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Prevention of Blood-borne Infections in Hospital Settings

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Abstract

Introduction: Blood-borne virus infections are caused by HIV, HBV, or HCV and are known for a high prevalence worldwide and significant associated morbidity and mortality. This review focused on the occurrence and prevention of blood-borne infections among health workers.

Methods: The electronic databases for the reviewed articles including Embase, CINAHL, OVID Medline, PubMed, Web of Science, and Foreign Medical Literature Retrieval Service (FRMS), were searched systematically and independently by two authors. The language of the literature was limited to English. Meanwhile, the System for Information on Grey Literature was also searched to reduce publication bias. Two authors performed the literature selection independently. The review question was formed in terms of PICOD elements (population, intervention, comparison, outcome, and design of study. The primary outcome for this review was healthcare worker exposure rates to bloodborne pathogens.

Results: the literature points to a number of opportunities for intervention and engagement such as pre-and post-travel advice, use of HIV treatments as prevention to reduce community viral load, in-country outreach and online and other health promotion

interventions. This is despite a number of previously completed reviews and policy documents , which provide explicit recommendations such as developing and increasing links and partnerships with affected communities, and creating closer cooperation with policy and support sectors in both origin and destination regions . Such methods may be disposed to measurement error which may weaken validity of findings. High-income countries have seen increasing acquisitions of overseas acquired blood-borne infections. Whist those travelling to and from countries with significant prevalence particularly of HIV have been identified as priority populations in a number of strategic frameworks.

Conclusions: The risk for health workers to be exposed to rare "exotic" pathogens increases with intercontinental travel and migrations. Emerging disease risks are also associated with progress in medical techniques, changes in nutritional or other social habits, or ecologic changes. Although the principal risks to which PEP experts are confronted are linked with HIV, HCV, and HBV, these experts must also be able to suspect other, less common transmissible pathogens. Clinicians should systematically follow up personnel who have sustained exposure to other pathogens.

Keywords: ***Blood-borne, Infection, Prevention , Control, Hepatitis***.

Introduction

Healthcare workers provide patient care in environments that are considered to be one of the most unsafe occupational settings . Occupational hazards that include biological, chemical, physical, ergonomic, psychosocial, fire and explosion, and electrical hazards threaten healthcare worker lives, safety, and well-being. Globally, it is estimated that 1 in 10 healthcare workers, experience a sharp injury every year . In the year 2000, sharps injuries to healthcare workers resulted in 16,000 hepatitis C virus (HCV) infections, 66,000 hepatitis B virus (HBV) infections, and 1,000 human immunodeficiency virus (HIV) infections. Between 2000 and 2030, these infections are estimated to cause 145 premature deaths due to HCV, 261 premature deaths due to HBV, and 736 premature deaths due to HIV [1]. In sub-Saharan Africa, the limited studies conducted have demonstrated that healthcare workers are frequently exposed to biological, chemical, and physical occupational hazards [2].

There are well-established guidelines to prevent exposure to occupational hazards, including blood and bloodborne pathogens. Furthermore, the World Health Organization (WHO) has instructed governments to transition to the exclusive use of safety injection devices by 2020 . Apart from provider behaviors that increase exposure to occupational hazards, system-level barriers increase the risk of exposure to hazards in the healthcare setting. Unsafe conditions in the healthcare environment, lack of personal protective in equipment (PPE), and high provider to patient ratio increase the risk of exposure to bloodborne pathogens and cause preventable infections [3]. Healthcare workers in four African countries (Cameroon South Africa Uganda and Zimbabwe), have reported that the top four reasons for migrating to developed countries include better remuneration, safer work environment, living conditions and lack of facilities . The World Health Report Working Together for Health drew attention to the severe healthcare worker shortages in 57 countries, most of them in Africa and Asia. In western Europe, the number decreased in Infectivity of patients with HIV. HIV has been isolated from many organs and tissues, including bone. Body fluid which contains even microscopic traces of blood is a potential source of infection [4].

Blood-transfusion therapy is integral to management of diverse hematological and other diseases. Prevention of transfusion-transmitted infectious agents (TTIs) remains a key element of blood-transfusion safety. Attributes of TTIs that pose greatest risk to blood safety include an asymptomatic infectious phase in the donor and the ability to persist despite processing and storage ; furthermore TTIs must be associated with clinically significant adverse outcomes to warrant intervention [5]. The responses to potential TTIs have advanced remarkably in terms of speed of assessment and implementation and efficacy of interventions, yet continue to be constrained by the need to strike a balance between blood availability,

cost, and safety [6]. Data from initial HBsAg screening demonstrating higher rates of infection in paid donors led to conversion to an all-volunteer blood supply in the United States and many other countries in the mid-1970s. Over the ensuing decades, donor deferral criteria have been implemented to exclude donors with infectious disease risk factors, testing for major TTIs has been enhanced, and systematic approaches for surveillance and responses to potential emerging infectious diseases (EIDs) have been developed. Also, it has been recognized that in addition to "classic" TTIs that cause chronic asymptomatic infections in donors, other agents that cause acute infections may be transmitted at significant rates if there are focal epidemics or ongoing vector-mediated or recurrent seasonal transmission [7]. Donor deferrals were implemented to reduce the risk of variant Creutzfeldt-Jakob disease (vCJD) and several other agents during outbreaks. Overview of current risks and laboratory screening to reduce these risks in the United States Laboratory screening of blood donors for the classic TTIs (HIV, hepatitis B virus [HBV], hepatitis C virus [HCV]) has evolved from performance of progressively more sensitive serological assays in the 1970s to 1990s to adoption of nucleic acid-amplification technologies (NATs) to detect acute window period (WP; when donor-screening markers are not yet detectable but a transfusion is still infectious) and occult infections [8].

The microbes that colonize catheter hubs and the skin surrounding the insertion site are the source of most catheter-related bloodstream infections . Therefore, successful preventive strategies must reduce colonization of the insertion site and hubs or minimize microbial spread extraluminally from the skin or intraluminal from the hubs toward the catheter tip lying in the bloodstream (Figure). Inhibiting the adherence and growth of pathogens that reach the intravascular segment of the catheter would also be ideal [8]. Preventive strategies are reviewed in the order in which one would approach a patient undergoing intravascular catheterization. Prophylaxis with vancomycin or teicoplanin during central venous catheter insertion has not been demonstrated to reduce the incidence of catheter-related bloodstream infection [9]. However Centers for Disease Control and Prevention guidelines recommend against prophylactic use of vancomycin because it is an independent risk factor for acquisition of vancomycin-resistant enterococci. Prolonged administration of vancomycin-containing dialysate through peritoneal dialysis catheters is associated with peritonitis due to Staphylococcus epidermidis, with markedly reduced susceptibility to vancomycin and exit-site colonization with vancomycin-resistant enterococci. Prolonged use of systemic vancomycin to treat S. aureus infection is associated with development of intermediate resistance to vancomycin and subpopulations of S. aureus with reduced vancomycin susceptibility. Thrombus formation on indwelling intravascular catheters is associated with catheter-related bloodstream infection. Most heparin solutions contain preservatives with antimicrobial activity. No randomized trials have assessed the risk for infection associated with catheter insertion into the subclavian, internal jugular, or femoral vein. Blood-borne virus infections are caused by HIV, HBV, or HCV and are known for a high prevalence worldwide and significant associated morbidity and mortality [10]. This review focused on the occurrence and prevention of blood-borne infections among health workers.

Methods

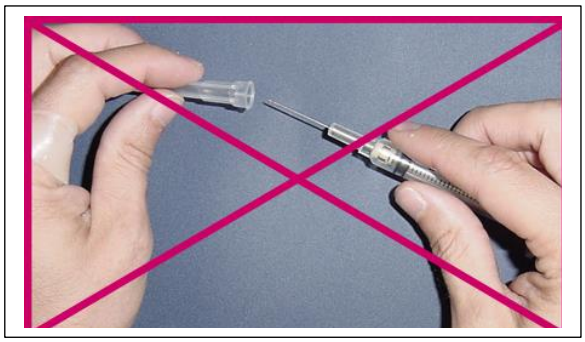
The electronic databases for the reviewed articles including Embase, CINAHL, OVID, Medline, PubMed, Web of Science, and Foreign Medical Literature Retrieval Service (FRMS), were searched systematically and independently by two authors. The MeSH terms used were "stab wound," "injury," "health personnel," "accidental blood disease," "occupational disease," "occupational exposure," and "blood-borne pathogen." Reference handbooks were consulted in addition to other resources. The hepatitis viruses. Viral hemorrhagic fever viruses. Viruses of the herpes group. Zoonotic viruses. Bacteria. In some rare instances, local infections became extensive (tenosynovitis, bacteriemia). Parasites. Other risks linked with BBF exposure and transfusion. BBF exposure and prion disease. The searching span was from the inception date of the database to 2022. The language of the literature was limited to English. Meanwhile, the System for Information on Grey

Literature was also searched to reduce publication bias. Two authors performed the literature selection independently. The review question was formed in terms of PICOD elements (population, intervention, comparison, outcome, and design of study. The primary outcome for this review was healthcare worker exposure rates to bloodborne pathogens.

Results and discussion

Few studies have been identified which examine the behaviors and contexts of HIV, other BBVs or STIs acquisitions amongst expatriates and travelers to low-and middle-income countries. To explore this issue further, and as part of a larger study examining male expatriate and traveler social networks and risks for HIV and other STIs, we sought to build on previous reviews exploring traveler sexual health [11]. This work was undertaken concurrently with work examining the experiences, barriers and enablers related to HIV acquisition risk amongst migrants from low-and middle-income countries travelling to high-income countries. We reviewed existing evidence regarding the sexual health behaviors, experiences and outcomes (including HIV, other BBVs or STIs) amongst expatriates and travelers from high-income countries aged 18 years or older travelling to low-and middle-income countries. Studies by Brown and colleagues Yokota and Collins , reported specifically on perspectives and experiences among male travelers particularly travelling to Africa and Asia. Several of the studies, including the study by Bauer in Peru, suggested that engaging in sex overseas may offer a bridge for connection with the destination country's culture, in order to successfully establish this long-term lifestyle, while mobility enables the opportunity for self-actualization and re-invention . Cabada et al. identified travelers from the U. Three studies reported on travelers' knowledge of hepatitis B (HBV) and related risks. Participants in studies by Alcedo et al. Manieri et al. reported on participant intention to pay for sex with Thai sex workers amongst men travelling for sex tourism [12]. Brown et al. reported that alcohol was often perceived as part of a holiday or beach culture with prospects to "let your defenses down with alcohol . However, several studies found that up to half of participants had not received specific sexual health or hepatitis B information regarding risk factors and vaccination during their consultation . A number of studies suggested that the longer participants were in the destination country, the greater the risk of having unprotected sex with a new partner , with a duration of stay over 30 days a key risk factor for unsafe sex while travelling [13]. Men who have sex with men were also found to have an increased number of sexual partners, however only few included studies focused explicitly on this population. Few studies explored the settings in which risk taking behaviors occurred or the role of social or peer group influences. Historically, many high-income countries have viewed low-and middle-income countries through a colonial lens, created a perspective of them as permissive places, sources of infection or as playgrounds for those from more wealthy regions to engage in a range of behaviors that are viewed as less sanctioned in their country of origin [14]. Research that explores domestic attitudes, policies and practices which lead to risky behaviors among travelers is imperative. Further, determining to what extent such laws and policies fuel negative attitudes in the general population towards low-and middle-income countries is vital. The review highlighted research opportunities which explore barriers and enablers to pre and post travel consultation and testing for both travelers and clinicians. A number of studies indicated poor knowledge and awareness regarding risks and protective behaviors related to HIV and other STI during travel. Recommendations for health promotion highlighted in the review mainly focused on the role of education [15]. Mobile and migrant populations are vulnerable for HIV, other BBV or STI acquisition, leading to significant health and other social impacts at the individual and community level.

It is estimated that approximately 350 million people are chronic hepatitis B virus (HBV) carriers worldwide. Consequently, most HD units treat chronic HBV carriers. Interestingly, because of the known acquired immunity disturbances in this population, after the initial HBV infection, 60% of hemodialysis patients become chronic carriers, while the respective percentage in the general population is only 5%. Although 30% of HBV carriers develop histologically confirmed chronic hepatitis, only 5% die from liver disease [16] . In comparison, hepatitis C virus (HCV) is less infectious and survives for a shorter period of



time, while Human immunodeficiency virus (HIV) is far less infectious and cannot survive in natural environment . Unfortunately, due to the impaired immune function of HD patients [17], response rates determined as anti-HBs titers higher than IU/L are smaller in HD patients than in the general population. Some authors referred a higher, but still less than in the general population, vaccine-induced seroconversion rate (75-80%), possibly due to differences in the patients' selection criteria [18].

There are about 170 million hepatitis C virus (HCV) carriers worldwide and HD patients belong to a high-risk population. A meta-analysis revealed that in HD patients HCV carriage is associated with 1.57 times increased risk of death. Liver cirrhosis and hepatoma contribute to the increased mortality [19] Typically HCV carriage is indicated by the presence of anti-HCV antibodies, which currently are assessed in the serum with third generation ELISA. Optimally, a positive result could be confirmed with RIBA (recombinant immunoblot assay) due to the higher specificity of this assay [20]. Interestingly, a patient can be anti-HCV positive, but HCV-RNA negative. In the opposite situation, a patient can be anti-HCV negative, but HCV-RNA positive. Generally, the desired serologic response to treatment is a negative HCV-RNA PCR 6 months after treatment is completed. Currently, routine ribavirin treatment is contraindicated in HD patients 81 and small trials showed increased rate of adverse effects with pegylated interferon A [21]. Thus the only available treatment is interferon A. Despite the existing doubts HCV positive patient isolation or use of separate machines are not officially recommended. The risk of infection due to contaminated needle stick exposure is about 1.8 % and unfortunately there is no preventive post exposure treatment available [22]. The prevalence of Human immunodeficiency virus (HIV) positivity varies and is dependent on the region where the dialysis unit is located. In the year 2000 1% of patients on dialysis in the USA has reached end-stage renal disease (ESRD) due to HIV associated nephropathy (HIVAN) . All HD patients should be tested for HIV since prompt diagnosis, monitoring and timely initiation of Highly Active Anti-Retroviral Therapy (HAART) consisted of three or more highly potent anti-HIV drugs, commonly reverse transcriptase inhibitors and protease inhibitors, improves prognosis. The risk of infection after contaminated needle stick exposure is about 0.3%. Preventive post-exposure treatment should start immediately. However, arteriovenous grafts are preferred to CVC due to high infection rates of CVC. Anemia is another common problem in these patients. Frequent infections and HAART toxicity have been incriminated. Otherwise, control of viremia might be impaired or toxicity can be significant resulting in increased mortality [23].

A prospective RCT was performed by to determine the efficacy of double-gloving method in preventing blood-borne pathogen exposure in terms of glove perforation. The current systematic review and meta-analysis are aimed at determining the effectiveness of double-gloving method on preventing glove perforation and blood contamination. Glove perforation is widely reported to be associated with duration of operation [24]. Pharmacists can play a key role in preventing the major bloodborne infections caused by human immunodeficiency virus (HIV), hepatitis C virus, and hepatitis B virus. Pharmacists, by increasing access to sterile syringes, can also help reduce the risk for transmission of blood-borne infections among injection drug users (IDUs) and, by participating in community needle disposal programs, decrease the chance that others will be infected through needle-stick injuries. However, laws and regulations limit access to sterile syringes. For example Georgia state pharmacy board regulations prohibit selling syringes for an "illegal purpose," 6 making Georgia 1 of 10 states in which it is clearly illegal for a pharmacist to sell syringes to an IDU. This regulation affects pharmacists' decisions about selling syringes to persons who may be IDUs [25]. In New Hampshire New York Rhode Island, and Washington,

attempts to pass syringe deregulation bills were defeated in several sessions of the legislatures before being passed and becoming law. Surveys and in-depth studies of the attitudes of pharmacists and pharmacy students about selling syringes without a prescription to IDUs have repeatedly found pharmacists to be divided into three groups: one that strongly favors such sales, a second that vigorously opposes such sales, and a third that is unsure [26]. These positions result from an interaction of individual factors (e.g., beliefs that selling syringes conflicts with efforts to reduce drug use) and structural issues (e.g., regulations that limit syringe sales). To increase pharmacy syringe sales to IDUs, the Maine and Washington state boards of pharmacy clearly stated that prevention of blood-borne infections was a legitimate medical purpose for such sales. IDUs and people who use insulin account for several billion injections a year in the United States. In addition to the states where syringe deregulation efforts helped stimulate syringe disposal programs interest in community-level safe syringe disposal has been heightened by concerns about worker (particularly those working with trash) safety and changes in state laws affecting syringe disposal [22]. While disposal of syringes from medical care facilities is extensively regulated, disposal of community-generated syringes has generally been exempted from regulation and not given a high public health priority. This option, however, puts solid waste workers, workers who hand pick recyclable materials out of trash, and custodial workers (e.g., those who collect trash from public restrooms) at risk for needle-stick injuries and, potentially, blood-borne infections.

To ensure safety for these workers, the public health goal is no syringes and other sharps in trash. Disposal programs described in this supplement typically involve collaborations of multiple community sectors, including local government, pharmacists, environmental health agencies, solid waste authorities, diabetes groups, health care facilities, infectious waste haulers, and fire departments. Pharmacists have proven to be central players in designing and maintaining most community disposal programs. In addition, greater consistency of syringe disposal regulations among the states could substantially reduce confusion about how to safely dispose of syringes. Because syringe exchange programs (SEPs) usually have some legal or informally agreed-upon protection for clients IDUs use SEPs to obtain new syringes. However IDUs may face substantial legal threats if they attempt safe syringe disposal in other ways [25]. However, the literature points to a number of opportunities for intervention and engagement such as pre-and post-travel advice, use of HIV treatments as prevention to reduce community viral load, in-country outreach and online and other health promotion interventions . These perceptions and attitudes toward mobility and sexual risk-taking behavior were shared among male Japanese travelers, particularly those seeking commercial sex in Thailand . Bauer found generally poor levels of knowledge of STIs and safer sex within both locals and visitors to Cuzco associated with a lack of prevention campaigns and other education [23]. The study found no association between time in destination country and increased alcohol use. However Bauer also found that alcohol consumption could reduce inhibitions and impair judgement, facilitating unsafe sex. Table 2 summarizes the key results. Few protective factors were highlighted in this review. A link was identified between travel to low-income destinations and an increase in risk taking behavior [28]. Travelers may seek sexual experiences and travel to destinations that are perceived to be less repressive, consequentially becoming less risk averse, especially males.

Other findings report on the "situational disinhibition" that travelling itself presents, which can lead to increased risky behavior , suggesting there may be a relationship between length of stay or frequency of travel and disinhibition as people become more familiar and confidant with a location and its culture and environment. The review suggests that levels of knowledge and risks for transmission relating to HIV, other BBVs or STIs were poor . These results are consistent with findings from other studies, which highlight the relationship between alcohol and other drug use and sexual risk taking . The findings from this review are consistent with another systematic review regarding pre-travel advice [26]. The lack of advice specifically for HIV or other STIs and sexual health for travelers is apparent, with the review highlighting key recommendations for STI specific pre-travel advice. This is despite a number of previously completed reviews and policy documents , which

provide explicit recommendations such as developing and increasing links and partnerships with affected communities, and creating closer cooperation with policy and support sectors in both origin and destination regions . Such methods may be disposed to measurement error which may weaken validity of findings . This review has a number of strengths. To our knowledge, it is the only study that sought to have an explicit focus on male expatriates and travelers, travelling from high to low-and middle-income countries [27]. After decades of awareness of the risks related to unsafe injections, the policy of ``one sterile syringe and needle for each patient'' was eventually adopted widely by the medical community in industrialized countries. The subsequent introduction of disposable syringes largely reduced the problem in industrialized countries to needle-stick injuries among health care workers and needle-sharing among injecting drug users, with a residual risk for the public through medical and dental procedures. In contrast, the general population in developing countries continues to be at risk of acquiring bloodborne diseases from unsafe injections [28].

Several studies have identified unsafe injections as a major risk factor in outbreaks of bloodborne infectious diseases. An injection is a skin-piercing event performed with a syringe and needle with the purpose of introducing a curative substance or a vaccine into a patient by the intramuscular, intravenous or subcutaneous route. . An unsafe injection is one in which the syringe, needle, or both, have been reused without sterilization. Anthropologists have described the flourishing business of untrained ``injection doctors'' in several developing countries[29]. However, several reports from countries in sub-Saharan Africa Asia and the Middle East estimated that 31% to >90% of childhood vaccinations were unsafe. The likelihood of acquiring an infection upon exposure to an unsafe injection depends on the transmissibility of any pathogen present. To assess the absolute and relative transmissibility of bloodborne pathogens via unsafe injections, we reviewed data from prospective studies of health care workers who had experienced a percutaneous needle-stick injury. For demographic reasons, the majority of hepatitis B carriers in the developing world are children and young adults who are likely to be HBeAg-positive. The transmission rate may vary considerably depending on the infectious stage and age of the HIV-positive patient. The likelihood of becoming infected through an unsafe injection also depends on the prevalence of the bloodborne pathogen in the population. We estimated the prevalence of HIV, hepatitis C and hepatitis B carriers in developing regions of the world based on the country-specific prevalence estimates for HIV, hepatitis C and hepatitis B, and using 1996 country-specific census data for the weights [26]. We examined epidemiological studies that reported an association between injections and bloodborne infections, and selected those that convincingly implicated unsafe injections as the cause of infection by including other potential risk factors such as blood transfusions, surgery and hepatitis-B-carrier siblings. In 1976 in Zaire, an outbreak of hemorrhagic fever caused by the emerging Ebola virus was linked to unsafe injections given at a hospital where the index patient had been treated for fever with injections. In Nigeria in 1995, an outbreak of Lassa fever occurred with a very similar epidemic pattern: febrile patients had been treated for suspected malaria with injections of quinine, which had probably led to loops of Malaria. HIV. Over the period 1989±91, 10% of all orphans in Romania became infected with HIV via a large number of unsafe injections given in hospitals and institutions [28]. In India, seven children awaiting adoption seroconverted for HIV over a 3month period in 1996±97. In Romania, a similar study in 1997±98 among a group of children not yet vaccinated against hepatitis B, estimated that the PAR was 40%.

In three prospective studies of hepatitis B infections among pre-school children in China (Province of Taiwan) prior to the introduction of hepatitis B vaccinations, exposure to unsafe injections was identified as a major risk factor (59± 61). In India, a study of risk factors for adult acute hepatitis B reported that 57% of the infections were attributable to unsafe injections. In Egypt, nationwide injection campaigns against schistosomiasis between 1920 and 1980 played a major role in the extensive spread of hepatitis C virus, leading to the high current prevalence (18%) of the virus in the population [29]. In a village hyperendemic for hepatitis C in China (Province of Taiwan), the high prevalence (50±70%) among older

age groups was linked to injections received at the local clinic. This review illustrates that injection therapy is popular and widespread in the developing world. Although transmissions of bloodborne pathogens via unsafe injections are bound to occur on a routine basis, the bulk of them are never attributed to this route owing to the time-lag (months or years) a Preventable fraction is equivalent to population-attributable risk (PAR). This figure was calculated on the basis of information provided in an English abstract. before an infection manifests itself as acute or chronic illness. In support of this indirect evidence, epidemiological studies convincingly linked the transmission of bloodborne pathogens to unsafe injections. Indeed, the nationwide schistosomiasis campaigns in Egypt may represent the world's largest iatrogenic transmission event that led to the high endemic rate of hepatitis C infection in Egypt [30]. We hypothesize that unsafe injections may, in general, be a major source of hepatitis C transmission in the developing world, since blood transfusions are not widely available in these countries. Furthermore, it has been estimated that routine vaccination schedules may lead to one HIV infection per 1000 children in a high prevalence region such as sub-Saharan Africa. In order to quantify the available data systematically, we chose to focus exclusively on patient-to-patient transmission of bloodborne pathogens. However, it has been reported that a large number of injections are given by persons other than trained health care workers, for example, ``injection doctors'', family members or friends. Such injections are likely to be even more unsafe than those given in health care centers, but there are no quantitative data available to indicate the magnitude of this problem. As reported elsewhere in this issue, we used a mathematical modelling approach to estimate the global incidence of bloodborne infections that may be attributable to unsafe injections [31].

The problem of unsafe injections is complex and therefore solutions will not be straightforward. Technical solutions, such as ``auto-disable'' (AD) syringes that can be used only once, are available; however, they are more expensive and do not eliminate the hazards of sharps waste in the environment. Although other pathogens (eg, monkeypox 6) have been shown to be transmissible via needlestick in experimental animals, we found it useful to limit our efforts to compiling an updated and exhaustive list of BBP whose transmission was documented following occupational exposure in humans. There are 26 viruses that have caused documented occupational infections following exposure to BBF. The impact of these infections is significant. HBV HCV and HIV prevalence among healthcare workers who experience sharp injuries highlight the disproportionate burden that sub-Saharan Africa bears in contrast to developed countries. The higher prevalence is partly explained by the higher prevalence of bloodborne pathogens in the general population but can also be attributed to poor healthcare infrastructure in sub-Saharan Africa [30]. The need for nurses in the home health care sector is predicted to grow at twice the rate for nurses overall between 2000 and 2020. The home health care setting presents hazards similar to those of the acute care setting. Unlike the hospital setting, no functional redundancy exists if nurses are injured and need to leave during their workday for postexposure prophylaxis care. found that home health care nurses' concerns regarding who would care for their patients if they sought health care was an important factor in their decisions about reporting and seeking follow-up care. To alleviate these concerns, home health care agencies should develop comprehensive percutaneous injury and bloodborne pathogen exposure control plans that include timely coverage and response capability. Sharps-handling practices and the lack of uniform methods for disposal of sharps in the home setting contribute significantly to home health care providers' risk of injury. Most municipalities do not offer this method of sharps disposal [31]. Moreover, some catheters can be inserted in urgent situations, during which optimal attention to aseptic technique might not be feasible.

If the average rate of CVC-associated BSIs is 5.3 per 1,000 catheter days in the ICU , approximately CVC-associated BSIs occur in ICUs each year in the United States. Therefore, by several analyses, the cost of CVC-associated BSI is substantial, both in terms of morbidity and in terms of financial resources expended. This effort should be multidisciplinary, involving health-care professionals who insert and

maintain intravascular catheters, health-care managers who allocate resources, and patients who are capable of assisting in the care of their catheters. Thus, it is not known whether implementing multiple strategies will have an additive effect in reducing CRBSI, but it is logical to use multiple strategies concomitantly [32].

Conclusions

High-income countries have seen increasing acquisitions of overseas acquired blood-borne infections. Whist those travelling to and from countries with significant prevalence particularly of HIV have been identified as priority populations in a number of strategic frameworks, this review is one of few that has had an explicit focus on blood-borne infections among health workers. The review revealed a high degree of heterogeneity among health workers, even when from similar sociodemographic backgrounds. This is a complex issue and one which requires greater inspection and a variety of tailored responses. Blood-borne infections acquisition among health workers highlight that the risks and responses for these risks are shared globally. The risk for health workers to be exposed to rare "exotic" pathogens increases with intercontinental travel and migrations. Emerging disease risks are also associated with progress in medical techniques, changes in nutritional or other social habits, or ecologic changes.

Conflict of interests

The authors declared no conflict of interests.

References

1. Lemaire, Roger., Masson, J-B. and Masson, Jean-Bernard. RISK OF TRANSMISSION OF BLOOD-BORNE VIRAL INFECTION IN ORTHOPAEDIC AND TRAUMA SURGERY. (33);32-39

2. Tarantola, Arnaud., Abiteboul, Dominique. and Rachline, Anne. Infection risks following accidental exposure to blood or body fluids in health care workers: A review of pathogens transmitted in published cases. (2006) American Journal of Infection Control. 34(6); 367-375.

3. Naomi., Alexander, Mary., Patchen Dellinger, E., Gerberding, Julie., Heard, Stephen., Maki, Dennis., Masur, Henry., Mccormick, Rita., Mermel, Leonard., Pearson, Michele., Raad, Issam., Randolph, Adrienne. and Weinstein, Robert. Prevention Guidelines for Catheter-Related Infections, CID 2002:35 (7) 1281.

4. Jones, T., Coffin, Phillip., Prevention, Atlanta., Phillip, O., Coffin, ., Coffin, San., Posey, Michael., Solomon, Kathy., Teeter, Ron. and Palmer, Scott. Supplement to the Journal of the American Pharmaceutical Association S7. 26(5); 330-339.

5. Thompson, Sandra., Boughton, Clem. and Dore, Gregory. Blood-borne viruses and their survival in the environment: is public concern about community needlestick exposures justified?. 26(5); 360-370.

6. and Mermel, Leonard. Prevention of Intravascular Catheter-Related Infections. (56(2); 371-378)

7. Simonsen, L., Kane, A., Lloyd, J., Zaffran, M. and Kane, &. Unsafe injections in the developing world and transmission of bloodborne pathogens: a review. 56(2); 371-378

8. and Eleftheriadis, Theodoros. Infections in hemodialysis: a concise review. Part II: blood transmitted viral infections. 13(12); 1249.

9. Pfaender, Stephanie., Von Hahn, Thomas., Steinmann, Joerg., Ciesek, Sandra., Steinmann, Eike. and Ry, M. Prevention strategies for blood-borne viruses—in the Era of vaccines, direct acting antivirals and antiretroviral therapy. (2016) Rev. Med. Virol. 26(5); 330-339.

10. Patel, Priti., Thompson, Nicola., Kallen, Alexander., Arduino, Matthew. and Drph, . Epidemiology, Surveillance, and Prevention of Hepatitis C Virus Infections in Hemodialysis Patients. (2010) American Journal of Kidney Diseases. 56(2); 371-378.

11. Lanini, Simone., Puro, Vincenzo., Lauria, Francesco., Fusco, Francesco., Nisii, Carla. and Ippolito, Giuseppe. Patient to patient transmission of hepatitis B virus: a systematic review of reports on outbreaks between 1992 and 2007. (2009) BMC Med. 7(1);

12. Crawford, Gemma., Lobo, Roanna., Brown, Graham., Macri, Chloe., Smith, Hannah. and Maycock, Bruce. HIV, Other Blood-Borne Viruses and Sexually Transmitted Infections amongst Expatriates and Travellers to Low- and Middle-Income Countries: A Systematic Review. (2016) IJERPH. 13(12); 1249.

13. Busch, Michael., Bloch, Evan. and Kleinman, Steven. Prevention of transfusion-transmitted infections. 1(12); 123.

14. Mossburg, Sarah., Agore, Angela., Nkimbeng, Manka. and Commodore-Mensah, Yvonne. Occupational Hazards among Healthcare Workers in Africa: A Systematic Review. (2019) 85(1);

15. Zhang, Zhihui., Gao, |., Ruan, |. and Zheng, |. Effectiveness of double-gloving method on prevention of surgical glove perforations and blood contamination: A systematic review and meta-analysis. (2021) J Adv Nurs. 77(9); 3630-3643.

16. Chalupka, Stephanie., Markkanen, Pia., Galligan, Catherine. and Quinn, Margaret. Sharps Injuries and Bloodborne Pathogen Exposures in Home Health Care. 35 (7) 1281.

17. Gorse, G. J., & Messner, R. L. (1991). Infection control practices in gastrointestinal endoscopy in the United States: a national survey. Infection Control & Hospital Epidemiology, 12(5), 289-296.

18. Puro, V., De Carli, G., Petrosillo, N., & Ippolito, G. (2001). Risk of exposure to bloodborne infection for Italian healthcare workers, by job category and work area. Infection Control & Hospital Epidemiology, 22(4), 206-210.

19. FitzSimons, D., Francois, G., De Carli, G., Shouval, D., Prüss-Üstün, A., Puro, V., ... & Van Damme, P. (2008). Hepatitis B virus, hepatitis C virus and other blood-borne infections in healthcare workers: guidelines for prevention and management in industrialised countries. Occupational and Environmental Medicine, 65(7), 446-451.

20. Baldo, V., Floreani, A., Dal Vecchio, L., Cristofoletti, M., Carletti, M., Majori, S., ... & Trivello, R. (2002). Occupational risk of blood-borne viruses in healthcare workers: a 5-year surveillance program. Infection Control & Hospital Epidemiology, 23(6), 325-327.

21. Priya, N. L., Krishnan, K. U., Jayalakshmi, G., & Vasanthi, S. (2015). An analysis of multimodal occupational exposure leading to blood borne infections among health care workers. Indian Journal of Pathology and Microbiology, 58(1), 66.

22. An, J. Y., Lee, Y. M., & Song, J. H. (2010). A study on performance level for universal precautions on blood-borne infections among nurses in hospitals. The journal of korean academic society of nursing education, 16(1), 92-100.

23. Gershon, R. R., Sherman, M., Mitchell, C., Vlahov, D., Erwin, M. J., Lears, M. K., ... & Alter, M. J. (2007). Prevalence and risk factors for bloodborne exposure and infection in correctional healthcare workers. Infection Control & Hospital Epidemiology, 28(1), 24-30.

24. Arafa, A. E., Mohamed, A. A., & Anwar, M. M. (2016). Nurses' knowledge and practice of blood-borne pathogens and infection control measures in selected Beni-Suef hospitals Egypt. Journal of the Egyptian Public Health Association, 91(3), 120-126.

25. Gorse, G. J., & Messner, R. L. (1991). Infection control practices in gastrointestinal endoscopy in the United States: a national survey. Infection Control & Hospital Epidemiology, 12(5), 289-296.

26. Rossouw, T. M., Van Rooyen, M., Louw, J. M., & Richter, K. L. (2014). Blood-borne infections in healthcare workers in South Africa. SAMJ: South African Medical Journal, 104(11), 732-735.

27. Goldmann, D. A. (2002). Blood-borne pathogens and nosocomial infections. Journal of allergy and clinical immunology, 110(2), S21-S26.

28. Beekmann, S. E., Vaughn, T. E., McCoy, K. D., Ferguson, K. J., Torner, J. C., Woolson, R. F., & Doebbeling, B. N. (2001). Hospital bloodborne pathogens programs: program characteristics and blood and body fluid exposure rates. Infection Control & Hospital Epidemiology, 22(2), 73-82.

29. Cleveland, J. L., Gray, S. K., Harte, J. A., Robison, V. A., Moorman, A. C., & Gooch, B. F. (2016). Transmission of blood-borne pathogens in US dental health care settings: 2016 update. The Journal of the American Dental Association, 147(9), 729-738.

30. Deuffic-Burban, S., Delarocque-Astagneau, E., Abiteboul, D., Bouvet, E., & Yazdanpanah, Y. (2011). Blood-borne viruses in health care workers:

prevention and management. Journal of Clinical Virology, 52(1), 4-10.

31. Wicker, S., Cinatl, J., Berger, A., Doerr, H. W., Gottschalk, R., & Rabenau, H. F. (2008). Determination of risk of infection with blood-borne pathogens following a needlestick injury in hospital workers. Annals of occupational hygiene, 52(7), 615-622.

32. Short, L. J., & Bell, D. M. (1993). Risk of occupational infection with blood-borne pathogens in operating and delivery room settings. American Journal of Infection Control, 21(6), 343-350.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