.

'Standard precautions' is a system of barrier precautions to be used by all personnel for contact with blood, all body fluids, secretions, excretions, nonintact skin, and mucous membranes. It applies to all patients receiving care in hospitals, irrespective of their diagnosis or presumed infection status [13]. Although this study supports previous studies in reporting a less than 100% compliance rate with standard precautions, a trend toward improved compliance is evident. The level of compliance in this study is similar to a finding from Alexandria Teaching Hospitals (57.5, 46.3%, respectively) [11] and higher than the report from the UAE (19%) [14], but lower than the finding in Ethiopia (80.8%) [15]. The rate of use of standard precautions in teaching hospitals in developed countries is considerably higher than that in our hospitals [16,17]. In addition, a previous study among medical doctors working in a tertiary care hospital in Pakistan reported that compliance with hand washing was 86%, that for wearing gloves was 79% and masks 46%, and 45% for the use of gowns/plastic aprons. Partial compliance and suboptimal practices were also reported in other countries such as Nigeria [18], India [2], and the UK [19], where HCWs make unjustified assessments of risks from and infection status of clients rather than properly and consistently applying standard precautions. However, there are sometimes high rates of noncompliance among HCWs and this may be

Table 4 Relationship between subscales of Health Belief Model and personal characteristics of the sampled surgeons

Variables	Categories	Mean $\pm$ SD					
		Perceived susceptibility	Perceived severity	Perceived benefits	Perceived barriers	Perceived self-efficacy	Cues to action
Sex	Male	4.0 $\pm$ 0.81	4.1 $\pm$ 0.65	3.19 $\pm$ 0.91	5.89 $\pm$ 1.2	1.21 $\pm$ 0.53	3.6 $\pm$ 1.47
	Female	4.1 $\pm$ 0.89	4.2 $\pm$ 0.77	2.8 $\pm$ 0.94	5.9 $\pm$ 1.01	1.11 $\pm$ 0.62	3.76 $\pm$ 1.38
	<i>T</i>	0.95	1.08	2.79	0.176	^a	0.72
	<i>P</i> value	0.34	0.278	0.005*	0.861	0.215	0.47
Age groups (years)	<35	4.17 $\pm$ 0.67	4.2 $\pm$ 0.65	3.2 $\pm$ 0.85	6.08 $\pm$ 0.94	1.35 $\pm$ 0.52	4.22 $\pm$ 0.99
	35–44	4.04 $\pm$ 0.89	4.2 $\pm$ 0.72	3.11 $\pm$ 0.95	5.83 $\pm$ 1.19	1.11 $\pm$ 0.59	3.59 $\pm$ 1.37
	45–54	4.12 $\pm$ 0.84	4.21 $\pm$ 0.74	2.98 $\pm$ 0.99	5.9 $\pm$ 1.11	1.17 $\pm$ 0.61	3.7 $\pm$ 1.44
	$\geq$ 55	3.53 $\pm$ 1.3	3.93 $\pm$ 1.03	3.08 $\pm$ 0.94	5.73 $\pm$ 1.3	1.0 $\pm$ 0.00	2.07 $\pm$ 2.1 ^a
	<i>F</i>	2.35	0.71	0.73	0.795	^b	10.17
	<i>P</i> value	0.072	0.55	0.53	0.49	0.028*	0.000*
Specialty	General surgery	4.01 $\pm$ 0.84	4.16 $\pm$ 0.68	3.09 $\pm$ 0.94	5.78 $\pm$ 1.05	1.19 $\pm$ 0.65	3.7 $\pm$ 1.3
	Gynecology and obstetrics	4.09 $\pm$ 0.96	4.24 $\pm$ 0.77	2.98 $\pm$ 0.97	6.17 $\pm$ 1.08	1.03 $\pm$ 0.46	3.8 $\pm$ 1.5
	Urology	4.2 $\pm$ 0.72	4.25 $\pm$ 0.71	3.21 $\pm$ 0.87	6.17 $\pm$ 1.08	1.35 $\pm$ 0.52	3.6 $\pm$ 1.6
	Orthopedic	3.94 $\pm$ 0.9	4.05 $\pm$ 0.79	3.06 $\pm$ 0.98	5.69 $\pm$ 1.29	1.19 $\pm$ 0.58	3.5 $\pm$ 1.6
	<i>F</i>	0.73	0.77	0.63	5.86 $\pm$ 1.13	^b	0.56
	<i>P</i> value	0.53	0.51	0.59	0.04*	0.011*	0.64
Job title	Residents	4.18 $\pm$ 0.78	4.3 $\pm$ 0.69	2.91 $\pm$ 0.93	6.18 $\pm$ 1.06	1.06 $\pm$ 0.50	4.3 $\pm$ 1.22
	Assistant lecturer	4.23 $\pm$ 0.68	4.3 $\pm$ 0.64	3.25 $\pm$ 0.85	6.12 $\pm$ 0.98	1.29 $\pm$ 0.53	4.2 $\pm$ 1.03
	Lecturer	4.05 $\pm$ 0.88	4.2 $\pm$ 0.96	3.07 $\pm$ 0.95	5.79 $\pm$ 1.19	1.13 $\pm$ 0.59	3.6 $\pm$ 1.42
	Assistant professor	3.94 $\pm$ 0.97	4.1 $\pm$ 0.86	2.8 $\pm$ 0.93	5.87 $\pm$ 1.17	1.21 $\pm$ 0.51	3.51 $\pm$ 1.58
	Professor	4.06 $\pm$ 0.87	4.07 $\pm$ 0.73	3.08 $\pm$ 0.94	5.59 $\pm$ 1.08	1.11 $\pm$ 0.6	2.9 $\pm$ 1.6
	<i>F</i>	1.29	0.72	1.49	1.83	^b	5.63
Years of experience	<i>P</i> value	0.276	0.58	0.203	0.124	0.306	0.000*
	<10	4.17 $\pm$ 0.75	4.2 $\pm$ 0.68	3.16 $\pm$ 0.89	5.9 $\pm$ 1.13	1.16 $\pm$ 0.56	3.51 $\pm$ 1.47
	$\geq$ 10	3.97 $\pm$ 0.94	4.1 $\pm$ 0.76	3.01 $\pm$ 0.97	5.8 $\pm$ 1.12	1.17 $\pm$ 0.57	3.89 $\pm$ 1.36
	<i>T</i>	1.92	1.128	1.4	1.208	^a	2.29
Training in infection control	<i>P</i> value	0.05*	0.26	0.16	0.23	0.83	0.022*
	No	3.9 $\pm$ 0.9	4.15 $\pm$ 0.72	2.98 $\pm$ 0.95	6.27 $\pm$ 1.11	0.78 $\pm$ 0.41	3.4 $\pm$ 1.2
	Yes	4.2 $\pm$ 0.7	4.24 $\pm$ 0.73	3.14 $\pm$ 0.9	5.63 $\pm$ 1.06	1.45 $\pm$ 0.49	4.06 $\pm$ 1.5
	<i>T</i>	2.9	1.02	1.44	4.9	^a	3.9
Exposure to NSI	<i>P</i> value	0.003*	0.307	0.152	0.000*	0.000*	0.000*
	No	3.69 $\pm$ 0.61	3.88 $\pm$ 0.46	3.02 $\pm$ 0.93	5.05 $\pm$ 0.68	1.31 $\pm$ 0.83 ^a	3.15 $\pm$ 1.15
	Yes	4.29 $\pm$ 0.92	4.38 $\pm$ 0.79	3.11 $\pm$ 0.94	6.44 $\pm$ 1.02	1.09 $\pm$ 0.28 ^a	4.02 $\pm$ 1.49
	<i>T</i>	6.07	5.97	0.84	12.78	^a	5.18
Exposure to splashes	<i>P</i> value	0.000*	0.000*	0.40	0.000*	0.000*	0.000*
	No	4.01 $\pm$ 0.78	4.13 $\pm$ 0.67	3.05 $\pm$ 0.92	5.7 $\pm$ 1.08	1.46 $\pm$ 0.50	3.65 $\pm$ 1.19
	Yes	4.1 $\pm$ 0.95	4.24 $\pm$ 0.79	3.10 $\pm$ 0.96	6.11 $\pm$ 1.15	0.84 $\pm$ 0.45 ^a	3.71 $\pm$ 1.67
	<i>T</i>	1.17	1.24	0.45	2.98	^a	0.313
	<i>P</i> value	0.25	0.218	0.65	0.003*	0.000*	0.755

NSI, needle-stick injury; ^aMann–Whitney was the test used; ^bKruskal–Wallis was the test used; *Significance difference ($P \leq 0.05$).

because of a lack of understanding among HCWs of proper use of protective barriers. Furthermore, noncompliance among medical doctors and nurses is associated with insufficient knowledge, work place safety, forgetfulness, and workload [20,21].

Among the demographic characteristics, only sex show a significant difference, where women were highly compliant with standard precautions. Of compliant surgeons, 46.7% were 35–44 years old, 42.6% worked in the general surgery department, and 55.7% had spent 10 or more years in their current occupation, which differed from a previous finding that reported a higher

level of noncompliance among older HCWs; this can be attributed to the fact that years of experience and tradition may result in resistance to changing their behavior. We found that 47% of the surgeons questioned had sustained at least one NSI in the past 3 months preceding the study. A higher prevalence of NSI was reported among HCWs of University of Alexandria Hospitals and Malaysian Teaching Hospitals (67.9 and 52.9%, respectively) [11,22]. However, in Vietnam, 38% of physicians reported sustaining a sharp stick injury in the previous 9 months [23]. Much lower finding of 1-year prevalence of NSI was obtained in a report from the UAE by Jacob *et al.* [14], in which

Table 5 Correlation between surgeons' compliance and Health Belief Model subscales

	Compliance	Knowledge	Perceived susceptibility	Perceived severity	Perceived benefits	Perceived barriers	Perceived self-efficacy	Cues to action
Compliance	1							
Knowledge	0.293**	1						
Perceived susceptibility	0.126*	0.235**	1					
Perceived severity	0.13*	0.359**	0.839**	1				
Perceived benefits	0.082	0.047	0.179**	0.163**	1			
Perceived self-efficacy	0.007	0.146*	-0.022	-0.052	0.067	1		
Perceived barriers	-0.08	0.389**	0.563**	0.587**	0.099**	-0.25**	1	
Cues to action	0.55	-0.084	0.592**	0.515**	0.067	-0.366**	0.623**	1

*Correlation is significant at the 0.05 level (two-tailed); **Correlation is significant at the 0.01 level.

19% of HCWs faced injury, but lower than a finding in northern Ethiopia [15], in which a 3-month prevalence of 17.2% was reported.

The variation in this prevalence may be related to the different categories of HCWs involved in these studies. Physicians mostly do not administer injections and hence their risk of injury exposure is lower than that of nurses. Housekeepers clean and collect waste without protective equipment and hence are at a high risk of exposure to injury. Accurate information on the risk of blood-borne transmission from occupational exposure to needle sticks is necessary and should include information on the most effective measures to control exposure and infection.

In agreement with another study among HCW in Ethiopia [24], our study detected a high level of self-reported exposure to blood and body fluids (61.3%) that was significantly different among noncompliant compared with compliant surgeons.

Training and education have been found to be of paramount importance in developing awareness among HCWs as well as improving adherence to good clinical practice [25,26]. The level of training in terms of standard precautions of the current participants (57.8%) is higher than a finding obtained in a study carried out in India [2], in which 36% HCWs had received training. Unfortunately, receiving training was not found to be protective from occupational exposures such as NSI and exposure to splashes of blood and body fluid. This will be a major challenge to infection prevention efforts. This is similar to previous reports [27–29] in which training to HCWs does not necessarily seem to lead to protection from exposures. The reason for this may be that the knowledge acquired may not necessarily translate into practice of preventive measures or that the training provided may be more theoretical than practical, and the limited sources of continuous information on standard precautions. The lack of an enabling environment to comply with standard

precautions may have also contributed toward poor compliance in these studies.

Ideally, HCWs are expected to have a good understanding of the risk of BBPs at the work place and of the preventive measures for reducing risk. Also, this study found that their knowledge was adequate as the mean score of the overall knowledge level of the surgeons was high (14.3 ± 3.5) compared with that (3.8 ± 2.3) in a previous study at first care facilities in Pakistan [10], and slightly high among compliant than noncompliant surgeons, which indicated that the consistent use of universal precautions can prevent major exposure to BBPs. Similarly, previous studies in the university hospital of the West Indies and in Thailand reported high knowledge of universal precautions among medical doctors [30]. The lower level of knowledge can be attributed to the incorporation of occupational safety, lack of investment in staff training, or limited understanding of HCWs' safe behavior in the clinical setting [31,32]. The differences in the knowledge of universal precautions among HCWs may be influenced by their different types of training. Also, there could be methodological differences in the assessment of knowledge levels in different studies. In addition, HCWs commonly overestimate their knowledge and practices of infection prevention [2,33], the magnitude of which is methodologically difficult to estimate. Providing a regular and systematic educational program may improve knowledge among HCWs.

This study partially supports the findings of an earlier study that showed that constructs of the HBM are appropriate to identify attitudes of HCWs in terms of standard precautions [34]. Barriers to compliance have been reported extensively in previous studies. Some of these include lack of time (71–74%), perceived 'low risk' of patient (50–57%), PPE interfering with care (55%), and PPE not available (19.3–41%) [35]. This study shows that all HBM subscales were correlated directly with the surgeons' compliance, except perceived barriers. However, previous studies [35] have concluded that a correlation exists between

barriers and compliance. In addition, perceptions of risk, severity, and benefits also exert an influence on compliance as reported by a previous study among operating room nurses in Australia [36]. It is clear from the data analysis and discussion that measures must be implemented to increase surgeons' compliance with standard precautions. Standard precautions are guidelines developed to protect the HCW from occupational exposure.

The commonly recommended preventive strategies for increasing conformity with standard precautions include education, awareness campaigns, use of risk-reducing devices such as single-use needles, reduction of unnecessary injections, legislative action, provision of PPE, introduction of safety guidelines and reporting mechanisms, and creating a compliance-enabling environment [37,38]. The involvement of HCWs in infection control decisions is considered important [39]. The best way to enable the staff to comply with written policies is to allow the staff to develop the policy. The more the input that staff members provide into policies on the unit, the more likely they are to comply with standard precautions [40].

Noncompliance is determined by a range of factors including lack of knowledge [17], interference with work skills [33], risk perception, conflict of interest [17,33], not wanting to offend patients [39], lack of equipment and time, uncomfortable PPE [33], inconvenience, work stress [20], and perceiving a weak organizational commitment to safety climate [20,21]. In our study, analysis of findings from the Pareto chart guided us on how to solve the 80% noncompliance problem by providing PPE to the surgeons, training courses for the surgeons, and increasing their information about MOHP guidelines. Similarly, another study carried out at first-level care facilities in Pakistan [10] reported that lack of knowledge, poor qualifications, absence of a system for prevention of BBPs and lack of training, equipment, and postexposure prophylaxis are major determinants for noncompliance. The differences in compliance between studies may be attributed to the differences in infection control policies mandated by each hospital or facility. The BBP prevention system is present in few tertiary care hospitals and none of the first-level care facilities. First-level care facilities in the private sector are completely different from hospitals because of their size, organization, manpower qualifications and training, and available finances. All these factors influence the BBP prevention program at these facilities and raise important pragmatic and ethical questions.

As this is a cross-sectional study, the limitations that come with this type of design need to be taken into

consideration when interpreting the findings. There was fewer than expected participation by surgeons as most of the time, they were busy at the clinics or operating rooms, which introduces a possibility of selection bias. Reporting of practices has been known to be affected by social desirability toward better practices.

In conclusion, this study showed that there is adequate compliance with standard precautions among surgeons in Zagazig University Hospitals, especially female surgeons. Knowledge of the mode of transmission of BBPs and precautions was high among compliant than noncompliant surgeons. All HBM subscales were correlated directly with the surgeons' compliance, except perceived barriers. Therefore, it is necessary to determine more factors that influence compliance (positively and negatively) and develop plans to eliminate those that do not allow the implementation of standard precautions and promote those that do. Our findings suggest that training of surgeons to increase their knowledge of BBPs and universal precautions could improve their use of universal precautions. Health authorities in the study area need to improve the training of HCWs and provision of infection prevention equipment. In addition, regular reporting, follow-up, and assessment of occupational exposures need to be introduced.

Acknowledgements

Conflicts of interest

None declared.

References

- 1 Resnic F, Noerdlinger MA. Occupational exposure among medical students and house staff at a New York City medical center. *Arch Intern Med* 1995; 155:75–80.
- 2 Kermode M, Jolley D, Langkham B, Thomas MS, Holmes W, Gifford SM. Compliance with universal/standard precautions among health care workers in rural north India. *Am J Infect Control* 2005; 33:27–33.
- 3 Tarantola A, Koumare A, Rachline A, Sow PS, Diallo MB, Doumbia S, *et al.* A descriptive, retrospective study of 567 accidental blood exposures in healthcare workers in three West African countries. *J Hosp Infect* 2005; 60:276–282.
- 4 Miceli M, Herrera F, Temporiti E, Li D, Vila A, Bonvehí P. Adherence to an occupational blood borne pathogens exposure management program among healthcare workers and other groups at risk in Argentina. *Braz J Infect Dis* 2005; 9:454–458.
- 5 CDC. Universal precautions for prevention of transmission of HIV and other blood-borne infections. Available at: <http://www.cdc.gov/>. [Last accessed on 23 Mar 2013].
- 6 Hazavehei SM, Taghdisi MH, Saidi M. Application of the Health Belief Model for osteoporosis prevention among middle school girl students, Garmsar, Iran. *Educ Health (Abingdon)* 2007; 20:23.
- 7 Daddario D. A review of the use of the health belief model for weight management. *Medsurg Nurs* 2007; 16:363–366.
- 8 Roden J. Revisiting the Health Belief Model: Nurses applying it to young families and their health promotion needs. *Nurs Health Sci* 2004; 6:1–10.
- 9 Tabak N, Shiaabana AM, Shasha S. The health beliefs of hospital staff and the reporting of needlestick injury. *J Clin Nurs* 2006; 15:1228–1239.

- 10 Janjua NZ, Razaq M, Chandir S, Rozi S, Mahmood B. Poor knowledge — predictor of nonadherence to universal precautions for blood borne pathogens at first level care facilities in Pakistan. *BMC Infect Dis* 2007; 24:7–81.
- 11 Hanafi M, Mohamed A, Kassem M, Shawki M. Needlestick injuries among health care workers of University of Alexandria hospitals. *East Mediterr Health J* 2011; 17:26–35.
- 12 Glanz K, Marcus Lewis F, Rimer BK. *Theory at a glance: A guide for health promotion practice*. 2nd ed. San Francisco, CA: National Cancer Institute, National Institute of Health; 2005.
- 13 Centers for Disease Control. Perspective in disease prevention and health promotion update. Standard precautions for prevention of transmission of HIV, HBV and other blood-borne pathogens in health care settings. *Morb Mortal Wkly Rep* 1988; 37:42.
- 14 Jacob A, Newson-Smith M, Murphy E, Steiner M, Dick F. Sharps injuries among health care workers in the United Arab Emirates. *Occup Med* 2010; 60:394–397.
- 15 Gessesew A, Kahsu A. Occupational exposure of health workers to blood and body fluids in six hospitals of Tigray region (August 1–30, 2006): magnitude and management. *Ethiop Med J* 2009; 47:213–219.
- 16 Henry K, Campbell S, Collier P, Williams CO. Compliance with standard precautions and needle handling and disposal practices among emergency department staff at two teaching hospitals. *Am J Infect Control* 1994; 22:129–137.
- 17 Michalsen A, Delclos GL, Felknor SA, Davidson AL, Johnson PC, Vesley D, *et al.* Compliance with universal precautions among physicians. *J Occup Environ Med* 1997; 39:130–137.
- 18 Sadoh WE, Fawole AO, Sado AE, Oladimeji AO, Sotiloye OS. Practice of universal precautions among health care workers. *J Natl Med Assoc* 2006; 98:722–726.
- 19 Cutter J, Jordan S. Uptake of guidelines to avoid and report exposure to blood and body fluids. *J Adv Nurs* 2003; 46:441–452.
- 20 Evanoff B, Kim L, Mutha S, Jeff D, Haase C, Anderek D, Fraser V, *et al.* Compliance with universal precautions among emergency department personnel caring for trauma patients. *Ann Emerg Med* 1999; 33:160–165.
- 21 Gershon RR, Karkashian CD, Grosch JW, Murphy LR, Escamilla-Cejudo A, Flanagan PA, *et al.* Hospital safety climate and its relationship with safe work practices and workplace exposure incidents. *Am J Infect Control* 2000; 28:211–221.
- 22 Ng YW, Hassim IN. NSI among medical personnel in Accident and Emergency Department of two teaching hospitals. *Med J Malaysia* 2007; 62:9–12.
- 23 Report on the implementation of the APW of a pilot survey on unsafe injection practice in Vietnam. Hanoi, Vietnam: Ministry of Health, Department of Therapy; 2003. 30.
- 24 Reda A, Fisseha S, Mengistie B, Vandeweerd J-M. Standard precautions: Occupational exposure and behavior of health care workers in Ethiopia. *PLoS One* 2010; 5:e14420.
- 25 Wang H, Fennie K, He G, Burgess J, Williams AB. A training programme for prevention of occupational exposure to blood-borne pathogens: Impact on knowledge, behaviour and incidence of needle stick injuries among student nurses in Changsha, People's Republic of China. *J Adv Nurs* 2003; 41:187–194.
- 26 Heinrich J. Occupational Safety: Selected cost and benefit implications of needle stick prevention devices for hospitals (letter to House of Representatives from US General Accounting Office); 2000.
- 27 Tadesse M, Tadesse T. Epidemiology of needlestick injuries among health-care workers in Awassa City, Southern Ethiopia. *Trop Doct* 2009; 40:111–113.
- 28 Parmeggiani C, Abbate R, Marinelli P, Angelilo IF. Health care workers and health care-associated infections: Knowledge, attitudes, and behavior in emergency departments in Italy. *BMC Infect Dis* 2010; 10:35.
- 29 Reda AA, Vandeweerd J-M, Syre TR, Egata G. HIV/AIDS and exposure of health care workers to body fluids in Ethiopia: Attitudes toward universal precautions. *J Hosp Infect* 2009; 71:163–169.
- 30 Danchaivijitr S, Tantiwatanapaiboon Y, Chokloikaew S, Tangtrakool T, Suttisanon L, Chitreechuer L, *et al.* Universal precautions: Knowledge, compliance and attitudes of doctors and nurses in Thailand. *J Med Assoc Thai* 1995; 78:S112–S117.
- 31 Twitchell K. Bloodborne pathogens. What you need to know — Part I. *AAOHN J* 2003; 51:46–47.
- 32 Godin G, Naccache H, Morel S, Ebacher MF. Determinants of nurses' adherence to universal precautions for venipunctures. *Am J Infect Control* 2000; 28:359–364.
- 33 Henry K, Campbell S, Maki M. A comparison of observed and self-reported compliance with universal precautions among emergency department personnel at a Minnesota public teaching hospital: Implications for assessing infection control programs. *Ann Emerg Med* 1992; 21:940–946.
- 34 Grady MM, Shortridge LA, Davis LS, Klinger CS. Occupational exposure to blood-borne diseases and universal precautions: Measurement of health care workers' self-reported attitudes. *AAOHN J* 1993; 41:533–540.
- 35 Nelsing S, Nielsen TL, Nielsen JO. Noncompliance with universal precautions and the associated risk of mucocutaneous blood exposure among Danish physicians. *Infect Control Hosp Epidemiol* 1997; 18:692–698.
- 36 Osborne S. Influences on compliance with standard precautions among operating room nurses. *Am J Infect Control* 2003; 31:415–423.
- 37 Hutin Y, Hauri A, Chiarello L, Catlin M, Stilwell B, *et al.* Best infection control practices for intradermal, subcutaneous, and intramuscular needle injections. *Bull World Health Organ* 2003; 81:491–500.
- 38 Fingerhut M, Driscoll T, Nelson DI, Concha-Barrietos M, Punnett L, *et al.* Contribution of occupational risk factors to the global burden of disease a summary of findings. *SJWEH Suppl* 2005; 1:58–61.
- 39 White MC, Lynch P. Blood contacts in the operating room after hospital-specific data analysis and action. *Am J Infect Control* 1997; 25:209–214.
- 40 Rana JS, Khan AR, Halem AA, Khan FN, Gul A, Sarwari AR. Hepatitis C: knowledge, attitudes and practices among orthopedic trainee surgeons in Pakistan. *Ann Saudi Med* 2000; 20:477–479.