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Khalid Alanazi Date

The Incidence of Needle Stick and Sharp Injuries among Healthcare Workers in Saudi Arabia, 2012-2014

By

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By

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MD, Jordan University of Sciences and Technology (2007)

Thesis Committee Chair: Ghada N. Farhat, PhD, MPH

An abstract of
A thesis submitted to the Faculty of the
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The Incidence of Needle Stick and Sharp Injuries among Healthcare Workers in Saudi Arabia, 2012-2014

By Khalid Alanazi

Abstract

Background

Needle Stick and Sharp Injuries (NSSIs) affect over 3.5 million HCWs per year globally, and 90 % of these incidents occur in underdeveloped countries, due to lack of education on safety procedures and time and resource constraints. In Saudi Arabia, no comprehensive assessment of the descriptive epidemiology of NSSIs has been performed. This restrictions hinder the implementation of safety programs to prevent NSSIs.

Materials and Methods

We conducted a secondary data analysis from 2012 to 2014 using the Exposure Prevention Information Network (EPINet™) database of the Saudi Ministry of Health (MOH) to determine the incidence of NSSIs in healthcare facilities in Saudi Arabia and its distribution according to different factors. The dataset contained annual information on departments where the incident took place, HCW job categories, bodily location of injury, type of sharps item, purpose of the sharps item and time of injury.

Results

A total of 395 cases of NSSIs occurred in 2012, 419 in 2013 and 547 in 2014. The highest incidence rate (IR per 1000 hospital beds) was recorded in Najran (5.63) followed by Tabouk (3.06). Regarding job category, nurses had the highest IR of needle-stick injuries across all years, while Allied Health Professionals had the lowest rates. The highest proportion of incidents occurred in patient room/wards (N=510), and the most common corporeal injury location was the index finger of the left hand (N=162).

Conclusion

We observed difference in NSSIs by HCWs job categories, geographic regions, locations and severity of injury. We suggest multi-pronged, interventional approach based on periodic training and education of HCWs as well as PI surveillance that pinpoints high-risk areas and job categories of healthcare facilities.

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Chapter 1 – Introduction

Overview on Needle Stick and Sharp Injuries in Healthcare Workers

Worldwide, there are approximately 35 million healthcare workers (HCWs) representing 12% of the working population. There is a misconception that the healthcare environment is safe and devoid of hazards; however, potential chemical and blood-borne exposures pose a serious risk to HCWs. [21] HCWs encounter occupational hazards in their workplace, and among the most serious are needle stick and percutaneous injuries (PIs).

Needle stick and sharp injuries (NSSIs) are defined as injuries caused by sharps (including any type of needle, intravenous cannula, surgical instrument, or scalpel) that may result in exposure of the HCW to blood or other body fluids. Sharps can include any material, such as glass, whether it was used or not. [33]

The World Health Organization (WHO) estimates that 2 million NSSIs occur among HCWs annually. These injuries can result in infections with hepatitis B virus (HBV), hepatitis C virus (HCV) and human immuno-deficiency virus (HIV). [6] According to the WHO, 40% of hepatitis B and C infections and 2.5% of HIV infections among HCWs are attributable to occupational exposures. [40]

In 2002, an estimated 16,000 cases of HCV, 66,000 cases of HBV and 1,000 cases of HIV were contracted as a direct result of NSSIs among HCWs worldwide. [17]

In the United States (U.S.), NSSIs cause HCWs to suffer from significant anxiety, fear and emotional distress and the economic cost of treating and managing these injuries is substantial (19). The Centers for Disease Control and Prevention (CDC) estimates the NSSIs in average around 385,000 events yearly in U.S. hospital settings (19). In Pakistan, the magnitude of NSSIs reported in one study was high; 54% of workers observed had experienced at least one incident over the past six months. More education about NSSIs was associated with a lower prevalence rate. [17] In Turkey, a retrospective study was done to determine the risk factors for percutaneous and muco-cutaneous exposures in HCWs showed that HCWs who have intensive workloads such as those working in emergency departments or intensive care units had a higher risk of occupational exposures. The study concluded that having heavy workloads and hours increases the risk of percutaneous and muco-cutaneous exposures. For the very same reason, it was also found that the most common groups at risk of occupational exposures are nurses and cleaning staff. Increasing work experience has reduced the frequency of occupational exposures. [37]

The WHO Eastern Mediterranean Regional Office (which includes Saudi Arabia), in 2000 estimated that 18,000 HCWs may be exposed to at least one injury by sharp objects contaminated with hepatitis C virus, 43,000 to HBV, and 170 to HIV. [19] In the same region, the number of infections among HCWs due to sharps injuries was 310 for HCV, 2,300 for HBV, and 1 for HIV in 2000. [28]

Problem Statement

In Saudi Arabia, a number of published studies have estimated magnitude of NSSIs among HCWs, but most of them focused on the causes of underreporting such as the lack of knowledge of blood-borne pathogen risks, aggravation, and not being aware of required reporting procedures. [28]

A high prevalence of NSSIs was reported across different regions in Saudi Arabia. From 1995 to 1997, there were 282 NSSIs among HCWs in 11 hospitals in the Eastern Province of the Saudi Arabia. [1] In Abha (south) a total of 116 cases were reported in one medical center between 1996 and 2000. [2] In Najran (south), 32 cases were reported in one hospital within a six-month period in 2012. [15] In Riyadh (central), there were 477 cases reported from January of 2007 to December of 2011. [1]

In Saudi Arabia, NSSIs are reported and documented using the Exposure Prevention Information Network (EPINet™) system. EPINet™ is a set of questions that identifies the details of each incident, such as job category, incident location within the hospital, parts of the body affected, and other factors. A number of other countries use EPINet™, including the U.S. and India. [29] Event reporting is significant; it triggers further action to limit these incidents, allows analysis of risk factors, sheds light on hospital performance, and informs the development and enforcement of further precautionary and preventive regulations to control NSSIs. Additionally, reporting is necessary to confirm the existence of post-exposure prophylaxis protocols. In the event that they do exist, an investigation into how closely they are being followed must be performed.

It is crucial to pose these questions about NSSIs: 1. Does the use of EPINet™ as a way of reporting percutaneous and needle injuries truly reflect the actual number of cases? 2. Do the variations in different healthcare systems around the world affect the number of incidents? 3. How likely is it for an HCW to report a case if it happened to them personally?

A prospective study was conducted from 2004 through 2008 to compare NSSIs and percutaneous injuries at one of medical cities in Riyadh to those occurring in U.S. hospitals participating in EPINet™. Although the results showed lower rates of NSSIs at the medical city relative to the U.S. EPINet™ hospitals, the question of how different healthcare systems and underreporting of cases can lead to imprecise results warrants debate and additional scrutiny. [6]

Despite the fact that many studies have documented numbers of NSSIs cases in Saudi Arabia, the majority of data reported have not covered many hospitals or regions around Saudi Arabia. No comprehensive assessment of incidents has been performed. To fill this gap, we conducted a secondary data analysis using EPINet™ collected from 2012 to 2014 to examine the descriptive epidemiology of NSSIs among health care workers in Saudi Arabia. Our data provides information on specific region and individual hospital departments, HCW job categories, purpose of using the sharp, timing of the incident in relation to the procedure, contamination details, severity of injury and injury location on the body.

Research Questions

Our specific research questions were:

1. What is the incidence of NSSI among health care workers from 2012 to 2014 and its distribution by region and HCW occupation category?

2. What is the pattern of NSSIs in terms of severity, body location of injury and circumstances of occurrence?

Significance

HCWs worldwide are plagued by the threat of NSSIs. However, HCWs in underdeveloped countries, such as Saudi Arabia, display higher incidence rates of NSSIs in comparison to developed countries, such as the U.S. This compilation of data will be utilized to broaden our understanding of NSSIs. The results of this study could help to assess the situation of NSSIs among HCWs in Saudi Arabia and describe their pattern of occurrence. Most importantly, our results can assist in developing solutions to decrease incidence rates of NSSIs in Saudi Arabia.

Chapter 2-Literature Review

Percutaneous injuries from needle sticks in healthcare facilities are an unavoidable part of daily patient care; however, they pose a serious occupational hazard. These injuries raise considerable concern about infection, cause psychological distress, and are associated with considerable management costs. They can cause serious illnesses and death among HCWs. The high prevalence of risky conditions that health care workers face every day should prompt more training, implementing goal oriented programs and work guidelines, and establishing surveillance systems for registering, reporting and management of occupational exposures in health institutions. [31, 7]

NSSIs in the United States

In the United States (U.S.), much evidence from prospective studies with aggressive monitoring suggests that the incidence of NSSIs is significantly higher than reported through passive surveillance, ranging from 14 to 839 NSSIs per 1,000 health care workers per year. The economic cost of managing these injuries is substantial, ranging from $51 to $3,766 per incident (2002 U.S. dollars). This amount excludes the cost of treating the long-term complications of NSSIs, such as the human immuno-deficiency virus (HIV) and hepatitis B and C infections (HBV and HCV), each of which can cost several hundreds of thousands of dollars to manage. In addition, health care workers experience significant fear, anxiety, and emotional distress following a NSSIs, sometimes resulting in occupational and behavior changes. Despite the availability of engineered injury prevention devices, the implementation of these new technologies has

been mixed in part because of the perception that these devices are costly and not cost efficient. However, widespread use of safety devices might be more easily justified on economic grounds when the full clinical and economic benefits of these new technologies are considered, especially within the context of injury prevention. [19]

General Characteristics of NSSIs in Saudi Arabia

A comprehensive evaluation of NSSIs among HCW in Saudi Arabia was conducted over a four-year period (August 1988-August 1992). The study observed that nurses had the highest rate of NSSIs among all HCWs. Hospital wards had the highest rate of these injuries, compared to all other areas of hospitals. The afternoon time of the day was when most injuries took place. Palmar surface of the distal forefinger of the non-dominant hand was the most susceptible body part to these NSSIs. The authors reported that serious medical conditions, such as HBV virus (HBV) pose a significant threat in many countries, such as Saudi Arabia. However, HIV is the main source of anxiety in hospitals and health care centers. [32] The main cause of anxiety among affected HCWs was HIV, although HBV due to its high prevalence in Saudi Arabia poses a greater risk. The high occurrence of these injuries among nurses in the non-dominant hand in comparison to the low rates among doctors and other healthcare professionals heavily implied that major adjustments must immediately be made in the clinical procedures and that hospitals must be supplied with safe protective venesection equipment. Also, the high rates of NSSIs in the afternoon indicated that the nursing staff is less alert and more likely to be tired after lunch, and their procedures require increased supervision during these time periods. [32]

Epidemiology of Needle Stick and Sharp Injuries (NSSIs) in Saudi Arabia

A prospective study on the management of NSSI was conducted at King Fahad National Guard Hospital from 1996 to 2000. Data relating to the epidemiology of NSSI were collected with the EPINet™ data collection tool to compare the results of 1997 to those of 1998. Three observations were made: (1) housekeeping staff injuries ranked third in 1997 and eighth in Saudi Arabia hospitals as reported by EPINet™ 1998; (2) injuries caused by devices discarded inappropriately occurred commonly at this facility but were not reported by EPINet™; and (3) injuries due to unsafe practices ranked third in 1997 but seventh in the 1998 EPINet™ report of Saudi Arabia hospitals. This surveillance highlighted risky practices and demonstrated employees and locations frequently involved in NSSIs. Upon establishing that the majority of NSSIs were the result of recapping contaminated needles and improperly disposing of contaminated needles, the study concluded that personnel did not entirely understand the epidemiological reasons behind the safety procedures. According to the data that was compiled, the majority of NSSIs that occurred over the course of the surveillance period was caused by preventable, unsafe practices, which would not have been the case had there been a continuing education program. An education program was designed for all staff at risk of exposure, targeting higher-risk employees. [27]

Knowledge, Attitudes and Practices in Saudi Arabia

During the Hajj season of 2003, a self-administered structured questionnaire was used to collect data about hospital infection control knowledge, attitude, and practice (KAP) of HCWs whose dispatched. A total of 392 HCWs was studied, of whom 215

(54.8%) were nurses and 177 (45.2%) were doctors. Three hundred and fifteen (80.4%) HCWs worked in hospitals, whereas 77 (19.6%) worked in primary healthcare centers. Of the 392 HCWs, 164 (41.8%) were from Makkah, and the remaining 228 (58.2%) were recruited from other regions in Saudi Arabia. A good proportion (81.8%) of HCWs correctly answered at least 5 of the 11 knowledge statements. However, obvious deficiency of knowledge was recorded concerning other important hospital infection control measures. A smaller proportion (61.9%) of HCWs achieved a score of at least 4 out of 7 for attitude statements. Response to questions concerning practice showed that both nurses and physicians reported variable compliance to hospital infection control practices in terms of strict or near-strict adherence. In conclusion, training of HCWs is needed to improve KAP in infection control. [14]

Southwest of Saudi Arabia, a study of injection safety in Abha health district was carried out. Data was collected from 47 physicians and 85 nurses at 24 primary health care centers, using an observation checklist and an interview questionnaire. All centers used individually packed disposable syringes and puncture-proof containers to collect used needles. NSSI in the previous year was reported by 14.9% of physicians and 16.5% of nurses (0.21 and 0.38 injuries/person/year respectively). Logistic regression analysis identified recapping the needle after use (physicians and nurses) and bending the needle before disposal (physicians) as significant risk factors for injury. [22]

Despite recent improvements in policies, practices, and device design, percutaneous injuries from needles and sharp instruments continue to expose health care

workers to the risk of blood borne pathogens. A prospective surveillance was instituted to study the epidemiologic characteristics of percutaneous injuries at King Abdulaziz Medical City, Riyadh, Saudi Arabia (KAMC-R) from 2004 through 2008 and to compare these characteristics relative to those of a network of US hospitals participating in the EPINet™ research group (2004-2007). It was found out that the mean percutaneous injuries rate per 100 occupied beds in KAMC-R was significantly lower than that reported by teaching and nonteaching U.S. EPINet™ hospitals. Similar to U.S. EPINet™ hospitals, nurses at KAMC-R reported more percutaneous injuries than physicians. In comparison to US EPINet™ hospitals, nurses at KAMC-R experienced more percutaneous injuries (52.8% vs 38.1%, respectively), whereas physicians experienced fewer percutaneous injuries (18.4% vs 28.6%, respectively). The majority of percutaneous injuries happened in patient wards (50.6%) in KAMC-R and operating rooms (34.1%) in U.S. EPINet™ hospitals. Suturing, which was involved in only 10% of percutaneous injuries at KAMC-R, was the most frequent percutaneous injuries mechanism in U.S. EPINet™ hospitals (23.3%). In both KAMC-R and U.S. EPINet™ hospitals, disposable syringes were the most frequent devices involved, the left hand was the most common site of injury, and the source patient was largely identifiable. Though this shows that we have lower rates of percutaneous injuries at KAMC-R relative to US EPINet™ hospitals, it is difficult to fully explain such differences, this could be due to variations in health care systems, underreporting or the impact of the percutaneous injury prevention activities. [6]

Education of the staff in healthcare facilities is a crucial factor in the prevention of percutaneous injuries. Percutaneous injury surveillance is a routine practice in King Abdulaziz Medical City (a 900-bed teaching tertiary health care hospital) in Riyadh. It is conducted using the EPINet™ data collection tool. From 2001 through 2003, educational activities were administered for HCWs to prevent percutaneous injuries. The education included lectures on the risk of unsafe practices that may lead to percutaneous injuries and how to avoid them. Data from before (1997-2000) and after (2004-2008) the intervention were imported from the surveillance system and statistically analyzed. Later on, the total overall rate of percutaneous injuries per 1000 HCWs was significantly lower in the post-intervention period than in the pre-intervention period (14 vs. 32.8/1000 HCWs, respectively). The rates of percutaneous injuries among nurses and housekeepers showed a significant decrease (15 vs. 37.6/1000 HCWs and 10 vs. 34.5/1000 HCWs, respectively). The frequency of percutaneous injuries in the emergency department (ED) and intensive care units (ICUs) showed a significant decrease (3.4% for both vs. 12.4% and 13.7%, respectively. The reason for this drop in percutaneous injuries was mainly attributed to the increase of safety education in healthcare. These educational programs had the greatest impact on the physicians and nursing staff. Although an approach that incorporates several methods of prevention is recommended, this study proves that education is the best tool to prevent percutaneous injuries in Saudi Arabia. [12]

Among Saudi medical students, once study assessed students' knowledge about standard precautions and their attitudes toward the current curriculum/training received. The study method was cross sectional and targeted students in clinical training at College

of Medicine, King Faisal University.An anonymous self-administered data collection form was used. Inquiries about students' characteristics, general concepts of infection control/SPs, hand hygiene, personal protective equipment, sharp injuries and disposal and care of health providers were included. The second part was to find out the approach toward the curriculum and training relevant to standard precautions. A total of 251 students were included. Knowledge scores in all domains were considerably low, 67 (26.7%) students scored 24 (out of 41points) 22.2% in 4th year, 20.5% in 5th year and 36.8% in 6th year. Sharps injuries, personal protective equipment and health care of the providers showed the minimum scores. The main sources of knowledge were self-learning, and informal bed side practices. Most medical students believed that the current teaching and training are insufficient in providing them with the necessary knowledge and skills regarding standard precautions. The overall knowledge scores for standard precautions were low especially in the domains of hand hygiene, sharps management and personal protective equipment reflecting insufficient and ineffective instructions received by medical students through the current curriculum making them vulnerable to health facilities related infections. Proper curricular reform and training are required to protect students and patients. [35]

Needle Stick and Sharps Injury Risk Factors

Regarding risk factors, a retrospective study involving all reported cases of needle stick and sharp object injury among health care workers was conducted at King Saud Medical City (KSMC) during the period of January 2007-December 2011 using EPINet™ data. It showed that 477 NSSIs were reported with peak incidence (13.84%)

during 2009. Distribution of NSSIs according to the location of their occurrence revealed that patient room/ward was the most common place of occurrence of NSSIs (150/477), followed by emergency departments (82/477), then the intensive and critical care units (70/477). The study revealed that nurses were encountered as the most affected job category and use of items is the most common activity associated with the incidents. Most of the incidents were caused by disposable needles, and hands were the most affected body parts. Prevention should be based on different working lines including immunization, education of health care workers and proper engineering control measures. [28]

In the western part of Saudi Arabia, knowledge and practices of HCWs in relation to blood-borne pathogens was assessed in a tertiary care hospital by a self-administered questionnaire. These questionnaires were distributed to evaluate demographic characteristics, knowledge and practices of physicians, nurses and technicians on risks of exposure and prophylaxis against human immunodeficiency virus, HBV virus and HCV virus infections. A total of 466 participants (151; 32.4 % physicians and 315; 67.6 % nurses/technicians) completed the questionnaire. Almost two thirds of the physicians (60.9 %) and half of the nurses/technicians (47.6 %) had history of exposure to risks of blood borne infection. Although both physicians and nurses/technicians showed acceptable level of knowledge about risks of blood-borne infections, only a small proportion knew the correct actions including reporting following exposure. Behavioral-based in-service training interventions and strict policy should be implemented to

promote compliance of HCWs to the protective measures against hazardous, blood-borne infections. [3]

Southwest of Saudi Arabia, in Jazan, few studies evaluated injection safety practices. They aimed to examine the structure and process of injection safety at the level of primary health care centers (PHCC) in Jazan, to evaluate knowledge, attitudes, and practices of primary health care physicians and nurses towards injection safety, and to determine the incidence of NSSIs among health care workers in Jazan region. Study design was cross-sectional and took place in Jazan Primary Health Care Centers (PHCCs), Saudi Arabia from September 2011 to March 2012. Data was collected using an observational checklist and data collection sheet. Jazan city health district was chosen at random from the 14 health sectors in Jazan region. All of the 33 (10 urban, and 23 rural) PHCCs of Jazan city were included in this study to get the predetermined sample size of health care workers. Two-hundred HCWs were recruited (29% physicians, and 71% nurses). Results indicated that syringes in the PHCCs were disposable (100%), individually packed (92%), and available at all volumes (98%). Methods of safe disposal of needles and sharps were also operated through contracting with professional companies in 84.8% of instances. Urban PHCCs had more posts for injection safety promotion than rural centers ($p=0.02$). Continuous Medical Education (CME) programs on infection control were present in only 60% of PHCCs. At least 95% of HCWs in Jazan believed that sharps objects should be kept in a puncture-proof container, kept in a closed container, or disposed by a professional company. More than 80% of HCWs washed their hands by soap and water and cleaned them by alcohol before giving

injection, and also got the three doses of HBV vaccine. The rate of NSSIs in the past year was 14%, without a significant difference between nurses and physicians (p=0.8). To conclude the study, Jazan PHCCs have reasonable facilities that prevent NSSIs. More educational programs on safety injection, and increase promotion of safety injection posters, especially in rural PHCCs need to be designed and utilized. [16]

Needle Stick and Sharps Injury Prevention Strategies

Speaking of prevention strategies, a meta-analysis of literature and studies that spans over the years of 2002-2012 was performed. Articles focused on proposed and tested methods of reduction of needle stick, sharp or percutaneous injuries. Random effects models were used to assess the efficacy of three various types of safety and prevention interventions, which were safety-engineered devices (SEDs), training on risks and safety protocols, safety-engineered devices and also a combined method of training and SEDs. Results indicated that all methods helped to reduce NSSIs, but the combination of training and SEDs was most effective. Training intervention reduced the rate of NSSIs by 34% and the SEDs intervention reduced NSSIs by 49%. When training was introduced along with SEDs, NSSIs were reduced by 62%. The conclusion was that NSSIs can be largely prevented with aggressive methods of training and strictly enforced safety protocols. [36]

Summary

The burden of NSSIs calls for more action and structured plans for prevention and control. Accurate reporting NSSIs is of primary importance, as this data directs efforts

towards sites requiring further attention and more awareness programs. Though many of the studies above document needle stick incidents in Saudi Arabia, the data they use is limited to only certain hospitals in a single city and does not specify which hospital department the incident took place in. In this study, our aim is to extend the existing literature in Saudi Arabia by covering a broader number of hospitals, selected from all regions in the country and analyzing a comprehensive array of variables in relation to NSSIs.

Chapter 3-Manuscript

Abstract

Background

Needle Stick and Sharp Injuries (NSSIs) affect over 3.5 million HCWs per year globally, and 90 % of these incidents occur in underdeveloped countries, due to lack of education on safety procedures and time and resource constraints. In Saudi Arabia, no comprehensive assessment of the descriptive epidemiology of NSSIs has been performed. This restrictions hinder the implementation of safety programs to prevent NSSIs.

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Conclusion

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Introduction

Worldwide, there are approximately 35 million healthcare workers (HCWs) representing 12% of the working population. There is a misconception that the healthcare environment is safe and devoid of hazards; however, potential chemical and blood-borne exposures pose a serious risk to HCWs. [21] HCWs encounter occupational hazards in their workplace, and among the most serious are needle stick and percutaneous injuries (PIs).

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precautionary and preventive regulations to control NSSIs. Additionally, reporting is necessary to confirm the existence of post-exposure prophylaxis protocols. In the event that they do exist, an investigation into how closely they are being followed must be performed.

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Materials and Methods

Setting

We performed a secondary data analysis using the NSSI database of the Saudi Ministry of Health (MoH) for the years 2012 to 2014. The database included 1361 reports of injuries occurring in MoH hospitals across the country.

Data Source

According to MoH policy, HCWs should inform their supervisors of any NSSI incidents and report them to the infection control staff in their facility. Those who are exposed in an incident are required to complete an Exposure Prevention Information Network (EPINet™) form with the assistance of a nurse supervisor (if necessary). The infection control staff is required to enter the information about each incident using EPINet™ version 1.5.

EPINet™ is a software program developed for recording and tracking occupational exposures to blood-borne viruses. The goal of program is to monitor and track sharps injuries, body fluid splashes and the consequences of these exposures. The EPINet™ platform is uniform and comprised of various questions about job category, where and when the injury occurred, what type of device was involved, and the original purpose of the sharp item. Additionally, it records whether or not the sharp item was

contaminated, whether the patient source is known, which part of body was injured, and the severity of the injury.

EPINet™ has the ability to register a wide breadth of information related to exposures, such as the device involved and the related procedure. The data collected can then provide input on the areas at greatest risk of exposure. This information can used to develop solutions to reduce incidences of occupational exposures to blood-borne pathogens.

The EPINet™ dataset was received from the General Directorate of Infection Control and Prevention in the Saudi MOH. The data on hospital sizes, names, and regions was also obtained from the Saudi MOH. Data regarding the number of hospital beds, the number of physicians, nurses, and allied HCWs per region was obtained from the Health Statistics Annual Book for the years 1433 Hijri (H; equivalent to 2012), 1434 H (2013) and 1435 H (2014).

Case Definition

In this study, NSSIs are defined as any injuries caused by sharps (including any type of needle, intravenous cannula, surgical instrument, scalpel, or other sharp item) that may result in exposure to blood or other body fluids. These sharp objects can be made of any material (such as glass) and be considered sharps independent of their intended usage.

Study Variables

The initial EPINet™ dataset contained information on department where the incident occurred, home department, job category of the injured worker, bodily location of the injury, patient source identification details, original user of the sharps item, description of the sharps item, and purpose of the sharps item and time of injury. The data was received in individual files for each year.

The variable home department was recoded into the following categories: Emergency Room, Operating Room, Medical Ward, Pediatrics, Maternity, Intensive Care Unit (ICU), and Surgical Ward among other categories. The initial dataset contained 20 regions of the Saudi Arabia, which were recoded into the 13 administrative regions. The initial dataset also contained job categories as defined by the EPINet™ form. For incidence ratio calculations, we recoded the job categories to align with job category classifications used by the Saudi MOH statistical yearbook. The job categories we created were Physician (e.g., dentists, medical students, interns, residents, attending physicians, and fellows), Nurse (e.g., nursing student, registered nurses) and Allied Health Professional (which included all other HCWs, e.g., respiratory therapists, paramedics, and medical technologists).

The dataset contained a set of two skip-pattern questions on contamination (used instrument) (when a questionable needle or sharps object has been involved in an incident) and whether blood was visible, where the latter was conditional on the former.

We combined responses to two question responses into five or categories: Contaminated with visible blood, Contaminated without visible blood, Contaminated with blood unknown, Uncontaminated and Unknown.

The initial dataset also included body part injury identification, which was recoded into face, hands, arms, torso and lower limbs. Furthermore, the purpose of needle usage encompassed an extensive multiple choice list that was recoded to a narrower list that described the general purpose (e.g., cutting, drilling and electro cautery were originally separate items and we recoded them as "surgical procedures").

Statistical Analysis

Data cleaning and computation of incidence rates (IRs) and confidence intervals (CIs) were conducted via Microsoft Excel 2016 (Microsoft, Seattle, WA) and descriptive statistics and statistical analyses were performed using SAS 9.4 (Cary, NC). We performed an exploratory analysis of data in addition to a derivation of summary statistics for all independent variables. Continuous variables were summarized with descriptive statistics (N, mean, standard deviation, standard error, range, and median). Categorical variables were summarized with frequency counts and percentages within each category or between levels of a category as appropriate.

We estimated the IR and 95% CI of needle-stick injury for each hospital, region, and job category along with each job category per region in Saudi Arabia from 2012 –

2014 in order to investigate the trend of the IR over the study period. IRs were estimated using the number of incidents per year over the total number of HCWs in that region in that year per 100,000 individuals, and also by number of beds per region per year according Exposure Prevention Information Network instruction book U.S. Version 1-3. [30]

Ethics

We used a secondary, de-identified dataset from the EPINet™ program housed in the Saudi MOH. Data was de-identified before it was made available for analysis, and it did not include any identifiers that might have link it back to specific patients. The study was submitted for review by the Emory University's Institutional Review Board (IRB). Because it did not meet the definition of human subject research, it was exempt from review.

Results

A total of 395 cases of needle stick and sharp injuries occurred in 2012, 419 in 2013 and 547 in 2014. Table 1 illustrates the IRs (and CIs) of needle stick and sharp injuries by region in Saudi Arabia per 100 beds. The denominator of 100 beds is used as a simple measure to which IR trends can be compared. The highest IR was recorded in Najran region (IR= 5.63; CI: 4.87-6.48) followed by Tabouk region (IR= 3.06; CI: 2.52 – 3.68) and then Northern region (IR= 2.66; CI: 2.12 – 3.30). The lowest IR was recorded in Al-Jouf region (IR: 0,54; CI: 0.35-0.97) and Makkah region (IR: 0,54; CI: 0.45-0.64) Regarding job category, nurses had the highest IR of needle-stick injuries across all years (IR for 2014: 4.85; CI: 4.34-5.38; for 2013: IR: 4.28; CI: 3.80-4.71; for 2012: IR: 3.84; CI: 4.34 –5.38), while Allied Health Professionals had the lowest rates (IR for 2014= 2.17; CI: 1.74-2.67; for 2013: IR: 1.92; CI: 1.51-2.20; for 2012: IR: 1.84; CI: 1.42 –2.36)) (Table 2).

From 2012 to 2014, patient rooms and wards were the most common locations for needle stick and sharp injuries to occur (510 total incidents), whereas home-care settings were the least common (4 total incidents) (Table 3). Regarding the location of injuries on the body, the left index finger (162 total needle) was found to be the most commonly punctured finger, and the left thumb (146 total NSSIs) was a close second. Other body parts are represented in Table 4. We observed that the highest number corresponded to the left hand as opposed to the right one.

Table 5 shows when during a procedure needle stick and sharp injuries took place. Needle stick and sharp injuries that occurred during the use of the item displayed the

highest percentage (460 incidents, 33.8% of total incidents over the study period). The incidence time with the lowest risk of NSSIs was when a needle or sharp object pierced the side of a disposal container (5 incidents, 0.37% of total incidents).

Table 6 presents the severity of needle stick and sharp injuries at three levels: Superficial (little or no bleeding), Moderate (skin punctured with some bleeding) and Severe (deep stick/cut and profuse bleeding). Over the study period, there were 740 superficial, 469 moderate and 70 severe needle stick and sharp injuries.

According to type of device (glass, needle, surgical, and unknown), we found that needles caused 77.52% of injuries (with a total 1,055 incidents) (Table 7).

Our study included 7 different categories of the original purpose for use of the sharp item (Table 8). General syringe use was the original purpose most frequently mentioned (associated with 358 injuries, or 26.3% of the total injuries). The original purpose associated with the lowest percentage of injuries was obtaining body fluid or tissue samples (16 injuries, 1.18% of total injuries).

Discussion

Despite the occupational injuries incidence is ranking very high in the way of awareness and perception especially among health care workers. Our study observed that the numbers of the NSSIs cases is increasing over the study duration, 395 cases in 2012, 419 in 2013 and 547 in 2014. Also, it demonstrated considerable regional variations in NSSI rates. Rates were highest in the Najran region (IR: 5.63; CI: 4.87-6.48), while Al-Jouf region (IR: 0,54; CI: 0.35-0.97) and Makkah region (IR: 0,54; CI: 0.45-0.64) had the lowest IR. The nurses are at the highest incidence of NSSI, and Allied Health Professionals had the lowest risk. The highest NSSI occurrence was related to the time when needles and sharp objects are being used without protection or safety devices during procedures. The largest proportion of injuries findings was caused by needles (77.52% of total injuries), and the smallest proportion was caused by glass (0.59% of total injuries).

Efforts are needed to understand the pattern and risk factors for NSSIs and to amplify precautionary and preventive measures. A weakness in Saudi Arabia NSSI epidemiology studies, is their focus on individual and local healthcare facilities. Our study aimed at filing this gap by assessing the epidemiology of NSSIs at a national scale across several MOH hospitals. Our study further described patterns of NSSI occurrence by different factors, including region, job category and other important variables (location of injury on the body, location of injury in the facility, type of object that caused the injury, and injury severity).. [26]

A comparison between Saudi Arabia and the U.S. indicates lower rates in the Saudi MOH hospitals for NSSIs in surgical attendants (1.3%-Saudi Arabia, 7.6%-U.S.) and NSSIs from operating and recovery rooms (17.9%-Saudi Arabia, 33.5%-U.S.). [26] However, these reports are largely attributed to underreporting in the MOH hospitals. Other rates were found to be higher in Saudi Arabia, including NSSIs among nurses (59.4%-Saudi Arabia, 94.9%-U.S), emergency rooms (18.2%-Saudi Arabia, 8.7%-U.S.) and procedures performed by HCWs without safety devices (86.8%-Saudi Arabia, 55.7%-U.S.). [26] Our results showed that Saudi Arabia hospital IRs per 100 beds ranged from 0.54 to 5.63 across several regions, and CIs ranged from 1.01 to 6.48. These results indicate that education and training as well as adherence to safety protocols require strengthening among Saudi HCWs.

Common themes emerged in this study that can be used as focal points in future research and experiments aimed at reducing NSSIs among HCWs. For example, underreporting appears to be a serious issue that could be detrimental if it continues to be dismissed and left unaddressed. This conclusion was derived from the previously mentioned discrepancies in U.S. and Saudi Arabia IR reports. Underreporting at MOH hospitals is a significant obstacle to establishing reliable IRs. [26]

Our study demonstrated considerable regional variations in NSSI rates. Rates were highest in the Najran region (IR: 5.63; CI: 4.87-6.48), while Al-Jouf region (IR: 0,54; CI: 0.35-0.97) and Makkah region (IR: 0,54; CI: 0.45-0.64) had the lowest IR. A 2007-2011 study addressed Saudi Arabia regional disparities in IRs by assuming that they

are attributed to variation in staff turnover rates and levels of knowledge regarding control of infections. Underreporting is also a possible explanation. They state that, as is the case in many other countries, there is marked underreporting of needle stick incidents involving HCWs in Saudi Arabia. Over half of dental HCWs experiencing NSSIs failed to report them to the appropriate department. This study shows an underreporting rate of 67.4% (161/239) after an NSSI. The main reasons for underreporting were assuming that no blood-borne pathogens existed in the source patient (62.8%), annoyance (17.9%) and lack of knowledge about the reporting procedure (6.0%). [28] In spite of the numerous similarities in Saudi Arabia HCWs that contribute to the aforementioned, common underlying factors of high IRs of NSSIs, regional spread appears to hold a great deal of significance in NSSI IRs.

Regarding the significance of job categories in relation of IRs, our study found that nurses had the highest occurrence of NSSIs, and Allied Health Professionals maintained the lowest rate. In a logical sense, nurses have higher IRs purely based on the particulars of their profession. For example, nurses routinely perform risky procedures that involve exposure and susceptibility to NSSIs and blood-borne pathogens, such as IVs, taking blood and administering injections, among other tasks. In support of this statement, the high risk factors that face healthcare worker positions when they comment. [16] The three-year study period was a sufficient amount of time to pinpoint which job categories were at the highest risk for NSSIs and why. Nurses displayed consistent and steady trends throughout the majority of studies in proving to be the positions with the most risk and have the highest rates of injury. In addition to high rates of NSSIs in the

nursing staff, there is a high risk of injury in the cleaning staff as well. They found that cleaning staff accounted for 20% of cases and that they were found to use inappropriate disposal receptacles for sharps. [37]

In addition to trends based on occupational specifics, trends that contribute to IRs of NSSIs also exist related to the time of day. The correspondence between the time of day and NSSIs in health care worker in one study of 107 NSSIs that occurred over a four-year duration, indicated that 28 cases took place in the morning, 68 in the afternoon, and 11 happened during the time period from 6pm to 7am. [32] This result further suggests that long hours, heavy workloads and low levels of experience contribute to high IRs, particularly during the post-midday period when alertness is difficult to maintain.

Much like our study, the results of which revealed a total of 510 NSSIs in patient rooms and wards in comparison to 4 NSSIs in home-care settings, a number of sources confirm that patient rooms and wards are in fact the medical facility locations with the highest incidents of NSSIs. A 2001-2003 safety intervention at the King Abdulaziz Medical city, Riyadh estimated that these areas required 8 to 10 times greater number of infection control educational sessions during their 2001-2003 safety intervention compared to less risky areas with lower reported IRs. [12] Our study results also revealed that the least amount of NSSIs occurred in home-care settings. We attribute this vast difference to smaller workload, shorter hours and the ability to focus on attention to detail regarding safety procedures.

Regarding types of procedures, our study results showed a corresponding 358 total NSSIs from syringe use as opposed to 16 while obtaining tissues samples or body fluid. Although these occupation hazards are risk factors, they are also simply part of the day-to-day duties of HCWs in the nursing profession. Allied Health Professionals do not encounter nearly as many risks as inclusive components of their job requirements. Therefore, their lack of exposure to possible injuries places them in the low-risk category. Fortunately, this information can be used to prioritize the frequency and intensity of safety interventions according to job category; however, further exploration of why these two groups of professionals have such drastically different IRs is necessary.

The results of our study, with a reported high of 162 NSSIs on the left index finger and a low of 36 NSSIs on the feet and leg areas over three years, maintained that the most common and vulnerable area of the body for NSSIs is the left distal finger. A documented 95% (of 102 accounts) of injuries were reported to be on the hands, (27 were on the dominant hand, while 75 were on the non-dominant). The area with the most NSSIs was the underside of the distal index finger. [32] The assumption of these two similar findings is that the majority of the population is right-handed with the left as the non-dominant hand. Also, a small portion (5%) of injuries were inflicted upon the feet and legs. However, they attribute this miniscule percentage to HCWs accidentally dropping instruments during surgical procedures. [32]

According to the results of our study, which indicated 740 superficial, 469 moderate and 70 severe total NSSIs over a three-year span, the risk of NSSI that leads to

the contraction of infectious disease is indeed high. HCWs are at constant risk for life-threatening and debilitating diseases, and safety protocols are crucial to their survival and guaranteed protection on the job. The risk of contracting infectious disease from blood-borne pathogens is probably the most common concern as well as the greatest fear among HCWs. The number of HCWs who have contracted HIV from NSSIs is over 100, and the number who have contracted HBV and HCV is in the high thousands. This statistic expresses the high severity of on-the-job risk of infectious disease contraction for HCWs. [13] HCW distress from fear of exposure is another concern theme, and it can be crippling in terms of job performance for HCWs. The potential of HIV exposure causes extreme distress and hinders nursing job performance. Also, it can lead to post-traumatic stress disorder in nurses after an incident. [13] This stress affects productivity, quality of patient care and the attention to detail necessary for prevention of NSSIs. After an on-the-job incident, HCW performance can be significantly impeded by the mental and emotional strain after exposure to blood-borne viruses (BBVs). A 2000 survey of 65 HCWs who experienced occupational exposure reported psychological effects such as anxiety, insomnia, depression, appetite loss, fatigue and crying. Additionally, some of the respondents blamed themselves for the incidents. HCWs continued to worry for as much as a year after incidents, even if outcomes were negative. [19] In certain cases, employers may be responsible for the counseling costs of HCWs.

Cost reduction, lack of time, lack of experience/education, skewed safety perceptions, and lack of compliance with safety policies and protocols are all potential factors that contribute to the problem of NSSIs in Saudi Arabia healthcare facilities.

Addressing these issues via a set of preventive measures will actually lower the magnitude of the problem and its associated costs. In the most costly scenario, $1,937 will be spent on damage control of occupational exposures per incident. The least expensive scenario, in which the patient involved in the occupational exposure tests negative for HIV, HBV and HCV, is $161 per incident. [19] The cost of prevention would certainly be less expensive than the cost of treatment after the occurrence of an injury. In addition to the costs for treated contracted diseases such as HIV, HBV and HCV, the mental health of HCWs must be addressed after the occurrence of an incident.

A multi-faceted approach that is centered on recurring and consistent education and training is crucial to the reduction of NSSIs in Saudi Arabia. This contention is supported by the conclusions of a relevant study that surmises that the benefits of occupational exposure surveillance indicate that the prevention and displacement of occupational exposures by means of several methods (such as education) is a priority at the medical establishment. This analysis and its fortitude is the first from Saudi Arabia that indicates a decrease in occupational exposures as a result of standardized and uniformed educational endeavors by an infection control division within a tertiary care health facility. [12] Furthermore, the issue of job satisfaction and the tone of the work environment must be addressed through the employment of motivational and inspirational techniques as part of the training process. This method of increasing knowledge will hopefully foster a collective synergy that prompts HCWs to view safety protocols as a group effort.

Newly-developed safety devices for needle and sharps handling will considerably decrease NSSIs in HCWs. According to our study, a total of 1,361 NSSIs were caused by glass, needles, sharp surgical tools and other unknown items from 2012 to 2014. In spite of advancing technology in medical equipment and practices, nurses will inevitably handle needles and sharps in their line of work. Capless-valve secondary intravenous systems and protective equipment for blood draws display a stellar degree of efficacy in preventing occupational exposure amidst the highly unavoidable use of needles and sharps. [9]

However, a standard basis for safety device utilization and facility-wide implementation must first be established. In order to curb the occurrence of NSSIs, healthcare facilities have three key elements. The first, is to train staff on safely injecting patients, and properly using and disposing of sharps (also known as "universal or standard precautions"). The second key element, is what is called safety-engineered device (SED) controls. This involves standards such as the replacement of commonly used needles with safety needles, while also implementing containers designed for the safe disposal of used needles. The third key element is a two-fold pairing of safety training and utilization of SEDs. [36] Although cost is a factor, costs will be reduced in the long-term future.

The strength of this study stems from its focus on a wide range of independent variables in relation to the dependent variable, NSSIs. Although this study focused on Saudi Arabia healthcare facilities, studies on NSSIs in other underdeveloped countries,

such as Turkey, Ghana and Pakistan, reinforced the contention that these incidents are a general problem due to lack of enforced regulations and protocols in comparison to developed countries like the U.S. An exploration of the usual practices of healthcare facilities in underdeveloped countries is crucial to uncover the key to solving the skyrocketing NSSI IRs among Saudi Arabia HCWs. For example, a study in Turkey August 2011 to June 2013 proved that risk factors for percutaneous and muco-cutaneous exposures in HCWs were linked to occupational exposures due to heavy workloads and long hours. Again, nurses were at the highest risk for occupational exposures. [37] Studies performed in Pakistan and Ghana yielded similar results to HCW job safety conditions in Turkey and, most importantly, in Saudi Arabia. Our data source was the EPINet™ system, which is proven to be one of the most reliable and useful sources of reported information on which studies can be based. This system is efficient because it is technologically based, and it creates a more uniform database of organized information that can be shared more rapidly and with greater ease as well as efficiency. [39] Narrowing studies down so that they target specific groups in specific settings is key to understanding the underlying issues of the problem and taking further steps towards developing a solution, and it is a strength of this particular study.

Regarding limitations, sources of data were limited due to underreporting and the reluctance of compliance of HCWs. This study would be enhanced by a great deal of refinement and recoding. Additionally, it could be adjusted to not include all the hospitals in Saudi Arabia but possibly other sectors, such as private and military.

In summary, our study assessed rates of NSSIs in Saudi Arabia and characterized their occurrence according to important factors. Our results provide valuable data for the Saudi MOH to develop solutions and preventive efforts that will ensure the improved safety of HCWs in Saudi Arabia.

Chapter 4 – Conclusion and Recommendations

NSSIs put HCWs at a great risk for contractions of blood-borne viruses. While eliminating this problem altogether is difficult, a significant reduction of NSSIs is entirely possible. In underdeveloped countries, such as Saudi Arabia, the main issues are adherence to protocol, perceptions of safety and education and training.

Recommendations for Future Research

Future research should address the following points:

- Compare rates before and after implementing educational and training sessions to assess training effectiveness.
- Compare NSSIs with experience of workers.
- Investigate underreporting.
- Investigate attitudes and perceptions of safety based on region, job category, and other factors.
- Perform further analysis of the work environment and the role that it plays in risk of injury.
- Conduct studies on safety devices that can be used in conjunction with procedures that require needles and sharps, such as the previously-mentioned, capless-valve technology.

In addition to the above, future research should also delve into recent innovations in skin pathergy testing (SPT). The ground-breaking nature of the SPT lies in the fact that it can foretell the possible contraction of certain diseases typically incurred from NSSIs by

examining the site of the injury. The term pathergy refers to skin hyper reactivity resulting from minor trauma. [38] This SPT is normally used to detect Behçet's disease (BD); however, it has the capability to identify a multitude of other diseases that are typically contracted from NSSIs. Although the SPT is costly and specified for BD, it can enhance the safety of HCWs via previous responses to reactions from blood-borne pathogen infections and, consequently, earlier administration of treatment for as well as higher survival rates for infected HCWs.

Finally, an investigation of additional factors concerning regional variation in Saudi Arabia is well worth consideration. Our study touched on this aspect of varying NSSI rates in Saudi Arabia, but further exploration of the details behind the vast differences between healthcare facilities in Riyadh and Najran could potentially pave new avenues for the improvement of Saudi Arabia HCW safety as well as the occupational safety of HCWs in other underdeveloped countries. Furthermore, a comparison of this regional analysis to practices, protocols and statistics in the U.S. will fashion a backdrop against which to compare additional and possibly unforeseen shortcomings in Saudi Arabia safety protocols.

Recommendations for Practice and Policy

Periodic education and training on updated safety protocols, close supervision of the practices of HCWs, safety devices for needles and sharps and frequent follow ups after the interventions are fundamental to the physical safety and mental well-being of Saudi Arabia HCWs. [12] However, the most integral component of this solution is education of HCWs. The findings of one source emphasizes the significance of

informational and training-centered approach to HCW safety advancement by stating that more collaborative efforts by those who have a stake in the issue, are required to stop needle stick injuries and their consequences before they happen. The source goes on to say that this is best accomplished with development of an all-inclusive program comprised of policies that concentrate on institutional, behavioral, and device-related aspects that are responsible for the occurrence of NSSIs in those that hold healthcare positions. For this endeavor, it is pertinent that unsafe, needle-bearing devices are eradicated, safe later natives are accessible, and needle devices with safety features are established, evaluated, and used. [15]

Policies inspired by our study will ideally focus on strict adherence to safety protocols with consequences for non-compliance, and they should also take incidence rates into consideration according to job categories in order to focus resources and attention where they are most needed. Furthermore, enforcement of policies must encompass firmly established reporting procedures for NSSIs and other potentially hazardous incidents.

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Tables

Table 1. Incidence rate and confidence intervals of needle stick and sharps injuries (NSSI) by region, Saudi Arabia, 2012 to 2014

Region	Number of NSSIs	Incidence Rate*	95% Confidence Interval
Najran	187	5.63	4.87 - 6.48
Tabouk	106	3.06	2.52 – 3.68
Northern	78	2.66	2.12 – 3.30
Aseer	146	1.61	1.35 - 1.88
Qaseem	126	1.61	1.35 – 1.91
Riyadh	265	1.14	1.01 – 1.28
Eastern	171	1.06	0.87 - 1.18
Al-Bahah	29	0.89	0.61 - 1.27
Medinah	61	0.76	0.58 - 0.95
Makkah	125	0.54	0.45 - 0.64
Al-Jouf	24	0.54	0.35 - 0.79
Unknown	43		
Total	1361		

*Incidence rate is per 100 beds

Table 2. Incidence rate (IR) and confidence interval (CI) of healthcare workers (HCWs) by job category, Saudi Arabia, 2012 to 2014.

Year	Allied Health Professionals		Physicians		Nurses	
	IR°	95% CI	IR°	95% CI	IR°	95% CI
2012	1.84	1.42 - 2.36	2.86	2.26 - 3.56	3.84	3.38 - 4.34
2013	1.92	1.51 – 2.20	2.20	1.70 - 2.80	4.28	3.80 - 4.71
2014	2.17	1.74 – 2.67	3.73	3.07 - 4.50	4.85	4.34 -5.38

°IR = incidence rate per 1000 workers of each category

Table 3. The numbers and percentage of needle stick and sharps injuries (NSSIs) by location of incidents within hospitals, Saudi Arabia, 2012 to 2014.

	2012		2013		2014		Total	
	Numbers of NSSIs	%	Numbers of NSSIs	%	Numbers of NSSIs	%	Numbers of NSSIs	%
Blood Bank	5	1.27%	5	1.19%	5	0.91%	15	1.10%
Clinical Laboratories	5	1.27%	5	1.19%	17	3.11%	27	1.98%
Dialysis Facility	5	1.27%	8	1.91%	12	2.19%	25	1.84%
Emergency Department	69	17.47%	64	15.27%	74	13.53%	207	15.21%
Home-Care	1	0.25%	1	0.24%	2	0.37%	4	0.29%
Intensive Care unit	30	7.59%	18	4.30%	31	5.67%	79	5.80%
Labor and Delivery Room	6	1.52%	7	1.67%	18	3.29%	31	2.28%
Operating Room/ Recovery	69	17.47%	63	15.04%	79	14.44%	211	15.50%
Other	31	7.85%	26	6.21%	40	7.31%	97	7.13%
Outpatient Clinic/Office	15	3.80%	16	3.82%	30	5.48%	61	4.48%
Outside Patient Room	10	2.53%	13	3.10%	14	2.56%	37	2.72%
Patient Room/Ward	133	33.67%	175	41.77%	202	36.93%	510	37.47%
Procedure Room	8	2.03%	4	0.95%	5	0.91%	17	1.25%
Service/Utility Area	3	0.76%	5	1.19%	8	1.46%	16	1.18%
Venipuncture Center	0	0.00%	1	0.24%	5	0.91%	6	0.44%
Unknown	5	1.27%	8	1.91%	5	0.91%	18	1.32%
Total	395	29.02%	419	30.75%	547	40.19%	1361	100%

Table 4. The numbers of needle stick and sharps injuries (NSSIs) by body parts within hospitals, Saudi Arabia, 2012 to 2014.

Body part	Left	Right	Total
Arms	**5**	**10**	**15**
Arm, left front	1		1
Arm, right front		4	4
Forearm, right back		2	2
Forearm, left back	3		3
Forearm, left front	1		1
Forearm, right front		4	4
Face	**0**	**1**	**1**
Face, right front	0	1	1
Hands	**649**	**594**	**1243**
Index finger, left palm	162		162
Index finger, left top	48		48
Index finger, right palm		103	103
Index finger, right top		66	66
Left portion hand, left top	7		7
Left portion hand, right top		5	5
Left portion palm, left	41		41
Left portion palm, right		20	20
Little finger, left palm	13		13
Little finger, left top	5		5
Little finger, right palm		10	10
Little finger, right top		7	7
Middle finger, left palm	109		109
Middle finger, left top	34		34
Middle finger, right palm		65	65
Middle finger, right top		51	51

Right portion hand, left top	3		3
Right portion hand, right top		15	15
Right portion palm, left	24		24
Right portion palm, right		33	33
Ring finger, left palm	26		26
Ring finger, left top	9		9
Ring finger, right palm		30	30
Ring finger, right top		21	21
Thumb, left palm	146		146
Thumb, right palm		85	85
Thumb, right top		81	81
Thumb, left top	22		21
Wrist, left front	1		1
Wrist, right front		2	2
Lowe limbs	**18**	**20**	**38**
Buttock, left	1		1
Buttock, right		1	1
Foot, left top	6		6
Foot, right bottom		1	1
Foot, right top		10	10
Lower leg, left back	2		2
Lower leg, left front	3		3
Lower leg, right front		2	2
Thigh, left front	6		6
Thigh, right front		6	6
Torso	**1**	**2**	**3**
Lower abdomen, right		2	2
Trunk, left front	1		1
Total	**673**	**627**	**1300**

Table 5. Numbers and percentage of needle stick and sharps injuries (NSSIs) in Saudi Arabia hospitals from 2012 to 2014 according to steps of procedure

When did the injury occur?	Number of NSSIS	Percentage
After disposal, item protruding from trash bag or inappropriate container	47	3.45%
After disposal, stuck by item protruding from disposal container	34	2.50%
Before use of item	18	1.32%
Between steps of a multi-step procedure	87	6.39%
Device left on floor, table, bed or other inappropriate place	53	3.89%
Disassembling Device or Equipment	22	1.62%
During use of item	460	33.80%
From Item Left On or Near Disposal Container	13	0.96%
In preparation for reuse of reusable instruments	18	1.32%
Item Pierced Side of Disposal Container	5	0.37%
Other after use, before disposal	163	11.98%
Other, describe	84	6.17%
Restraining patient	17	1.25%
While putting the item into the disposal container	85	6.25%
While recapping a used needle	135	9.92%
Withdrawing a needle from rubber or other resistant material	20	1.47%
Missing	100	7.35%
Total	1361	100%

Table 6. Severity of needle stick and sharps injuries (NSSIs) in Saudi Arabia hospitals from 2012 to 2014

Year	Moderate-skin punctured, some bleeding	Severe-deep stick/cut, profuse bleeding	Superficial-little or no bleeding	Total
2012	169	25	179	373
2013	138	17	247	402
2014	189	28	314	531
Total	**496**	**70**	**740**	**1306**

Table 7. Numbers and percentage of needle stick and sharps injuries (NSSIs) in Saudi Arabia hospitals by type of device from 2012 to 2014

Type of Device Caused the Injury	No of NSSIs.	Percentage
Glass	8	00.59%
Needle	1055	77.52%
Surgical	250	18.37%
Unknown	48	3.53%
Total	**1361**	**100%**

Table 8. Numbers of needle stick and sharps injuries (NSSIs) in Saudi Arabia hospitals according to original purpose of sharp item use from 2012 to 2014

Original purpose for using sharp item	2012	2013	2014	Total	Total%
IV Line	49	29	40	118	8.67%
Surgical	81	58	100	239	17.56%
Syringe Use	114	100	144	358	26.30%
To contain a specimen or pharmaceutical	9	3	6	18	1.32%
To Draw Blood	78	87	97	262	19.25%
To obtain a body fluid or tissue sample	5	7	4	16	1.18%
To place an arterial/central line	3	4	11	18	1.32%
Unknown/Other or Not Applicable	45	110	104	259	19.03%
Missing	11	21	41	73	5.36%
Total	**395**	**419**	**547**	**1361**	100.00%