AMSSM position statement update: blood-borne pathogens in the context of sports participation

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ABSTRACT

This American Medical Society for Sports Medicine position statement update is directed towards healthcare providers of patients involved in sport and exercise. There have been significant advances in clinical and scientific research in the understanding of blood-borne pathogens (BBPs), and this update incorporates these advancements. This document is intended as a general guide to clinical practice based on the current state of the evidence, while acknowledging the need for modification as new knowledge becomes available. Confirmed transmission of BBPs during sport is exceedingly rare. There are no well-documented reports of HIV, HCV or HDV transmission during sport. There is also no evidence for universal testing for BBPs as a specific requirement for participation in sports. Competitive athletes and non-athletes should follow appropriate general public health agency recommendations for screening for BBPs, considering their individual risk factors and exposures. Standard (universal) precautions must be followed by those providing care to athletes. Exercise and athletic participation can help promote a healthy lifestyle for persons living with BBPs. Those with acute symptomatic BBP infection should limit exercise intensity based on their current health status. Education is the key tool for preventing BBP transmission. Research gaps include evaluation of the prevalence of BBP infections in competitive athletes, the effects of long-term, intense training on infected athletes and the effects of BBP treatment therapies on performance.

INTRODUCTION

The past 20 years have witnessed significant advances in clinical and scientific research in the understanding of blood-borne pathogens (BBPs). Prior to 1995, there was limited scientific information concerning BBP including HIV, hepatitis B virus (HBV), hepatitis C virus (HCV) and hepatitis D virus (HDV) as they are related to sports and athletic participation. This substantial knowledge deficit led to misunderstanding and misinformation about sports-related transmission risks and whether exercise participation for those harbouring these conditions should be permitted. In recognition of growing concerns by sports physicians and other healthcare providers, both the American Medical Society for Sports Medicine (AMSSM) and American Orthopaedic Society for Sports Medicine (AOSSM) responded by examining then-known medical science of BBPs as related to sports participation.[1] Other groups followed with their own sports-related HIV/AIDs/BBP statements.[2–9] Subsequent scientific and clinical research has led to significant advances in our understanding of BBPs.

This AMSSM position statement update, directed towards all healthcare providers who care of patients involved in sport and exercise, incorporates these advancements. This document is intended to act as a general guide to clinical practice based on the current state of the evidence, while acknowledging the need for modification as new knowledge becomes available.

Epidemiology and transmission—general considerations: HIV, HBV, HCV and HDV

The prevalence of BBPs among athletes has not been studied extensively. A 1995 study evaluated the prevalence of HBV infection in South Australian soccer players and found no difference compared with a group of blood donors of the same age.[10] A 2008 study examined the prevalence of HCV in 208 former professional and amateur Brazilian soccer and basketball players. It reported a prevalence of 7.2%, with values of 11% among professionals and 5.5% among amateurs.[11] The study found a close correlation between the use of injectable stimulants and HCV infection rates. In comparison, the prevalence of BBPs in athletes who did not inject such drugs was 0.6%, suggesting that sports participation itself had little to do with the relatively high overall prevalence rates. A 2011 study involving 420 male wrestlers (high-contact sport) and 205 volleyball and soccer players (low to moderate contact sports) found no evidence that participation in wrestling led to higher rates of HBV or HCV transmission compared with low-contact to moderate-contact sports.[12]

In athletic practices and competition, the potential route of transmission for BBPs occurs via blood from direct contact between an infected athlete with disrupted skin and/or mucous membranes of an uninfected athlete. Analysis of PCR for HIV RNA and pro-viral DNA present in eccrine sweat has verified that HIV is not transmitted through sweat or saliva.[13–15] Key biological characteristics of BBPs relevant to the potential for transmission in athletic settings include: (1) HIV has the lowest stability/infectivity and hepatitis B has the highest stability/infectivity, (2) the molecular structure of the HBV allows the virus to withstand environmental surfaces for ≥1 weeks and (3) HBV is highly concentrated in infected individuals making the speculative transmission risk higher when compared with HIV and HCV.[13 15 16] Transmission of HCV and HIV in the

healthcare setting remains a serious concern. Although rare, it is recommended that dental treatment should be included among the risk factors of HBV and HCV infection. Multiple case reports describe possible HCV transmission via blood splash into the conjunctiva, although the viral load of the splash donors has not been reported in these cases, therefore, no infection risk has been estimated. Among the reported cases, no phylogenetic analysis has been reported between donor and recipient HCV. Risk of transmission via these methods can easily be eliminated using standard precautionary measures.[15–18]

Similar to the non-athletic population, high-risk behaviours outside of competition and practice, such as unprotected sex and the sharing of injection-related equipment, present the most likely route of transmission. HIV is not transmissible through casual contact, *swimming pools, mosquitoes, saliva, sweat, tears, urine, faeces and inanimate objects (ie, wrestling mats, toilet seats and sinks). Sharing of objects such as razors and toothbrushes* carries at least a theoretical risk of infection and should be avoided.[19–24]

Human immunodeficiency virus

Approximately 37 million people worldwide are currently infected with HIV, with an estimated 2.45 million new diagnoses annually.[25] Sub-Saharan Africa has the highest prevalence of HIV. New infections worldwide show declining trends.[25] In the USA, approximately 1.2 million individuals are living with HIV (compared with 1 million in 1995) with approximately 40 000 new infections diagnosed every year. New infections in the USA are declining, consistent with global trends, though prevalence increases the success of highly active antiretroviral therapy (HAART) and other life-extending treatments.[26]

HIV is transmitted through sexual contact, parenteral exposure to blood and blood components, contamination of infected blood into open wounds or mucous membranes and perinatally from an infected mother to fetus or infant. There is no evidence of transmission via other routes, such as contact in a household or athletic venue or by viral particles in droplets suspended in the air. Transmission of HIV by sexual contact is reduced to an extremely low rate for infected patients managed with suppressive HIV treatment.[27]

There are no well-documented, confirmed reports of HIV transmission during sport. Only one instance of HIV infection thought to be possibly related to sports was reported in a 'letter to the editor' in the medical literature. In this report, the infection was diagnosed in a recreational soccer player in Italy following head-to-head contact with another player who was infected with HIV.[28] Public health officials in Italy, who reviewed the available data from this case, found that testing was not done on either athlete at the time of the incident, and thus, non-athletic risk factors could not be reasonably excluded.[29] In the over 27 years since this report was published, there have been no additional reported cases of HIV transmission during sport.

The theoretical risk for transmission of HIV has been estimated in the National Football League (NFL) to be <1 per 85 million game contacts or <1 transmission in 58.6 seasons.[30] This low-risk assessment is likely overinflated, as it was determined using the number of observed bleeding injuries during one season and then correlating to the risk of percutaneous HIV transmission involving hollow bore needles in the healthcare setting. This would not be directly applicable to athletic scenarios.

Although not the equivalent of sanctioned combative sports such as boxing and mixed martial arts, transmission of HIV in street fighting has been documented in case reports.[31] Increased risk for transmission was associated with high-risk behaviours (unprotected sex and needle sharing) and was tremendously reduced in any population if the infected individual was being treated with antiretroviral therapy (ART).[27 32]

Hepatitis B virus/Hepatitis D virus

Approximately two billion people worldwide have evidence of past or present infection with HBV, and 248 million individuals are chronic carriers (ie, positive for HBV surface antigen).[33] Acute hepatitis B has been declining in incidence since 1990 mainly due to effective preventive strategies such as vaccination. The Centres for Disease Control (CDC) estimates a US prevalence of approximately 2% with a reported 2953 acute HBV cases in 2014.[34] The number of Americans who are living with chronic HBV infection is growing due to the increasing prevalence of chronic carriers, despite a gradual decline in new cases. Recent CDC investigations report approximately 2.2 million chronic carriers in the USA.[34]

HBV is spread by percutaneous and mucous membrane exposures to infectious body fluids (ie, serum, semen and saliva). The risk of transmission of HBV is 50–100 times higher than that of transmission of HIV.[35] Explanations for this difference may include the fact that HBV is far more concentrated in blood, more stable in the environment and can survive ex vivo for up to 7 days with the capability of causing infection during this period.

The body of evidence for transmission of HBV in sports activity is limited to three case series dated before the year 2000. There are no recent reports to delineate the current risk. HBV transmission was documented in Japan in 5 members of a high school sumo-wrestling club[36] and 11 members of a Japanese University American Football Team.[37] In both studies, the horizontal transmission came from an index case through compromised skin contamination to a presumed contact. In addition, over a 6-year period, a cluster of 568 cases of HBV infection was reported in Swedish cross-country track finders (orienteering).[38] Inoculation with HBV during competition during the first outbreak was thought to have occurred from blood transmission from shrubs on which infected athletes had scraped themselves and from the sharing of bathtubs post-race. The authors contend that although more than one mode of transmission contributed to the spread of the disease, the likely infectious mode of transmission occurred through postcompetition common bathing. Of note, the epidemic was controlled when regulations introducing adequate protective clothing for competitors were enforced. In the nearly two decades since the last of these isolated and remote case series occurred, there have been no new published reports.

There are no published estimates of the risk of HBV transmission during sport, but extrapolation from NFL-based reports for HIV gives an estimate of one transmission in every 850 000 to 4.25 million game contacts for HBV,[39] an extrapolation based off of the significantly flawed approach of the original NFL calculation for potential HIV transmission.[30]

HDV is a defective RNA virus that requires HBV for assembly, replication and transmission and thus can only infect those who concurrently have HBV.[40 41] An estimated 10–20 million individuals are co-infected with HDV worldwide with a greater relative prevalence in the USA, Australia and Europe.[41–43] The modes of transmission of HDV are the same as for HBV, via blood products and body fluids.[40 41 43]

Hepatitis C virus

At least 4.6 million persons are HCV-antibody positive and approximately 3.5 million are currently infected with HCV.

Most patients with acute HCV infections are largely asymptomatic and do not seek medical attention.[41] The CDC estimates 3.3 cases of asymptomatic acute HCV for each newly diagnosed symptomatic acute HCV case.[41] In the USA, the number of HCV-related deaths (n=15 106) exceeded the number of HIV/AIDS-related deaths (n=12 734) for the first time in 2007 and has since continued to rise.

The most common modes of transmission of HCV occur through exposures to small quantities of blood via unsafe healthcare practices, injection practices, intravenous drug use, blood-tainted bodily fluids or objects, sexual transmission and transfusions. HCV can survive on environmental surfaces for roughly 16 hours.[39] Failure to identify infected individuals is a major obstacle to appropriate care and successful control of HCV. Appropriately screening asymptomatic patients with identifiable risk factors for HCV is an important step towards improving the detection and treatment of affected individuals.

The theoretical risk of HCV transmission in sport has not been published. There are no documented reports of transmission of HCV through sports participation in isolated case reports. Confirmed cases of transmission of HCV between team mates sharing needles for performance-enhancing injections exist.[15] HCV transmission has also been documented after bloody combat outside of the sanctioned combative sports setting.[44]

BBPs in sport-related activity

Testing/Screening

Mandatory screening for BBP is not medically justified as a condition for athletic participation or competition given the low risks of infection and transmission described above.[1–9 45] These tests cannot be used effectively for prevention, the costs are excessive and there are additional logistical, legal and ethical considerations.[16 45] Voluntary testing and screening may be recommended to all individuals, regardless of athletic participation, if one or more of the criteria which confer higher risk is met[16]:

1. Multiple sexual partners.
2. Injections of drugs (including drugs of abuse and doping with ergogenic aids).
3. Sexual contact with at-risk individuals.
4. Sexually transmitted infections.
5. Blood transfusions before 1985.

The CDC and United States Prevenative Services Task Force (USPSTF) both recommend HIV screening of at-risk adolescents and adults aged 15–65 years.[46 47] Evidence is insufficient at this time to recommend an optimum time interval between screenings.[46 47] Both the CDC and USPSTF also recommend that persons at high risk for infection (eg, people with HIV, men who have sex with men, people who inject drugs, and endemic parts of the world) be screened for HBV and HCV.[48–50] Additionally, USPSTF recommends offering one-time screening for HCV to adults born between 1945 and 1965.[51] However, the CDC recommends against testing asymptomatic individuals in the general population for HBV.[49] If testing is performed, then the ordering healthcare provider is responsible for ensuring that pretest and post-test counselling is available and testing is completed within the framework of state and federal law.[45]

Some specific sports' governing organisations require pre-participation screening for BBPs, including the International Federation of Associated Wrestling Styles, International Boxing Federation, International Amateur Boxing Association and various state boxing commissions. These groups have not published any evidence-based scientific rationale for their screening requirements. Athletes in these sports should have the ability to request testing if they participate in high-risk behaviours and may have an opportunity to opt out of sport-related pre-participation BBP screening contingent on sport-specific regulations and rules.[45]

Specific management and preventive measures for sports events and practices

An understanding of the risk factors and development of precautionary procedures to reduce blood exposure is instrumental for decreasing the already small risk for transmission of BBPs in organised sports.[52–54] Adherence to basic hygiene and standard precautions (formerly called universal precautions) is appropriate for all athletic settings. The following recommendations are intended to provide treatment guidelines for all providers delivering care in athletic settings:

1. Preparation: pre-event preparation includes proper care for pre-existing skin injuries or conditions that compromise the integrity of the protective skin barrier such as abrasions, existing or healing wounds, and dermatitis. These conditions may serve as a source of bleeding or as a point of entry for BBPs and should be covered until completely healed, with an occlusive dressing that will withstand the stress of competition to prevent transmission.
2. Supplies: supplies that reduce blood exposures and are compliant with standard precautions should be used for the care of all patients and be available to caregivers. These resources include latex or vinyl gloves, face/eye shields, soap/disinfectant, bleach (freshly prepared in a 1:10 dilution with tap water) or Environmental Protection Agency (EPA)-approved germicide, safer needles (eg, self-sheathing needles, blunted suture needles, needleless connectors and infusion sets), bandages or dressings, designated receptacles for soiled equipment or uniforms (with separate leak-proof bags or receptacles appropriately marked for uniforms and equipment contaminated with blood) and a puncture-resistant sharps disposal container.[55–61] It is recommended that participants in sporting events use squeeze-type water containers to avoid direct contact with the mouth as they drink as there is a potential risk of transmission through bleeding around the mouth.[62 63]
3. Early recognition: during the sporting event, prompt recognition and appropriate response of active bleeding is the responsibility of officials, athletes and medical personnel. Participants with bleeding should be removed from the event as soon as practical. Bleeding must be controlled, and exposed mucus membranes should be flushed with water and wounds cleansed with soap and water. Antiseptic products are not recommended as they do not reduce the risk of BBP transmission and damage or compromise normal tissue repair.[15 28 64 65] The wound must be covered with an occlusive dressing that can withstand the stress of the activity. Once bleeding is controlled and the wounds are properly covered, the player may return safely to competition. Any participant with exposed blood or blood-containing body fluids present should change that uniform and/or cover and control an area of active bleeding before returning to competition.
4. Reporting: participants should be educated that it is their obligation to report all wounds and injuries in a timely manner, including those recognised before the sporting activity,

and wear sport-specific appropriate protective equipment at all times (ie, mouth guards).

5. Precautions: standard precautions must be followed for the care of all patients with the practice of hand hygiene before and after every patient contact.[66–68] Appropriate gloves are required for all interactions when direct contact with blood, body fluids and other fluids containing blood can be anticipated. Gloves must be changed after treating each individual participant and hands should be washed with soap and water or antiseptic following glove removal.
6. Access to protective equipment: personal protective equipment (PPE): gloves, goggles, mask and fluid-resistant gown, as well as airway devices should be readily accessible. The lack of protective equipment should not delay emergency care for life-threatening injuries.
7. Decontamination: any equipment or playing surfaces (eg, wrestling mat) contaminated with blood or potentially infectious body fluids should be wiped immediately with paper towels or disposable cloths, and disinfected with a daily-prepared 1:10 ratio of bleach to water solution or EPA-approved germicide.[61] The cleaned area should be dry before reuse and individuals cleaning the equipment or collecting soiled linen should wear appropriate PPE.
8. Postevent follow-up: postevent management may include re-evaluation and management of any wounds sustained during the sporting event, including but not limited to covering wounds, cuts and abrasions, debriding dirty wounds and suturing clean wounds. Participants should be provided with appropriate follow-up with medical personnel for proper medical evaluation, postexposure counselling and prophylaxis, as indicated. Blood-soiled uniforms and towels should be collected using standard precautions and laundered according to the appropriate protocol: in hot water at a temperature of at least 71°C (160°F) for 25 min cycles.[61]
9. Procedures: procedures performed in the training room and during practices must be governed by adherence to standard infectious precautions. Medical providers should be equipped with appropriate PPE when coming into contact with potential BBP. Blood, potential infectious body fluids or other fluids containing blood should be cleaned as previously described. Equipment handlers, laundry personnel and janitorial staff should adhere to standard precautions and be advised to wear gloves whenever contact with bloody equipment, clothing or other items may occur. Appropriate containers for the disposal of needles, syringes or scalpels should be available.
10. Universal precautions: adherence to blood exposure plans should be consistent. Complacency concerning adherence to standard (universal) precautions has been documented in a major sporting competition.[69] Given anecdotal reports of transmission of HIV and HCV in bloody street fights, sports with rules against fighting (ie, all sports except North American professional hockey) should be emphasised and enforced.
11. Prophylaxis: pre-exposure and post-exposure prophylaxis for HIV, HBV and HCV should be based on the risk of exposure, except the hepatitis B vaccine. The strategy of vaccinating individual groups considered to be at high risk for contracting hepatitis B has not been successful in reducing the incidence of new infections, and universal vaccination of all individuals is recommended for prevention by the WHO, CDC, AAP, NFL and FIMS.[70–75]
12. Training: all personnel involved with sports should be trained in basic first aid and infection control, including the preventative measures outlined here.

The effects of exercise on athletes living with BBPs and general principles of management

Since the 1995 AMSSM and AOSSM statement, advances in the development of combination ART(cART) for HIV have transformed the infection from a fatal and progressive disease into a complex but manageable infection for those diagnosed who receive timely evidence-based care. Effective therapy results in a near-normal life span.[76] HCV had only been clinically recognised for 6 years in 1995, and available therapy was ineffective and had significant side effects. Today HCV-infected patients can benefit from the development of a growing number of direct-acting antiviral agents (DAA), which are well tolerated and curative in nearly all patients with treatment durations of ≤12 weeks.[77] HBV continues to decrease in prevalence secondary to global immunisation programmes and there are now six approved antiviral agents to manage the infection for those who have active disease.[78]

Effect of exercise on those infected with BBPs

Exercise has been found to be beneficial to the health and well-being of individuals infected with HIV, HCV or HBV. Compared with controls, patients with chronic hepatitis have decreased strength, exercise time to exhaustion and performance, and increased liver enzyme elevation during endurance exercise bouts.[79–83] When these patients engaged in a regular structured exercise programme, they experienced improved aerobic capacity, insulin sensitivity, body mass index, quality of life, and pain and depression scores.[84 85]

Moderate aerobic exercise increases CD4 levels in asymptomatic HIV-positive patients. Individuals with advanced stages of HIV infection may experience increased CD4 counts and CD4:CD8 ratio in response to aerobic exercise.[86] However, intense exercise may impair the ability of HIV-positive patients to mobilise neutrophils and natural killer cells.[86 87] For patients on cART, moderate aerobic exercise decreases lipolysis and fatty acid oxidation, improves insulin sensitivity, decreases central adiposity, decreases anxiety and tension, and improves quality of life.[88–91]

Numerous systematic reviews have concluded that 20 min of aerobic exercise performed three times per week for as little as 5 weeks can improve the efficiency of oxygen consumption, body composition, insulin sensitivity, depression and other psychological symptoms. Participation in longer duration programmes inhibits neurocognitive decline, improves body composition, improves both lipid profiles and glucose levels, and increases VO_2max.[92–96] Resistance exercise training increases muscle mass, strength, function and insulin sensitivity; decreases body fat; and improves lipid profiles in HIV-positive individuals.[97–102]

Recent systematic reviews have concluded that combining aerobic exercise with progressive resistance exercise in HIV-infected individuals improves cognition, insulin sensitivity, lean mass, upper and lower extremity strength, endurance, exercise time to exhaustion, VO_2max and quality of life and depression scores. It also decreases resting heart rate.[101–103] It does appear that combined programmes are safe for HIV-positive patients of either gender at nearly any age and result in significant overall improvement in health.[103 104]

Exercise recommendations

Exercise appears to improve overall general health and well-being with low risk of adverse effects for those individuals infected with HBV/HDV and HCV; thus, it is recommended that those with chronic hepatitis should exercise as tolerated.[84] Those with acute hepatitis infection will need to limit the exercise intensity based on their general health status. Further research is needed to define specific exercise recommendations in those with acute or chronic HBV/HDV or HCV infections.

Moderate exercise is beneficial to the physical and psychological well-being of the HIV-positive patient, but strenuous exercise may be detrimental.[86 92] HIV-infected individuals should begin exercising while healthy and maintain their exercise programme to help manage their illness and improve their quality of life. For healthy, asymptomatic HIV-positive individuals, unrestricted exercise is acceptable. For HIV-positive athletes with mild to moderate symptoms (eg, fatigue, menstrual changes, swollen lymph nodes, mild rashes, night sweats and so on) or low CD4 counts (<200), strenuous, exhaustive exercise should be avoided. Athletes with AIDS may remain active as directed by symptomatology but should avoid strenuous exercise and reduce or stop training during acute, opportunistic illness.

Treatment

Appropriate care of BBP considers two goals: suppression and cure. Suppression of the infection to clinically undetectable levels is now achievable. For HIV-infected individuals, complete viral suppression is achievable in the vast majority of cases. In addition, viral suppression decreases transmission risk by both sexual and non-sexual routes.[32 105] The second goal, specifically for HCV-infected patients, is to cure the infection with one of the many approved combination antiviral regimens.[77] Following virological cure and in the absence of advanced liver damage, return to health is now achievable for the majority of treatment-compliant patients. For HBV-infected patients, chronic and possibly lifelong viral suppression is possible, though the cure is currently not achievable in the majority.[106] In summary, full viral suppression is a powerful means to reduce transmission for all BBPs.

Education

Healthcare providers should play a vital role in the education of patients, including athletes, regarding BBP.[107] Athletes must be educated about the risks of blood-borne disease transmission via unsafe sexual practices and needle sharing.[107 108] The consistent use of condoms with water-based lubricants is recommended as a means of reducing spread. The WHO strongly advises against the use of spermicides containing nonoxynol-9 stating that it does not protect against HIV infection and is less effective in preventing pregnancy than other methods.[109] Furthermore, spermicides containing nonoxynol-9 may increase the risk of HIV infection in women using these products frequently.[109] Besides sexual practices, sharing contaminated needles for any purpose, including tattoo applications, can increase the transmission risk of BBPs.[110] Additionally, athletes should be educated to avoid sharing personal items, such as razors, toothbrushes and nail clippers, that carry BBP contamination risks.[107] During sport-related travel to certain parts of the world, players should be made aware of potential exposure to populations with higher prevalence of BBPs and higher risk medical scenarios including unscreened blood transfusion and injections with contaminated needles.

Athletes must be educated that the risk of transmission of BBPs during athletic competition is highly unlikely, both to provide comfort and dispel misconceptions regarding risks and routes of transmission.[111] Practical hygienic measures (eg, prompt application of first aid to bleeding injuries) should be emphasised, and athletes must understand that it is in their best interest to provide timely reports regarding significant injuries to appropriate personnel.

The athletic setting affords unique opportunities for educational initiatives aimed at reducing fear and misconceptions concerning BBP transmission among individuals. Sports can be a vehicle for information sharing and may be used alongside other strategies to raise awareness of the HIV epidemic and to facilitate prevention.[112] The convening power of sport can be effectively used to tackle stigma and discrimination as well as influence the most vulnerable populations with messages about HIV/AIDS prevention. The United Nations (UN) has highlighted sport as an effective platform to increase HIV/AIDS knowledge and awareness.[113] For example, the first HIV/AIDS advertisement to air during Super Bowl Sunday was part of the KNOW HIV/AIDS global media campaign launched by Viacom and the Henry J. Kaiser Family Foundation in 2004.[114] This form of mass media was proven effective in reaching a national audience and drawing attention to the global HIV/AIDS pandemic.[113] Such examples demonstrate how sports can empower a community with facts, skills and means for protection to halt the spread of an epidemic.[113] Programmes should also recognise the ability of athletes to serve as positive role models and educators, capable of connecting with at-risk groups in a manner not accessible to members of the medical community.[113 115]

SUMMARY

The spread of BBPs has been proposed as a potential concern in athletic participation, yet the confirmed transmission of BBPs during sport is exceedingly rare. There are no well-documented reports of HIV, HCV or HDV transmission during sport. There is also no evidence for universal testing for BBPs as a specific requirement for participation in sports. Competitive athletes and non-athletes should follow appropriate general public health agency recommendations for screening for BBPs, considering their individual risk factors and exposures. Although the risk of transmission for any BBP in the athletic setting is minute, common sense dictates that standard precautions be followed by anyone providing care to athletes. Exercise and athletic participation are compatible with a healthy lifestyle for everyone, including those persons living with BBPs. Those with acute symptomatic BBP infection should limit exercise intensity based on their current health status. Exercise and training do not appear to be harmful to the health of asymptomatic athletes infected with BBP pathogens; therefore, moderate levels of exercise should be encouraged for those with BBP. Education is the key tool for preventing BBP transmission. Future research considerations may include evaluation of the prevalence of BBP infections in competitive athletes, the effects of long-term, intense training on infected athletes, and the effects of BBP treatment therapies on performance.

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