



## Assessment effects and risk of nosocomial infection and needle sticks injuries among patents and health care worker

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### ABSTRACT

In medical centers and hospitals one of the most dangers that threaten health care worker and patient are Nosocomial infections (NIs) and Needle stick injuries (NSIs). The aim of this study was to determination the effects of nosocomial infection and needle sticks injuries on patents and health care worker. A review study of literature was conducted to One thousand and fifty manuscripts were retrieved based on various databases: Elsevier, PubMed, Web of Science, Springer, and Google Scholar. Reporting data were used on predetermined consequences nosocomial infection and needle sticks injuries and related to adverse health effects, routes of transmission, control and reduction. The literature signs a notable undesirable affect from potential NIs and NSIs attributed to risk investigated among patents and health care worker. Based on Result this study, the resistance of antibiotics, non-standard personal protective equipment, and Needle recapping can endanger health of human and increase transfer infectious disease risk among exposed patients and health care worker. Useful for health system decision makers and political officials in order to cope with the incidence of nosocomial infections and decrease number of needle stick injuries among patients and health care worker can be the main application the results of this study. Increasing the level of awareness, especially of sensitive groups (patients and HCW), about the ways to prevent nosocomial infections and reduce needle sticks and proper use of personal protective equipment are the main vital managers of the health department actions for decrease the prevalence of NIs. Further research using more sophisticated methodology is warranted. Holding regular and periodic training workshops in connection with standard precautions and prevention of occurrence nosocomial infection and needle sticks injuries can play an important role in increasing the health of patents and health care worker.

**Abbreviations:** NIs, Nosocomial infections. NSIs: Needle Stick injuries; UTI, Urinary Tract Infection; BSI, Bloodstream Infection; SSI, surgical site infections; HBV, Hepatitis B Virus; HCV, Hepatitis C Virus; HIV, Human Immunodeficiency Virus; ICUs, Intensive Care Units; WBC, White Blood Cell; CDC, Center Disease Control; WHO, World Health Organization.

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## 1. Introduction

Nosocomial infections (NIs) and Needle stick injuries (NSIs) are the most important agents that can increase causes of disability, transfer infectious disease, morbidity and mortality, increasing hospitalization, and high health problems in hospitals and medical centers [2,20]. NIs and NSIs are one of the most important factors in increase treatment and hospital costs [77].

Nosocomial infections (NIs) is defined infections that occurs in patients due to treatment procedures consequence of hospitalization in hospital or medical centers [7,60,66,82]. Nosocomial infections occur among patient's 48 h or more following hospital admission [22,66]. According to reported Center Disease Control (CDC) in the United States, 60,000–80,000 cases of needle stick injuries each year occur among health care worker [89,95,97]. Based on result different studies needle stick injuries and nosocomial infections is one of the strongest factor in patients and health care worker in infections incidence [3,75,81,94]. Urinary tract infection (UTI), bloodstream infection (BSI), surgical site infections (SSIs), and pneumonia are the main common infections in medical centers [12,75]. Nosocomial infections, each year 4.5-billion-dollar economic damage due to 90,000 individuals die from nosocomial infections caused by hospitalization and 2,000,000 persons' additional health care worker expenses annually [12,14,35,39].

Low level of knowledge of patients and treatment staff about the causes of nosocomial infections, inadequate personal protective equipment, thin gloves, drawing blood, needle recapping, transit disposal needle, needles penetration to skin, non-standard safety boxes, resistance of antibiotics, failure to observe standard precautions in contact with the patient by the care staff and failure to properly observe the principles of hand hygiene are the main common routes and reasons of transfer and enter infectious microorganisms into human body [10,28,58].

In healthcare settings, the most common healthcare groups exposed to at greater risk of needle stick injuries and catching infectious diseases such as HIV and hepatitis are workers, nurse aid, operating room technicians, radiologists, pediatricians, surgeons and anesthesiologists, residents, midwives, and nurses [8,17,61,62,98,102].

Use caution when using sharp and winning medical devices, using useful safety boxes, proper use of safety boxes and preparation of standard safety boxes rigidity in all wards in hospital and medical centers, avoiding hand-to-hand passing and needle recapping, increasing knowledge of health care worker, holding workshops and training courses in connection with about infections, reduction of use of sharp devices, and direct contact with needles, observance of standard precautions in the process of collecting, decontaminating and disposing of winning tools are the most important actions to reduce of the risk of needle stick injuries and nosocomial infections [5,41,54,79].

The purpose of this narrative review report is to understand the needle sticks injuries (NSIs) and nosocomial infections (NIs) risk assessment among patients and health care worker on potential transfer infectious diseases such as hepatitis B virus (HBV), hepatitis C virus (HCV) and the human immunodeficiency virus (HIV).

## 2. Material and methods

### 2.1. Inclusion criteria

In this a narrative review study, was performed with One thousand and fifty manuscripts were retrieved based on Web of Science, Elsevier, PubMed, Springer, and Google Scholar databases.

### 2.2. Data gathering

The data collection was based on Search terms: 'Nosocomial Infection', 'Needle Sticks', 'Patients', 'Health Care Worker', 'Hepatitis B Virus (HBV)', 'Hepatitis C Virus (HCV)', 'Human Immunodeficiency Virus

(HIV)', and 'Hospital'.

### 2.3. Search strategy

Search strategy included the explanations provided through database searching and other sources were found 162 and 42, respectively. Then, after review 112 full-text articles were screened and final evaluation 65 were entered into the analysis stage. Finally, 32 articles were selected in this study. Search restrictions included English language and all the studies were searched during time 2001–2021. Fig. 1 showed the how to prepare studies and article selection process.

### 2.4. Ethical approval

This a narrative review study does not contain any studies involving animals performed by any of the author(s). According to the national guidelines, studies such as this do not require individual consent.

## 3. Result and discussion

### 3.1. Nosocomial infection associated to healthcare

The nosocomial infection is classified according to the species and the causative agent into 4 parts, including surgical site infections (SSI), urinary tract infections (UTI), bloodstream infections (BSI), and respiratory pneumonia (RP) (Fig. 2) [22,90,96].

Ventilator-associated hospital-acquired pneumonia, gastrointestinal infections by *Clostridioides difficile*, inadequate equipment, the presence of contamination in the patient's hospital environment, non-observance of standard precautions in contact with the patient by the HCWs, failure to observe proper hand hygiene when dealing with the patient, improper disinfection of the hospital ward and failure to properly equipment used such as catheter and suction are the main agents caused nosocomial infection [32,51,63,68].

According to reported different studies that most human organs that are affected by the complications of nosocomial infections are lung, skin, bone, eye, throat, ear, and nose [46,74,90]. Also, the main systems in human body that NIs has many side effects included central nervous systems, circulatory system, gastrointestinal tract, skin and soft-tissue, respiratory and cardiovascular systems [21,50,55,86]. Based on result studies conducted in the United States, the incidences and prevalence pneumonia, SSI, gastrointestinal, UTI and BSI were 21.8%, 21.8%, 17.1%, 12.9% and 9.9%, respectively [52,53].

### 3.2. Assessment of needle sticks injuries

Needle stick injuries (NSIs) is called any accidental piercing of the skin by a needle or sharp instruments during medical or nurse interventions [1,42]. Needle stick injuries are a serious occupational hazard for health care providers and nurses that are often not reported for various reasons [30].

Needle wound does not pose any danger on its own with a new, sterile needle. The greatest concern occurs when the skin is pierced by a needle used and contaminated with the patient's blood, with the highest risk of contracting hepatitis B virus (HBV), hepatitis C virus (HCV) and human immunodeficiency virus (HIV) [18,30,87]. Based on result studies, each health care provider suffers from needle stroke 4 times a year [5,30]. The prevalence of these injuries due to exposure to physical demands and mental stress has increased in the work place [91].

Most needle-like injuries occur during activities such as blood transfusions, blood sampling, venous implantation for patients, removal of needles and sharp instruments, and the collection of blood and body secretions [30,40].

Injuries caused by needle sticks among health care workers impose heavy costs on health care systems, which can include loss of useful labor, increased workload for other health care workers, and payment of

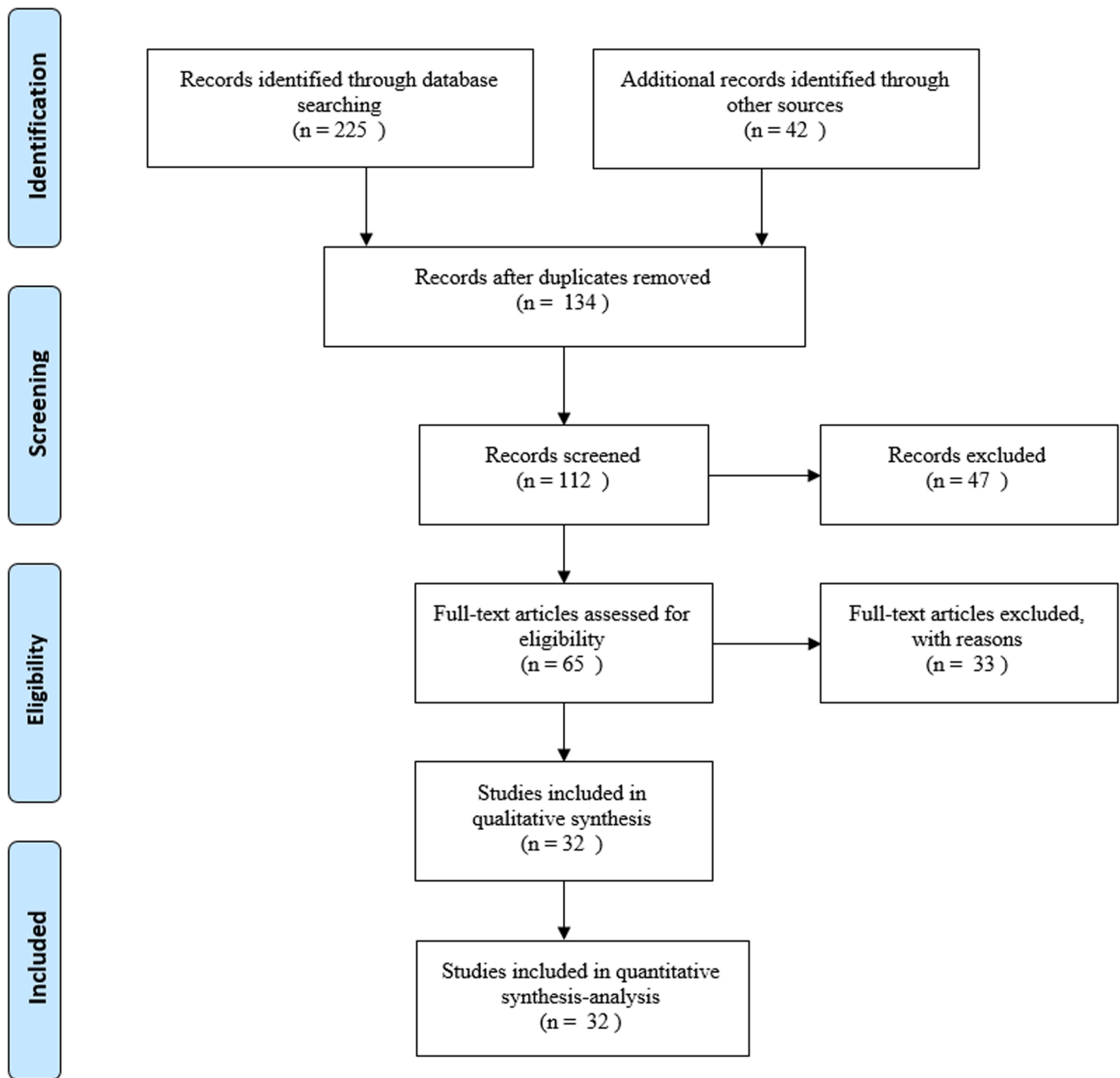


Fig. 1. . Flowchart of the how to prepare studies and article selection process (manuscript).

health care costs resulting from These are injuries [91]. Therefore, it is necessary to formulate and present appropriate solutions in this field. Due to the increasing prevalence of injuries caused by needles and sharp objects and the resulting risks, the need to pay attention to its influential factors is of particular importance to reduce these injuries among the nursing staff [91].

### 3.3. Routes of transmission nosocomial infection and needle sticks

Among the most important ways and routes of transmission of nosocomial infections are non-observance of hand hygiene, contact direct or indirect with microorganisms, the use of non-sterile surgical and non-sterile dressing, needle sticking, failure to use appropriate stiffness boxes, non-observance of standard precautions during the patient's hospitalization and medical care, improper use of personal protective equipment such as masks and gloves, non-observance of

environmental health, improper implementation of medical waste management, non-use of appropriate disinfectants, and lack of proper air conditioning system [23,43,76,83].

The human immunodeficiency viruses (HIV), Hepatitis C virus (HCV), urinary tract infections, respiratory infections, influenza, COVID-19, pneumonia, fungal and skin infections are among the diseases transmitted due to nosocomial infections [9,15,27,38]. Fig. 3 showed the routes of transmission nosocomial infection and needle sticks.

### 3.4. Risk assessment of nosocomial infection

Usually the most important pathogens related to causes nosocomial infections are Bacteria [16]. Staphylococcus aureus, Enterococcus species, Acinetobacter species, Pseudomonas aeruginosa, Candida species, Enterobacteriaceae Legionella species, and Aspergillus species are the



Fig. 2. Classified the nosocomial infection.

main pathogens that cause nosocomial infections [44,69,101].

Demographic patients (age and gender), type of catheter used (arteriovenous, urinary and blood syringe head), procalcitonin, white blood cell (WBC), and use of ventilator in ICU ward are the main factors attributed to nosocomial bacterial infection [16]. One of the most important Complications NIs is increase recovery time and psychological and mental problems for the patient [6,93].

### 3.5. Incidence of nosocomial infection, needle sticks injuries

According to the reports of health monitoring systems of different countries of the world and the report of the World Health Organization (WHO), the incidence and prevalence of nosocomial infection and needle sticks injuries is very different. The WHO data showed that in the world, 35 million health care workers are exposed to the risk of needle sticks injuries [11,70]. The prevalence of needle stroke is 58% in Iran and Needles, angiocatheter, and ampoules are the most common means of this Injuries [29,84]. The prevalence of NISs in different study reported between 20% and 25% [11,47,72].

Based on result different study in the developed countries, incidence of nosocomial infection in regular wards and intensive care units (ICUs) ward reported to 5–15% and 50%, respectively [64,85,100]. Reported WHO showed that amount incidence of nosocomial infection for hospitalized patients evaluated about 15% [45].

The geographical definition of the regions relation to the incidence of nosocomial infection, needle sticks injuries in the world showed in Fig. 4 [6,13,67].

### 3.6. Methods diagnosis of nosocomial infections

Laboratory, demographic, blood and urine cultures, serological equilibrium analysis, a chest x-ray, physical examination and the clinical

observations, are used to confirm diagnoses of nosocomial infections [16,90].

Tests available for nosocomial infections diagnosis, is positive culture plates (including chocolate agar, blood agar, and blood culture plates) containing pathogens (agents of bacteria) isolated from patients. The main characteristics of this method include have higher speed detect, genome detects, follow and the determination of agents the infection disease. Samples were transferred to microbiology laboratory. In the next stage, the species of bacteria, genus of bacteria, and antibiotic susceptibility testing of the isolates should be determining [59, 80].

Incubation the samples at 37 °C with and without CO<sub>2</sub> for the duration 24–72 h, Gram staining and prepared microscopic slides are other steps of sample preparation [36]. Depending on the result of Gram staining, differential tests were performed according to the guidelines, standard protocols, and antibiotic susceptibility testing provided by the WHO and reference laboratories [36]. the Kirby-Bauer method is the standard method for determination and diagnosis the species and genus [59,80]. The diameter of inhibition zone was measured and the sensitivity or resistance of isolates was determined based on standard tables. Antibiotic sensitivity test was performed using the same antibiotic disks used in the hospital laboratories.

### 3.7. Adverse effects of nosocomial infection and needle sticks injuries

#### 3.7.1. Antimicrobial resistance

Pathogenic microbes that are used to fight antibiotics become resistant to these drugs by gene mutation, and new generations emerge that cannot be fought, called antibiotic resistance [26,65]. Excessive use of antibiotics has provided the basis for drug resistance of available and common drugs and has increased the prescribing of new and more expensive drugs [92]. One of the most important causes of this type of



Fig. 3. Routes of transmission nosocomial infection and needle sticks.

drug resistance is the arbitrary or excessive use of antibiotics [37,73]. In the development of antibiotic resistance, underlying factors such as anomalies, abnormalities of the genitourinary system, genitals, bladder return to the ureter, recent use of antibiotics, recurrent urinary tract infections should be considered; Because some of these factors can cause irreparable problems [49]. Based on reported different studies the highest antimicrobial resistance, with 8/10 resistant to methicillin, sulbactam-ampicillin, ceftazolin, erythromycin, gentamicin, ciprofloxacin, ofloxacin in the strains of *S. aureus*.

### 3.7.2. Length of hospital stay

Nosocomial infections are always one of the major health problems along with the expansion of hospitals and increase the incidence and death of these infections by increasing the length of hospital stay [25, 56]. As a result, it drastically increases hospital costs. Nosocomial infections alone cause 88,000 deaths per year in the United States and cost more than 6 billion \$ a year in additional medical care [25].

Increased hospitalization time due to nosocomial infection can lead to the cancellation of surgeries and adverse effects on the patient and companions, disruption of the operating room, waste of time, confusion and unemployment of staff, unnecessary occupation of hospital beds and increasing hospitalization time, increasing costs and increase the risk of nosocomial infections [33,88].

Analysis of surveillance models in a German hospital showed that additional length of hospital stay (LOS) was sensitive to the location of acquisition and the type of HAI. The extra LOS due to all HAI was 12 days for all units but differed on the type of HAI such that CAUTI, SSI, and primary bloodstream infections were responsible for 3.3, 12.9, and 12.5 additional days, respectively [78].

### 3.7.3. Associated costs

Increase in hospital costs and enhancement number of mortality and

morbidity in patients admitted to medical centers is one of the most important side effects due to the creation nosocomial infections [16]. Based on result different study nosocomial infections increase 8–10% of number hospitalized patients in all of world [93]. Also, according to various reports and findings, the annual economic losses caused by the NIs are calculation at about \$ 10 billion [103,24,90]. in US healthcare system Based on reported to the Centers for Disease Control and Prevention (CDC) approximately annually estimate of the direct cost of nosocomial infections were between \$28 billion to \$45 [19,99].

### 3.8. The most important measure is control and reduction of nosocomial infection and needle sticks injuries

#### 3.8.1. Prevention of nosocomial infection and needle sticks injuries

Hygiene policies and performance standards for removing and placing syringe caps always provide the best and safest way for staff. In all hospital departments and health, safety boxes and containers for collecting sharp and cutting waste such as needles and needles should be placed, and personnel are required to place all sharp and disposable tools in these boxes [31]. The boxes, depending on the financial resources of the medical center, are made of first-class plastic or metal and have a special place for hooking the needle from the syringe to separate it [31].

Recommending the use of protective equipment, strengthening the scientific skills of staff, providing manpower, paying attention to hepatitis B vaccination coverage and examining the immediate effect of the wind after it, strengthening the care and reporting system and holding training classes and providing less risky equipment. Minimizing consecutive work ceilings should be included in the planning of universities' educational and medical centers [34]. Hand hygiene is the most important aspect of infection control and prevention of healthcare-associated infection (HAI) [57]. Pathogenic microorganisms

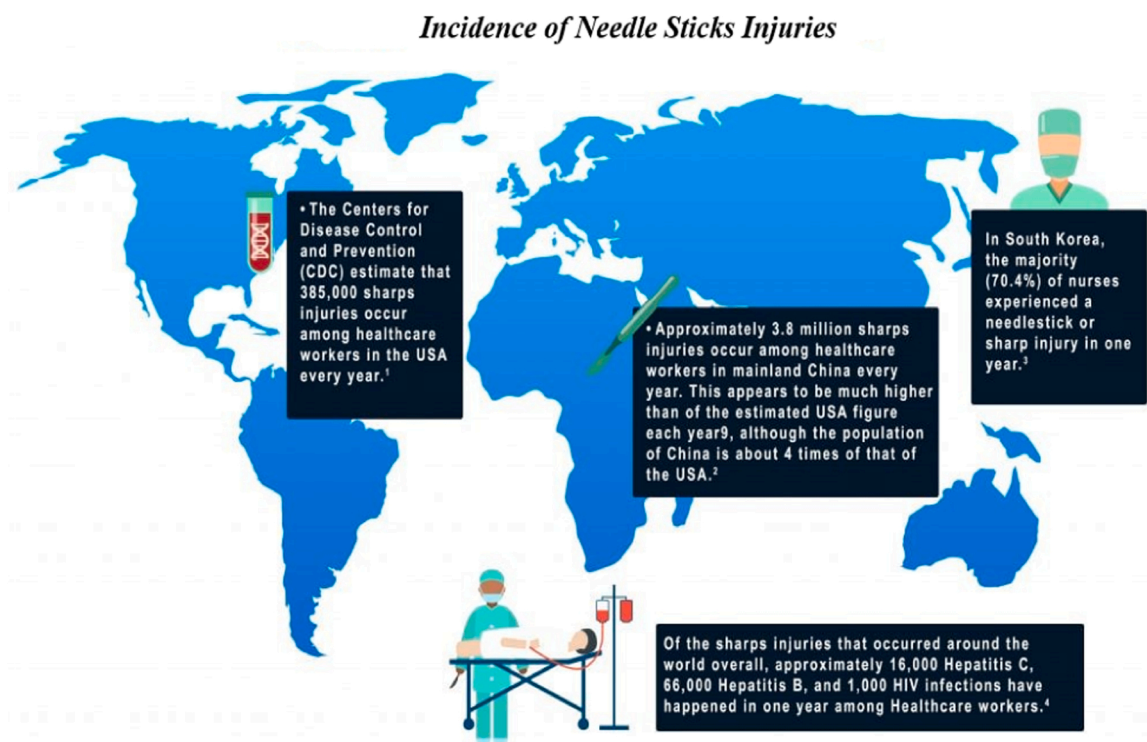
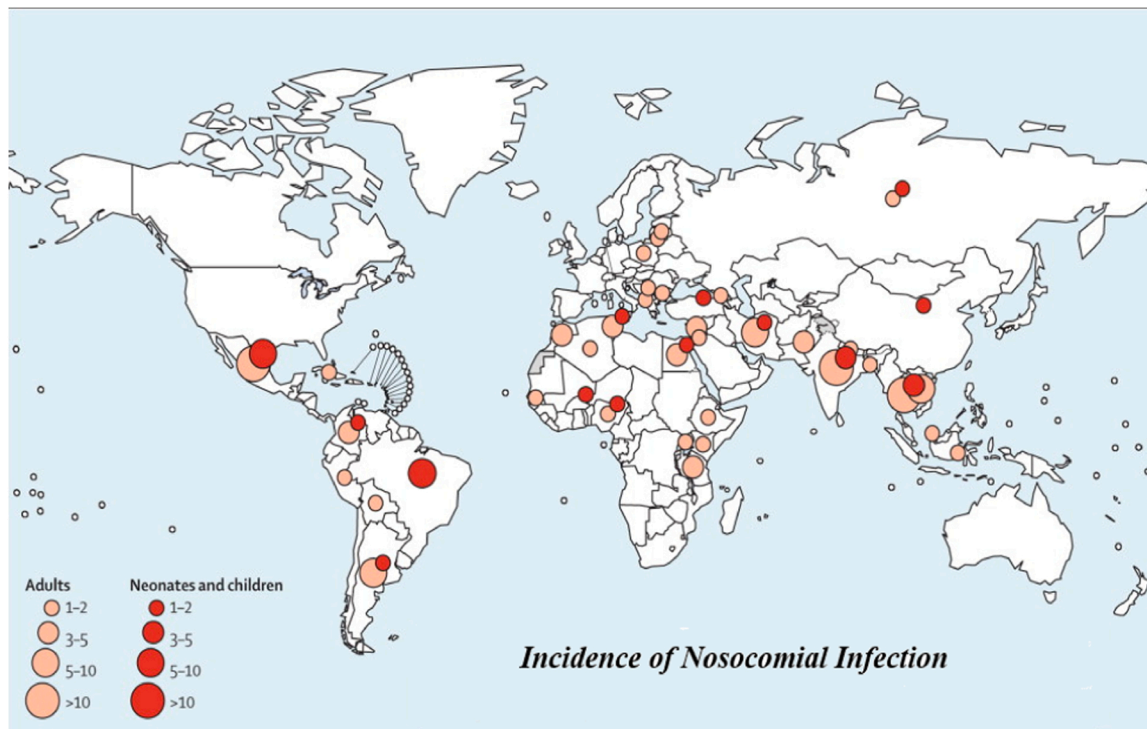


Fig. 4. Incidence of nosocomial infection, needle sticks injuries in the world.

that are transiently on the healthcare worker are readily removed with routine hand hygiene and limit the risk of transmission to the patient [103]. Hand hygiene also prevents colonization and infection in the healthcare worker and the contamination of the environment [103].

### 3.8.2. Patient education

Patients should be informed about the potential risk of developing HAI when receiving care. Healthcare workers should assess the patient’s risk factors for developing a specific infection and identify and address

ways to limit modifiable risk factors. Patients with modifiable risk factors should be educated on ways that they can reduce their risk of developing HAI. For example, smoking habits, cleaning, and not shaving the area before a surgical procedure can reduce SSI. Providers should be careful and cautious with the use of devices and the need for invasive interventions. Patients should be educated on appropriate antibiotic use and indications to prevent potential antibiotic misuse [48].

Summary of the association between hazardous pollutants, major sources and adverse health effects are presented in Table 1.

**Table 1**

Summary of the association between Nosocomial Infection and Needle Sticks Injuries, causative factor and adverse health effects.

Agents	The most important causative factor	Routes of Transmission	Adverse health effects	References
Nosocomial Infection	Bacteria (Gram-positive organisms include coagulase-negative Staphylococci, Staphylococcus aureus, Streptococcus species, Legionella species, and Aspergillus species, Enterococcus species, Gram-negative organisms include species of the Enterobacteriaceae family, including Klebsiella pneumoniae and Klebsiella oxytoca, Escherichia coli, Proteus mirabilis, and Enterobacter species; Pseudomonas aeruginosa, Acinetobacter baumannii, and Burkholderia cepacian), viruses (hepatitis B and C and human deficiency virus (HIV)), and fungi (Candida species, such as C. albicans, C. parapsilosis, C. glabrata), microorganisms,	Clostridioides difficile Infection (CDI), Pneumonia, Skin and Soft Tissue Infection (SSI), Central Line-Associated Blood Stream Infection (CLABSI), Catheter-Associated Urinary tract Infection (CAUTI), Intravenous catheterization, cytotoxic drugs, radiation therapy	Transmission of infectious diseases, Antimicrobial resistance, develop hospitalized patients, Not cost-effective,	[16,21,44,50, 55,71,86,90, 93]
Needle Sticks Injuries	A needle or sharp instruments	Blood transfusions, blood sampling, removal of needles and sharp instruments, skin, arteriovenous catheterization, cytotoxic drugs, venous implantation for patients, and the collection of blood and body secretions	hepatitis B virus (HBV), hepatitis C virus (HCV) and human immunodeficiency virus (HIV), Antimicrobial resistance, Not cost-effective, length of hospital stay,	[16,31,42,44, 79]

### 3.9. Limitations and strengths

The most important limitations of this study include the limitations of numbers of studies which as data source for the association between Nosocomial Infection and Needle Sticks Injuries, causative factor and adverse health effects.

### 4. Conclusions

The properly managed nosocomial infection and needle sticks injuries is very vital for avoid the issues associated creating nosocomial infections. In conclusion, it should be mentioned that the Nosocomial Infection and Needle Sticks Injuries are one of the most important risk factors that threaten the health of medical staff and patients and can cause high costs due to increased hospitalization time and more use of antibiotics and increase stress and psychological burden on patients' families and increase. Antibiotic resistance and increased occupational hazards due to needle sticking and transmission of dangerous infectious diseases due to needle sticking and reduction of occupational productivity of medical staff and reduction of quality of medical care.

We in this a review study, consideration of risk assessment of nosocomial infection and needle sticks injuries among patents and health care worker.

The results this study showed that an increase the level of knowledge and awareness health care worker about reduce causes of Nis and NSIs and its consequences can be reducing the number of mortality, control the occurrence of nosocomial bacteria infection, reducing hospitalization rates, decrease in incidence cases nosocomial infections and needle stick injuries, save on treatment costs and hospital costs. Therefore, it is recommended that further examination should be carried out to assess the nosocomial infections (NIs) and needle stick injuries (NSIs).

### Authors contributions

Study concept, design and critical revision of the manuscript for important intellectual content: Wanich Suksatan, Saade Abdalkareem Jasim, Gunawan Widjaja, Abduladheem Turki Jalil, Supat Chupradit, Mohammad Javed Ansari, Yasser Fakri Mustafa, Hayder A. Hammoodi, Mohammad Javad Mohammadi; drafting of the manuscript and advisor: Mohammad Javad Mohammadi, Gunawan Widjaja; performing the experiments Saade Abdalkareem Jasim, Supat Chupradit, Mohammad Javed Ansari; Revised the manuscript and finalizing Mohammad Javad Mohammadi, Yasser Fakri Mustafa, Hayder A. Hammoodi, and Wanich Suksatan.

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### Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

### Availability of data and materials

'Not applicable' for that specific section.

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### Consent to Participate

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### Consent to Publish

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