



Brief on Blood Borne Virus (BBV) Infection via Spitting or Biting

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Overview of the Brief

Part One of this brief presents a top-level summary of the current clinical literature (2000–2023) regarding the transmissibility of blood-borne viruses (BBVs) via spitting and biting, particularly human immunodeficiency virus (HIV) and hepatitis B and C viruses (HBV and HCV).

To supplement the summary, two tables derived from the Australasian Society for HIV, Viral Hepatitis and Sexual Health Medicine (ASHM) ‘Police and Blood-Borne Viruses’ guide are included at the end of Part One.

ASHM is the peak body representing the BBV and sexual health clinical workforce in Australia and New Zealand. This guidance was endorsed by the Australian New Zealand Policing Advisory Agency.

The tables set out:

- 1) facts about HCV, HBV and HIV
- 2) estimated risk of HCV, HVB, and HIV transmission from a known positive source

Part Two presents some additional detail from a review of the scientific literature on the transmissibility of BBVs. The review examined existing clinical reviews, clinical studies and reports. This part provides further background information. Although data on spitting and biting are commonly combined, for the purpose of this section, spitting and biting are discussed separately.

Part One. The Transmissibility of Blood-Borne Viruses via Spitting and Biting: Top-level Summary of the Current Clinical Literature and Expert Consensus Statements

HIV

As La Brooy and others explain, expert consensus statements are ‘documents developed by independent and usually multidisciplinary panels of experts, convened to review the research literature for the purpose of advancing the understanding of an issue, procedure, or method.’¹

Three separate expert consensus statements, published within Canada, Australia and internationally, each reach the conclusion that there is ‘**no possibility**’ of transmission of HIV via a single event of either biting or spitting.²

The 2018 *Expert Consensus Statement on the Science of HIV in the Context of Criminal Law*, authored by twenty leading HIV expert scientists from across the world, presents a detailed analysis of the ‘best available scientific and medical research data on HIV transmission, treatment effectiveness and forensic phylogenetic evidence’.³ This statement was endorsed by additional international scientists and by the *International AIDS Society*, the *International Association of Providers of AIDS Care* and the *Joint United Nations Programme on HIV/AIDS*.⁴

The Statement sets out the following conclusions:

Regarding HIV transmission via saliva, biting or spitting: ‘There is **no possibility** of HIV transmission via contact with the saliva of an HIV-positive person, including through kissing, biting or spitting.’⁵

Regarding HIV transmission via biting or spitting where there is no or a small amount of blood: ‘There is **no possibility** of HIV transmission from biting or spitting where the HIV-positive person’s saliva contains no, or a small quantity of, blood.’⁶

Regarding HIV transmission via biting or spitting where there is a significant quantity of blood and viral load is **not low or undetectable**: ‘The possibility of HIV transmission from biting where the HIV-positive person’s saliva contains a significant quantity of blood, and their blood comes into contact with a mucous membrane or open wound, and their viral load is not low or undetectable **varies from none to negligible**.’⁷

The consensus statement also notes:

Many studies have detailed a large number of cases where bites have not resulted in HIV transmission or found transmission to be unlikely. For transmission to be plausible in the case of biting, the HIV-positive person must have blood in their mouth at the time of the bite, a sufficient amount of HIV must be present in the blood of the HIV-positive person, and the bite must be deep enough to penetrate the HIV-negative person’s skin, causing trauma and tissue damage. **Even when all these conditions are present, the possibility of transmission during a single bite is negligible at most.** [Footnotes omitted].⁸

¹ Camille La Brooy, Bridget Pratt and Margaret Kelaher, ‘What Is the Role of Consensus Statements in a Risk Society?’ (2020) 23(5) *Journal of Risk Research* 664, 665.

² Mark Boyd et al, ‘Sexual Transmission of HIV and the Law: An Australian Medical Consensus Statement’ (2016) 205(9) *Medical Journal of Australia* 409; Mona Loutfy et al, ‘Canadian Consensus Statement on HIV and Its Transmission in the Context of Criminal Law’ (2014) 25 *Canadian Journal of Infectious Diseases and Medical Microbiology* 135; Françoise Barré-Sinoussi et al, ‘Expert Consensus Statement on the Science of HIV in the Context of Criminal Law’ (2018) 21(7) *Journal of the International AIDS Society* e25161.

³ Barré-Sinoussi et al, above n 2, 1.

⁴ For a list of supporting scientists, see Barré-Sinoussi et al, above n 2 (Supplementary Material S1).

⁵ *Ibid* 2.4.2.

⁶ *Ibid*.

⁷ *Ibid*.

These findings and conclusions are repeated in

- ‘The Sexual Transmission of HIV and the Law: an Australian medical consensus statement’;⁹ and
- ‘Canadian Consensus Statement on HIV and its Transmission in the Context of Criminal Law’.¹⁰

The Australian Medical Consensus Statement also finds that as at 2016: ‘No transmission through biting or spitting has ever been documented in Australia’.¹¹

Hepatitis B & Hepatitis C Virus (HBV; HCV)

Hepatitis B and C transmission has not been criminalised in a manner comparable to transmission of HIV. Consequently, scientific and clinical hepatitis experts have not produced equivalent national and international resources and consensus statements regarding the risks and circumstances of hepatitis transmission. However, the existing clinical literature provides guidance and conclusions regarding transmission via spitting and biting.

First, a question remains regarding transmission pathways and the presence (at all) of hepatitis viruses and their viral integrity in saliva. In a comprehensive review of whether oral fluids can be considered a source of viral transmission of HBV and HCV, Mahboobi et al state:

There is some evidence that [they are] present in oral fluids ... and may thus be possible sources of viral detection in clinical diagnosis and monitoring. However, the data are inconsistent and warrant the need for well-planned longitudinal studies to explore the precise frequency of oral carriage of such viruses and to determine the virological and host factors that may influence the oral presence of hepatitis A, B and C viruses.¹²

Concerning hepatitis transmission via spitting, Pintilie and Brook’s clinical literature review concludes that:

Although both HBV...and HCV... can be found in the saliva of infected patients, it seems unlikely that there is enough to transmit infection unless there is blood contamination... the risk of acquiring HCV through spitting is **negligible** and is **very low** for HBV.

Concerning hepatitis transmission via biting, Pintilie and Brook conclude that:

The risk is also **low** for acquiring HBV and HCV through biting, especially if no blood is apparent in the saliva.¹³

ASHM, in its national guidance document ‘Police and Bloodborne Viruses’ sets out that for Hepatitis C there is **zero** risk of transmission via spitting and a **very low** risk of transmission via biting.¹⁴

For Hepatitis B, there is a **‘very low’** risk of transmission via biting or spitting.¹⁵ (See Tables 1 & 2 below).¹⁶

⁹ Boyd et al, above n 2.

¹⁰ Loutfy et al, above n 2.

¹¹ Boyd et al, above n 2, 41.

¹² Nima Mahboobi et al, ‘Oral Fluid and Hepatitis A, B and C: A Literature Review’ (2012) 41(7) *Journal of Oral Pathology & Medicine: Official Publication of the International Association of Oral Pathologists and the American Academy of Oral Pathology* 505, 505.

¹³ Hannah Pintilie and Gary Brook, ‘Commentary: A Review of Risk of Hepatitis B and C Transmission through Biting or Spitting’ (2018) 25(12) *Journal of Viral Hepatitis* 1423, 1423.

¹⁴ Australasian Society for HIV Medicine, ‘Police and Blood-Borne Viruses’ (July 2015) 3 <https://ashm.org.au/wp-content/uploads/2022/04/Resource_PBB_2020_POLICE_V3_updated_mk2807.pdf>.

¹⁵ Ibid.

¹⁶ Australasian Society for HIV Medicine, above n 14.

It is important to recall here that Hepatitis B is a vaccine-preventable disease. ASHM’s guidance was endorsed by the Australian New Zealand Policing Advisory Agency.

Interestingly, when discussing other studies on the topic, Pintilie and Brook raise the possibility that biting may also pose a risk to the biter, as well as the person who is bitten. This was also raised by Lohiya et al, who report that although BBV transmission through human bites is very uncommon, the biter may face a ‘higher risk of transmission’ due to exposure of their oral mucosa to blood from the bitee.¹⁷

Finally, findings that hepatitis transmission via biting or spitting are unlikely or low risk are drawn from comprehensive studies based on the limited available research and evidence.¹⁸ Findings of low risk (rather than negligible or zero risk) are based on individually reported cases that lacked reliability regarding cause of infection where hepatitis is detected. Individually reported cases provide questionable, incomplete information regarding transmission events and causes, and should also be read with caution in light of the heterogeneity of clinical opinions regarding the presence of hepatitis in saliva.

Table 1. The facts about HBV, HCV and HIV. Source: *Police and Blood-Borne Viruses (ASHM 2015)*

| Table 1: The Facts About hepatitis B, hepatitis C and HIV | | | |
|--|---|---|--|
| | Hepatitis B | Hepatitis C | HIV |
| Prevalence | An estimated 210 000 people in Australia living with chronic HBV at the end of 2013. ¹ (less than 1% of the population) | An estimated 230 000 people in Australia were living with chronic HCV at the end of 2013. ¹ (about 1% of the population) | At the end of 2013, an estimated 26800 people in Australia were living with HIV infection. ¹ (about 0.1% of the population) |
| Vaccination/ Immunity | HBV can be prevented by vaccination 95% of adults infected with HBV naturally clear the virus and become immune for life. | There is no vaccine for HCV. 25-45% of adults infected with HCV clear the virus naturally, but do not become immune. | There is no vaccine for HIV. HIV infection cannot be cleared by the body and infection is for life. |
| Transmission | Blood-to-blood contact: <ul style="list-style-type: none"> ■ injecting equipment ■ needle-stick injury ■ open wounds ■ tattooing and body piercing equipment. Sexual contact (unprotected anal and vaginal sex). Mother to baby. Infected blood products (all blood screened for hepatitis B in Australia since 1970s). <i>Note: vaccination prevents HBV transmission.</i> HBV is not spread through spitting or saliva exchange. Bites that break the skin and draw blood are very low risk. | Blood-to-blood contact: <ul style="list-style-type: none"> ■ injecting equipment ■ needle-stick injury ■ open wounds ■ tattooing and body piercing equipment. Not considered sexually transmitted unless blood contact occurs. Mother to baby. Infected blood products (all blood screened for hepatitis C in Australia since 1990). HCV is not spread in saliva. | Blood-to-blood contact: <ul style="list-style-type: none"> ■ injecting equipment ■ needle-stick injury ■ open wounds ■ tattooing and body piercing equipment. Sexual contact (unprotected anal and vaginal sex). Mother to baby. Infected blood products (all blood screened for HIV in Australia since 1985). HIV is not spread in saliva |
| “Window period” <small>The time period from the point of infection to when the virus is detectable in the person’s blood.</small> | 1-3 months | 3-6 months | 3-6 months |

¹⁷ Ghan-Shyam Lohiya et al, ‘Human Bites: Bloodborne Pathogen Risk and Postexposure Follow-up Algorithm’ (2013) 105(1) *Journal of the National Medical Association* 92.

¹⁸ Pintilie and Brook, above n 13.

Table 2. Estimated risk of HBV, HCV and HIV transmission from a known positive source.
Source: Police and Blood-Borne Viruses (ASHM, 2015)

Table 2: Estimated Risk of Hepatitis B, Hepatitis C and HIV Transmission From a Known Positive Source
 © ASHM Adapted from HIV, viral hepatitis and STIs: a guide for primary care 2014 Table 2.1 page 29

| Type of exposure | Source Status | | |
|--|--------------------------|------------------------------|-----------------------------------|
| | HBV+* | HCV+ | HIV+** |
| Blood and saliva to intact skin and skin-to-skin contact | zero | zero | zero |
| Saliva in bites that break the skin | very low | zero | zero |
| Blood contact with broken skin, mouth or eyes e.g. <ul style="list-style-type: none"> ■ Punch from bleeding person to body causing break in skin ■ Large blood splash, e.g. bleeding artery ■ Blood contact to mouth from giving mouth-to-mouth resuscitation if no protective equipment used | Moderate | low | low |
| Needle-stick injury and other penetrating injuries e.g. <ul style="list-style-type: none"> ■ Cut by a blade which recently cut another person ■ Needle-stick injury from recently used needle | very high | high | moderate |
| Sexual exposure (no condom used) <ul style="list-style-type: none"> ■ Oral ■ Vaginal or anal (insertive) ■ Anal (receptive) | moderate high high | zero very very low low | very low moderate very high |

*HBV source status not relevant when officer is fully vaccinated and immune

**HIV source status may not be relevant when source is on treatment and viral load is suppressed.

Part Two. The Transmissibility of Blood-Borne Viruses via Spitting and Biting: Detailed Review of the Clinical Literature and Further Sources List

Spitting

There remains some debate within the clinical literature regarding the relative oral presence, and integrity and transmissibility of, hepatitis viruses via saliva. Regarding the oral presence of hepatitis viruses, Mahboobi et al. state in a review article:

There is some evidence that [they are] present in oral fluids, particularly whole saliva and gingival crevicular fluid, and may thus be possible sources of viral detection in clinical diagnosis and monitoring. However, the data are inconsistent and warrant the need for well-planned longitudinal studies to explore the precise frequency of oral carriage of such viruses and to determine the virological and host factors that may influence the oral presence of hepatitis A, B and C viruses.ⁱ

In relation to HIV presence in saliva, Cresswell et al point out, ‘saliva has been shown to lyse [break up] HIV particles in vitro ... and many salivary proteins inhibit and inactivate HIV particles’.ⁱⁱ In a study of HIV transmission, via a systemic literature search (n = 742), which resulted in the analysis of 13 case reports/case series, Cresswell et al found no reported cases of HIV transmission related to spitting. Further, they conclude there is “no risk” of transmission via this pathway.ⁱⁱⁱ

Similarly, in their review of 9 case studies of hepatitis infection (n = 245), Pintilie and Brook identified only 1 as a ‘possible case’ of hepatitis transmission via spitting. Notably, the authors identified 245 possible papers, which they reduced to those relevant to HBV and HCV transmission through biting or spitting that had scientific plausibility. In their conclusion, Pintilie and Brook stated that while HBV and HCV *can* be found in the saliva of infected patients, it ‘seems unlikely that there is enough to transmit infection unless there is blood contamination’.^{iv}

Beyond the clinical literature, expert consensus statements on HIV have been definite in highlighting the impossibility (or ‘negligible possibility’) of HIV transmission via saliva/spitting. For instance, Barré-Sinoussi et al. stated:

this Consensus Statement recognises that the possibility of HIV transmission during a single sexual encounter ranges from no possibility to low possibility, while it ranges from no possibility to negligible possibility in cases of spitting or biting.^v

It should be noted here that when describing the evidence, the authors aimed to use scientific concepts that would be helpful in the context of criminal law. For example:

The statistical concept of confidence intervals is designed to address uncertainty inherent in results derived from sampling a subset of a population. When dealing with probabilities that are or approach zero, confidence intervals take on special significance because the fact that something was not observed to happen during a study cannot prove that it could never happen. The larger the study, the more precisely the authors can estimate that the probability is zero. Consequently, a zero probability calculated from study data is associated with a confidence interval from zero to a small, positive probability. It is important that calculations of confidence intervals are not misinterpreted to exaggerate remote theoretical possibilities.^{vi}

Based on this premise, the authors continued: ‘There is no possibility of HIV transmission via contact with the saliva of an HIV-positive person’.^{vii} Notably, this language is repeated similar consensus statements; for instance, in a Canadian expert statement, Loufty et al. stated that ‘being spat on by an HIV-positive individual poses no possibility of transmitting HIV’.^{viii} Moreover, Barré-Sinoussi et al. stated that their approach to the science of HIV in the context of criminal law was similar to that used

in national scientific consensus statements, the most recent Australian version of which considers sexual transmission.^{ix}

Biting

The following paragraphs outline claims regarding the potential of HIV and Hepatitis B and C transmissibility via biting.

In Cresswell et al.'s review of HIV transmissibility, contrast to spitting which they described as 'no risk', they claimed that biting poses a 'negligible' risk. Their assessment is worth unpacking, as it demonstrates the complexity of assessing or determining risk from a clinical perspective.^x

The 13 identified articles that reported alleged HIV transmission vis-à-vis biting included information on 23 people bitten by HIV-positive individuals', 9 of whom (39%) seroconverted to HIV positivity following the incident, and 14 (61%) of whom did not.

Of those who seroconverted to HIV positivity, the alleged transmissions occurred 1) between family members (6/9); 2) in fights involving the infliction of serious wounds (3/9); or 3) due to untrained first-aiders placing their fingers in the mouths of people having seizures (2/9).

Moreover, there was significant heterogeneity in the quality of the reports.^{xi} Of these nine cases, only four cases were classified by the authors as having 'high plausibility or confirmation of HIV infection' attributable to the bite. Regarding these cases, Cresswell et al. reported that the person living with HIV:

had advanced HIV infection, was not on combined ART [antiretroviral therapy] and was therefore likely to have high-level HIV viraemia. In the majority of these cases, the bite resulted in a deep wound and [the person living with HIV] had blood in the mouth at the time of the incident. Two cases occurred in the context of a seizure whereby an untrained first-aid responder was bitten while trying to protect the seizing person's airway.^{xii}

Based on their assessment, the authors concluded that the 'necessary conditions for the transmission of HIV from a human bite' appear to be the presence of untreated HIV infection, severe trauma (involving puncture of the skin), and usually the presence of blood in the mouth. In the absence of these conditions, they wrote, '[post-exposure prophylaxis] is not indicated, as there is no risk of transmission'.^{xiii}

As such, the most common concerns regarding HIV transmissibility are 1) the presence of blood in the mouth of the biter, 2) viral load at the time of bite, and 3) the severity of the wound.

As is the case with spitting, consensus statements provide much wider syntheses of clinical studies regarding biting and HIV transmissibility. For instance, Barré-Sinoussi et al in their consensus statement on HIV transmission via biting, stated:

Many studies have detailed a large number of cases where bites have not resulted in HIV transmission or found transmission to be unlikely. For transmission to be plausible in the case of biting, the HIV-positive person must have blood in their mouth at the time of the bite, a sufficient amount of HIV must be present in the blood of the HIV-positive person, and the bite must be deep enough to penetrate the HIV-negative person's skin causing trauma and tissue damage. Even when all these conditions are present, the possibility of transmission during a single bite is negligible at most ... Consequently, it is our expert opinion that there is no possibility of HIV transmission from saliva containing small quantities of blood.^{xiv}

Loutfy et al.'s consensus statement included a similar framing of risk:

Being bitten by an HIV-positive individual poses a negligible possibility of transmitting HIV when the biting breaks the other person's skin and the HIV-positive individual's saliva contains

blood. Otherwise, being bitten by an HIV-positive individual poses no possibility of transmitting HIV. Biting as a cause of HIV transmission is extremely rare and difficult to confirm. Saliva does not contain enough HIV to transmit the virus and unbroken skin is an effective barrier to the virus. In the small handful of cases in which HIV transmission was reported and attributed to a bite as the likely source, severe trauma with extensive tissue (i.e., skin) damage and blood were present.^{xv}

Regarding hepatitis transmission and biting, Pintilie and Brook identified 2 cases of HCV and 15 of HBV in their search (10 of the 15 HBV cases occurred in an institute for people with learning disabilities, and the authors described them as ‘less plausible’).^{xvi}

Individual reported cases are limited in terms of evidence of potential hepatitis transmissibility (or, indeed, any other BBV). This is due to the studies’ non-standardisable nature; the limited, potentially questionable and incomplete information they provide regarding transmission events; and the diversity of clinical opinions regarding transmission pathways. In addition, concerning statistical power, the limited sample sizes used in reviews, such as those by Pintilie and Brook, mean that caution is required when interpreting their generalisability. This may be one reason for Pintilie and Brook noting that ‘research on the exact risk of becoming infected after a biting ... incident is lacking’.^{xvii}

That aside, in concluding their assessment, Pintilie and Brook stated that ‘the risk is ... low for acquiring HBV and HCV through biting, especially if no blood is apparent in the saliva’. Interestingly, when discussing other similar studies on the topic, the authors raised the provocative issue of biting potentially posing a risk to the biter as well as the bitee.^{xviii} This same issue was raised by Lohiya et al. who reported that BBV transmission through human bites is very uncommon, and that the biter may face a ‘higher risk of transmission’ due to exposure of their oral mucosa to blood from the bitee.^{xix}

ENDNOTES

ⁱ Mahboobi, N., Porter, S. R., Karayiannis, P., & Alavian, S. M. (2012). Oral fluid and hepatitis A, B and C: A literature review. *Journal of Oral Pathology & Medicine*, 41(7), 505–516.

ⁱⁱ Cresswell, F. V., Ellis, J., Hartley, J., Sabin, C. A., Orkin, C., & Churchill, D. R. (2018). A systematic review of risk of HIV transmission through biting or spitting: Implications for policy. *HIV Medicine*, 19(8), 532–540. See also Shugars, D. C., Sweet, S. P., Malamud, D., et al. (2002). Saliva and inhibition of HIV-1 infection: Molecular mechanisms. *Oral Disease*, 8(Suppl 2), 169–175.

ⁱⁱⁱ Cresswell et al.

^{iv} Pintilie, H., & Brook, G. (2018). Commentary: A review of risk of hepatitis B and C transmission through biting or spitting. *Journal of Viral Hepatitis*, 25(12), 1423–1428.

^v Barré-Sinoussi, F., Abdool Karim, S. S., Albert, J., Bekker, L. G., Beyrer, C., Cahn, P., Godfrey-Faussett, P. (2018). Expert consensus statement on the science of HIV in the context of criminal law. *Journal of the International AIDS Society*, 21(7), e25161. On method: twenty HIV scientists with expertise in scientific research, epidemiology and patient care across the world developed this consensus statement, prompted by concern that criminal law is sometimes applied inconsistently with contemporary medical and scientific evidence and overstates both HIV transmission risk and its potential to harm a person’s health and wellbeing. The consensus statement has been endorsed by additional international scientists and by the International AIDS Society, the International Association of Providers of AIDS Care and the Joint United Nations Programme on HIV/AIDS. An initial meeting was held in Seattle in February 2017 to decide on the content and framing of this consensus statement. A detailed literature review was conducted based on a search of studies published in English using the PubMed online database up to April 2017. Specific search terms relating to the possibility of HIV transmission were used, including ‘HIV and viral load’, ‘HIV sexual transmission risk per act’, ‘oral sex HIV transmission’, ‘anal sex HIV transmission’, ‘vaginal sex HIV transmission condom per act’, ‘anal sex HIV transmission condom per act’ and ‘anal sex HIV transmission circumcision per act’. The authors also searched key articles for references

to related articles, giving preference to meta-analyses, reviews and important studies. Other sources were identified by the expert authors, and abstracts from scientific conferences were used, if appropriate. The authors next engaged in multiple rounds of drafting and review, considering the best available scientific and medical research data according to the following hierarchy: systematic review of randomised trials and comparative studies (i.e. cohort studies, case-control studies and historical control studies). Two teleconferences were held to discuss a preliminary draft, followed by three rounds of redrafting via electronic correspondence by all the authors. National and international legal experts, including UNAIDS staff members, were consulted on the application of criminal law to cases involving HIV.

^{vi} Barré-Sinoussi et al

^{vii} Barré-Sinoussi et al

^{viii} Loutfy, M., Tyndall, M., Baril, J. G., Montaner, J. S., Kaul, R., & Hankins, C. (2014). Canadian consensus statement on HIV and its transmission in the context of criminal law. *The Canadian Journal of Infectious Diseases & Medical Microbiology*, 25(3), 135–140. <https://doi.org/10.1155/2014/498459>. On method: to promote an evidence-informed application of the law in Canada, a team of six Canadian medical experts on HIV and transmission led the development of a consensus statement on HIV sexual transmission, HIV transmission associated with biting and spitting, and the natural history of HIV infection. The statement was based on a literature review of the most recent and relevant scientific evidence (current in December 2013) regarding HIV and its transmission. The statement was endorsed by over 70 additional Canadian HIV experts and the Association of Medical Microbiology and Infectious Disease Canada.

^{ix} Barré-Sinoussi et al.

^x Cresswell et al.

^{xi} Cresswell et al.

^{xii} Cresswell et al.

^{xiii} Cresswell et al.

^{xiv} Barré-Sinoussi et al

^{xv} Loutfy et al. See also Schürmann, D., Hoffmann, C., Stegemann, M.S., Ruwwe-Glösenkamp, C., Gürtler, L. (2020). HIV transmission by human bite: a case report and review of the literature-implications for post-exposure prophylaxis. *Infection*, 48(6):949-954.

^{xvi} Pintilie & Brook.

^{xvii} Pintilie & Brook.

^{xviii} Pintilie & Brook.

^{xix} Lohiya, G. S., & Tan-Figueroa, L. (2013). Human bites: Bloodborne pathogen risk and postexposure follow-up algorithm. *Journal of the National Medical Association*, 105(1), 92–95.

ADDITIONAL SOURCE LIST

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