REVIEW ARTICLE

A Systematic Review of the Literature on the Unsafe Injection Practices in the Health-Care Settings and the Associated Blood-Borne Disease Trend: Experiences from Selected South Asian Countries

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ABSTRACT

Unsafe injection practices in the health-care settings are common occurrences in the low resource underdeveloped or developing countries. The unsafe injection practices are a global public health challenge because they involve a significant risk factor for the transmission of the blood-borne diseases (BBDs) such as hepatitis B, hepatitis C, and the human immunodeficiency virus worldwide. In this systematic literature review, our main focus is to analyze the current situation of the unsafe injection practices in the health-care settings in the low resource developing South Asian countries and to select the available research articles to gather the data for the meta-analysis. As per this review, the common unsafe injection practices in the South Asian countries are identified as (i) reuse of the needle, (ii) needle recapping, (iii) use of unsterile needles and syringes, (iv) improper disposal of the used needle and syringes, and (v) the overuse of the injection medication. Accidental needlestick injuries (NSIs) among the health-care staff and patients result from (a) needle reuse, (b) needle recapping, and (c) improper disposal after use. Improper disposal of the medical waste is another reason for the easy accessibility of the used needle and syringe from the disposal area to illegal sellers of contaminated needles. The risk of the BBDs among the patients and the healthcare workers results from the cumulative effects of the main three factors. These are the lack of awareness among the patients on the unsafe injection practices, an overuse of the injection medication by the healthcare workers to treat their patients and the unsafe injection practices. In this systematic review, the studies on the unsafe injection practice trends in some of the developed and developing countries with the main focus on the South Asian countries are selected to acknowledge the association of NSIs and the exposure to the BBDs among the healthcare workers (odd ration = 6.414, 95% confidence interval = 4.999 to 8.231, $P = 0.00$). Data from various studies have been extracted to calculate the event rates for the needle recapping, improper disposal, and reuse of needles. The statistical findings are provided with each figure in the result section under the meta-analysis.

Key words: Blood-borne infection, health-care providers, hepatitis B, hepatitis C, human immunodeficiency virus, needlestick injury, safe disposal of sharp, South East Asia, unsafe injection

INTRODUCTION

Injection is a common practice in the medical field. Out of total injections administered worldwide, 95% are administered for a curative purpose, and only 3% are administered for vaccination and the remaining 2% for other indications, for example, blood transfusion.[1] The unsafe injection practice is also very high in some countries. In 2000, globally, 16.7 billion injections were received annually, and 6.6 billion were made with the reused equipment.[2] The

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reuse rate is as high as 75% in some countries.[2] A prevailing misconception among the consumers and the providers are that the injections provide fast recovery from any specific disease when compared to the medication taken orally. The unsafe injection practices that include the reuse of needles and syringes and the improper disposal of the used needle are associated with a significant number of blood-borne infections (hepatitis B, hepatitis C, and human immunodeficiency virus [HIV]) among the healthcare workers and the patients.[2] The improper disposal of the used needle and syringes results in the illegal scavenging, repackaging, and reselling by the perpetrators.[3,4]

UNSAFE INJECTION PRACTICE IS A SIGNIFICANT PUBLIC HEALTH ISSUE IN DEVELOPING COUNTRIES

Health-care sectors in the developed countries are regulated by all the levels of the government. It is rare to see an untrained health-care provider without a license providing invasive procedures or administered injections in the developed countries.[5] In comparison, in many developing countries, the health-care system is not properly regulated, and the legislative framework and regulations in place are ignored and do not protect the patients and the healthcare workers' rights.[6] The developing and the underdeveloped countries' formal health-care sector are misconstrued as the informal health-care sectors influence a significant number of people. These informal sectors consist of untrained providers, traditional healers, faith healers, village doctors, alternative medicine, and quacks.[7] An effective infection control that includes the safe injection practices is an essential part of the health-care system in many developed countries. These countries have a strong public health capacity to implement the infection control mandates and have effective surveillance systems to monitor the healthcare-associated infections resulting from the needlestick injuries (NSIs). In contrast, the developing countries are still far behind in implementing the effective infection prevention and control measures such as the standard practices and additional precautions[8] and in having an effective surveillance system[9] for monitoring the blood-borne diseases (BBDs). In the developing countries, many health-care facilities do not have infection control policies.[7,10] Occupational health and safety should be considered as an essential component of any workplace. The occupational safety of the health-care workers in the developed countries is a high priority. Occupational injuries, such as the NSIs, are often underreported or unreported in the developing countries.[7] In many health-care settings, there are no policies to provide the post-exposure prophylaxis to prevent the blood-borne infections among the healthcare workers or for the patients who suffer from NSIs at the health-care settings.[3]

Finally, the developed countries spend an adequate percentage of their Gross Domestic Product (GDP) on health-care expenditure.[11] In comparison, the low resource countries spend an insufficient percentage of their GDP on health-care expenditure.[12] Hence, the health-care facilities are always under insufficient budgets to provide the adequate resources and staff training.

CHALLENGES IN IMPLEMENTING THE SAFE INJECTION PRACTICES IN THE LOW RESOURCE COUNTRIES

The healthcare workers in the developing countries often fail to receive the updated information on needle safety due to the geographical separation. For example, the health-care facilities in the rural areas may receive less communication from the teaching hospitals, or fewer opportunities to participate in the conferences and seminars.[13] The developing countries are also isolated from the developed countries in terms of getting up-to-date knowledge and resources.[7] Private health sectors may unjustifiably prescribe injections to receive extra money, and use the unused medication without medical need before the expiry date.[10,14] In many developing countries, injectable medications can be purchased without a prescription often from over the counter and unauthorized sources. These injections are administered outside of the health-care facilities, either by an unqualified injection man or the relatives. Thus, injection safety practices are jeopardized in different ways.[7]

BIOHAZARDOUS WASTE DISPOSAL IN SOUTH ASIAN COUNTRIES

There is a lack of segregation of the hazardous waste from the non-hazardous waste in many developing countries, producing an enormous amount of hazardous waste.[15] In spite of the various efforts to reduce the reuse of needles and syringes in the developing countries, the unsafe injection practices are still a major public health issue. In 2010, an estimated 33,800 new HIV infections, 1.7 million hepatitis B and 315,000 hepatitis C infections resulted from the unsafe injection practices.[16] In the South Asian countries, illegal scavenging from the easily accessible waste disposal site and reselling of the used needle and syringe multiplied the estimated risk. In many developing countries, the staff at the waste department manually sorts out the waste without any personal protective equipment such as thick puncture resistant gloves.[17] They are at high risk of the NSIs. Many health-care facilities do not have enough workforce, financial resources, or waste management systems. In some countries, there are no regulations or bylaws to enforce, whereas, in some countries, there is legislation against the improper

disposal of medical waste. However, these are still at an early stage and are not enforceable.[18]

A SYSTEMATIC REVIEW OF THE UNSAFE INJECTION PRACTICES IN THE HEALTH-CARE SETTINGS

Literature search

For this systematic review, articles were searched for in the PubMed, Scopus, and Google Scholar. Only articles with the full text have included in this review using several search strategies. For example, (1) "Unsafe Injection" and "Bangladesh," "India," "Pakistan," "Nepal," "Maldives" or "Sri Lanka" - a total of 1599 articles were found from PubMed. (2) "NSI" and "Blood-borne infection," "Hepatitis B," "Hepatitis C," or "HIV" and "Case–control study," "Experimental," "Control" or "Randomized Control Trial" and "Healthcare Workers" or "Nurse" - 22 articles were found from Pubmed, (3) "Injection," "Needle," and "Needle Stick" or "Unsafe Injection" and "Hepatitis B," "Hepatitis C," "HIV" or "blood-borne pathogen." (4) "Safe disposal of sharp" or "Biohazardous container," "Prevention or Reduction" and "Blood-borne infection," "Hepatitis B," "Hepatitis C" or "HIV" - 7 items were found from PubMed. (5) "NSIs," "healthcare workers," and "case–control studies"- a total of 202 articles were found in Scopus. (6) Google scholars - a total of 22 articles were found.

The total number of the articles found from the keyword search result was 1852. Many of these articles are excluded based on the abstract review. Articles are also excluded if they are not written in English and if the full text is not accessible from the online databases. Approximately 200 articles were selected based on the abstract review. Based on the full-text review, many of these articles are further excluded as they are not helpful to the analysis of the topic of interest such as the information that is not relevant to the developing or the underdeveloped countries or the South Asian countries. In addition, the references from some selected articles were reviews to examine the full text of the other relevant articles. The duplicated articles were removed from the list. After an appraisal of the listed articles, the total number of articles finally selected was 45. Out of these 45 articles, 22 articles are related to the studies conducted in India, Pakistan, Bangladesh, Sri Lanka, and Nepal.

Study objectives

The purpose of this systematic literature review is to (1) assess the unsafe injection practices at the health-care settings in the South Asian countries, (2) determine the prevalence of Hepatitis B, Hepatitis C, and HIV infection among the population with a history of unsafe injection practices or in a situation where the injection safety is unknown, and (3) establish an association of NSIs among the healthcare workers in the health-care settings due to various unsafe injection practices.

METHODS

A systematic review and meta-analysis were carried out to examine the variables related to the unsafe injection practices, the relationship between the unsafe injection practices and the NSIs, and the association of the NSIs with the occurrence of the BBDs. Data were extracted from the cross-sectional studies and case–control studies. The following quantitative analysis has been done using the comprehensive meta-analysis software:

1. The NSIs among the healthcare workers/patients from various unsafe injection practices in the health-care settings and the associated BBDs such as hepatitis B, hepatitis C, and HIV; to get the adequate data, the studies conducted in the South Asian countries as well as other countries are included in this meta-analysis.
2. Recapping of the used needles and the associated NSIs among the HCWs data were analyzed.
3. Specific unsafe injection practice trends such as the "reuse of injections and syringes" related data were extracted from the available studies to understand the unsafe injection practice trend in the south Asian countries.
4. Unsafe injection practices such as the rate of the inappropriate disposal of the sharp, the NSIs associated with the improper needles and the syringe disposal data will reflect the unsafe injection practice situation in the developing countries.

Inclusion criteria

This systematic review comprises the studies concerned with the unsafe injection practices in the health-care settings and NSIs due to unsafe injection practices such as recapping and improper disposal of sharps. Although this systematic review mainly aimed at the South Asian nations, it includes some key studies conducted in the countries outside of the south Asian geographical boundaries. Data from these selected studies were extracted to see the association between the unsafe injection practices and the transmission of the BBDs among the healthcare workers, which helped the reviewer to gather enough data on the various injection practice variables to conduct quantitative analysis.

Exclusion criteria

Studies that discussed the non-injection-related blood and the body fluid exposure among the patients and the healthcare workers are excluded. Data related to the injection practices in informal settings such as a private home or unregulated non-healthcare professionals (For example, tattoo, body piercing, and barber shop) are not included in this review. Articles without the full text and the articles written in the languages other than English are

excluded. Hepatitis and HIV transmission through blood transfusion is not included.

RESULTS

Descriptive analysis of findings from the systematic review

The important study findings related to the unsafe injection practices and the prevalence of hepatitis B, hepatitis C, and HIV among the population in the selected South Asian countries is highlighted in the following sections.

Pakistan

Evidence suggested that the unsafe injection practices and an overuse of the injections are the risk factors for the BBD transmission in Pakistan. The number of injections per person per year is about 8.5 in Pakistan.[19] The prevalence of Hepatitis B and Hepatitis C is high in Pakistan. In the South Asian countries, the prevalence of Hepatitis B is ranging from 2% to 8%,[9] and in 1999, the prevalence of Hepatitis C was 1–2.4%.[9] Due to the high prevalence of hepatitis B and hepatitis C among different population groups, the unsafe injection practices in the South Asian countries have strong implications for the transmission of infections. One study conducted in Darsano Channo,(subdistrict located 20 km north-east of Karachi, Pakistan) indicated that 44% of study participants were positive for Hepatitis C antibody and 19% of the participant was positive for Hepatitis B viral antibodies. These findings are interpretable as higher exposure or infection of Hepatitis C and Hepatitis B virus among the participants.[20] This same study also illustrated an injection overuse and unsafe injection practices among the study participants. For example, 44% of the participants in the study preferred injections over oral medication, despite both medications being equally effective.[20] About 81% of the total sample (165 individuals who were patients) received injections at the clinic while under the study, and a total of 73% of the participants were unaware whether the needle was sterile or not. 17% of the participants reported that the injection provider reused a needle, and only 10% said that they saw new syringes being drawn from the package.[20] Another case–control study result indicated that the unsafe injection practices are associated with most cases of hepatitis B and hepatitis C among the public health-care sector workers in the Jamshoro district, Pakistan.[13] The same study result shows that the Hepatitis C was associated with risk factors such as the NSI (odds ratio [OR] = 6; 95% CI = 1.4–23), recapping the needle (OR = 5.7; 95% CI = 1.1–28), female gender (OR = 3.4; 95% CI = 1–AQ4), and more than 10 years of formal education (OR =0.25; 95% CI = 0.07–0.8). Hepatitis B infections among the cases were associated with a bending or breaking needle after use (OR = 4.9; 95% CI = 1–24).[13] A protective factor was the higher numbers of years in formal education. It was also found that the women are more likely to be exposed than the male due to the female workers being more involved with immunization-related work and receiving inadequate training. The same study also found that 53.8% of the staff had NSIs within the past 6 months, and the frequency of the NSI rate varied in the different staff categories, such as 85.7% among the operation theatre staff, 66.7% among the vaccinators, 57% among the obstetric staff, 55.3% among the lady health workers, and 40% among the doctors.[13] Health determinants such as the lower level of education, female gender, incomplete doses of the Hepatitis B vaccine, and no injection safety training put the healthcare workers at high risk for a blood-borne infection. At the organizational level, inadequate occupational health and safety legislation, inadequate infection control guidelines to follow at the health-care facilities, and lack of resources are the common barriers to safe injection practices and a risk of exposure to the BBDs.[13]

India

Around 2%–8% of the Indian population have the HBV surface antigen (HBsAg), with a total of 50 million Indians being HBV positive.[21] A high prevalence of the reuse of needles resulted in a Hepatitis B outbreak with a total of 456 Hepatitis B cases and the deaths of 89 individuals in Gujarat, India, in 2009.[22] During this outbreak, a random sample of 25 patients (17 male and 8 female) was screened for HBV markers. 88% of the patients were positive for Anti-HBc IgM, and another 44% were positive for HBeAg. All the patients received the infected shots 2–3 months prior.[21] Unsafe injection practices are also very prevalent in the rural parts of India; about 77% of the health-care providers had unsafe injection practices, unfortunately, and the proportion was higher among the government health sector.[22] As with the other developing nations, unsafe injection practices are caused by a lack of awareness, inadequate health-care resources, and an increase in the demand for injection medication, and a lack of training among the staff.[22]

In January 1997, there was another Hepatitis B outbreak detected among the villagers in 3 villages (Khata-Amba, Parsa, and Charadu) located in the Mehsana district of the Gujarat State, India. An increase in the fatalities among the cases (46.7%) within 2–3 weeks of the illness onset was a trigger to the further investigation of the cases. The investigation result yields information on receiving an unsafe injection in most of the cases from an Ayurvedic and Unani medicine doctor.[23] The same study reported that the injectable antibiotics such as gentamicin, ampicillin, chloramphenicol, or deriphyllin were used by this informal practitioner in the rural areas using contaminated syringes and needles.[23] The study participants of one study also stated that they are the earning members of the family and need to recover quickly, so the demand for the injectable medication is high.[21] Due to the lack of a routine surveillance system especially in the rural areas, many hepatitis outbreaks may remain unnoticed.[21,23]

Bangladesh

In Bangladesh, the prevalence of hepatitis B and hepatitis C among the general public is high, and the estimated rate is 5.5–10% for hepatitis B and 2.8–3.6% for hepatitis C.[10] HIV is also on the rise due to the cross-border migration from India and Myanmar.[10] One study showed that anywhere from 3 to 8 million people have chronic hepatitis B virus (HBV) with positive HBsAg, and another 50 million Bangladeshis are infected with HBV which may not be symptomatic but are still infectious and capable of spreading the disease.[24] A study was conducted in the Savar, Dhaka, in 2007, to find the prevalence and risk factors for Hepatitis among the study population.[25] The study shows a high prevalence of Hepatitis B (5.5% of were positive for HBsAg, and 58.93% were HBeAg positive) among the sample population of 1018 individuals. The major risk factors of the transmission of HBV are indicated as receiving treatment from an untrained non-medical person (85.71%), intravenous injection (32.14%) or infusions (71.43%), and barbers (42.86%). Both, the needle reuse during mass vaccinations and the piercings of the nose and ears are the possible risk factors since many individuals reported as such.[25] Another study was conducted between May 2008 and February 2009, to assess the injection practices in 24 Upazila Health Complexes (UHC) from all the geographical divisions (Dhaka, Chittagong, Khulna, Rajshahi, Sylhet, and Barisal) in Bangladesh. In this study, the retrospective audit of the prescriptions on the injection use indicated that 78% of the study sample (n = 4230) received an injection and 60–80% of used injections were unnecessary or avoidable. Almost one-third of the injection providers reported a NSI in the past 6 months. Other problems such as the inappropriate disposal of injection needles, syringes, and other materials existed in 83.5% (n = 20/24) of the facilities. 73% (n = 87/12) of the injection providers and 90% (n = 43/48) of the waste handlers were not trained in the injection safety practices or infection control procedures.[10] Reports of overflowing containers were also prevalent with 80.7% of the facilities. There were loose injection materials scattered around the open areas. Two-third (81.5%) of the UHCs or the rural health-care facilities do not have a puncture-proof sharps container. Only 16.2% of the facilities were found with safe final waste disposal methods. 15.5% of the events are observed where the providers reuse the same syringes and needles up to 3 times (especially for the very poor patient).[10] Moreover, a study in Kamalapur, between June 2005 and November 2006, found that 582 (29%) participants were positive for HBV. Typical risk factors such as unsafe injection practices such as NSIs, visiting unregistered health-care providers, piercings, and circumcisions are the prevalent risk factors.[26]

Nepal

Between September 2012 and January 2013, a total of 69 health-care facilities were selected to conduct a study in the Kaski District of Nepal.[3] This study result illustrates the unsafe injection practices in the health-care settings in Nepal. During the study, 132 injections administered by injection providers were observed, and 96 injection providers were interviewed. The injection providers showed knowledge that at least one pathogen was transmitted by the unsafe injection practices. The injection providers in the urban health-care settings are significantly higher in number (75.6%) than their rural counterparts (37.3%), naming jaundice/hepatitis as one of the diseases transmitted by unsafe injection practices. The median number of the therapeutic injections and injectable vaccines administered per day by the injection providers were 2 and 1, respectively. Two-handed recapping by the injection providers was significantly higher in the urban area (33.3%) than in rural areas (21.6%). Most injection providers were not aware of the post-exposure prophylaxis guideline. A lack of awareness of the injection safety practices by the injection providers is probably why 51% of needles were recapped after use.[3] 22.6% of the health-care providers did not have a safety box to dispose of the used needle and syringe. Auto-disable syringes were used in all the cases of the vaccinations, and all the injection providers administered injectable therapeutic medicines using the single-use disposable syringes taken from sealed packages.[3] Open burnings of the hazardous waste were a common practice in the health-care facilities, and the selling of the used disposable syringes to the scrap purchaser also was prevalent. A lack of space and inadequate waste disposal are the contributing factors to these health problems.[3]

Sri Lanka

In Sri Lanka, HBV among the adult population is 1%, and HIV is <0.1%.[27] The current prevalence of HIV is higher due to the high HIV prevalence in the neighboring country, India.[24] There is a lack of the current statistical data on the BBDs in Sri Lanka. Unsafe injection practices are a risk factor for the transmission of BBDs from high-risk groups to the general public and the healthcare workers. A cross-sectional study conducted on the students of the University of Colombo, on the prevalence of sharp injuries among the 4th-year medical students, found that out of 190 students, 89% of the students experience one or more sharp injuries and there was no statistical difference between the males and the females.[27] Universal precautions during the procedures such as the avoidance of recapping and the avoidance of improper disposal of sharps were not followed, and both, the students and staff, lack an awareness of the universal precautions, and the consequences of the sharps injuries. The lack of resources, lack of anticipation of the injuries and inadequate practices in conducting the procedures are the main reasons for not adhering to the Universal precautions. 47% of the students who sustained a NSI completely ignored the event and only 5.7% of the students followed the accepted post-exposure treatment. Only 15% of the students reported that their knowledge regarding the sharps injury prevention and management was adequate. The majority (97%) believe

that the curriculum should put more emphasis on improving the knowledge and practice regarding the sharps injuries.[27]

Meta-analysis [Tables 1-5 and Figures 1-10]

In the meta-analysis section, we have incorporated Table 1 to 5 and Figure 1 to 10. Data from each table were input into the Comprehensive Meta-analysis Software to conduct statistical analysis, and the result of each table are present in two figures. The Figure 1 and 2 show the statistical analysis of data from Table 1. Similarly, Figure 3 & 4 show the statistical analysis of data from Table 2, Figure 5 & 6 show the statistical analysis of data from Table 3, Figure 7 & 8 show the statistical analysis of data from Table 4, and Figure 9 & 10 show the statistical analysis of data from Table 5. Each of these tables and figures is labeled to clarify the purpose of data collection and data analysis. For example, Table 1 related to the needle stick injuries among the healthcare workers and the associated blood borne diseases. The Figure 1 and Figure 2 show the statistical analysis of data from Table 1

DISCUSSION

Health-care provider's role

It is important to address the fact that in several instances, the health-care professionals' negligence is obvious in terms of not advocating for injection safety in their practice. Rather than taking a leading role to avoid the unsafe injection practices and an overuse of the injection medication, more emphasis is given to the administered injectable medication for less severe illnesses to keep the patient-flow high in their practice. Long-term disadvantages of an overuse of the high potent antibiotics or painkillers on the patients' health such as antibiotic resistance are not considered seriously. Quick recovery from the infection or pain is considered as an indicator of patient satisfaction, ignoring the fact that in the long run, unnecessary injections are harmful to the patient.

Shortage of resource

In general, inadequate health-care resources are a major challenge in many underdeveloped and developing countries. More specific to the injection safety issue, an inadequate supply of the pre-packaged sterile needles, syringes, bio-hazardous sharp containers to dispose of the used needles and personal protective equipment such as gloves are still major challenges. On many occasions, the poor patients receive unsafe injections as they failed to pay for the medicine or the injection equipment.

Inadequate training for the frontline healthcare workers

Several studies conducted in the South Asian countries revealed that the health-care providers are not concerned as they have a poor or an inadequate knowledge of the consequences of unsafe injection practices. Lack of infection control and prevention training, as well as an opportunity for continuing the education, is one of many barriers to keep their knowledge up to date on the safe injection practices. For example, the untrained healthcare workers involved in the vaccine administration role can jeopardize the vaccination process with the reuse of the needles and syringes among multiple patients.

Low-risk perception

A low-risk perception by the health-care providers is one of the significant factors for not being in compliance with the standard practices associated with injection. The "health belief model" described variables related to the perception of risk or threat, the perception of susceptibility, the perception of benefits and barriers have effects on people's decision on adherence to a health-promoting behavior or actions.[8] Healthcare workers face barriers to practice safe injection in developing countries. As discussed in the earlier section, the inadequate resource is a major barrier to safe injection practices. The health-care providers also perceived less threat as there is still a knowledge gap and a policy related gap in this area. One of the examples of the policy related gap is that many health-care settings have not established the guidelines to deal with the NSIs. As a result, the staff working in the health-care settings may not be familiar with the risk involved.

Inadequate research

One of the limitations of this study was to find the adequate amount of the current published literature on the unsafe injection practices in the south Asian countries. Thus, it was difficult to determine the true burden of the hepatitis infection results from the unsafe injection practices at the national level. There are many cross-sectional studies that provided data on the unsafe injection practices within a small geographical region or in a limited number of health-care settings in the rural or the suburban regions; however, they are not enough to generate a report on the unsafe injection practices at the national level. It is also difficult to say if these findings related to the unsafe injection practices are also applicable in the urban health centers where the health-care sectors are resourceful and deal with the high and middle-class urban dwellers who are educated and more concerned with their health. More research is required to get comparative data and determine the health disparities. Another limitation of this review is that the reviewers found a very limited number of case–control studies or cohort studies. Therefore, the reviews had a limited scope to include the study data or results free from the selection bias, information bias, or effects of confounding. There was no published literature found that related to the unsafe injection practices in Bhutan.

LESSONS LEARNED

In this review, we have included the data from several studies conducted in many developed and developing countries.

Table 1: The NSIs among the HCWs and the associated BBDs such as hepatitis B, hepatitis C, and HIV

Author and Year	Study design	Geography/ countries	Number of participants	Event or NSI	Outcome or seroconversion with the hepatitis B, C, or HIV
Cardo, 1997[28]	CCS	French, Italy, UK, USA	HCWs *n*=27 (case) *n*=488 (control)	Large–gauge (<18) hollow-bore NSIs. NSIs among cases=4 (15%) and NSIs among controls=6 (1.2%)	The seroconversion with the BBDs (HIV) after the needle-related injuries among the HCWs
Cardo, 1997[28]	CCS	French, Italy, UK, USA	HCWs *n*=33 (case) *n*=675 (control)	NSIs from the procedure involving needle in an artery or a vein. NSIs among cases=24 (73%) and NSIs among controls=7 (31%)	The seroconversion with the BBDs (HIV) after the needle-related injuries among the HCWs
Yazdanpanah, 2005[29]	CCS	5 European countries (France, Italy, Spain, Switzerland, and UK)	HCWs *n*=60 (case) *n*=204 (control)	Percutaneous exposure involving different kinds of needles. NSIs among cases=60 (100%) and NSIs among controls=171 (83.8%)	The seroconversion with the BBDs (hepatitis C) after the needle-related injuries among the HCWs
Yazdanpanah, 2005[29]	CCS	5 European countries (France, Italy, Spain, Switzerland, and UK)	HCWs *n*=60 (case) *n*=204 (control)	Percutaneous exposure involving Hollow bore needle in a vein or an artery. NSIs among cases=48 (80%) and NSIs among controls=78 (38.2%)	The seroconversion with the BBDs (hepatitis C) after the needle-related injuries among the HCWs
Alemayehu, 2016[30]	CCS	Ethiopia	HCWs *n*=391 (case) *n*=429 (control)	Percutaneous exposure or sharp injury (include needle stick, lancet, and glass related). # of event among cases=217 (26.5%) and # of event among controls=0% or 0	The seroconversion with the BBDs (hepatitis C) after the needle-related injuries among the HCWs
Canini, 2008[31]	CCS	Brazil	HCWs *n*=200 (case) *n*=200 (control)	Percutaneous injury associated risk factor like recapping of used needles (event). # of event among cases=132 (66%) and # of event among control=29 (14.5%)	Case=HCWs who reported the percutaneous injury. Control=HCWs who did not report any percutaneous injury
Sohn, 2015[32]	CCS	Republic of Korea (Busan, Gyeongnam, Jeonnam Provinces in Korea)	Patient *n*=234 (case) *n*=234 (patient control)	Needlestick Injury is a risk factor among the cases and the controls. NSIs among cases=18 (7.7%) and NSIs among controls=2 or 0.9%	Case=HCV positive patient. Control=Hepatitis C virus negative patient Risk factors (e.g., NSIs)
Gorar, 2014[13]	CCS	Pakistan (Sindh province and Jamshoro District)	HCWs *n*=81 (case) *n*=83 (patient control)	NSI is a risk factor among case and control. NSIs among cases=47 (58%) and NSIs among controls=24 (28.9%)	Case: HCWs with positive hepatitis C antibody and HBsAg. Control: Patient who do not have hepatitis C antibody or presence of HBsAg

CCS: Case–control study, NSIs: Needlestick injuries, HCWs: Healthcare workers, BBDs: Blood-borne diseases, HIV: Human immunodeficiency virus, HBsAG: HBV surface antigen, HCV: Hepatitis C virus

Table 2: The unsafe injection practices (the NSIs result from the recapping of the used needles by the HCWs)

Identifying number	Author, year of publication	Study design	Country	Sample size=*n*	Needle recapping data	Results of statistical analysis	*P* value
1	Gyawali, 2015[3]	CSS	Nepal, Kaski district	Sample # *n*=96	One handed recapping=21 (21.9%)	Chi-square=19.AQ59	*P* value <0.001
1	Gyawali, 2015[3]	CSS	Nepal, Kaski district	Sample# *n*=96	Two-handed recapping=26 (27.1)		
2	Gorar, 2014[13]	CCS	Pakistan, Sindh province	Sample # *n*=164	Not provided	Unadjusted OR 1.2 95% CI (0.36–4.4) for hepatitis B positive HCWs	*P*=0.7
2	Gorar, 2014[13]	CCS	Pakistan, Sindh province	Sample # *n*=164	Not provided	Unadjusted OR=3. 95% CI (0.92–9.9) for hepatitis C positive HCWs	*P*=0.06
3	Zafar, 2009[17]	CSS	Pakistan, Sindh province	Sample # *n*=1382 NSI	Mean of the NSIs due to recapping between the year of 2002 and 2007=12.25%		
4	Canini, 2008[31]	CCS	Brazil	Case (HCWs with PCIs) =200, Control (HCWs without PCIs)=200	Recapping among cases: Yes=132 (66%) No=68 (34.0%) Recapping among controls: Yes=29 (14.5%) No=171 (85.5%)	Unadjusted OR for recapping=11.44 95% CI=(7.00–18.69)% and unadjusted odd ratio for no recapping=1	Not provided
5	Yao, 2012[33]	CSS	China	Study participant (nursing student) *n*=246	Recapping associated NSIs among nursing students: Before intervention=230 (20.11%) After intervention=4 (1.62%)	Chi-square=3.9	
6	Rais and Jamil, 2013[34]	CSS	Pakistan, Sindh province	HCWs *n*=100	Recapping of needle by HCWs; Yes=88 (88%); No=12 (12.0%); Total number of NSIs=76.92 (100%). # of NSIs due to recapping=15 (19.5%)		
7	Yoshikawa, 2013[35]	CSS	Japan, 67 HIV referral hospitals	Total NSIs *n*=5,463	Recapping as a cause of NSI=476 (8.7%)	Mean=0.6. 95% CI=(0.5–0.7)	*P* value=0.76
8	Vong, 2002[36]	CSS	Cambodia (Takeo province and Phnom province)	Participants=60 (30 prescribers and 30 injection providers)	Two-handed recapping of used needles=58%	Not provided	Not provided

(Contd...)

Table 2: (*Continued*)

Identifying number	Author, year of publication	Study design	Country	Sample size=*n*	Needle recapping data	Results of statistical analysis	*P* value
9	Alemayehu, 2016[30]	CCS	Eastern Ethiopia	Case=HCWs with a history of NSI=391 and Control=HCWs with no history of NSIs=429	# of NSIs among cases=108 (27.62%) and # of NSIs among control=0 (0%) Total # of NSIs due to recapping=18 (9.8%)	Not provided	Not provided
10	Guo, 1999[37]	CSS	Taiwan 16 hospital	HCWs *n*=8645 (82.4%)	# of NSIs due to recapping=1809 (24.0%)	Not provided	Not provided

CCS: Case–control study, NSIs: Needlestick injuries, HCWs: Healthcare workers, BBDs: Blood-borne diseases, HIV: Human immunodeficiency virus, CI: Confidence interval, OR: Odds ratio

Although the developed countries have infection control and prevention strategies in place to mitigate the healthcare-associated blood-borne infections from the unsafe injection practices, the accidental NSIs, and the unsafe injection practices have not been completely eliminated. In comparison to many developed nations, in the South Asian countries, the health-care sectors located in both, the urban and the rural areas, without proper infection control policies are seriously at risk for being the potential exposure ground of the blood-borne infection from the NSIs. Due to a lack of the NSI reporting requirement, the healthcare-associated outbreaks of the blood-borne infections also remain unreported and undiagnosed.

Due to various competing healthcare issues, the injection safety policy is on the back burner in many underdeveloped countries.[48] Long-term disabilities and complications associated with the BBDs have significant burdens on the society and the health-care system,[48] so the injection safety issues need to be addressed to ensure long-term health-care benefits. The World Health Organization has recommended the national injection safety strategies to improve the unsafe injection practice situations in the low resource countries.[49]

It is also important to utilize the available resources with care, and the prioritization of the high-risk areas is required to reduce the healthcare-related disparities. For example, healthcare workers need to ensure that they are immune to Hepatitis B by doing a serology or blood work. Another example is that every health-care facility needs to take the responsibility to manage their medical, hazardous waste at the local level. Rather than reinventing the wheel, the authorities should first see how the existing system and legislation can be applied to improve the situation at a local level. In addition to the local efforts, the Government should implement the national injection safety strategies.

CONCLUSION

This systematic literature review has highlighted the current situation of the unsafe injection practices in the South Asian countries and their contribution to the overall burden of BBDs in these developing and underdeveloped countries. The magnitude of the total situation in these countries is difficult to portray due to a lack of the population-level data from the adequate surveillance systems and the underreporting of the healthcare-associated blood-borne infections. One of the successes of this literature review is in identifying the most common unsafe injection practices in the primary health-care sectors in the South Asian countries. The review also addressed several barriers to the successful implementation of the safe injection practice related programs at the health-care facilities. Some of this information can be applied to plan and implement injection safety programs. In conclusion, we would like to emphasize that a multifaceted intervention

Table 3: The reuse of needles and syringes in the South Asian countries

Study #	Author's name and year of publication	Study design	Geography	Study sample size=*n*	Reuse of needle and syringes/unsterile syringes
1	Chowdhury, 2011[10]	CSS	Bangladesh (6 divisions)	*n*=4230	The total # injection administration events were observed=480 # of the reuse of the same syringe or needle by HCWs=74.4 (15.5%)
2	Janjua, 2016[38]	Systematic review	India	Percentage available	62.9% injections were considered unsafe
3	Janjua, 2016[38]	Systematic review	Pakistan (Sindh province survey)		49% of injections were provided with reused syringes (as per the national HBV and HCV survey)
4	Janjua, 2016[38]	Systematic review	Western Nepal	*n*=2470	95% of injections were provided with a new single-use syringe 5% of injections were not provided with a new syringe
5	Shill, 2011[39]	CSS	Bangladesh (at 6 upazilla Health complex- Dhamrai, Dohaar, Keranigonj, Savar, Shaturia, Singair)	*n*=1048	Reuse of syringe or needle=0% New syringe used=100% Unsafe injection practices (such as lack of hand washing by staff or lack of disinfection of the injection field or area)=50%
6	Khan, 2000[20]	CSS	Pakistan, DarsanoChanno	*n*=203	17% of the participants reported the reuse of syringes 10% observed new syringe being drawn from the packet and 73% patient does not know if the sterile syringes were used
7	Janjua, 2005[14]	CSS	Pakistan, Lyari (an urban town in Karachi) and Digri (a rural sub-district in Mirpur Khas district)	*n*=575 from an urban and 575 from a rural setting. total=1150	# of total injection provided=848 450 (53%) of injection were used a freshly open syringe. 398.56 (47%) injections were not open from the new packages in front of patients or at the injection sites

(Contd...)

Table 3: (*Continued*)

Study #	Author's name and year of publication	Study design	Geography	Study sample size=*n*	Reuse of needle and syringes/unsterile syringes
8	Singh, 1998[23]	CSS (hepatitis B outbreak investigation)	India, 3 affected villages (Khata-Amba, Parsa, and Charadu)	# of cases=15 and # of healthy person=31 Sample size *n*=46	89.13% of study participants received unsafe (reuse of needle and syringes) injection by informal injection providers
9	Altaf, 2013[40]	CSS	Pakistan (Tando Allahyar, Sindh)	*n*=300 (participant)	45 or 15% of participants were aware that the syringe was new. 75% (*n*=219) did not know if the syringe was new or not
10	Gupta, 2013[22]	CSS	India, Sabarkantha district, Modasa Town, Gujarat	*n*=25 (100%) of the admitted patient	25 (100%) of study participants reported having an unsafe injection

CCS: Case–control study, HCWs: Healthcare workers, HCV: Hepatitis C virus, HBV: Hepatitis B virus

Table 4: The improper disposal of needle and syringes by the HCWs at the health-care settings in the developed and the developing countries

#	Author and Year	Study design	Geography/ country	Subpopulation	Sample size	Number of Improper needle disposal data
1	Gyawali *et al.*, 2015[3]	CSS	Nepal, Kaski district	HCWs	*n*=53	Safety box was available near to injection site=41 (77.4%) Safety box or needle/ sharp disposal box was not available near to injection site=12 (22.64%)
2	Vong *et al.,* 2002[36]	CSS	Cambodia, Takeo province, and Phnom Penh city	HCWs	Injection provider *n*=60	Improper disposal of needles and syringes by 13% of injection provider
3	Wu *et al.*, 2014[41]	CSS	China	HCWs	*n*=1783	Proper disposed of sharps immediately after injection=1435 (80.5%) Improper disposed of sharps=348 (19.51%)
4	Yao *et al.*, 2009[42]	CSS	China	HCWs	*n*=248 (#of participants)	Used needles or sharp instruments were not timely places in a specific container = 273 (23.91%) Sharp containers were properly used = 845 (76.09%) times

(Contd...)

Table 4: (*Continued*)

#	Author and Year	Study design	Geography/ country	Subpopulation	Sample size	Number of Improper needle disposal data
5	Mohammadi *et al.*, 2011[43]	CSS	Central Iran, Qazvin	HCWs	*n*=138	Correct approach to discard needles=49 (35.5%) Incorrect approach to discard needle=89 (64.49%)
6	Wood *et al.*, 2001[44]	Prospective Cohort study	Vancouver, Canada	IDUs	*n*=776	Number of safe needle disposal=354 (45.6%) Number of unsafe needles disposal=422 (54.38%)
7	Yao *et al.*, 2013[33]	Intervention Study (CSS)	China	Nursing students	*n*=246	Before providing education to nursing students: Appropriate use of sharps containers=187 or 76.09% and no use of sharps container immediately after working with needles=56.58 or 23.91% Improper disposal rate was reduced to 0% after receiving the education
8	Ersin *et al.*, 2016[45]	Semi-experimental study	Turkey	HCWs	*n*=144	38 (26.4%) HCWs answered wrong before training (e.g., change sharp box when completely full) and 4 (2.8%) answered wrong after receiving training
9	Sangeetha *et al.*, 2015[46]	Intervention study (CSS)	India, Bangalore	HCWs	*n*=17	Inappropriate use of sharps container is 38 or 24.21%
10	Chowdhury *et al.*, 2011[10]	CSS	Dhaka, Bangladesh	HCWs	*n*=120 *n*=480 injection provided by 120 HCWs	Used syringes and needle disposed of Immediately after injection into sharp container=88.8 or 18.5% Used needle and syringe were not immediately disposed of after injection=391.2 or 81.5%

IDU: Intravenous drug users, CCS: Case–control study, HCWs: Healthcare workers

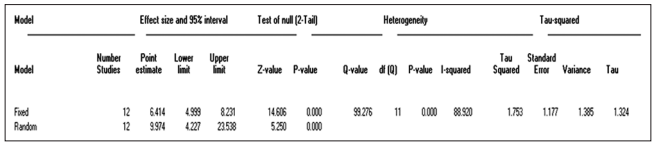

Figure 1: The calculated effect size and 95% confidence interval, p-value, measures of (within and between) study variances of selected studies (Table 1) both by random and fixed model

approach is essential to ensure safe injection practices at different health-care facilities in the South Asian countries.

Unsafe injection practices in the health-care sectors are associated with the BBDs among the staff and the patients. Many of these reviewed articles address the multiple challenges associated with the unsafe injection practices. Some of these include poverty, literacy level, competing needs at the health-care sectors, profitable business at the private sector, lack of resource, lack of awareness, inadequate staff training, sociodemographic and geographical factors, lack of advocacy, and inadequate actions from the government to reform the health-care sectors. As many of these issues are

Table 5: The improper disposal of needles and syringes and the associated NSIs among the HCWs

Identifying #	Author and year of publication	Study design	Geography/ country	Study population	Sample size (*n*)	NSI related to improper needle and sharp disposal by HCWs	Statistical analysis results
1	Yoshikawa, 2013[35]	CSS	Japan, Kawasaki	HCWs	*n*=5463	409 (7.5%)	Mean=0.5 95% confidence interval is 0.4–0.5
2	Samargandy, 2016[52]	CSS	Saudi Arabia	HCWs	*n*=302 percutaneous exposure	49 (16.8%) percutaneous exposure due to improper sharp disposal	
3	Alemayehu, 2016[30]	CCS	Ethiopia	HCWs	*n*=820 HCWs	*n*=217 sharp injury. Average=19.53 or 9%. Results from improper disposal	
4	Guo, 1999[37]	CSS	Taiwan	HCWs	*n*=8645	A total number of NSIs=5431 NSIs due to improper sharp disposal=80.66 or 1.4%	
5	Tomkins, 2010[47]	CCS	Italy, Spain, and Japan	HCWs	*n*=626 Case=13 (seropositive HCWS after NSIs) and Control=503 (seronegative after NSIs)	#of NSIs result during/ after needle/sharp disposal among cases=3 and # of NSIs result during/after needle/sharp disposal among controls=121	Unadjusted OR=1.1 (0.8–1.5)
6	Zafar, 2009 [17]	CSS	Pakistan	HCWs	*n*=1382 (NSIs)	162 or 11.75% injuries related to garbage collection	
7	Rais and Jamil, 2013[34]	CSS	Pakistan, Karachi	HCWs	*n*=77 (NSIs)	6 out of 77 total NSIs are related to improper needle and sharps disposal	

CCS: Case–control study, NSIs: Needlestick injuries, HCWs: Healthcare workers, OR: Odds ratio

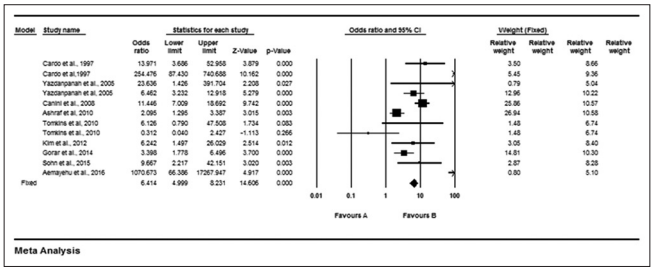

Figure 2: This forest plot shows the crude odds ratio (OR) for needlestick injuries and the associated risk of the blood-borne diseases in each study and the pooled crude OR of all included studies (Table 1). *P* value is 0.000 which is <0.05. Therefore, the finding is statistically significant

out of the scope of this review, we would like to recommend some important prevention strategies to ensure safe injection practices in various health-care sectors. These include: (1) to increase the knowledge and awareness of the unsafe injection practices among the health workers and the public through different routes such as media coverage, upgrading the relevant medical practice guidelines, and continuous education, and training for staff, (2) to establish a national level surveillance to identify the true burden of the blood-borne infections, (3) to implement Hepatitis B vaccination strategies for the public and the healthcare workers, and (4) to ensure that the adequate supplies are available to provide the injection safely, which is a very basic healthcare need. For Example, various international health organizations such as WHO and UNICEF have recommended auto-disabled (AD) syringes for the administration of the vaccine to reduce the reuse of syringe and needle. These international agencies also came to an agreement that all of the injectable vaccines that

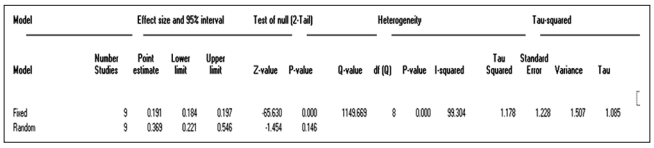

Figure 3: The calculated effect size and 95% confidence interval. *P* value, measures of (within and between) study variances of selected studies (Table 2) both by random and fixed model

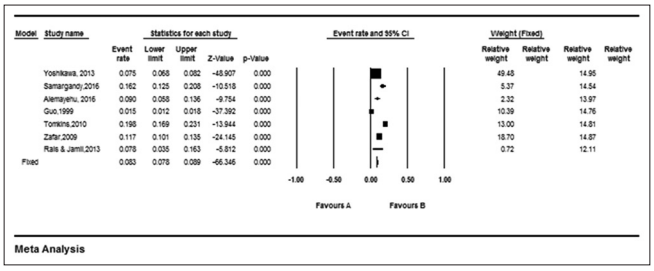

Figure 4: This forest plot shows the crude event rate for the recapping of used needles by the healthcare workers in each of the selected study and the pooled event rate of all included studies (Table 2). By the fixed model, *P* value is 0.000 which is <0.05 and therefore, the finding is statistically significant

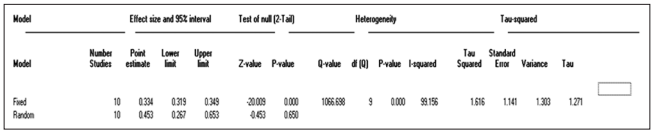

Figure 5: The calculated effect size and 95% confidence interval. *P* value, measures of (within and between) study variances of selected studies (Table 3) both by random and fixed model

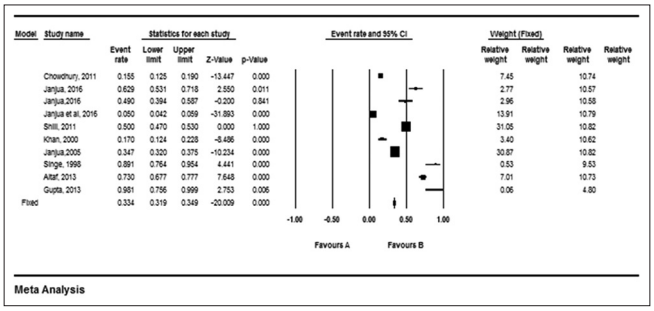

Figure 6: This forest plot shows the crude event rate for the reuse of needle and syringe in each the study and the pooled event rate for the reuse of needles and syringes in all included studies (Table 3). By the fixed model, *P* value is 0.000 which is <0.05 and therefore, the finding is statistically significant

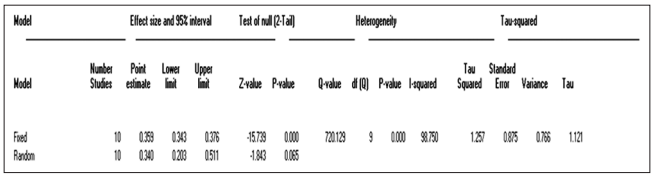

Figure 7: The calculated effect size and 95% confidence interval. *P* value, measures of (within and between) study variances of selected studies (Table 4) both by random and fixed model

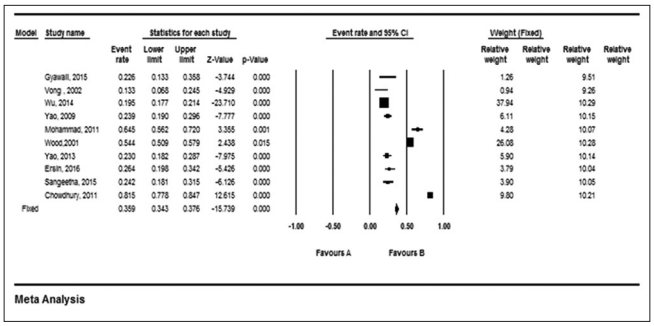

Figure 8: This forest plot shows the crude event rate for the improper disposal of needle and syringes by the healthcare workers in the health-care settings in each of the study and the pooled event rate of all included studies (Table 4). By the fixed model, *P* value is 0.000 which is <0.05, and the finding is statistically significant

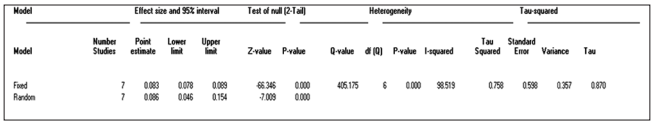

Figure 9: The calculated effect size and 95% confidence interval. *P* value, measures of (within and between) study variances of selected studies (Table 5) both by random and fixed model

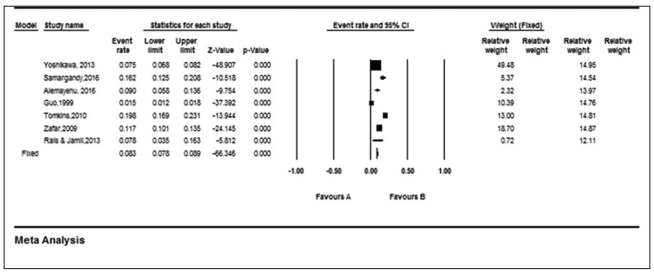

Figure 10: This forest plot shows the crude event rate for the needlestick injuries related to the improper disposal of used needle and syringes by healthcare workers in each of the study and the pooled event rate of all included studies (Table 5). By the fixed model, *P* value is 0.000 which is <0.05, and the finding is statistically significant

are purchased through these agencies should also include the supply of AD syringes and puncture proof safety boxes[50,51] to ensure there are national infection safety strategies[49] in place to progress toward the long-run success in this issue.

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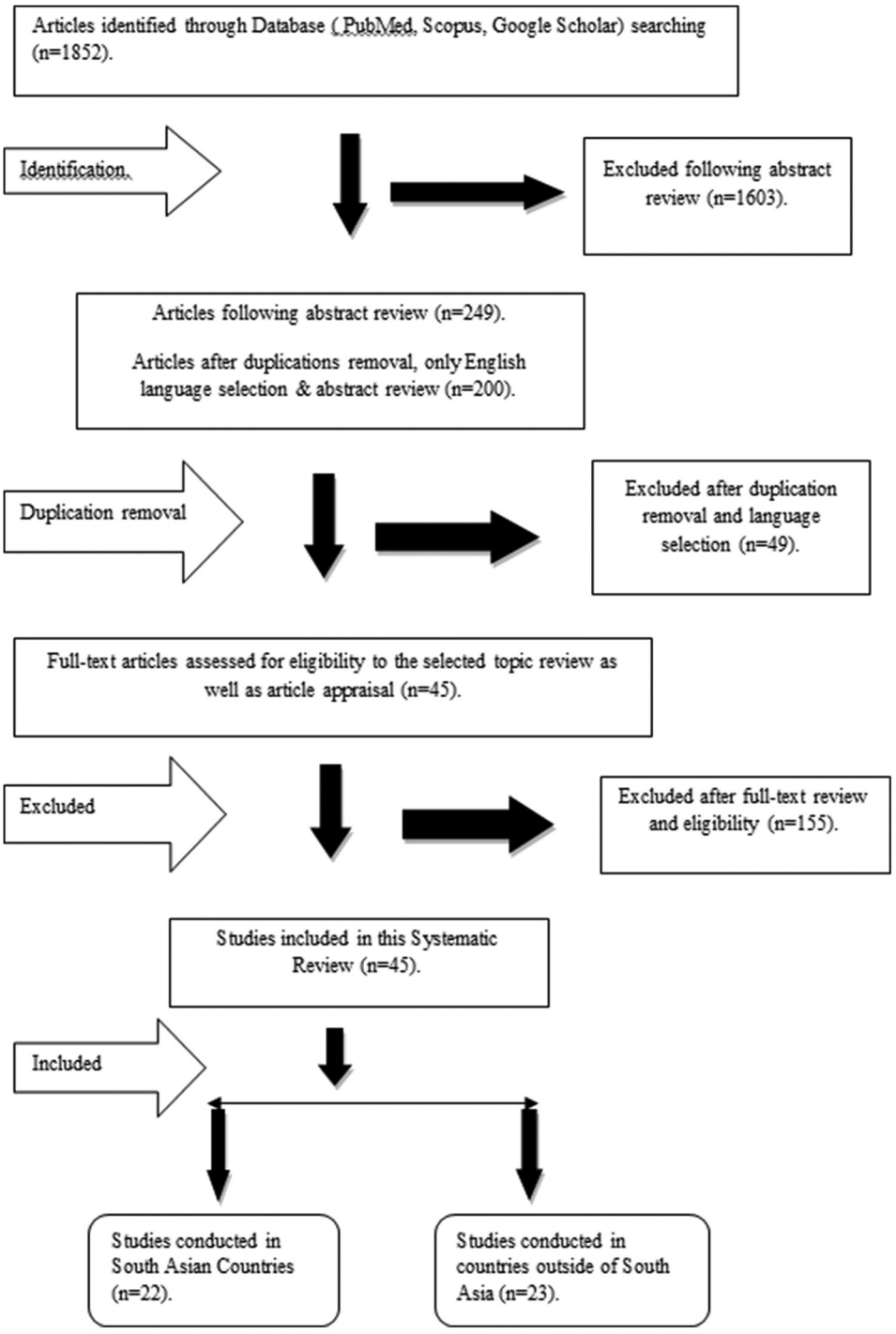

Figure 11: This flow chart shows the inclusion and exclusion process of potentially eligible articles

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