CLINICAL ALERT

Blood-borne infections in healthcare workers in South Africa

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The risks associated with infection of healthcare workers and students with blood-borne pathogens, specifically HIV, hepatitis B virus and hepatitis C virus, are often neglected. South Africa (SA) currently has no official policies or guidelines in place for the prevention and management of these infections. This article reviews the available data and international guidelines with regard to infected healthcare practitioners and makes minimum recommendations for the SA setting.

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The occupational risk of blood-borne infection in healthcare workers and students – collectively termed healthcare professionals (HCPs) – is a significant yet under-researched area in medical practice, especially in the developing world. Although many viral pathogens have been associated with occupational exposure, three are known to pose the most serious risk: HIV, hepatitis B virus (HBV) and hepatitis C virus (HCV). The route of transmission can be percutaneous or mucosal and is related to the work environment and practices of HCPs.[1]

Importantly, not only are HCPs at risk of acquiring these infections, but once infected they also pose a risk to patients. This has serious policy implications and raises significant ethical challenges. HCPs and patients in developing countries, especially South Africa (SA), are particularly vulnerable to occupational and nosocomial exposure because the prevalence of HIV and HBV is much higher than in the developed world. The work environment may contribute further to this risk, because injection routes are frequently used for administration of medication and improper venesection practices and inadequate facilities for sharps disposal are common.[1,2] Medical and dental students and junior doctors are at high risk owing to their developing skills level, frequent exposure to invasive procedures and long working hours. Two studies in large teaching hospitals in SA reported that 55% and 64% of interns, respectively, reported one or more episodes of occupational exposure. Exposures were more common among first- than second-year interns (62% v. 38%), and only 64% of percutaneous injuries involving HIV-infected blood were reported.[3,4]

Many international bodies have developed guidelines for the prevention and management of infection with blood-borne viruses (BBVs) in HCPs. SA, however, does not have management guidelines in place, and large disparities in disease burden, work practices and healthcare resources complicate adoption of international guidelines. This article attempts to frame BBVs in the local context and suggests strategies for prevention, reporting and management responsibilities in a developing-world context.

Prevalence and transmission risk

The exact prevalence of BBV infection in SA HCPs is unknown, but is estimated to mimic that of the general population: HBV 0.2 - 16%, HIV 17.9% and HCV ~2.4%. The risk of occupational infection is highest for HBV (30%), followed by HCV (1 - 2%) and HIV (0.3%). It has been estimated that globally 66 000 HCPs have been infected with HBV through occupational exposure, 1 000 with HIV and 16 000 with HCV.[5] Rare cases of patients contracting HIV from infected HCPs have been documented, but the exact risk of provider-to-patient transmission has not been quantified.[6] Estimated figures are derived from settings of low HCP HIV prevalence (0.4% and 0.7%), and figures may well be higher in settings where high prevalence is coupled with late diagnosis. Transmission of BBVs is associated with exposure-prone invasive procedures (EPPs) (Table 1), inadequate infection control precautions and drug diversion by HCPs who abuse injection drugs, and determined by the circulating viral burden.[7]

Prevention

Standard universal precautions (Table 2) should always be followed, regardless of the perception of risk of the procedure or the patient. The use of safety-engineered devices such as retractable syringes, needle-free intravenous systems and winged butterfly needles is encouraged. The following disease-specific measures are also advised.

Hepatitis B virus

Proof of immunity (arbitrarily defined as a hepatitis B surface antibody (anti-HBs) level >10 IU/L) or knowledge of infection status should be a mandatory requirement for all HCPs. HCPs are required to be vaccinated against HBV before they start their training, but no compulsory systems are in place to document immunity or to exclude pre-existing chronic HBV infection. HBV

Table 1. Classification of EPPs*

Procedures and techniques	Examples
Major abdominal surgery	General surgery, nephrectomy, small-bowel resection, cholecystectomy, transplantation surgery
Obstetric/gynaecological surgery	Abdominal and vaginal hysterectomy, caesarean sections and vaginal deliveries, cone biopsy, ovarian cyst removal, other transvaginal obstetric and gynaecological procedures involving hand-guided sharps
Cardiothoracic surgery	Valve replacement, coronary artery bypass grafting, other bypass surgery, heart transplantation, repair of congenital heart defects, thymectomy, open lung biopsy
Orthopaedic surgery	All orthopaedic surgery, total knee arthroplasty, total hip arthroplasty, major joint replacement surgery, open spine surgery, open pelvic surgery
Head and neck surgery	Subtotal thyroidectomy and all surgery involving bones, including oncological procedures
Neurosurgery	Craniotomy, other intracranial procedures, open spine surgery
Plastic surgery	Extensive cosmetic procedures, e.g. abdominoplasty and thoracoplasty
Oral or maxillofacial surgery	Surgical extractions, hard- and soft-tissue biopsy, apicoectomy, root amputation, gingivectomy, periodontal curettage, mucogingival and osseous surgery, alveoplasty or alveoectomy, endosseous implant surgery
Trauma surgery and procedures performed in the emergency department	Open head injuries, facial and jaw fracture reductions, extensive soft-tissue trauma, ophthalmic trauma, open resuscitation efforts, deep suturing to arrest haemorrhage, internal cardiac massage
Procedures and techniques in poorly visualised areas	Digital palpation of a needle tip in a body cavity and/or the simultaneous presence of an HCP's fingers and a needle or other sharp instrument or object in a poorly visualised or highly confined anatomical site
Situations with significant risk of the patient biting the HCP	Interactions with violent patients or patients experiencing an epileptic seizure

EPPs = exposure-prone procedures; HCP = healthcare professional.
*Adapted from Centers for Disease Control[15] and Henderson *et al.*[7]

Table 2. Standard universal precautions*

Barrier precautions	Wear gloves when: in contact with blood and body fluids, mucous membranes, or non-intact skin of all patients handling items or surfaces soiled with blood or body fluids performing venepuncture and other vascular access procedures Double-glove for all invasive procedures Change gloves: during long procedures after contact with each patient Wear masks, protective eyewear or face shields when: performing procedures likely to generate droplets of blood or other body fluids Wear gowns or aprons when: performing procedures likely to generate splashes of blood or other body fluids
Hand washing	Wash hands and other skin surfaces immediately and thoroughly if contaminated with blood or other body fluids directly after gloves are removed
Prevent sharps injuries	Do not recap, remove from disposable syringes, or manipulate needles by hand Immediately place all disposable syringes and sharp items in puncture-resistant containers for disposal Locate puncture-resistant containers as close as practical to the use area
Minimise mouth-to-mouth resuscitation	Equip all areas where resuscitation is likely to be performed with mouthpieces, resuscitation bags or other ventilation devices
HCP with exudative lesions or weeping dermatitis	Refrain from all direct patient care and handling patient care equipment until the condition resolves

HCP = healthcare professional.
*Adapted from Centers for Disease Control.[19]

vaccination is approximately 92% effective in immunocompetent adults <40 years of age, and only 84% effective in those aged ≥40 years.[7] All vaccine recipients with anti-HBs <10 IU/L after the primary vaccine series should be investigated for chronic HBV infection (hepatitis B surface antigen) and non-vaccine exposure (hepatitis B core antibody (anti-Hbc)). If both tests are negative, a second series of single or double vaccine doses can be given.[8] If anti-HBs remains <10 IU/L after the second vaccine series, the individual is classified as a non-responder and should receive hepatitis B-specific immunoglobulin after exposure to a known HBV-infected individual.[8]

As from 2014, a new cohort of potentially Extended Program on Immunization (EPI)-vaccinated healthcare students started their training. Only 16% of persons vaccinated at age <1 year are estimated to have detectable anti-HBs ≥10 mIU/mL 18 years later. However, they generally show good immunological memory, with 60 - 97.4% showing protective anti-HBs levels after a booster dose of HBV vaccine, and are then considered protected.[8,9]

HIV

In 2006, patients with HIV-related diseases occupied more than half of the hospital beds in sub-Saharan Africa, and in SA, even in the era of widely available antiretroviral therapy (ART), at least 44% of medical admissions are of HIV-infected patients.[10] Post-exposure prophylaxis (PEP) is advised in all cases of occupational exposure with perceptible risk. The Southern African HIV Clinicians Society 2008 PEP guidelines[11] recommend the use of two nucleos(t)ide reverse transcriptase inhibitors together with either a non-nucleoside reverse transcriptase inhibitor (NNRTI), efavirenz, or a protease inhibitor (PI), lopinavir/ritonavir. The newly revised 2013 US Public Health Services PEP guidelines[12] advise the use of tenofovir (TDF) and emtricitabine together with the integrase strand transfer inhibitor raltegravir (RAL). This regimen is effective and better tolerated than NNRTI- and PI-based regimens. RAL has the additional advantage that restricted availability limits the likelihood of drug resistance. A combination of zidovudine (AZT)/lamivudine (3TC)/RAL can be used in HCPs with pre-existing renal disease, and an HIV expert should be consulted in cases of pregnancy, breastfeeding, serious medical disease in the HCP, and known or suspected HIV drug resistance in the source patient.

It is vital to ensure that the full 28-day course is completed. This can be achieved through active management of side-effects and anxiety.[11] Follow-up is essential and should specifically address condom use, as well as the timing of subsequent HIV and hepatitis tests. Post-PEP HIV testing should be performed by serial enzyme-linked immunosorbent assay (ELISA) testing, and there is currently no consensus on the use of polymerase chain reaction testing in this setting. A case may be made for the use of the HIV viral load (VL) for testing HCPs presenting with possible acute HIV infection after exposure to high-risk patients. These tests do, however, have several limitations such as a window period (albeit shorter than for ELISA) and considerable cost.

Finally, it is essential to exclude active HBV in all HCPs on PEP, because the effect of withdrawing TDF or 3TC after 1 month of treatment in the setting of active HBV is uncertain.

Hepatitis C virus

There is currently no vaccine or effective PEP to protect against HCV after exposure. Effective treatment of HCV is available, however, and it is important to identify and document HCV exposure and monitor for acute infection.

Management of HCPs infected with HBV/HIV/HCV

The optimal management of HCPs infected with BBVs has always been controversial because so few cases have been documented and randomised controlled clinical trials are not feasible. Management is further complicated by the absence of a comprehensive SA policy or guideline. By default, cases are managed on an *ad hoc* basis and monitoring is sparse or absent. Using international guidelines as a point of reference, with due cognisance of the local context, we suggest specific management strategies in the following sections, as well as in Table 3.

Any management programme should start with acknowledging the importance of HCPs knowing their infection status with respect to all three BBVs, and their obligation to know it, especially when performing EPPs.[7] This approach allows for protection of patients from nosocomial transmission, but also enables appropriate and timely access to care for HCPs. HCPs are at greater risk of active tuberculosis (TB), as well as drug-resistant TB, than the general population, a situation exacerbated by the presence of immunodeficiency.[13,14] In SA, owing to the burden of infectious diseases and the general lack of adequate infection control practices, HCPs are exposed to extraordinary risk in their work environment and every effort should be made to protect them.

Once HCPs are aware that they are infected with one of the BBVs, they should be supported by the medical fraternity, e.g. through expert review panels in their institution or health department or by a designated specialist in the field.[7] The role of such a panel or expert should be supportive, not punitive, and they should be governed by the professional rules of confidentiality and non-discrimination. Expert advisers can assist infected students and practitioners in minimising the risk of transmission and disease progression by advising on appropriate treatment, monitoring and infection control practices.

International guidelines advise monitoring of infectivity by means of DNA serum levels, i.e. VL, with restriction of EPP above a certain cut-off point (Table 3). Activities not classified as exposure prone are not restricted, provided the HCP does not have a medical condition, such as HIV-related neurocognitive dysfunction, resulting in the inability to perform tasks; there is no prior evidence of transmission of a BBV by the HCP to a patient; and the HCP follows standard infection control guidelines, is able to perform regular duties, and is closely monitored by an expert review panel, occup-

Table 3. VL criteria and testing frequency for HCPs infected with HBV/HCV/HIV*

	HBV†	HCV	HIV
No restrictions	VL <10^4‡	VL <10^4	VL <5×10^2§
Restriction of EPPs	VL ≥10^4 or HBeAg+	VL ≥10^4	VL ≥5×10^2
VL testing frequency	Twice a year	Twice a year	Twice a year

VL = viral load; HCPs = healthcare professionals; HBV = hepatitis B virus; HCV = hepatitis C virus; EPPs = exposure-prone invasive procedures (Table 1); HBeAg = hepatitis B e antigen.
*Adapted from Henderson *et al.*[7]
†Standardised guidelines based on VL are constrained by the following factors: (*i*) variability of HBV DNA levels among chronically infected individuals; (*ii*) paucity of data linking levels of viraemia to risk of transmission; (*iii*) variable reliability and reproducibility of the molecular tests used to measure HBV DNA; (*iv*) lack of standardisation among the different tests used to detect HBV DNA; and (*v*) the variability and durability of therapeutic antiviral effects, and specifically the length of time viraemia can be effectively suppressed before 'escape' mutant viruses emerge.[7]
‡Unit of measurement for VL = copies/mL.
§In HIV a VL threshold of 500 copies/mL is selected, since this is the cut-off level for viral 'blibs'.

ational safety staff and a physician. Importantly, infection with any of the three BBVs *per se* is not viewed as sufficient to warrant preclusion of the study or practice of medicine.[7,15]

Reporting and management responsibilities

Neither the Health Professions Council of South Africa nor the South African Medical Association (SAMA) oblige HCPs to know their HIV infection status or disclose this status to an employer. Both encourage voluntary counselling and testing after an exposure incident.[16,17] Infected practitioners are encouraged to seek counselling from an 'appropriate professional source' familiar with current recommendations, who can advise on the need for restricting professional practice. The SAMA guidelines stress the importance of upholding confidentiality, especially in healthcare institutions, and the right to non-discrimination, as delineated in the SA Constitution (1996) and the Employment Equity Act.[17]

The ethics of managing infected HCPs are complex and will not be discussed in detail. The debate is strongly influenced by the ethical, professional and fiduciary responsibility HCPs have towards their patients. Suffice it to say that balance should be sought between the HCP's right to confidentiality and non-discrimination and the patient's right to non-maleficence and a safe environment.

While we support voluntary and confidential testing of HCPs, we argue that structures and procedures should be in place to facilitate such testing and that the individual should not be held responsible for the cost of testing. Ideally, institutions should have an expert review panel, or at minimum an occupational health officer, to monitor testing and take responsibility for follow-up of infected HCPs. Restriction of scope of practice should be evidence based and should not be applied if the HCP is adequately treated and is able to practise safely and competently.

An HCP who has been the source of patient exposure should report such an exposure to the occupational health officer and undergo testing for infection with BBVs. The patient should be informed of the exposure and of the outcome of the source's BBV results, and be offered counselling and PEP as appropriate.[7] In order to protect confidentiality and in line with international guidelines, patients need not be informed of the name of the source or the exact circumstances of the exposure. Pre-notification of patients regarding their HCP's infection status is also not indicated, provided infection is appropriately managed.

In addition, the following precautions are advised in HIV-infected HCPs: (*i*) screen for active TB every 6 - 12 months; (*ii*) isoniazid prophylactic therapy (treat tuberculin skin test (TST)-negative HCPs for 6 months and TST-positive HCPs for 18 months); (*iii*) pneumococcal vaccine as per current recommendations;[18] and (*iv*) influenza vaccine annually.

HIV-infected healthcare students deserve further mention. Given that students are more likely to experience exposure incidents, they should be offered special assignments while working in high-risk environments such as surgery and TB wards. They should be allowed to withdraw without penalty from any clinical setting they feel poses a high risk of transmission. Students who are not on optimal treatment should be encouraged to seek such treatment, and VL results and ART regimen changes should be reported to the dean or a designated person on an annual basis. The teaching institution should assist students in selecting career paths best suited to their specific situation, and students whose HBV, HCV and/or HIV cannot be effectively cleared or suppressed below the recommended thresholds should be encouraged to select careers that do not involve the highest-risk procedures.

Recommendations

In the absence of SA guidelines, we suggest the following basic principles as minimum requirements:

- All healthcare providers and all healthcare students should know their infection and immune status (as appropriate) for all three major BBVs.
- All HCPs not infected with HBV should be vaccinated and have their immune status confirmed prior to initiation of training. Chronic HBV infection must be excluded in non-responders.
- HCPs infected with HIV, HBV or HCV should seek treatment and obtain expert advice, whether through an institutional expert review panel, occupational health officer or specialist in the field.
- Institutions and healthcare facilities should be familiar with current international guidelines on the management of occupational exposures.
- All institutions should have a dedicated person, such as an occupational health officer, who can monitor and support infected HCPs.
- All occupational injuries need to be documented and the data used to adapt training programmes and introduce innovative ways to prevent such injuries.
- HCPs should have easy and confidential access to testing and treatment for all three BBVs in their place of work.
- PEP should be individualised as more patients are on ART and should be accompanied by adequate medical and psychological support.

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