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Review

Precautions for Health Care Workers to Avoid Hepatitis B and C Virus Infection

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Abstract

The burden of exposure to blood-borne pathogens (such as hepatitis B and C viruses) is considerable for health care workers. Hepatitis virus transmission requires a non-immune host, an infectious source, and skin or mucous membrane injury. These three aspects are the main fields for preventional interventions. We reviewed major recent studies on this topic to identify precautions health care workers should take to avoid hepatitis B (HBV) and C virus (HCV) infections. Accordingly, this review looks at aspects of epidemiology, risk factors, economy, knowledge, attitudes, practice, and ethics of HBV and HCV that affect health care workers. The risk of transmission depends on the load of pathogen, infectious characteristics and exposure frequency. Health care workers skill levels and the specific hospital department involved appear to be the most important factors in the exposure of health care workers to blood-borne pathogens. However, many health care workers surveyed, believed that educational programs about standard precautions in their setting were not adequate. Obviously, more detailed studies will be needed to clarify risks and opportunities for health care workers precautions aimed at avoiding HBV and HCV infection, especially in emerging health research communities.

Keywords: Universal precautions; Hepatitis B virus; Hepatitis C virus; Needlestick injury

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Introduction

Occupational blood-borne infections are associated with significant morbidity and mortality. Health care workers (HCWs) are exposed to hazardous blood-borne pathogens such as hepatitis B (HBV) and hepatitis C virus (HCV). HBV and HCV infections are serious public health problems that can have consequences in terms of psychological and occupational diseases. HBV and HCV are common causes of occupational diseases transmitted from patients to HCWs and *vice versa*, and also to HCWs' families. Fortunately, most occupational transmissions can be prevented by standard precautions.[1]

Despite many publications about programs and strategies to prevent transmission, HBV and HCV infections remain major public health issue. This review looks at aspects of epidemiology, prevention, risk factors, economy, knowledge, attitudes, practice, and ethics of HBV and HCV management that affect HCWs.

We reviewed the literature to identify important contributions from current research to thinking about health care precautions against HBV and HCV infection. Our search terms were hepatitis C, hepatitis B, health care workers and health precaution, and we used them to search the *PubMed* (NIH) and *ScienceDirect* (Elsevier) bibliographic databases. We also searched *Google* to detect additional Web sites and Iranian medical journals, and the Web sites of the United States Centers for Disease Control and Prevention (CDC) and the World Health Organization

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TAKE-HOME MESSAGE

- Occupational blood-borne infections are associated with significant morbidity and mortality.
- HBV and HCV are common causes of occupational diseases transmitted from patients to health care workers and *vice versa*, and also to health care workers' families.
- 14.4% and 1.4% of hospital workers are infected with HBV and HCV, respectively.
- The major source of HIV, HBV, HCV and other blood-borne pathogens is blood. However, it should be kept in mind that all body fluids can be infectious.
- The highest prevalence of HBV is seen in dentists.
- Nurses were most commonly exposed to infection (41%), followed by physicians (31%).
- Exposure to body fluids such as breast milk, bile, and cerebrospinal fluid is less often involved.
- Unnecessary injections, the frequent use of unsterile needles and inappropriate hazardous waste disposal are the major blood-borne infection risk factors in developing countries.
- Proper hand washing, use of barriers and puncture-resistant containers for sharp disposal can minimize mucocutaneous exposures.

(WHO). We excluded non-English literature and in case of duplicate publication, we chose the most recent one.

Epidemiology

In their occupational environment, HCWs are exposed to multiple blood-borne pathogens such as HBV and HCV. CDC reported that 3.9 million individuals (1.8%) are contaminated with HCV, and that 2.7 million of these infections will become chronic.[2] It has been estimated that 14.4% and 1.4% of hospital workers are infected with HBV and HCV, respectively.[3] Physicians, dentists, nurses, laboratory staff, and dialysis center personnel are at high risk of acquiring infection. The highest prevalence of HBV is seen in dentists.[4] In another study, nurses were most commonly exposed to infection (41%), followed by physicians (31%).[5]

The Netherlands study found that 35%of HCWs and 47% of nursing staff were not vaccinated against HBV.[6] In a study conducted in Uganda, the prevalence of HBV in HCWs was 8%; 48% of HCWs had life-time exposure to HBV infections.[7]

Transmission from a HCW to patients is rare, and only few cases have been reported.[5] A Brazilian study found that about three million HCWs reported percutaneous injuries with infected sharp instruments each year.[8] In another study conducted in Iran, 82% (401 of 489) of dental, nursing and midwifery students reportedly had needle stick injuries (NSI).[9] Globally, despite the potential risks, 24% of HCWs were not vaccinated at all and HCV infections were positive in 1.6% of all HCWs.[10] In a study done in surgeons, the prevalence of HBV infection was 13%–17% and HCV infection have been found in 0.8%–0.9% of them.[11]

Risk factors of HBV and HCV transmission among health care workers

Transmission of HBV and HCV from pa-

tients to HCWs has been known for many years; however, the roots of transmission have not been recognized completely.[12] Data from a case-control study conducted in several European countries including France, Italy, Spain, United Kingdom, and Switzerland showed that HBV and HCV transmission among HCWs was significantly correlated with factors such as the type of procedure (*e.g.*, replacing a hollow-bore needle in a patient's vein or artery), the severity of injury, and the gender of the HCW. Contact with patients whose viral load was >6 $\log_{10}$ copies/mL increased the transmission risk 11-fold compared to a viral load <4 $\log_{10}$ copies/mL.[13]

Exposure to body fluids such as breast milk, bile, and cerebrospinal fluid is less often involved. In Tehran, northern Iran, approximately 1.8% of HCWs became serologically HCV-positive after percutaneous exposure, with hollow-bore NSI being the major root of transmission.[14]

Unnecessary injections, the frequent use of unsterile needles and inappropriate hazardous waste disposal are the major blood-borne infection risk factors in developing countries. There is an association between the prevalence of blood-borne pathogens and the frequency of injections. Other sharp instruments such as lancets can also be harmful.[15] The risk of blood-borne transmission among HCWs and patients depends on factors related to individual infectivity such as viral load, the clinical context, technical skill and the hospital environment.[16]

One study in Korea showed that occupational exposure risk was more pronounced among women than men. Approximately 83% of the infected personnel were women. Hepatitis was one of the most common occupational disease among HCWs. High-risk groups included nurses, doctors, and pathology workers. The personnel that were infected most frequently were those working in inpatient wards and intensive care units.[17]

An evaluation of Australian HCWs at teaching hospitals in 1998–2003 revealed that blood and body fluid exposure were most frequently affect the medical staff (10.4%). Approximately 50% of percutaneous injuries were associated with a hollow-bore needle stick, which mostly occurred during the use of sharps. In contrast, 68.5% of the mucocutaneous exposure was reported by nursing staff.[18]

The behavior of HCWs can place them at risk for some blood-borne pathogens. One study in a tertiary hospital in Uganda showed that the prevalence of NSI among HCWs was 67.8% and that of mucous membrane exposure was 41% during a one-year period. Among physicians, 31.7% reported a cut injury during their work. The risk of HBV among nurses and laboratory technicians was higher.[7]

A study in Pakistan found that junior doctors (28.5%) followed by nurses (20.4%) had experienced the most injuries. "Blood collection" was the activity that accounted for the most exposure to blood-borne pathogens.[19]

A cross-sectional study among nurses in Fars province, southern Iran, during one year showed that 79% of them had been exposed to blood or body fluids at least once, with blood exposure being more frequent. Needle recapping (rather than immediate disposal of the used needle) after injection into an intravenous line was the most common cause of finger injury. Factors such as gender of the staff member, skill level and the hospital ward have been associated with sharps injuries. Among these factors, expertise level and hospital wards are important for body fluid exposure. Blood and body fluid exposure levels among nurses in an Iranian study, as in other developing countries, were high especially compared to the USA. Iranian nurses, despite continuous training, do not always modify their needle-handling

behavior on the ward to reduce their exposure.[20]

Another study among nurses in Fars province showed that 49.6% of them recalled at least one sharps injury they had during the last year. More than half of these injuries (52.6%) were related to NSI. The most frequent injury type was hollow-borne NSI. The risk in registered personnel and midwives was higher than in other personnel. The occurrence of even one NSI history in the past may make nurses pay more attention to standard precautions.[21]

Prevention of HBV and HCV transmission among HCWs

Prevention of hepatitis B and C transmission through the medical care setting is an important public health issue.[22] In 1987, CDC published universal precaution guidelines in response to the growing need for better protection of both HCWs and patients from blood-borne infections in health care settings. The guidelines emphasize that the major source of HIV, HBV, HCV and other blood-borne pathogens is blood.[23] However, it should be kept in mind that all body fluids including peritoneal, synovial, pericardial, cerebrospinal and amniotic fluids can be infectious. Vaginal discharge and semen are also important source of infection. Therefore, it is better to apply standard precautions with regard to all of them.[24]

Proper hand washing and use of barriers such as gloves, gowns, and masks—the main components of standard precautions—can minimize mucocutaneous exposures. Reducing the manipulation of manual sharps can also prevent occupational injuries. The use of puncture-resistant containers for sharp disposal is also an effective strategy.[25]

In 1997, the Canadian integrated protocol was published on better management of HCWs who were exposed to blood-borne pathogens. According to this protocol, the use of HBV vaccine and hepatitis B immune globulin is an effective method for preventing post-exposure HBV infection. However, the authors noted that there is no effective post-exposure prophylaxis for HCV infection; therefore the prescription of interferon and immune globulin are not recommended.[12]

A study in the Netherlands showed that a large proportion of HCWs (especially nursing assistants) did not receive HBV vaccination. The rate of NSI and accidental exposure to body fluids was relatively low, but there was evidence that many accidents have never been reported. According to this study, the reasons why HCWs did not receive HBV vaccination were the lack of a payment support system for vaccination and the lack of attention to standard precautions.[6]

Another study in India reported that a large proportion of HCWs have had at least one NSI in their career. The average number of NSIs was 3.85 per HCW; more than half of the workers mentioned fatigue as the most important cause of their injury. Injuries often (34.0%) occurred during recapping. Most of the injured staff (60.9%) washed the injury site with soap and water immediately after the NSI but 14.8% did not take any precautions. After follow-up for one and a half years, all participants in the study were seronegative for hepatitis B surface antigen, and all of them had received hepatitis B vaccination prophylactically.[26]

A survey among dentists in Belo Horizonte, Brazil on self-reporting factors that might correlate with hepatitis B vaccination and immunization status revealed that 73.8% of the dentists had received three doses of the vaccine. Factors such as gender, use of individual protective equipment, history of blood transfusion and history of drug abuse independently correlated with vaccination against hepa-

titis B. About 14.8% of the participants checked their antibody level after vaccination. The use of protective instrument, history of asking patients about hepatitis before dental treatment, family history of hepatitis B and years of work experience were independently associated with post-vaccination testing of hepatitis B antibody titers.[8]

Another study in France which assessed the availability of proper equipment to prevent transmission in the operating room reported that despite recent awareness about occupational exposure, NSI rates remained high among HCWs in France. Less than one-fifth of HCWs (18.8%) were double-gloved during all procedures and changed their gloves after one hour. Blunt-tipped suture needles were available in 49.1% of the operating rooms but 55.3% of the HCWs never used them. More than half of the surgeons had never checked their HIV and hepatitis C virus status.[27]

Economic costs of HBV and HCV transmission among health care workers

Hepatitis has many direct and indirect effects. Its direct effects including the costs of treatment, pre- and post-exposure prophylaxis are considerable. Indirect effects include premature death, chronic illness and time lost from work. The likelihood of hospitalization and the duration of stays were high in HCV and HBV antigen seropositive patients; their survival is poor and expensive drugs are needed for treatment.[28] The early detection of HCV RNA after occupational exposures can make early HCV RNA testing cost effective.[29] Another study showed that the costs of managing the occupational exposure to body and blood fluids was approximately US$ 71–4838 overall. There was an association between the patient's infection status and management costs. Exposure to co-infected patients (HIV, HBV, HCV) involved a cost of US$ 2456, and contact with HCV-infected patients entailed a cost of US$ 650. The findings showed that occupational exposure management is very costly; therefore, prevention practices are cost-effective.[30]

NSIs have many economic costs such as the need for follow-up tests, prophylaxis after exposure, counseling, treatment of the infected personnel, and ethical or legal issues. [31] In Australia, one study showed a significant increase in NSI from 1990 to 1999. Nurses were exposed more than other HCWs. The cost of avoiding bloodborne exposure by using safety needles was about US$ 365 000 per year. Another study found that using safety needles could be cost-effective for hospitals.[32]

Knowledge, attitudes and practice regarding HBV and HCV transmission among health care workers

Using standard precautions among HCWs is important. Adherence of HCWs to standard precautionary guidelines can be low in some settings.[33] Many surveys showed that HCWs such as nurses, physicians, medical students and nursing students receive incomplete and variable training in infection control.[34] Knowledge, attitude and practice (KAP) studies provide information about the people's awareness of certain topics, their feelings and their performance.[35] In a KAP study of medical groups with 369 participants in Tehran, Zanjan and Ahwaz, Iran, 88.1% of studied groups were vaccinated and their knowledge of disease transmission was unsatisfactory. Their awareness of the seroconversion rate after exposure was low; however, their mean±SD scores (out of a total of 100) for concern about contamination with HBV and HCV were 69.4±2.1

and 76.3±2, respectively. These findings suggest that post-vaccination testing for anti-HBs antigen level is important in these groups.[36]

A study in Sharourah, Saudi Arabia, on 70 HCWs showed that the average knowledge score for HCV transmission by NSI among nurses and medical assistants was approximately 80%, and that 93% of the participants did not report NSI.[37] In another study in Iran, although the knowledge and attitudes of medical students about HBV and HCV were acceptable and corresponded to the CDC guidelines, their behavior with regard to the infections did not reflect their knowledge and attitude.[38]

In a study in Iran, 90.9% of medical university midwives, nurses and students reported that their education about standard precautions was insufficient and expressed their desire for more training. This study revealed that the causes of many infection risks in HCWs were the lack of knowledge about disease and protective systems.[39] Another study from Iran, reported that checking HBV antibody titer after vaccination reduced the stress in nurses after NSI.[14] Another KAP study of HBV and HCV in Pakistan on 180 medical students found that >85% of the participants were aware of the risk of HBV and HCV transmission. However, in spite of increasing their knowledge about NSI risks as students' education and training progressed, the prevalence of NSI unfortunately increased too.[40]

Ethics

Nowadays, ethical issues and related factors such as the limitations of practice for medical staff are receiving much attention.[41] In the early 1970s, it was recognized that some people acquired hepatitis B infection via contact with infected physicians, nurses and medical students who were chronic carriers or asymptomatic.[42] CDC, in 1991, reported that during the past two decades, 300 infected persons had been exposed to HBV and HCV by infected HCWs.[43] Previously, there were no policies for informing HCWs about the possibility of infection in the course of their work with patients, but patients need to know the truth. This makes informed consent an important aspect of the treatment. The Laboratory Centre for Disease Control suggested that HCWs and medical students with a positive HBs Ag test should refrain from clinical practice and complete assessment.[41] Ethical issues regarding the risk factors of blood-borne pathogen transmission should be examined in more detail in future studies.

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