



# Analysis of Work-related Injuries among Health Care Workers in Armed Forces Hospital Southern Region, Kingdom of Saudi Arabia

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## Authors' contributions

This work was carried out in collaboration between both authors. Both authors read and approved the final manuscript.

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## ABSTRACT

**Introduction:** Safety of healthcare workers (HCWs) is essential for patients safety. Despite of this fact, HCWs are at high risk of work-related injuries (WRI). Those injuries include falls, musculoskeletal disorders, needle stick injuries (NSIs) and workplace violence. These injuries have a negative impact on HCWs and reduces the quality of care. It is, therefore, important to analyze the occurrence of WRIs aiming the design of better targeted interventions to improve safety environment and work conditions in hospitals, which in turn, can improve the quality and outcomes of patient care.

**Methods:** A retrospective study collected data about WRI reports available in the Armed Forces Hospital Southern Region (AFHSR). Injuries were NSIs that occurred during the period from January 2010 to June 2015 and workplace violence during the period from March 2014 to June 2015.

**Results:** Total NSIs were 338 with a peak incidence of 85 (4.39%) during 2010, while the lowest incidence occurred during 2015 (n= 31, 1.12%). Regarding to workplace violence, 211 incidents

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were reported over the period of two years, and there was decreasing from 125 cases (4.73%) in 2014 to 86 cases (3.11%) in 2015.

**Discussion:** The analysis showed that nurses had the highest rate of NSIs and workplace violence as compared to other HCWs. The highest rate of NSIs took place in dental, family and community medicine clinics which are usually crowded and had more activities, but emergency room and other clinics had the highest frequency of workplace violence.

**Conclusion:** Needle stick injuries and workplace violence represent a major occupational challenge to HCWs in the hospital. To prevent those types of WRIs, there is a need for a system of environmental safety, continuous education, skills development, and infection control surveillance that is based on best available evidence of quality and safety best practices.

*Keywords: Occupational; injuries; health care workers; hospital worker safety; work environment.*

## 1. INTRODUCTION

Healthcare workers worldwide face numerous threats to their personal health while serving the needs of others. Research and studies related to hospital employee injuries addressed a number of issues. There are various types of injuries an employee may incur on the grounds of the hospital. These include introduction into the bloodstream of pathogens, respiratory infections, musculoskeletal injuries, and mental illness from stress. The ways injuries may occur include falls, moving patients, malfunction of equipment, improper use of equipment, needlestick injuries and violence perpetrated by other employees or outsiders. The healthcare professionals encountering these injuries place their professional careers and sometimes their lives in jeopardy [1].

As defined by National Institute of Occupational Safety and Health (NIOSH), "the needlestick injuries are wounds that accidentally puncture the skin caused by needles or sharp instrument". Also, NIOSH defined "the workplace violence as violent acts directed toward staff at work such as physical assault, verbal harassment or threatening behavior in work setting" [2].

It has become evident that healthcare workers are exposed to threats to personal health in the performance of their duties. In a review of research, it is evident that there are some areas of a facility more conducive to injuries in hospitals and clinics than others [3].

Many factors were found to be associated with work-related injuries in hospitals' environment. There are influences on compliance based on the perception of leadership by staff [4]. In addition, there are indications that insufficient policies and procedures are at least partially responsible for employee injury. After all factors

are considered, the favorable outcome is always an injury-free environment by promotion of best practices and with employee awareness of the importance of prevention.

Another important concept is that the procedures and policies in medical facilities are in a constant state of flux because of the innovations and medical technological advances.

Interested parties investigate the literature and new releases of the latest information to evaluate if it is appropriate for the hospital, for example, the new type of syringes with a retractable needle. Recapping is a result of countless nurses suffering from needle stick injuries attempting to replace the cap on the needle after use or injecting a patient.

There were some articles published related to this issue that discussed the relationships between the incidence of worker injuries, perceptions of organizational policies, and the social support system in hospital facilities [5]. When workers, particularly registered nurses, felt strong support from social systems and approval of organizational policies, injuries in the workplace were reportedly lower. In the surveys, injury rates were higher for assistants, probably due to their job responsibilities for transporting and repositioning patients more often than the nurses. These injuries were primarily musculoskeletal sprains and strains.

Another study dealt with the rates of percutaneous injuries in a Saudi Arabia tertiary care hospital, but the authors were more concerned with the impact of educational policies promoted by the hospital [6]. Data obtained in the periods before (1997-2000) and after the implementation (2004-2008) of an educative strategy showed the effectiveness of the program evidenced by rates of incidents significantly lower in the final period.

Kim et al. [7] preferred to address musculoskeletal disorders (MSDs) in the United States. The objective was to determine the effect of patient handling on hospital employees complaining of MSDs. The sample was taken from employees in a large healthcare system. The method used was evaluation of Workmans' Compensation Claims from 2003 to 2009 from healthcare employees. The result of MSDs injuries was highest among nurses.

A cross-sectional study by Virtanen et al. involved establishing a baseline through surveys to follow up 8003 employee records in 21 Finnish hospitals. The objective was to look for a correlation between various parts of the hospital for risk factors. The results showed that workers in the psychiatric wards rated highest, probably because of the working conditions [8].

In Southern Ethiopia, a study was carried out to investigate the incidence of needle stick injuries and the risk factors associated with them in Hawassa City. Results indicated that lack of personal safety and protective equipment resulted in an incidence rate of 35.8%, placing workers at high risk for infection. The issue of false reporting was addressed as a limitation [9].

In a survey of health care workers, McCaughey and others investigated the attitudes of workers when they perceive their environment to be unsafe. The finding was that when a workplace was considered unsafe more accidents occurred and when more accidents occurred, the perception of the employees was that the workplace was unsafe [10].

Effective management and reporting of injuries include staff documentation, documentation by the injured employee, contact by legal representatives, contact by outside medical facilities, and patient complaints.

Locally, a retrospective study by Memish, investigated different risk factors that are associated with the needle stick injury among the health care workers in a Saudi Arabia's tertiary care hospital. In 2009, the total number of needle stick injuries were 477 recorded with peak incidence of 13.84 percent. The results allowed to consider the injuries from needle stick and sharp object in the tertiary care hospital a serious occupational issue among the health care workers. It was also affirmed that there is need of preventive actions directed to several working lines, which were assumed to include proper

engineering control measures, immunization, and provision of efficient education to all health care workers [11].

In order to understand more about the type of injuries incurred by hospital staff and the factors that may increase the likelihood of injury, this study is an attempt to address this issue in the local context of a military hospital in the southern region of Saudi Arabia.

The current study aims basically to analyze the rates of work-related injuries among health care workers in Armed Forces Hospital Southern Region. This can be the first step toward the development of targeted interventions to promote safer hospital work environment, which in turn, can improve the quality and outcomes of patient care.

The study objectives were to assess the frequency and time trend of occupational injuries among health care workers and to analyze the distribution of injuries across hospital departments, job categories and nature of the injury.

The main research hypothesis is: The work-related injuries at the hospital are associated to the type of occupation, gender, causes, departments and the types of incidents.

## **2. METHODOLOGY**

### **2.1 Study Design**

Retrospective study of data gathered from January 2010 through June 2015 drawing all the information from the entire hospital staff. Information was collected about the demographic characteristics that had an impact on the incidence of the injuries, included age, gender, type of job, location, types and rate of injury.

### **2.2 Study Setting**

The study has been conducted in the Armed Forces Hospital Southern Region, which is considered as one of the largest Armed Forces hospitals in Saudi Arabia. It is noted that at the end of this study in June 2015 the total bed capacity of the hospital were 506 beds, and the total number of staff were 2766. Out of this number, a total of 2603 employees were under a contract while a significant number of 163

employees were the medical directorate staff (MSD).

### 2.3 Study Subject

The study sample included all employees in Armed Forces Hospital, who reported a work-related injury during the time period of study. The inclusion criteria consisted of being full-time clinical and non-clinical employees in Armed Forces Hospital Southern Region and to be working approximately 40 hours or more per week.

### 2.4 Sample Size

The study population that has been considered in this study was comprised of all hospital staff. Evidently, the study sample adopted for the study included all employees at the hospital who reported a work-related injury during the time period of study. No sample size calculation was needed because we did not select a subset of the total injuries, but we have included all available injuries represented by needlestick injuries (n=338), and workplace violence (n=211). Source of data included health clinic files, quality department system, and infection control system.

### 2.5 Data Collection Methods, Instruments Used, Measurements

Data collection was exclusively from a compilation of employee records concerning incidence reports on reported injuries. Data were extracted about incident reports from the employee health clinic, infection control and quality departments. A standard Excel sheet was used to enter the data into the appropriate variable code.

Using the official data from the hospital records on the injuries incurred was the main focus of this study.

### 2.6 Data Management and Analysis

All collected data were tabulated and systematically analyzed using Microsoft Excel and (SPSS) Statistical Package for the Social Sciences (Version 20) in developing statistical graphs and charts for interpretation. We performed univariate, descriptive analysis, such as frequencies and percentages, to describe the

whole data. A trend line was created for all the data over time. Risk analysis was conducted to inspect the distribution of incidents, according to occupation, location, cause and other variables.

The data collected were captured daily and the analysis was made on a monthly basis.

### 2.7 Ethical Consideration

Ethical clearance for accessing health worker records was obtained from the ethical committee of King Abdullah International Medical Research Center (KAIMRC) and Armed Forces Hospital Southern Region in Saudi Arabia. The principal investigators were responsible for safeguarding the confidentiality of the study.

## 3. RESULTS

### 3.1 Needle Stick Injuries

The study findings (Table 1) show that the highest incidence rate of needlestick injuries was among the 31 to 39 years age group (n= 162, 47.9%) compared to the older employees (49-55 years), which had the lowest incidence (n= 20, 5.9%). Females had the higher number of needlestick injuries (n=206, 60.9%) compared to males (n= 132, 39.1%). Among all hospital employees, nurses had the highest rate of NSI (n= 148, 43.8%) and next highest were physicians (n= 94, 27.8%).

The highest rate of needlestick injury, by departments, were dental (n= 56, 16.6%), and family and community medicine (n= 42, 12.4%) While the lowest rate was in the diabetic center (n= 10, 3.0%).

The most common causes of NSI occurred during recapping used needles (n= 100, 29.6%) followed by preparing medication (n= 57, 16.9%) and item left on sharp containers (n= 48, 14.2%) while suturing was the lowest cause of NSI (n= 13, 3.8%).

### 3.2 Workplace Violence

On the other hand, workplace violence incidents (Table 1) were highest among the 31 to 39 years age group (n= 126, 59.7%), compared to the older employees (49-55 years), which had the lowest incidence (n= 4, 1.9%).

**Table 1. Description of work-related injuries among health care workers in armed forces hospital Southern Region. Needlestick injuries (n= 338, Jan 2010 – June 2015) and workplace violence (n= 211, March 2014 – June 2015)**

<b>Characteristic/Variable</b>	<b>Frequency (N)</b>	<b>Percent (%)</b>
<b>1. Needlestick Injuries (NSI)</b>		
<b>Age</b>		
22-30	98	29.0
31-39	162	47.9
40-48	58	17.2
49-55	20	5.9
Total	338	100.0
<b>Sex</b>		
Female	206	60.9
Male	132	39.1
Total	338	100.0
<b>Job</b>		
Nurses	148	43.8
Physicians	94	27.8
Housekeepers	54	16.0
Other specialists	31	9.2
Technicians	11	3.3
Total	338	100.0
<b>Departments</b>		
Dental	56	16.6
Family & Community	42	12.4
Medicine		
Surgical	30	8.9
OB/GYN	28	8.3
Radiology	28	8.3
Critical care	28	8.3
Medical	26	7.7
Out patient clinics	15	4.4
ER	14	4.1
Operating room	14	4.1
Lab	13	3.8
Renal transplant	12	3.6
Hemodialysis	11	3.3
Housekeeping	11	3.3
Diabetic center	10	3.0
Total	338	100.0
<b>Causes</b>		
Recapping used needle	100	29.6
Preparing medication	57	16.9
Item left on sharp container	48	14.2
Blood extraction	41	12.1
During injection	28	8.3
Preparing instrument	26	7.7
During clean up	25	7.4
Suturing	13	3.8
Total	338	100.0
<b>2. Workplace violence</b>		
<b>Age</b>		
22-30	48	22.7
31-39	126	59.7
40-48	33	15.6
49-55	4	1.9

Characteristic/Variable	Frequency (N)	Percent (%)
Total	211	100.0
<b>Sex</b>		
Female	130	61.6
Male	81	38.4
Total	211	100.0
<b>Job</b>		
Nurses	133	63.0
Technicians physicians	39	18.5
Other specialists	33	15.6
	6	2.8
Total	211	100.0
<b>Departments</b>		
ER	36	17.1
Outpatient clinics	36	17.1
Critical care	27	12.8
Surgical	23	10.9
Medical	20	9.5
Operating room	18	8.5
OB/GYN	15	7.1
Family & community medicine	13	6.2
Pediatric	11	5.2
Hemodialysis	6	2.8
Dental	6	2.8
Total	211	100.0
<b>Types</b>		
Verbal harassments	97	47.0
Shout	84	39.8
Physical violence	30	14.2
Total	211	100.0
<b>Parties</b>		
Patient family/Nurse	51	24.2
Patient/Nurse	63	29.9
Two nurses	42	19.9
Patient/Physician	19	9.0
Two physicians	15	7.1
Pt family/Physician	13	6.2
Physician /Nurse	8	3.8
Total	211	100.0

Females were more affected by workplace violence (n= 130, 61.6%) than males (n= 81, 38.4%).

Among all hospital employees, nurses were most affected by workplace violence (n= 133, 63.0%) and next were technicians (n= 39, 18.5%).

The most affected departments by workplace violence were Emergency Room (ER) and outpatient clinics with both having 36 occurrences (17.1%), then critical care unit (n= 27, 12.8%) while the least affected were dental and hemodialysis with both having six occurrences (2.8%).

The highest rate of workplace violence types were verbal harassment (n= 97, 46.0%) followed

by shout (n= 84, 39.8%) while the physical violence had the lowest rate (n= 30, 14.2%).

Available data showed that most frequent violence cases were carried out by patients against nurses (n= 63, 29.9%), patient family against nurse (n= 51, 24.2%), and violence between two nurses (n= 42, 19.9%) while the lowest rate of violence involved physician against nurse (n= 8, 3.8%).

### 3.3 Time Trend of WRI's

The calculation of the rate of injuries to create the trend line in this study depends on the total number of injuries in each year divided by the total number of staff in each year multiplied by 100.

Fig. 1 shows that overall trend line of needlestick injury incidents decreased steadily from 2010 (n= 85, 4.39%) to 2015 (n= 31,1.12%). Only in 2013, there was a slight increase in the rate of injury (63, 2.53%).

The Bar chart (Fig. 2) shows that workplace violence incidents decreased from 125 cases (4.73%) in 2014 to 86 cases (3.11%) in 2015. It should be noted that 2015 reflects data reported up until the month of June. Therefore, the incidence rate may have increased by the end of 2015.

#### 4. DISCUSSION

##### 4.1 Trend Over Time

The analysis of work-related injuries during the study period, January 2010 to June 2015,

showed that there were 338 reported needle stick injuries. The peak number of needle sticks occurred in the first year of study, 2010, and was also the highest rate of reports per population of employees. Generally, this frequency decreased in each year, both by the number of incidents and by reports per employee. The decreasing trend suggests that the hospital efforts in occupational safety and infection control may have played a role in preventing needlestick injuries.

##### 4.2 Needle Stick Injuries

The current study showed that older employees had the lowest rates of NSI. This may suggest that the staff with more work experience have a lower incidence of NSI, compared to those with less work experience.

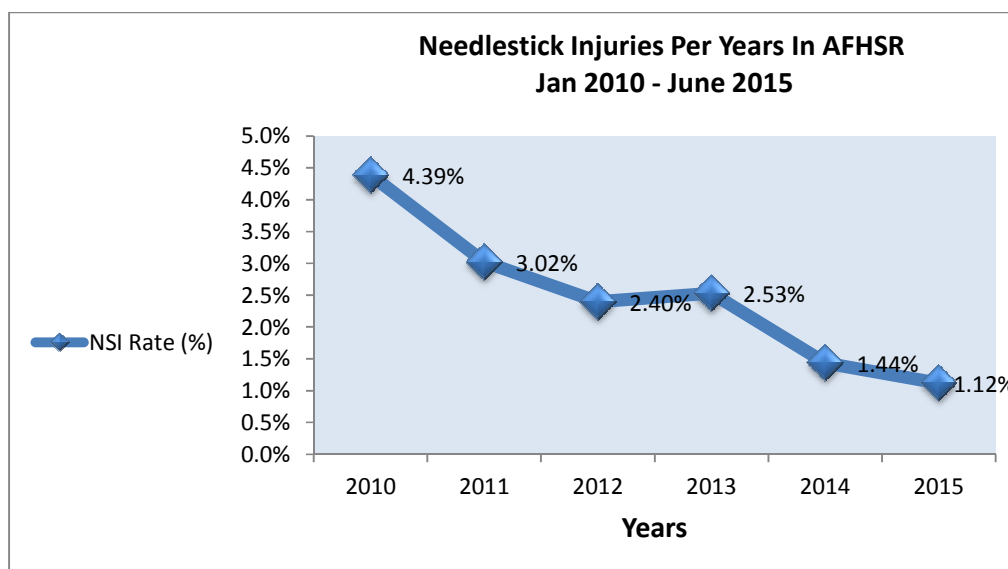


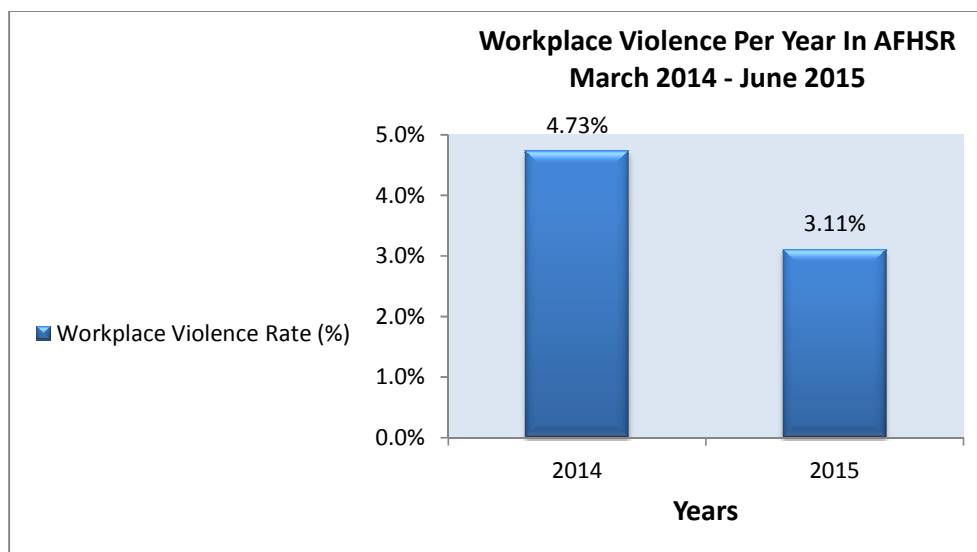
Fig. 1. Needlestick injuries per year (Jan 210 – June 2015)

Table 2. Needlestick Injuries rate (%) per year in the hospital

Years	Frequency (N)	Percent (%)	Total no of employees rate (%)
<b>1. Needlestick Injuries (Jan 2010 – June 2015)</b>			
2010	85	25.1	1937 4.39
2011	64	18.9	2118 3.02
2012	57	16.9	2379 2.40
2013	63	18.6	2490 2.53
2014	38	11.2	2641 1.44
2015	31	9.2	2766 1.12
Total	338	100.0	14331 2.36

**Table 3. Workplace violence (%) per year in the hospital**

Years	Frequency (N)	Percent (%)	Total no of employees rate (%)	
<b>2. Workplace Violence (March 2014 – June 2015)</b>				
2014				
2015	125	59.2	2641	4.73
Total	86	40.8	2766	3.11
	211	100.0	5407	3.90



**Fig. 2. Workplace violence per year (Jan 210 – June 2015)**

The data also showed that nurses had the highest number of NSIs. This pattern may be due to nurses being responsible, in the most part, for collecting blood specimens and being more exposed to sharps than other staff. This also was consistent with findings of many studies published internationally and locally [12].

It is also important to assess where the injuries occur most of the time. The most common locations for NSI took place in dental, family and community medicine clinics. This is due to the nature of the procedure, equipment design and improper disposal. This was not the case in other local studies where they found that locations of the hospital with the highest number of NSI were ER, operating room and intensive care units [13]. The current study showed that NSIs were caused primarily during recapping of used needles, preparing medication, and item left on sharp containers. This is due to unsafe equipment or malpractice in handling sharp instruments and staff shortage. According to the Centers for Disease Control and Prevention (CDC), almost all NSIs resulted during these tasks.

### 4.3 Workplace Violence

The study showed that there were 211 reported cases of workplace violence over the previous two years. Just as with NSI, the older employees had the lowest workplace violence. This may suggest that they accumulated communication and relationship skills that mitigated or prevented potential workplace violence before it occurred.

In this study, nurses had the highest incidence of workplace violence. This finding is consistent with other studies [14]. This pattern may be a result of nurses greater workload and the direct and frequent contact with patients and their families compared to other hospital staff.

The study data indicated that areas in the hospital which were crowded and had more activities, ER and clinics, had the highest frequency of workplace violence. The highest rate types were verbal harassment, such as offensive or abusive language, gestures,



threatening behavior. Disorderly conduct was second highest, which included shouting due to work stress. The third was physical violence, which included beating the employees, physical aggressive acts against another person due to long waits for service. Risky conditions that may contribute to workplace violence include uncomfortable waiting rooms, overcrowded, lack of staff training, inadequate security, and lack of policies for managing and preventing crises with potentially volatile patients. To prevent this issues, the hospital provides safe working environment for health care workers through continuous education and training. It also enhances safety by providing more security officers in the crowded areas. The supervisor or manager takes action during the violence in the workplace and they will allow the violent patients to write incidence report about the incident and send the case to the security officer and to the quality and patient safety department to take the necessary action in each case.

## 5. CONCLUSION

Needlestick injuries and workplace violence represent a major occupational challenge to health care workers and hospitals. Nurses, in particular, experience the highest rate of needlestick injuries and workplace violence. Needlestick injuries occurred more often in dental department and family and community medicine while workplace violence was more frequent in the ER and outpatient clinics.

Therefore, it is imperative that hospitals develop a system of injury surveillance and control to detect and prevent occupational hazards. This can be done by using of many strategies such as acquiring safer equipments, adopting evidence-based guidelines for work safety, and education and training workshops for hospital employees. This system of safety requires the integration of infection control services and continuous quality improvement efforts to achieve safe and healthy work conditions. Hospitals should adopt a vision of safe and healthy staff for better patient care.

## 6. RECOMMENDATIONS

Based on the findings of this study, we propose the following recommendations:

1. Needlestick Injuries
  - a. Improve safety culture among healthcare workers through continuous education and training.

- b. Maintain a safe working environment by providing safe equipment e.g. retractable needles, etc.
- c. Avoid recapping the needles.

## 2. Workplace Violence

- a. Provide social workers 24 hours covering the crowded areas such as ER and clinics for assessing and managing the psychosocial needs for the patients and their family.
- b. Staff training and competency assessment of:

\* Dealing with difficult patients

\* Communication skills

## 7. STUDY LIMITATIONS

This study includes one hospital system only, so the results may not be generalizable to other hospitals. We recommend that future studies address these limitations by including multiple hospitals and adopting a case-control study design. Nevertheless, the current study provides some important insights about baseline data of work-related injuries, upon which future studies can be built.

## CONSENT

It is not applicable.

## COMPETING INTERESTS

Authors have declared that no competing interests exist.

## REFERENCES

1. Thomas NI, Brown ND, Hodges LC, Gandy J, Lawson L, Lord JE, Williams DK. Risk profiles for four types of work-related injury among hospital employees a case-control study. *AAOHN Journal*. 2006;54(2):61-8.
2. Kamen TG, Lowe SN, Piligian JS, Freund A. Controlling health hazards to hospital workers. *New Solutions*. 2013;23:1-67.
3. Reiling John, Ronda G. Hughes, Mike R. Murphy. The impact of facility design on patient safety. *Patient safety and quality: An evidence-based handbook for nurses*, edited by Hughes RG. Rockville, MD/United States: Agency for Healthcare Research and Quality; 2013.

4. Hersey P, Blanchard KH, Natemeyer WE. Situational leadership, perception and the impact of power. *Group & Organization Management*. 1979;4(4):418-28.
5. Tveito TH, Sembajwe G, Boden LI, Dennerlein JT, Wagner GR, Kenwood C, Stoddard AM, Reme SE, Hopcia K, Hashimoto D, Shaw WS. Impact of organizational policies and practices on workplace injuries in a hospital setting. *Journal of Occupational and Environmental Medicine*. 2014;56(8):802-8.
6. El Beltagy K, El-Saed A, Sallah M, Balkhy HH. Impact of infection control educational activities on rates and frequencies of percutaneous injuries (PIs) at a Tertiary Care Hospital in Saudi Arabia. *Journal of Infection and Public Health*. 2012;5(4):297-303.
7. Kim H, Dropkin J, Spaeth K, Smith F, Moline J. Patient handling and musculoskeletal disorders among hospital workers: Analysis of 7 years of institutional workers' compensation claims data. *American Journal of Industrial Medicine*. 2012;55(8):683-90.
8. Virtanen M, Vahtera J, Batty GD, Tuisku K, Oksanen T, Elovainio M, Ahola K, Pentti J, Salo P, Vartti AM, Kivimäki M. Health risk behaviors and morbidity among hospital staff-comparison across hospital ward medical specialties in a study of 21 Finnish hospitals. *Scandinavian Journal of Work, Environment & Health*. 2012;228-37.
9. Mengesha HB, Yirsaw BD. Occupational risk factors associated with needle-stick injury among healthcare workers in Hawassa City, Southern Ethiopia. *Occupational Medicine & Health Affairs*. 2014;2014.
10. McCaughey D, DelliFraine JL, McGhan G, Bruning NS. The negative effects of workplace injury and illness on workplace safety climate perceptions and health care worker outcomes. *Safety Science*. 2013;51(1):138-47.
11. Memish ZA, Assiri AM, Eldalatony MM, Hathout HM, Alzoman H, Undaya M. Risk analysis of needle stick and sharp object injuries among health care workers in a Tertiary Care Hospital (Saudi Arabia). *Journal of Epidemiology and Global Health*. 2013;3(3):123-9.
12. Sabbah I, Sabbah H, Sabbah S, Akoum H, Droubi N. Occupational exposures to blood and body fluids (BBF): Assessment of knowledge, attitude and practice among health care workers in general hospitals in Lebanon. *Health*. 2013;5(01):70.
13. OSHA Occupational Safety and Health Administration. Facts about hospital worker safety. Caring for our Caregiver, 1-27. U.S. Department of Labor; 2013. Available:[www.osha.gov](http://www.osha.gov) • (800) 321-OSHA (6742)
14. Smith P, Bielecky A, Koehoorn M, Beaton D, Ibrahim S, Mustard C, Saunders R, Scott-Marshall H. Are age-related differences in the consequence of work injury greater when occupational physical demands are high? *American Journal of Industrial Medicine*. 2014;57(4):438-44.

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