**HUMAN BITE INJURIES, SALIVA AND TRANSMISSION OF BLOODBORNE VIRUSES**

**Summary of BBV transmission risk from exposure to saliva**

The risk of BBV transmission from exposure to saliva is very low overall. It is related to the type of injury, the type of virus present, and the amount of blood in the saliva. Saliva cannot transmit BBVs unless blood is present, although blood can be present without being visible. The risk is increased if there is visible blood, poor oral hygiene, or if the source or recipient is immunocompromised. If there is a large amount of blood present in the saliva, the risk is similar to the risk from exposure to blood.

With bite cases, an individual risk assessment is required, taking account of the extent of the injury, the HBV immunisation status of the injured person and the BBV status of the source and the injured person. With the exception of a deep bite wound sustained from a HBV infected, or high-risk, source, in a recipient who is not HBV immune, the risk of BBV transmission is negligible. The evidence suggests that the risk of transmission from a HIV positive or HCV positive source is minimal to non-existent. A recipient of a bite that breaches the skin but with no visible source blood does not require any follow-up from the point of view of HIV and HCV.

HBV vaccination should be advised for an unvaccinated recipient following a percutaneous or mucous membrane exposure to saliva from a source who is HBV infected or high-risk but of unknown sero-status (see appendix 8). HBIg may also be indicated, depending on the risk assessment, but generally only if the source is HBV positive. If HBIg is required, it should ideally be given within 48 hours of exposure, but not later than a week after exposure. HIV PEP would not be indicated except in extreme circumstances.

**Saliva and bloodborne viruses**

Although composed mainly of water (99%), saliva is a complex secretion. Saliva can be considered as gland-specific saliva or whole saliva. Whole saliva (mixed saliva) is a mixture of oral fluids and includes secretions from both the major and minor salivary glands, in addition to several constituents of non-salivary origin, such as gingival crevicular fluid, expectorated bronchial and nasal secretions, serum and blood derivatives from oral wounds, bacteria and bacterial products, viruses and fungi, desquamated epithelial cells, other cellular components, and food debris. Saliva has protective properties and contains a variety of antimicrobial constituents and growth factors.

In general, complete bloodborne viruses are not secreted into saliva, even though the bloodborne viruses HBV, HCV and HIV have all been detected by molecular techniques in saliva of infected patients. BBVs get there from blood leakage into the oral cavity, either from soft or hard tissue trauma or from periodontal bleeding. Salivary fluids exiting the glands mirror the composition of macromolecules in blood. Viral particles usually are too large to filter through the salivary glands and into saliva. However, individual components of unassembled viral particles can get through the glands, such as hepatitis B surface antigen or DNA, and appear in saliva without the presence of blood. However, transmission can only occur if completely assembled HBV particles are in the saliva. No studies are available that prove that HBV is transmitted through saliva in the absence of blood. The same holds true for HCV and HIV. The bottom line is that saliva can only transmit BBVs to the extent that blood is present.

However, even when blood is not visible, it can still be present in limited quantities in the saliva and therefore saliva is considered a potentially infectious material in any percutaneous or mucous membrane exposure by the US CDC and Occupational Safety and Health Administration.
(OSHA). A bite from someone known to have poor gum health, diabetes, immunocompromise, or on anticoagulant medication, may increase the risk. Dentists are occupationally exposed to saliva, and prior to 1982 when the HBV vaccine was not available and exam gloves were not routinely used, their seroprevalence of HBV markers of infection was about 15%. The HCV seroprevalence in dentists is about 0.5%, and for HIV it is under 0.025%. Therefore, the risk of transmission from percutaneous or mucous membrane contact is proportional to the amount of blood in the saliva and the type of virus present.

**Hepatitis B**

HBV has been demonstrated in the saliva of HBV infected people and a high correlation has been shown between HBV DNA levels in serum and saliva. Saliva has been suggested as a vehicle for horizontal transmission of HBV among children. A study of paired saliva and plasma samples from 43 children with chronic HBV infection found high levels of HBV DNA (mean 33.9 x 10^3 IU/ml) in saliva of HBeAg positive children but HBV DNA was not detectable in the saliva samples from the HBeAg negative children.

Transmission of HBV by human bite has been described and definitively proven by genome sequencing of the virus in the carrier and in the bitten person.

**Hepatitis C**

HCV has been shown to be frequently present in the saliva of HCV infected people. However, epidemiological studies show that infection by contact with contaminated saliva is rare. It may be that the specific and non-specific defence mechanisms present in saliva could attenuate or abolish the infective capacity of viral particles. Saliva of patients with chronic HCV infection contains specific IgG and IgA neutralising antibodies directed against the E1 and E2 surface glycoproteins which could block viral adhesion to the host cell. There is conflicting evidence about the relationship between the presence of the hepatitis C virus in the saliva and the viral load in the blood, with one review suggesting a direct relationship; however, one study found that the presence of HCV in saliva is independent of the level of viral load.

There have been no reports proving the direct transmission of HCV by saliva: the possibility of transmission of HCV by a human bite has not been confirmed by molecular studies. Data suggest that nosocomial transmission of HCV to dental HCWs is unlikely. A review of the evidence on HCV transmission by saliva found that the prevalence of HCV infection among dental health care workers exposed to saliva is similar to that for the general population.

**HIV**

Salivary proteins play a role in the inactivation of HIV and preventing its infectivity. HIV virus is detectable in saliva, especially in immune compromised patients as CD4 count declines and plasma viral load increases. In countries where HIV positive patients receive successful anti-viral therapy (HAART), viral load is undetectable in most cases and the risk of oral transmission of HIV is probably low to non-existent.

Bite injuries represent a potential means of transmitting HIV. However, HIV transmission by this route has been reported rarely. The few documented cases of possible HIV transmission following bites were in adults exposed to blood-tinged saliva.

Transmission might theoretically occur either through biting or receiving a bite from a HIV-infected person. Biting a HIV-infected person, resulting in a break in the skin, exposes the oral mucous membranes to infected blood; being bitten by a HIV-infected person exposes non-intact skin to saliva. Saliva that is not contaminated with blood contains HIV in much lower titres and constitutes a negligible risk. A bite is not considered a risk exposure to either party when the integrity of the skin is not disrupted.
A review of literature on human bites and HIV transmission concluded that it is possible for a bite from a HIV-infected individual to transmit HIV. The likely risk of transmission is increased if:

- Blood is present in the oral cavity
- The bite breaks the skin
- The bite is associated with a previous injury
- The biter is IgA deficient.

**HUMAN BITE INJURIES**

*(appendix 6, algorithm for management of human bites)*

**Background**

Human bite wounds may result in infection such as cellulitis, osteomyelitis or septic arthritis. Current data suggest an infection rate from human bite wounds of the order of 10% to 50%, depending on the wound type and location. However, human bite wounds to the hand are associated with infection rates of almost 50%. A clenched-fist injury (“fight bite”) is considered the most serious of all human-bite wounds, with bites to feet, face, or skin overlying cartilaginous structures, or bites that penetrate deeper than the epidermal layer also significant. Human bites in other areas pose no greater risk than animal bites.

Human bites cause more serious infections than dog and cat bites because the human oral flora contains multiple species of bacteria. Human bite wound pathogens include aerobic bacteria (such as Streptococci, *S. aureus* and *Eikenella corrodens*) and anaerobic bacteria (such as *Fusobacterium*, *Peptostreptococcus*, *Prevotella*, and *Porphyromonas spp.*).

Because individuals with human bite wounds have a high-risk of serious bacterial infections close assessment of any bite wound is necessary. Overall, the risk of transmission of bloodborne viruses by human bites is likely to be low (see above). However, a significant risk of transmission must be considered following a human bite from a high-risk individual where a breach of the skin occurs and particularly if there is blood in the saliva. The risk is highest where the biter is HBV positive.

**Pathophysiology**

In a closed-fist injury (“fight bite”), forces sufficient to break the skin from striking an opponent’s tooth often inoculate the extensor tendon and its sheath. As the hand is flexed at the time of impact, the bacterial load is transferred caudally when the hand is opened and the tendon slides back to its relaxed state. Resulting contamination cannot be removed readily through normal cleansing and irrigation.

When a finger is bitten, such as in a chomping-type injury, tendons and their overlying sheaths are in close proximity to the skin. The wound may appear to be a minor abrasion-type injury, but careful inspection is required to rule out deep injury.

When a tooth strikes the head, even a deep puncture wound may appear innocuous. Deep, subgaleal, bacterial contamination is possible. This is especially true in young children who have relatively thin soft scalp and forehead tissue.

**Frequency, age and sex**

In a 4-year retrospective review in the United Kingdom, 421 (13%) human bites were identified out of 3136 case notes in emergency medicine departments. The majority of those bitten were young males, with 44% of the males aged 16-25 years. The male-to-female ratio was 3:1. Closed-fist injuries are encountered almost exclusively in young males. Toddlers frequently bite one another, but injuries usually are superficial and low-risk.

**Mortality/Morbidity**

The primary concern with human bites of the hand is infection, which can be severe because of spread along tendon sheaths and deep into the hand. Surgical incision and drainage may be needed. Resultant scarring and tissue damage may compromise normal function of the hand.
Infection is also the major complication of bites in other areas of the body. Most can be treated adequately; however, infections of poorly vascularized structures, such as ear cartilage, may be difficult to treat.

Other serious infectious complications such as deep soft tissue infection, septic arthritis, osteomyelitis, infectious tenosynovitis, bacteraemia, necrotizing fasciitis, and osteomyelitis of the skull vault have been associated with human bites.

**Risk assessment following a human bite**

**History**
- Circumstances of the injury
- Time of injury (after three hours, the bacterial count in a wound increases dramatically)
- Past medical history, including immunocompromised state
- Tetanus immunisation status
- Routine or recent medications (especially steroids, anticoagulants)

**Examination**
- Vital signs: Temperature, blood-pressure and heart rate.
- Dimensions of wound, including depth
- Assess for signs of infection, drainage or tissue loss
- Assess for vascular, neurological or tendon injury
- Photographic documentation (patient’s consent is required)

**Special tests – to be considered**
- Labs: wound swab, blood culture and sensitivities, complete blood cell count with differential, HIV, HBV, HCV serological status.
- Cultures for both aerobic and anaerobic bacteria are recommended if the wound shows clinical evidence of infection.
- Radiographic: for wounds near a joint or bone - to evaluate for foreign bodies (e.g. tooth fragments).

**Treatment of human bite wounds**

Wound management plays a key role in prevention of infection. The surface should be cleaned and lacerations should be irrigated with sterile saline using pressure irrigation. Devitalized tissue should be debrided. The management of puncture wounds is more controversial. High pressure irrigation into a puncture wound should be avoided.

Clinical findings which indicate infection of bite wounds include erythema, swelling, tenderness, purulent drainage, lymphangitis and fever. Wounds which are infected at presentation should be swabbed and cultured, and blood cultures should also be taken. Infectious diseases/clinical microbiology advice should be sought regarding appropriate antimicrobial treatment, and surgical opinion should be sought regarding debridement and other surgical interventions. Inpatient treatment with intravenous antibiotics and surgical input is often required.

The use of prophylactic antibiotics after human bites to the hand has been shown to reduce the risk of infection. Prophylactic antibiotics should be given for human bites if *any* of the following are present:
- bite to hand (clenched fist injuries are particularly high-risk), foot, face or ear;
- bite through dermis or puncture wound;
- moderate-severe wound with crush injury;
- wound near bone or joint;
- wounds requiring closure;
- wounds in areas of impaired venous/lymphatic drainage including post-mastectomy;
- immunocompromised hosts (including patients with transplants, HIV, post-splenectomy, cirrhosis or diabetes mellitus).
The recommended regimen for prophylaxis of infection is co-amoxiclav 625 mg tds for 3 to 5 days, with alternatives for penicillin allergic patients including doxycycline 100 mg bd plus metronidazole 400 mg po tds, or ciprofloxacin 500 to 750 mg bd plus metronidazole.19

HBV vaccination should be advised for all unvaccinated recipients of a human bite wound. HBIG may also be indicated, depending on the risk assessment, but generally only if the source is HBV positive (see appendix 8).

HIV PEP would almost never be indicated following a human bite except in extreme circumstances.

Tetanus prophylaxis may be indicated (see appendix 15).

Outpatient follow-up of patients with human bites is advised to monitor for any evidence of development of infection.

References