Infection Control Education for Major Sports (ICS) Guide to Cleaning and Disinfection in SEC Athletic Facilities

Introduction

The COVID-19 pandemic has shed a light on the importance of infection prevention practices throughout society. Cleaning and disinfection have always been an important aspect of disease prevention, but never have they been quite as critical as they are during this pandemic. We at ICS have a longstanding history of infection prevention expertise and applying infection prevention practices to athletic facilities. Many of the best practices and recommendations we provide are informed by the research that we perform and publish in peer-reviewed journals.

The foundation of our program and this guide to cleaning and disinfection is based on one major tenet: **athletic training facilities are medical facilities.** Many of the same infection prevention practices and recommendations related to medical care provided in hospitals and outpatient clinics are applicable guides for infection prevention in athletic training facilities. As a result, this manual includes many of the guiding principles and basic practices used in these medical facilities to reduce the risk of infection.

Finally, this manual is intended to be a general resource and not a rigid list of absolute standards. Although the best practices and recommendations provided in the manual are based on the evidence available to date, team physicians, facilities personnel, and athletic trainers may encounter unique situations that are either not addressed in this manual or that require modification of the general recommendations provided. If and when these situations occur, we look forward to discussing them with you.

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Meet the Team

ICS is an independent agency that provides consulting and education services for the largest professional and collegiate sports organizations in the country. With over a decade of experience advising leagues on infectious disease mitigation strategies and techniques, we are among the most experienced sports epidemiology experts in the world. For more information about our team and our partners, please visit our website at https://www.icforsports.com/.

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A. CLEANING POLICIES

A.1. Best Practice – Develop and use a cleaning and disinfection protocol to guide *routine* standard cleaning of the training facility.

A.1.i. Recommendation – Develop a written protocol that addresses how often the facility is cleaned and by whom.
A.1.ii. Recommendation – Use a professional cleaning company or professionally trained university cleaning staff to perform routine cleaning of the facility.
A.1.iii. Recommendation – Perform routine cleaning of all areas of the training facility a minimum of once daily.
A.1.iv. Recommendation – Request documentation of daily cleaning from the professional cleaning company.

Rationale: The CDC describes cleaning and disinfecting environmental services as "fundamental in reducing the incidence of healthcare-associated infections."[1] Environmental cleaning agents kill bacteria and viruses that can make your players and staff sick.

Environmental cleaning protocols are recommended by the CDC to standardize the approach for cleaning used at the healthcare facility.[1,2] Environmental cleaning in healthcare settings is frequently inadequate. For example, studies using bioluminescent markers to document whether a specific surface was or was not physically cleaned demonstrate that as many as 50% of surfaces in hospitals are inadequately cleaned.[3] This study illustrates the limitations of environmental cleaning. Thus, we recommend that athletic teams use a professional cleaning company or professionally trained university cleaning staff to perform routine cleaning of the facility. These companies and trainings should provide specific education to housekeepers regarding appropriate chemical use and safety. The entire training facility should be thoroughly cleaned at least once each day. Finally, we advocate for specific documentation of cleaning. Thus, we recommend consulting with the professional cleaning company or professionally trained university cleaning staff for your facility to determine if and how daily cleaning will be documented. One potential strategy is to use a daily cleaning checklist. In acute care hospitals, checklists have been shown to improve patient care,[4] ensure adherence to best practices, and remind staff which areas need to be cleaned. Daily cleaning checklists are recommended by the American Society for Health Care Engineering (ASHE) for all hospitals. Since our goal is to bring hospital-grade disinfection to athletic facilities, we believe that utilizing these checklists may be similarly helpful for athletic teams.[5]

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A.2. Best Practice – Use EPA-registered cleaning and disinfection products to perform routine disinfection of the facilities.

A.2.i. Recommendation – Use a quaternary ammonium-containing disinfectant solution, a bleach-containing solution, or a hydrogen peroxide-containing solution for routine cleaning of surfaces in the training facility.
A.2.ii. Recommendation – Use a quaternary ammonium-containing disinfectant solution, a bleach-containing solution, or a hydrogen peroxide-containing solution for cleaning when surfaces are visibly soiled.
A.2.iii. Recommendation – Use disinfectants that are listed on EPA list N to ensure they have an emerging viral pathogens claim against SARS-CoV-2, the virus that causes COVID-19.

Rationale: Athletic training facilities should only use "hospital-grade" disinfectants registered by the Environmental Protection Agency (EPA) to "ensure chemical potency, materials compatibility, and safety." EPA-registered chemicals are recommended by the CDC for cleaning both routine surfaces and visibly soiled surfaces in healthcare facilities.[6] A list of the EPA-registered disinfectants is available online through the EPA website (https://www.epa.gov/pesticide-registration/selected-epa-registered-disinfectants). Utilizing disinfectants that are specifically listed on EPA list N (https://www.epa.gov/pesticide-registration/list-n-disinfectants-use-against-sars-cov-2-covid-19) will ensure that you are using products that have an emerging viral pathogens claim against SARS-CoV-2, the virus that causes COVID-19. Regardless of which product is used, we prefer the use of pre-mixed bottles instead of concentrated disinfectants that require dilution. The most common EPA-registered disinfecting agents for surfaces in healthcare facilities include quaternary ammonium-containing solutions ("quats"), bleach-containing solutions, and hydrogen peroxide-containing solutions. All three products are effective against a wide variety of human pathogens. In fact, all three are equally effective against vegetative bacteria (including MRSA) and the vast majority of viruses. They do not, however, have equal effectiveness against two important causes of diarrhea: certain viruses such as norovirus and *C. difficile* spores.

There are several advantages and disadvantages to each product. Quats are the preferred disinfectant at most hospitals in the US for routine cleaning of environmental surfaces because they are non-toxic to exposed skin, less corrosive to medical devices than other disinfectants, and cheap. These properties make quaternary ammonium compounds ideal compounds for cleaning and disinfecting contaminated "high-touch" surfaces and equipment. Quats are ineffective, however, against some bacteria[7] such as *C. difficile* and viruses such as norovirus. In addition, the antimicrobial activity of quats can be reduced by dilution using "hard water" or by using cotton towels or gauze pads to apply these chemicals.[6]

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Bleach-containing solutions are the second most commonly used EPA-registered disinfecting agent in hospitals. Bleach has several advantages over other disinfecting agents. Bleach-containing solutions have a broad spectrum of antimicrobial activity; they do not leave toxic residues on surfaces; and they are unaffected by water "hardness". In addition, bleach-containing solutions are inexpensive, fast acting, and effective in removing dried organisms and biofilms from surfaces.[1] However, bleach-containing solutions also have disadvantages. Bleach-containing solutions can corrode metal surfaces, produce toxic chlorine gas when mixed with ammonia or acid, discolor fabrics, and irritate the mucous membranes of the eyes, mouth, and stomach when exposure is prolonged or intense. Bleach is also easily inactivated by organic materials.

EPA-registered disinfectant solutions containing hydrogen peroxide are less commonly used as a hospital disinfectant. Hydrogen peroxide has one specific advantage over other disinfectants: it enhances the removal of organic matter and organisms from contaminated surfaces.[6] Hydrogen peroxide is also odorless, has a broad spectrum of antimicrobial activity, decomposes into water and oxygen, and is thus safe and non-toxic. However, use of currently available hydrogen peroxide-containing solutions can be irritating to the eye if splash exposure or other direct contact with the sclera or conjunctiva occurs. While hydrogen peroxide is generally more expensive than the quaternary ammonium- and bleach-containing disinfectants, it represents the best combination of characteristics of EPA-registered disinfectants.

A.3. Best Practice – Use microfiber cloths to administer quaternary ammonium-containing disinfectant solutions.

A.3.i. Recommendation – **Use microfiber cloths to clean surfaces if a quaternary ammonium-containing disinfectant is used.**

Rationale: Microfiber cloths are highly effective and should be used for all types of cleaning when a quaternary ammonium-containing solution is used. More specifically, we recommend using microfiber cloths for daily, routine cleaning of the facility and when equipment and treatment areas are cleaned between players. Microfiber fabrics consist of polyester and polyamide (nylon) threads that have been manufactured and modified in unique ways to produce a number of exceptional characteristics such as high absorptive capability, durability, and softness.

Microfibers are now widely used in clothing, shoes, accessories, upholstery and other textiles, industrial filters, and cleaning products. Microfiber cloths have two specific properties that make them superior to cotton cloths in routine cleaning. First, microfiber cloths have phenomenal absorptive properties. A microfiber cloth can absorb up to 6-times its weight in water. Second, microfiber cloths have unique

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electrodynamic properties that allow them to lift and remove debris from a surface. Negatively charged dirt and dust are attracted to and retained by the positively charged microfibers until the microfiber cloth undergoes laundering.

The preceding unique properties of microfiber fabrics make them excellent for disinfection and cleaning. Microfiber fabrics have a higher rate of microorganism removal from ceramic tiles and hospital floors compared to cotton blends.[8] When microfiber mops were tested against conventional string mops with a detergent cleaner, the microfiber mop removed 94% of microbes compared to 68% removal with the string mop.[8] Microfiber cloths effectively reduce the quantity of MRSA, *E.coli*, and *C. difficile* (in spore form) by up to 99% from stainless steel, furniture laminate, and ceramic tile.[9] In contrast, cotton cloths remove only 30%.[10] Additionally, microfiber products more effectively deliver disinfectant solution to a surface.[11] Cotton and gauze pads absorb and bind the active ingredients in quaternary ammonium-containing disinfectants and deliver less of the solution to a surface. Over time, a cotton cloth will release half of the amount of quaternary ammonium compound that was present in the original disinfectant.[12] In contrast, a microfiber cloth will release 85% of the amount of quaternary ammonium compound in the original disinfectant.

A.3.ii. Recommendation – Follow manufacturer's instructions for use and laundry of microfiber cloths.
A.3.iii. Recommendation – Replace microfiber cloths used for cleaning at least one time each year.

Rationale: Cleaning with and laundering of microfiber products requires different techniques compared to standard cleaning materials. Traditional cotton mop pads, for example, are repeatedly placed in buckets with water and disinfectant and "wrung out" before each use. This "wringing out" process may occur up to 75 times during a typical work shift when a cotton mop is used, leading to contamination of the disinfectant solution.[13] In contrast, microfiber cloths and microfiber mop pads should be placed in a basin or bucket of disinfectant and removed one at a time for use. After use, the microfiber product is placed in a "used" bucket. In other words, microfiber cloths are designed to be used once and then laundered before subsequent use to prevent the transfer of microbes via contamination of disinfectants. A new microfiber pad should be used to mop individual rooms. A single standard-sized microfiber mop pad is sufficient to mop an entire hospital room. Finally, it is also important to note that bleach degrades microfiber products. Thus, bleach-containing solutions should not be used with microfiber cloths and mops.

Though some microfiber cloths can be washed in regular washing machines, most microfiber cloths require a special laundering process that varies slightly depending on the brand of microfiber cloth. In particular, fabric softeners and bleach should not be used to launder these products. Similarly, water temperature should not exceed 160°F

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to avoid damaging the cloths. Microfiber mops can withstand over 300 standard laundering cycles in a washing machine, whereas the conventional cotton string mop withstands approximately 75 laundering cycles.[12] Refer to the manufacturer's recommendations regarding how many uses each microfiber product can withstand before losing its effectiveness.

A.4. Best Practice – Observe appropriate contact time to ensure adequate disinfection.

A.4.i. Recommendation – Ensure disinfectant chemicals are used properly and left on surfaces an adequate amount of time to achieve appropriate bacterial killing.

Rationale: Disinfectants are not effective if they are simply sprayed on surfaces and immediately wiped off. Surfaces should be visibly wet with disinfectants for a sufficient duration to ensure adequate antimicrobial effect. This duration is called the "contact time." The "contact time" is printed on all EPA-registered disinfectants. EPA-registered contact times are generally very conservative (up to 10 minutes) and include the time required to kill hardy microbes like *Mycobacterium tuberculosis* and spores. In our experience, strict adherence to the EPA-registered contact time is rarely followed in healthcare settings for general disinfection purposes. In fact, hospital grade disinfectant contact times of 1 minute are sufficient against the vast majority of healthcare-associated pathogens relevant to the athletic training environment (e.g., vegetative bacteria like MRSA).[6,14,15] Thus, while we don't believe that adherence to such conservative "contact times" is necessary for routine use in a training facility, it is nevertheless important to ensure that disinfectant remains visibly wet for at least 1 minute. In the event that a player has an uncommon infection such as *C. difficile*, longer contact times may be needed (i.e., 2 to 3 minutes, depending on the disinfectant). SARS-CoV-2 is not a particularly hardy pathogen, so a 1-minute contact time is likely sufficient for hospital grade disinfectants to eradicate SARS-CoV-2. That said, to err on the side of caution, the contact time listed on EPA list N (the list of disinfectants that have an emerging viral pathogens claim against SARS-CoV-2, which can be found at https://www.epa.gov/pesticide-registration/list-n-disinfectants-use-against-sars-cov-2-covid-19) should be observed.

A.5. Best Practice – Incorporate electrostatic sprayers into your facility cleaning protocol.

A.5.i. Recommendation – Use an electrostatic sprayer as an adjunct to normal daily cleaning to enhance application of disinfectants to hard-to-reach surfaces.

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A.5.ii. Recommendation – Add use of the electrostatic sprayer to the responsibilities of the overnight cleaning team.

Rationale: Electrostatic sprayers are an effective and efficient means to ensure that disinfectant is applied to surfaces. The pest control industry has used electrostatic sprayers for over 30 years to apply insecticides. Numerous studies have shown that less volume of insecticide is needed, application time is shorter, and overall dispersion of insecticide is greater with electrostatic sprayers compared to conventional compression sprayers.[16–18]

Within the last several years, commercial cleaning companies have begun marketing electrostatic sprayers for application of disinfectants. While there are no studies demonstrating the effectiveness of electrostatic sprayers in reducing transmission of pathogens such as MRSA, the data supporting application of a substance with an electrostatic sprayer are robust compared to other strategies for disinfectant application. The electrostatic charge applied to the disinfectant allows it to bind to surfaces. This strategy would be particularly helpful in locations with numerous and/or hard-to-reach surfaces, including the locker rooms and weight rooms.

Disinfectants only work when applied to surfaces. As noted above, manual application of disinfectants leads to missed surfaces. Thus, because electrostatic sprayers lead to better and more complete surface coverage, their use overcomes one of the biggest issues in healthcare disinfection. Accordingly, we believe that electrostatic sprayers are a useful adjunct to routine cleaning and disinfection. However, this technology should not replace routine cleaning and disinfection. Instead, we recommend that the overnight cleaning team **add** the electrostatic sprayers to their nightly activities. Be sure to follow manufacturers' instructions for appropriate use and compatibility of specific disinfectants. For example, some electrostatic sprayers are only compatible with quaternary ammonium-containing disinfectants.

B. ROUTINE CLEANING OF TREATMENT AND TRAINING AREAS

B.1. Best Practice – Disinfect treatment and training equipment after each player use.

B.1.i. Recommendation – Clean and disinfect training and nonmedical treatment equipment after use by individual players.

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Rationale: In addition to the regular nightly cleaning recommended and described in *Best Practice A.1.*, we recommend that training and non-medical treatment equipment undergo cleaning and disinfection after use by an individual player. The vast majority of equipment described in this section are classified as "non-critical items," defined as surfaces or equipment that come into contact with intact skin but not mucous membranes.[6] Intact skin is an effective barrier against most bacteria and viruses. Thus, sterility of these items is *not* required. Instead, disinfection is sufficient to reduce the risk of pathogen transmission. See *Best Practice G.1.* for recommendations regarding cleaning, disinfection, and sterilization of medical equipment.

Cleaning and disinfection of surfaces and training (non-medical) equipment in the training room performed by athletic trainers should follow the basic tenets and recommendations provided in *Best Practices A* and *B.*

B.1.ii. Recommendation – Ensure that appropriate disinfection chemicals are available in convenient and consistent locations in the training facility.
B.1.iii. Recommendation – Assign responsibility for cleaning and disinfection of non-medical equipment after use.

Rationale: Compliance with principles and policies of disinfection requires that disinfection products are stored in convenient and consistent locations so that they are quickly accessible when needed for routine cleaning. Specifically, these cleaning products should be available in *each* area of the training facility where their use is indicated (e.g., the taping, treatment, and rehabilitation areas of the training room; examination and procedure rooms; weight room; locker room; etc.) rather than exclusively stored in a single or central location. The responsibility of cleaning and disinfecting non-medical equipment used in each area of the facility should be clearly and formally assigned to designated individuals. Athletic trainers and their associates should be primarily responsible for disinfecting equipment after use by individual players in the training room; other personnel may take responsibility for cleaning equipment in other areas of the facility (e.g., food service areas, meeting rooms, lounges, and weight rooms). For example, strength coaches may be responsible for equipment in the weight room and designated cleaning personnel may take responsibility in the locker room.

Treatment Room and Rehabilitation Area/Room

B.1.iv. Recommendation – Disinfect taping tables after each taping session (i.e., not necessarily between each player within the same session).
B.1.v. Recommendation – Disinfect treatment tables after each use.

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Rationale: We realize that it usually is not practical to disinfect taping beds and chairs between each player during high-volume taping sessions. Fortunately, routine taping sessions pose minimal risk to players; however, taping tables should be disinfected, at minimum, after each taping session. Additional disinfection should be performed after any player contacts surfaces with skin that is not intact.

In contrast to taping sessions, treatment sessions generally involve player contact with treatment beds or tables for longer durations and are more likely to involve surface contact with skin. Therefore, these surfaces should be cleaned with an appropriate disinfectant after *each* player's treatment session. These disinfectants need an appropriate "contact time" with surfaces before they are wiped off. If a quaternary ammonium-containing disinfectant solution is used, per *Best Practice A.3.*, use microfiber cloths to apply disinfectant.

B.1.vi. Recommendation – Disinfect treatment equipment (e.g., Normatec, Game-Ready, and Graston devices, HawkGrips, ultrasound probes, and electrostimulation equipment) after each use.
B.1.vii. Recommendation – Ensure each player has and uses individual electrostimulation pads.
B.1.viii. Recommendation – Launder hydrocollator pads after each use.

Rationale: Non-medical treatment equipment has close and at times prolonged contact with players' skin. Therefore, such items require cleaning and disinfection after each use. Quaternary ammonium-containing wipes may be easier to use than spray bottles of solution to clean some of these items.

Electrostimulation pads cannot be routinely disinfected and consequently should be used by only one player. Hydrocollator pads should ideally be laundered after each use, particularly if they are applied directly to skin without use of a clean towel barrier.

B.1.ix. Recommendation – Use single-use, sterile ultrasound gel when performing any invasive procedure.

Rationale: Large bottles of multi-use ultrasound gel can be utilized for routine use when applied to intact skin; however, single-use, sterile gel must be used for invasive procedures such as a joint or other aspiration procedure or a biopsy. Although large multi-use bottles of ultrasound gel can be utilized on intact skin, this gel frequently becomes contaminated with pathogenic bacteria. Contaminated bottles of multi-use ultrasound gel have caused serious outbreaks of healthcare-associated infections when used for invasive procedures.[19] Thus, multi-use bottles of gel should never be used for invasive procedures; when possible, single-use containers of gel are also preferred for non-invasive procedures.

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Rehabilitation Area/Room

B.1.x. Recommendation – Disinfect cardiovascular, rehabilitation, and training equipment after each use.

Rationale: Similar to equipment used in the training room, rehabilitation equipment should be disinfected after each use. Smaller items may be better suited for disinfection with quaternary-ammonium containing wipes, while spray bottles may work best for equipment with large surface areas.

Examination/Procedure Room

B.1.xi. Recommendation – Disinfect treatment tables between player uses. If sheets or paper covers are used, replace between players.

Rationale: Treatment beds and tables used in examination or procedure rooms should be disinfected in the same manner as treatment tables in the training room. As explained in ***Recommendation A.4.i,*** adequate "contact time" is necessary before wiping off disinfectants, and microfiber cloths should be used to apply quaternary ammonium-containing disinfectants. Sheets or paper covers for treatment tables should be replaced between players and the use of sheets or paper covers should not replace the additional use of disinfectants.

Weight Room

B.1.xii. Recommendation – Provide clean towels to players as they enter the weight room.
B.1.xiii. Recommendation – Instruct players to use clean towels as barriers when using equipment.
B.1.xiv. Recommendation – Instruct players to wipe down equipment after each use.
B.1.xv. Recommendation – If equipment becomes visibly soiled, use an appropriate EPA-registered disinfectant to clean the equipment.
B.1.xvi. Recommendation – Disinfect all equipment after team workout sessions.
B.1.xvii. Recommendation – Inspect vinyl surfaces for cracks and defects and replace/repair if identified.
B.1.xviii. Recommendation – Use electrostatic sprayers to perform nightly disinfection.

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Rationale: Players should use clean towels when using weight room equipment to decrease direct skin contact with surfaces. It may not be practical to clean surfaces with disinfectants after use by each player during high-volume workout sessions, but players should wipe equipment down with towels after each use. If equipment becomes visibly soiled, however, it should be cleaned with an appropriate disinfectant and wiped after the specified contact time. Strength coaches or other athletic staff should be responsible for appropriately disinfecting all weight room equipment at the conclusion of team workout sessions.

Bacteria and viruses – including SARS-CoV-2 – can survive for extended time periods on vinyl surfaces.[20,21] This longevity may be prolonged further if vinyl surfaces are damaged. Vinyl surfaces need frequent inspection, and if defects are present, such equipment or flooring should be replaced or repaired.

Finally, the number of surfaces that players may potentially contact in the weight room is extraordinary. Given that many athletes are more likely to have MRSA colonization on hands, weights and surfaces in the weight room may serve as a source of transmission. Manual application of disinfectants on the large number of surfaces is difficult. As a result, the weight room is an ideal location for use of an electrostatic sprayer to apply disinfectant.

Hydrotherapy Room

B.1.xix. Recommendation – Launder booties regularly, though these items do not need to be cleaned between uses.
B.1.xx. Recommendation – Replace shoes used in treadmill pools regularly, though these items do not need to be cleaned between uses.

Rationale: The practice of sharing pool booties and shoes poses little risk to players if shared between players who have intact skin and no evidence of bacterial or fungal foot infections. Therefore, booties and shoes used in the hydrotherapy room are not required to be laundered or disinfected after each use. We recommend developing a schedule to routinely launder pool booties (e.g., once each week). We also recommend developing a schedule to routinely replace pool shoes (e.g., once each month).

Locker Rooms

B.2. Best Practice – Develop and implement a protocol to clean and disinfect competition venues prior to each home game.

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B.2.i. Recommendation – Use a commercial cleaning company to clean and disinfect the locker rooms (home, away, and officials) and coaches' booths immediately after departure of a team and the day prior to a team's arrival (See *Recommendation A.1.ii*).
B.2.ii. Recommendation – Housekeepers must follow the basic tenets outlined in this manual when cleaning and disinfecting locker rooms, including a) cleaning all surfaces with EPA-registered hospital-grade disinfectant, b) cleaning toilets with a bleach- or hydrogen peroxide-containing disinfectant, and c) ensuring adequate "contact time" (e.g. 1 minute or more) for the disinfectants (See *Best Practice A.4.*).

Rationale: Cleaning and disinfection are crucial components of every post-game routine, as they reduce the overall bioburden in the facility. While disinfection is certainly important, many organisms will not exist in the environment for prolonged periods of time, so attention to facilities that are used infrequently (e.g. stadiums used once weekly) should not distract from the attention paid to facilities where staff and athletes are present on a daily basis. We recommend cleaning and disinfection prior to games as well in order to instill confidence in the staff and athletes that the facilities are appropriately disinfected and unlikely to contribute to disease transmission.

Public Areas of Competition Venues

B.2.iii. Recommendation – Clean and disinfect bathrooms and high touch surfaces in public areas of competition venues before and after use.
B.2.iv. Recommendation – If indoor venues will not remain unoccupied for >72 hours, use an electrostatic sprayer to disinfect seats or bleachers.
B.2.v. Recommendation – Outdoor venue seats and bleachers do not need to be routinely disinfected unless the venue will be used within 24 hours of prior competition.

Public arenas and stadiums are not commonly known as pathways for transmission of infectious diseases. Significant attention has (appropriately) been paid to cleaning and disinfection practices since the onset of the COVID-19 pandemic due to the fact that SARS-CoV-2 can survive on some surfaces for up to 72 hours in ideal laboratory conditions,[21] but it's important to recognize that infrequently used facilities pose significantly less threat of infectious diseases transmission than frequently used facilities due to the natural effects of time on most bacteria and viruses. Additionally, many pathogens (including SARS-CoV-2) are ultraviolet-sensitive, meaning that exposure to sunlight will accelerate their inactivation.[22]

Cleaning and disinfection of bathrooms and high touch surfaces before and after competitions was good practice before this pandemic. It remains an appropriate use of resources now because individuals are most likely to contaminate themselves via

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contact with high touch surfaces. These include handrails, door handles/pushbars, sink knobs, and toilet handles.

Seating areas should continue to be cleaned after competition, but given the current pandemic, we also recommend disinfecting seating areas in indoor facilities if additional competitions will occur within 72 hours of the preceding competition. This is most easily done with an electrostatic sprayer that can apply disinfectant to the seating area in an efficient manner. In outdoor venues such as open-air stadiums, sunlight will provide some natural disinfection, so we recommend disinfecting stands only if the venue will be used within 24 hours of the previous competition.

Competition Surfaces

B.2.vi. Recommendation – Reprocess and disinfect artificial turf fields in accordance with manufacturer guidance.
B.2.vii. Recommendation – Clean and disinfect hard, non-porous surfaces such as basketball courts in the same way that the training facility is disinfected.

Rationale: Artificial turf fields present a relatively low risk of harm to athletes and staff. Quaternary ammonium disinfectants can be applied to artificial turf fields, but most manufacturers recommend that these disinfectants be applied no more frequently than quarterly. More frequent application may result in an excessively slippery surface, which could pose a greater threat to staff and athletes than the incalculable threat posed by the turf itself. Normal maintenance of artificial turf fields (grooming, sweeping and dragging) is appropriate and will further minimize the risk of transmission.

Outdoor surfaces do not need to be routinely disinfected given their exposure to sunlight.

B.2.viii. Recommendation – Clean and disinfect wrestling mats between matches or practice sessions.

Rationale: Wrestling confers significant risk of athlete-to-athlete transmission of infectious diseases due to prolonged skin-to-skin contact and the high frequency with which athletes suffer abrasions. Many of the organisms that can be passed directly from athlete-to-athlete can also pass from athlete-to-wrestling mat and vice versa. During practices or wrestling meets, subsequent athletes who use the wrestling mat may contract an infection. There are several studies which have demonstrated that wrestlers are commonly colonized with MRSA and that wrestling mats can become contaminated with MRSA or HSV during use.[23–26] Given the propensity of SARS-CoV-2

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to remain viable on surfaces for extended periods of time, disinfection is an essential strategy to minimize the risk of COVID-19 transmission during wrestling matches as well. In order to reduce the risk of transmission, we recommend that mats be disinfected with an EPA-approved disinfectant between practice sessions or matches. A study performed at Ohio Northern University between 2013-2014 demonstrated that mats quickly become contaminated during use but by using the "backward mopping" technique (applying disinfectant with a mop while walking backwards so as not to step on the surface during the required contact time), the bioburden on the mat was reduced by over 75% throughout the course of the competition.[27]

Game Balls

B.2.ix. Recommendation – Disinfect game balls with some frequency during gameplay in accordance with manufacturer guidance.

Rationale: This is an area for which there are no data to guide best practices. Historically, game balls have not been disinfected before or after gameplay even though there have been some examples of game balls playing a role in disease transmission. For instance, in 2000, an outbreak of norovirus was associated with a football game between Duke and Florida State, and in 2018, outbreaks of Hand, Foot and Mouth disease in football and baseball games were clearly tied to the game ball.[28,29] Given the focus on disinfection associated with SARS-CoV-2, we believe that it's reasonable to disinfect game balls with some frequency during gameplay. The frequency with which game balls should be disinfected will depend on the manner in which balls are used during gameplay. Alternatively, facilities can provide an increased number of game balls so that balls are no longer used after a certain amount of time. In football, where the ball remains with a single team each series, it would be reasonable to disinfect or replace the ball after each series. In sports such as volleyball or basketball, where the ball is used by both teams throughout gameplay, choosing a set number of times to disinfect or replace the ball per match is reasonable (e.g. 4 times per match). We recommend discussing with the manufacturer which disinfectants should be used on their products to ensure the game balls are not degraded. Additionally, disinfection of game balls should not detract from the focus on hand hygiene.

B.3. Best Practice – Use appropriate disinfection strategies based on the type of surface.

B.3.i. Recommendation – Use EPA-registered disinfectants on non-porous materials, and launder porous materials.

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B.3.ii. Recommendation – Avoid use of porous materials that cannot be laundered (e.g., wood, marble).

Rationale: Non-porous surfaces used throughout the facility (e.g., vinyl, stainless steel, ceramic) should be disinfected with EPA-registered disinfectants, as outlined in *Best Practice A.2*. Occasionally, manufacturers may recommend that non-porous materials not undergo disinfection due to potential aesthetic concerns (e.g., stainless steel adjacent to a shake station). We disagree with this approach, and strongly believe that all non-porous surfaces should undergo routine disinfection. All porous material used in the facility (e.g., textiles) should be laundered as outlined in *Best Practice E.1*. Porous materials that cannot be laundered (e.g., wood, marble) should not be used. Avoid use of these materials in player areas, if possible.

B.3.iii. Recommendation – Reusable athletic equipment that cannot be washed and dried in commercial washers and dryers should be appropriately disinfected after it is visibly soiled or otherwise dirty.

Rationale: Some equipment includes a combination of porous and non-porous materials. Appropriate disinfection of this type of equipment is challenging. Fortunately, reusable athletic equipment such as helmets and pads present a minimal risk of transmission of infectious agents. Routine drying, cleaning, and disinfection (wiping with a disinfectant) of such equipment is most likely safe and satisfactory. Importantly, there have been reports of skin burns among football players following the use of quaternary-ammonium disinfectants to clean shoulder pads. Therefore, equipment managers must be cautious when choosing which specific cleaning and disinfecting agent to use. While many agents can be used for this purpose, equipment managers should inspect the labels of the disinfectants under consideration to determine if skin contact is recommended. If not, equipment managers need to wipe the equipment with water after applying the disinfectant.

Cleaning with self-contained/closed units that utilize ozone as a disinfectant is a common practice in athletic facilities. We are unaware of any clinical data demonstrating that ozone disinfection of equipment leads to a decreased risk of transmission or infection (although it is a relatively effective disinfectant). Ozone disinfection requires high humidity, can be corrosive, and can be potentially toxic to humans (safe exposure level in the United States is <0.1 ppm), so effective containment of the gas and strict adherence to manufacturer's instructions must be achieved. Nevertheless, the use of ozone cleaning methods for equipment may have secondary benefits such as odor reduction/control and better acceptance by players.

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C. ENHANCED CLEANING OF TREATMENT AND TRAINING AREAS

C.1. Best Practice – Perform "enhanced cleaning" of all treatment and training areas in the facility when a cluster of diarrheal illness has been identified in the facility.

C.1.i. Recommendation – Temporarily use a bleach- or hydrogen peroxide-containing cleaning agent to perform all cleaning in the training facility whenever two or more team players or staff develop diarrheal illnesses.
C.1.ii. Recommendation – Continue to use "enhanced cleaning" for approximately 1 week after the last case of diarrheal illness has resolved.

Rationale: COVID-19 can cause diarrhea, but it is important to remember that there are numerous other causes of diarrheal illness. Indeed, norovirus is the most common cause of diarrheal illness and is highly contagious. However, as outlined in *Best Practice A.1*, quaternary ammonium-containing disinfectant solutions do not kill norovirus. Outbreaks of norovirus infections periodically occur in football teams, cruise ships, hospitals, and college campuses. Norovirus transmission in such outbreaks occurs by multiple routes, including aerosols produced during vomiting or flushing toilets, direct contact, food ingestion, and via contact with contaminated environmental surfaces. Thus, when two or more players have a diarrheal illness, facilities that use a quaternary-ammonium containing disinfectant for routine cleaning must change to a more appropriate disinfectant (e.g., bleach- or hydrogen peroxide-based). If possible, the disinfectant should be used for all cleanings in all settings, including the electrostatic sprayer, if compatible (see *Best Practice A.5.*).

It is usually not possible to determine if an individual player or group of players with a diarrheal illness is infected with norovirus or one of a multitude of other viral pathogens that cause gastroenteritis. However, we believe that diarrheal illness in such instances should be presumed to be due to norovirus, particularly if affected individuals have both vomiting and diarrhea. Indeed, the measures outlined above can be assumed to be effective in limiting the spread of **all** common viral causes of gastroenteritis. Disinfection with bleach- or hydrogen peroxide-based disinfectants should continue for at least 48 hours after all players have returned to full health and are symptom free with no diarrhea.

C.2. Best Practice – Use novel technologies for environmental disinfection strategies only in extenuation and extreme conditions.

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C.2.i. Recommendation – Use novel technologies for enhanced environmental disinfection to enhance public relations approaches in extenuating and extreme conditions.

Rationale: The recommendations in this manual are based on published data and evidence-based practices. Members of ICS have performed many of the landmark studies in enhanced cleaning strategies over the last several years.[30–33] For example, we published a study in 2017 demonstrating that the addition of ultraviolet (UV) light to disinfection with quaternary ammonium-containing disinfectants led to a 35% relative decrease in infection or colonization with multidrug-resistant organisms among hospitalized patients.[33] While this reduction is significant in hospitalized patients who have prolonged exposure to a small space (e.g., their hospital room) and are commonly immunocompromised, it is important to keep in mind that the absolute reduction in colonization or infection was only 0.8% (2.3% to 1.5%) even in this high risk population.

In another study published by investigators from Johns Hopkins University, vaporized hydrogen peroxide (VHP) terminal room disinfection decreased a newly admitted patient's risk of acquiring a multidrug-resistant organism.[34] Despite these data, we believe that these strategies would provide little benefit to athletic training facility cleaning and safety for several reasons. First, training facility rooms are much larger and have different uses than hospital patient rooms. The effectiveness of UV disinfection is dependent upon proximity to the light source, so large spaces will not experience the same degree of disinfection as more confined spaces. Second, athletes have substantially less risk than hospitalized patients of developing infections from pathogens acquired from the environment. If VHP is employed, we recommend consultation with an engineering group to ensure that the vaporized hydrogen peroxide will not be distributed throughout the facility while personnel are working and that an appropriate system is in place to monitor hydrogen peroxide levels and ensure they remain below OSHA requirements (1 ppm).[35]

Other enhanced cleaning strategies, including long-lasting disinfectant sprays and disinfecting visible light, have mixed results in clinical settings. Tamimi et al. evaluated a quaternary ammonium organosilane compound and noted that the bacterial count on treated surfaces in an ICU were >99% lower for up to 8 weeks following treatment.[36]

In contrast, Boyce et al. evaluated 2 types of organosilane compounds in 9 patient rooms and concluded that these compounds were not more effective than standard cleaning at reducing bacterial contamination from high touch surfaces.[37] Several studies have examined the effects of long-acting water-stable organosilanes on microbial counts in health care settings, and most report successful long-term reduction in microbial burden compared to routine cleaning.[38–41] Unfortunately, the methods used in these studies prevent us from determining if these technologies add value to

standard approaches or actually improve patient outcomes. None of these studies address spore-producing organisms; organism identification in several studies is not performed in accordance with accepted practices; the studies are conducted in experimental, non-clinical (i.e. "real world") settings; no control groups are included; and clinically significant reduction in healthcare-associated infections has not been demonstrated (or examined) by any study. Similarly, several companies manufacture light-emitting diodes (LED) with disinfecting properties through high-intensity, narrow-spectrum (HINS) light.[42] Other investigators recently completed a study evaluating this technology in experimental conditions, and demonstrated significant reductions in epidemiologically important organisms such as MRSA over a 72-hour exposure period.[43] Given the low-level disinfection achieved by these products, however, it remains unclear if this technology will remain effective in real-world settings with repeated contamination of the environment.

Though we remain interested in and are exploring the potential value of novel disinfection technologies, we remain skeptical about the effectiveness of most of these products in athletic training facilities based on currently published data. In contrast, we have little to no concern that these technologies would lead to harm. Thus, the decision to continue or discontinue such adjunctive strategies is a decision best and most appropriately made on a team-by-team basis, particularly if they are already in use, or if the team hopes to improve public relations messaging. Finally, environmental decontamination is a rapidly changing field, so modified or new products may become available that provide greater benefit to training facilities.

D. BLOOD AND BODY FLUID SPILLS

D.1. Best Practice – Follow OSHA standards for training staff and reporting exposures.

D.1.i. Recommendation – **Athletic trainers should receive annual training regarding OSHA recommendations for handling blood and body fluid spills and avoiding exposures.**

Rationale: All healthcare personnel are required to receive regular education on how to reduce the risk of occupational exposures to bloodborne pathogens. OSHA standards designed to reduce the risk of exposure to bloodborne pathogens include numerous recommendations that should be followed in all athletic training facilities. Though the details of the standards are beyond the scope of this manual, the basic tenets include:

- Use of universal precautions for all care

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- Use of personal protective equipment (PPE) whenever exposure to blood or body fluids is considered possible
- Hand washing after removal of PPE
- Use of safe needle devices
- Discarding soiled materials appropriately
- Appropriate disinfection of surfaces that are known or suspected to be contaminated with blood or infectious body fluids

Team physicians receive appropriate training through their medical facilities. We suspect, however, that most athletic training staff do not routinely receive this training. Training modules are available from OSHA and other groups such as the Red Cross. If your team facility is associated with a specific hospital or healthcare organization, athletic trainers can likely receive training from that facility. A commitment to regular training updates has secondary benefits that include continued and appropriate awareness of risks of transmission of blood-borne pathogens and risk-reduction of litigation risks should an individual or group of players develop an infection with a blood-borne pathogen and then allege negligence by team personnel. The training plan should be outlined in the facility's Bloodborne Pathogen Exposure Control Plan.

D.1.ii. Recommendation – Ensure you have blood or body fluid spill kits available in your facility and that training staff know where they are and how to use them.
D.1.iii. Recommendation – Dispose of contaminated supplies, materials, and linens in red bags or containers labeled "Infectious Waste" or marked with the biohazard label.

Rationale: "Kits" are not technically required by OSHA standards, but we believe they simplify the process of handling a blood or body fluid spill. In other words, use of kits can help ensure that the correct chemicals are conveniently and immediately available for use if a blood or body fluid spill occurs. Kits typically include standard, red bags with labels for disposal of contaminated items. All contaminated items should be placed in these bags to ensure that everyone in the facility realizes the materials in the bag may be contaminated with blood-borne pathogens. We suggest traveling with a blood or body fluid spill kit to ensure access to these materials at away games.

D.1.iv. Recommendation – Use a bleach-containing cleaning product (or other effective disinfectant) to clean or remove blood or body fluid spills.

Rationale: Solutions containing a 1:10 dilution of household bleach (5.25-6.15% aqueous sodium hypochlorite) are highly effective in eradicating blood borne viruses such as Hepatitis B, Hepatitis C, and HIV. Because solutions of bleach diluted with tap water lose potency after storage in opaque bottles for greater than 1 month, we recommend that teams purchase commercially available bottles of appropriately diluted bleach to be used when blood spills occur. Alternatively, most commercially

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available "kits" contain chemicals required for appropriate disinfection following a blood or body fluid spill.

D.1.v. Recommendation – Maintain a sharps injury log in the training facility.

According to OSHA standards, medical facilities must maintain a sharps injury log in conjunction with their occupational injury and illness reporting requirements (OSHA 29 CFR 1904). Training staff on OSHA standards can help ensure compliance with this mandate by educating staff on the need to report and document these injuries.

A summary of OSHA standards is available at https://www.osha.gov/OshDoc/data_BloodborneFacts/bbfact01.pdf.

The full, official OSHA document is available at https://www.osha.gov/pls/oshaweb/owadisp.show_document?p_table=FEDERAL_REGISTER&p_id=16265.

E. APPROPRIATE HANDLING AND DISINFECTION OF LAUNDRY

E.1. Best Practice – Disinfect laundry to prevent the transmission of potentially infectious organisms.

E.1.i. Recommendation – Use disinfectants in all laundry cycles for all textiles.
E.1.ii. Recommendation – Use a professional laundry service to provide appropriate amounts of detergents and disinfectants in each cycle.
E.1.iii. Recommendation – Develop and use pre-programmed laundry cycles for different types of laundry.

Rationale: Overall, the risk of transmission of pathogens through clothing and textiles is extremely low. This very low risk can be eliminated, however, with appropriate handling and disinfection of laundry. Pathogens such as MRSA and *C. difficile* can persist on inanimate objects such as soiled clothing, but the risk of transmission of bacteria through laundry is small. Traditionally, laundry disinfection has been achieved through high-temperature wash cycles (>160°F). Hot temperatures, however, are infrequently achieved in industrial washers used by most teams. Several carefully performed peer-reviewed studies have demonstrated that levels of microbial killing similar to those achieved with high-temperature wash cycles can be achieved at lower water temperatures (22° to 50°C or 72° to 122°F) *when disinfectant solutions are*

added.[44,45] The authors of these studies emphasized that the three critically important factors in achieving an appropriate reduction in the bacterial bioburden were:

1. Agitation and dilution
2. Addition of disinfectant
3. Passage through a drying cycle

Thus, low-temperature washing with appropriate disinfectants is as effective as high-temperature washing for eliminating pathogenic bacteria from laundry. As a result, laundry soiled with blood or body fluids can be effectively disinfected in standard laundry cycles that use disinfectants.

Many athletic facilities contract with professional laundry companies (e.g., Proctor & Gamble, Ecolab, ISS, etc.). These companies provide preset cycles for different types of laundry loads to ensure that appropriate amounts of chemicals and, most importantly, disinfectants are added.

In our experience, however, many professional laundry companies do not routinely include disinfectants in ALL laundry cycles. Contact your professional laundry service to ensure 1) they provide a disinfectant in their laundry cycles and 2) the disinfectant is included in *each* load. Some companies include a specific disinfectant while others rely on a color-safe bleach product with an appropriately high concentration of hydrogen peroxide; either approach is acceptable. Although contracting with a professional service is not absolutely necessary, a well-defined and systematic approach to laundry disinfection is required to achieve the goal stated in *Best Practice E.1.*

E.1.iv. Recommendation – Use of towels or clothing coated with antimicrobial substances, such as silver ions, copper, or disinfectants, is optional.

Rationale: Textiles that are coated with antimicrobial materials (e.g., towels) may lead to beneficial effect in reducing transmission of pathogenic organisms. This effect, however, is neither proven nor logically necessary to prevent transmission, as normal washing and drying (using criteria described above) are considered to be adequate and sufficient by most experts.

The number and type of silver-, copper-, and permanent disinfectant- containing non-medical devices is increasing. For example, numerous companies use silver fiber or silver-impregnated fabric in their products on the assumption that their presumed antibacterial and wound-healing properties may be beneficial. Examples include shoes for people with diabetes, outdoor equipment and clothing, and ski equipment and clothing. While some companies use their own technology to manufacture these products, others contract with companies to include silver-containing products such as Microban. Based on our review, none of these companies have performed rigorous,

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methodologically sound studies to confirm their claims of efficacy as a method to decrease the risk of transmission and infection.

Investigators recently performed a randomized controlled trial to determine whether antimicrobial-impregnated textiles decreased the acquisition of pathogens on healthcare provider clothing.[46] Participating nurses wore standard cotton-poly scrubs, scrubs embedded with silver, and scrubs impregnated with an organosilane-based quaternary ammonium. Forty nurses were enrolled and randomly participated in all three arms during three consecutive 12-hour ICU shifts. After analyzing over 5,000 cultures, we concluded that scrub type was not associated with a change in clothing contamination. We suspect these antimicrobial-containing textiles were ineffective because they are "low-level" disinfectants and could not overcome the bioburden of repeated contamination.

One study from Japan looked at the antimicrobial properties of different metal-containing towels during an outbreak of a food-related diarrheal illness.[47] Researchers inoculated silver-impregnated towels, copper-impregnated towels, and "standard" towels (the control group) with specific quantities of *E. coli*. They then compared the number of colony forming units (CFUs) of *E. coli* at several time points after inoculation. Both metal-impregnated towels had fewer CFUs than the control towels at all time points. However, the rigor of the methods used in this study remains unconfirmed. Finally, to our knowledge, no studies have been published that determine the duration of antibacterial effect of silver when silver containing products are used in the manufacturing of medical or non-medical devices. Similarly, there are currently no published data that examine whether the antibacterial effect of a silver-containing product changes over time with regular use.

In summary, the efficacy of antimicrobial-impregnated textiles against *S. aureus,* rates of colonization by bacteria, and on-going efficacy of antimicrobial-containing products after repeated use, washing, and wear-and-tear remain unproven. However, silver- and copper-containing products have a long track record of safety. Thus, due to theoretical plausibility and no clear harm (see exception below) from the product, we believe that there may be some benefit to antibiotic-impregnated towels. However, as these products offer only "low-level" disinfection, they are unlikely to prevent transmission when a towel is used (contaminated) and immediately handed to a different player to use, as routinely occurs in practice and game settings. The cost-effectiveness of these towels compared to non-antimicrobial-impregnated towels is unknown. The only harm that may come from these products is a sense of complacency due to the erroneous belief that these products are more protective than they actually are (i.e., "I don't need to clean my wound or wash my hands because I wiped them with this antibacterial towel").

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As such, we believe that antimicrobial-impregnated towels should not be used as a replacement for good hygienic practices, including regular hand washing and dedicated towels for each player. In addition, we firmly believe that no towels should be reused without laundering, especially if applied to open wounds and/or blood or body fluids.

F. HYDROTHERAPY ROOM

F.1. Best Practice – Contract with a professional maintenance company to oversee the cleaning and maintenance of hydrotherapy pools.

F.1.i. Recommendation – Use a commercial vendor or company to provide maintenance and regular cleaning of treadmill pools and other multi-use whirlpools in the hydrotherapy room.

Rationale: Cleaning and maintenance of whirlpools are keys to reducing the risk of transmission of potentially pathogenic bacteria. Although the daily monitoring of water temperatures, pH, and bromine or chlorine levels can be done by local staff, the responsibility of servicing filters, chlorine or bromine dispensers, and periodically draining and cleaning large whirlpools in hydrotherapy rooms is complex and is best done by commercial vendor technicians. These vendors should follow specific cleaning protocols (provided to the team) and keep service logs.

F.1.ii. Recommendation – Require the commercial vendor to document compliance with CDC guidelines for environmental infection control of hydrotherapy tanks and pools.

Rationale: Medical treatment is provided in the hydrotherapy pools in training facilities. Thus, hydrotherapy tanks and pools must be maintained according to CDC guidelines.[48] The recommendations provided in this section outline some strategies to achieve this goal. However, we believe adherence to these guidelines should be regularly documented by the commercial vendors as well. Documentation should be provided to and kept by the athletic training staff. In particular, the vendor should document the hydrotherapy equipment is in good working order. The vendor and athletic training staff must develop a plan to routinely check pH and chlorine residual levels and that pH and chlorine residual levels are maintained according to local and state health agencies. Most states use the following approach:

- For pH ranges of 7.2-7.8 (ideal is 7.5), ensure a minimum concentration of 0.6 mg/L and a maximum concentration of 5 mg/L free chlorine residual.
- For pH range of 7.8-8.2, ensure a minimum concentration of 1.5 mg/L free chlorine residual.

Refer to guidelines from your local and state health agencies to ensure you are following local regulations.

F.2. Best Practice – Appropriately disinfect individual-use/extremity whirlpools to reduce the risk of bacterial/viral transmission between players.

F.2.i. Recommendation – Drain water from the extremity or individual whirlpools and disinfect with an EPA-registered disinfectant between uses.
F.2.ii. Recommendation – Pour a hypochlorite-containing solution (e.g., bleach) into drains of extremity and individual whirlpools as part of the cleaning process.
F.2.iii. Recommendation – If drainage of extremity and individual whirlpools between uses is not possible or feasible during high traffic periods, use disinfectants such as bromine tablets in the water.

Rationale: Many teams provide extremity or individual whirlpool treatments for players. According to CDC guidelines for infection control with hydrotherapy tanks and pools, individual use pools should be drained and cleaned after each use, and equipment should be disinfected using an EPA-registered product.[48] Bacteria such as Pseudomonas predictably contaminate whirlpools and hydrotherapy equipment. Pseudomonas can produce painful pustules and folliculitis following exposure in whirlpools (i.e., "hot tub rash"). Simple cleaning followed by complete drying of the equipment is effective in preventing this complication. However, Pseudomonas and other water-borne pathogens may persist in retained water in drains in these devices. Thus, we also recommend pouring additional disinfectant down the drain after disinfecting the surfaces.

We agree with using EPA-registered, "hospital-grade" disinfectants to wipe down the surfaces after water is drained from these whirlpools (see *Best Practice A.2*). We recognize, however, that draining, cleaning, and refilling of extremity and individual whirlpools may not be feasible during high-traffic periods. If this process cannot be completed, we suggest using bromine or other powder-based disinfectants in these types of whirlpools to minimize the risk of bacterial transmission. Bromine tablets are available from vendors of pool supplies. These tablets also may be available from the vendor who currently maintains and chlorinates your large whirlpools.

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G. MEDICAL EQUIPMENT

G.1. Best Practice – Perform proper cleaning, disinfection, and sterilization (when necessary) on medical equipment to reduce the risk of transmission of infection.

G.1.i. Recommendation – Know the difference between "critical," "semi-critical," and "non-critical" medical equipment.

Rationale: The Center for Disease Control and Prevention (CDC) classifies medical equipment into three basic categories: critical items, semi-critical items, and non-critical items.[6] Critical items, often used for medical procedures, require sterilization while less critical items require lower levels of disinfection. Semi-critical items typically undergo high-level disinfection. Less critical equipment can undergo higher-level disinfection, but lower level disinfection cannot be used on critical or semi-critical items. Visible soiled surfaces (from body fluids, tissue, etc.) must be cleaned before disinfection or sterilization for two reasons. First, organic residues reduce the effectiveness of disinfection and sterilization.[6] Second, organic materials from soiled surfaces inactivate or substantially reduce the efficacy of products used disinfection and sterilization.[6]

Definition of Critical Items – According to the CDC, critical items "enter sterile tissue or the vascular system [and] must be sterile because any microbial contamination could transmit disease."[6] *Critical items at athletic training facilities include any equipment used in procedures where blood or body fluid exposures are expected (e.g. needles for injections, surgical equipment, or suturing equipment).* The CDC states that critical items should be "purchased as sterile or sterilized between uses."[6] If multi-use equipment is used, hospitals and clinics typically sterilize reusable "critical items" in autoclaves after cleaning, though other sterilization methods are also available.

Definition of Semi-critical Items – Semi-critical items contact mucous membranes or non-intact skin. *Semi-critical items at athletic training facilities include nail clippers and callus shavers*. According to the CDC, semi-critical items should be "free from all microorganisms; however, small numbers of bacterial spores are permissible" because mucous membranes and non-intact skin are resistant to infection by most bacterial spores.[6] Athletic training facilities have several options as to how to safely use semi-critical items. They can discard them after one use; they can sterilize semi-critical items between uses; or they can disinfect semi-critical items with an FDA-cleared high-level disinfectant between uses. Most hospitals and outpatient medical and surgical clinics disinfect reusable "semi-critical items" with FDA-cleared high-level disinfectants.

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Definition of Non-critical Items – The CDC defines non-critical items as items "that come into contact with intact skin but not mucous membranes." Non-critical items in the training environment include training equipment that comes into contact with bare skin and environmental surfaces such as floors, walls, computers, and examination beds. Equipment used on intact skin and scissors used to remove tape overlying intact skin are considered non-critical items.

G.1.ii. Recommendation – **Use single-use (disposable) "critical" and "semi-critical" medical equipment whenever possible.**

Rationale: Pre-sterilized, single-use (disposable) "critical" and "semi-critical" medical equipment is available from most medical equipment distributors. These items are increasingly used in hospitals and clinics because they are convenient, readily available, high quality, and cost effective in most environments.[49–51] In addition, athletic training staff can avoid the legal responsibility of adhering to burdensome federal guidelines needed for sterilization and high-level disinfection of non-single use medical equipment by disposing of critical and semi-critical medical equipment after a single use.

G.1.iii. Recommendation – **If single-use medical equipment is not available, send "critical" medical equipment to a commercial vendor for processing, cleaning, disinfection, sterilization and subsequent packaging for reuse.**
G.1.iv. Recommendation – **If non-single use medical equipment is not sent to a commercial vendor for processing, ensure that "critical" medical equipment is thoroughly cleaned, disinfected, and sterilized between uses.**
G.1.v. Recommendation – **If an autoclave is used to perform sterilization of "critical" medical equipment on site, ensure that use of the autoclave is properly monitored and testing of its efficacy is documented.**

Rationale: The sterilization of critical medical equipment is complicated and subject to stringent regulatory requirements. However, such sterilization is necessary as adequate processing of critical medical equipment is essential for player safety. Complex monitoring methods are employed in hospitals and clinics to ensure that critical equipment is processed in autoclaves according to federal guidelines. Although adherence to these complex requirements is achievable at athletic training facilities, we believe that the benefits of having an in-house autoclave are outweighed by burdensome regulatory requirements and the liability risks of non-compliance with these regulatory mandates.

For example, autoclaves must be monitored through a combination of mechanical, chemical, and biological techniques.[6] The mechanical measurements of the autoclave cycle (time, temperature, and pressure) must be monitored and documented with each cycle. Incorrect values for any of these parameters suggest inadequate sterilization.

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"Indicator tape" is typically used as a chemical indicator. These indicators are placed in and on the plastic packaging of all equipment placed into the autoclave and change color when the temperature reaches adequate sterilization levels. Biological indicators contain highly resistant bacteria that are only killed when an autoclave is functioning properly. The CDC recommends that biologic indicator monitoring be performed at least weekly.[6]

Autoclave users must also receive formal safety training on proper use of the equipment, adhere to manufacturer maintenance guidelines, maintain autoclave use logs, and record preventative maintenance or repairs.

We are unable to provide a single set of autoclave maintenance guidelines because these guidelines vary between autoclave devices and manufacturers. Thus, each team that uses an autoclave in the athletic training facility must closely follow the maintenance guidelines provided by the manufacturer of their individual autoclave. Finally, *use of high-level disinfectants (e.g., glutaraldehyde or Cidex) is not sufficient to achieve sterilization for "critical" medical equipment.*

G.1.vi. Recommendation – If single-use medical equipment is not available, send "semi-critical" medical equipment to a commercial vendor for processing, cleaning, disinfection, and sterilization.
G.1.vii. Recommendation – If non-single-use medical equipment is not sent to a commercial vendor for processing, ensure that "semicritical" medical equipment is properly cleaned and disinfected between uses.

Rationale: Proper use of FDA-cleared high-level disinfectants requires adherence to complex and burdensome requirements, including detailed monitoring, safety training, and record keeping. These steps and requirements vary depending on which disinfectant is used. Failure to follow these requirements can result in transmission of pathogens if medical instruments and equipment are reused. Although safe use of high-level disinfectants is achievable at athletic training facilities, we believe that the potential cost savings of disinfecting and reusing semi-critical items are far less than the cost and inconvenience of a) following these burdensome regulatory and safety requirements and b) exposure to safety risks if disinfection is not performed properly.

FDA-cleared high-level disinfectants include glutaraldehyde, hydrogen peroxide, ortho-phthaladehyde (OPA), and peracetic acid with hydrogen peroxide. The mechanisms of action and procedure of use of each of these chemicals are different. Each high-level disinfectant has advantages and disadvantages (Table 1).

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Table 1. Comparison of the characteristics of high-level disinfectants and chemical sterilants.[6]

	Hydrogen Peroxide (7.5%)	Peracetic Acid (0.2%)	Glutaraldehyde (≥2.0%)	OPA (0.55%)
High level disinfection claim	30 min @ 20°C	N/A	20-90 min @ 20-25°C	12 min @ 20°C
Sterilization claim	6 hr @ 20°C	12 min @ 50°C	10 hr @ 20-25°C	None
Activation required	No	No	Yes	No
Reuse life (days)	21	Single use	14-30	14
Shelf life stability	2 years	6 months	2 years	2 years
Disposal Restrictions	None	None	Local	Local
Materials compatibility	Good	Good	Excellent	Excellent
Monitor MEC[a]	Yes (6%)	No	Yes (≥1.5%)	Yes (0.3%)
Safety	Serious eye damage	Serious eye and skin damage	Respiratory	Eye irritant, stains skin
Processing	Manual or automated	Automated	Manual or automated	Manual or automated
Resistant to organic material	Yes	Yes	Yes	Yes
OSHA exposure limit	1ppm TWA[b]	None	None[c]	None

a – MEC = minimum effective concentration (the lowest concentration of active ingredients at which the product is still effective)
b – TWA = time-weighted average for an 8-hour workday
c – The ceiling limit recommended by the American Conference of Governmental Industrial Hygienists is 0.05 ppm.

A list of FDA-cleared high-level disinfectants can be found at the following FDA website: https://www.fda.gov/medical-devices/reprocessing-reusable-medical-devices-information-manufacturers/fda-cleared-sterilants-and-high-level-disinfectants-general-claims-processing-reusable-medical-and.

G.1.viii. Recommendation – If "semi-critical" medical equipment is processed for repeat use in the athletic training facility, use an FDA-cleared "high-level" disinfectant such as glutaraldehyde (e.g., Cidex, Wavicide, etc.).
G.1.ix. Recommendation – If a high-level disinfectant (i.e., glutaraldehyde) is used to perform disinfection of "semi-critical" medical equipment on site, staff must be trained in their proper use. Such training must be documented and logs must be kept when disinfection is performed.

Rationale: The most frequently used high-level disinfectant for basic semi-critical medical equipment is glutaraldehyde (e.g., Cidex, Wavicide, etc.). This compound is highly effective, noncorrosive to metal, and does not damage lensed instruments,

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rubber, or plastics. Staff members involved in reprocessing semi-critical medical equipment must receive specific training on the use of glutaraldehyde in order to understand important use, safety, and disposal requirements.

Complete information regarding the use of glutaraldehyde in medical facilities can be found at https://www.osha.gov/Publications/glutaraldehyde.pdf. Aqueous solutions of glutaraldehyde are acidic. Solutions of glutaraldehyde must be "activated" (made alkaline) in order to become sporicidal and thus qualify as a "high-level disinfectant". Once activated, these solutions have a shelf life of 14-30 days (depending on the specific product) because of the polymerization of the glutaraldehyde molecules at alkaline pH levels. This polymerization blocks the active sites (aldehyde groups) of the glutaraldehyde molecules that are responsible for its biocidal activity. Antimicrobial activity, however, depends not only on age but also on dilution and organic stress. 2% alkaline glutaraldehyde (the formulation available from most manufacturers) is highly effective in killing vegetative bacteria in less than 2 minutes; *M. tuberculosis*, fungi, and viruses in 10 to 30 minutes; and spores of Bacillus and Clostridium species in 3 hours.[6] Dilution and degradation of glutaraldehyde occurs over time; 1.0%–1.5% glutaraldehyde is the minimum effective concentration (MEC) for >2% glutaraldehyde solutions. Thus, chemical test strips or liquid chemical monitors must be used to determine whether an effective concentration of glutaraldehyde is present.[52,53]

Frequency of testing should be based on how frequently the solutions are used. In general, glutaraldehyde solutions should be tested prior to first use of the chemical each day. Chemical test strips deteriorate over time. Thus, test strips must be replaced at designated times depending on the manufacturer's instructions. Finally, the results of test strip monitoring must be documented in a logbook.

Inappropriate, potentially harmful exposure to glutaraldehyde occurs when equipment is processed in poorly ventilated rooms, when spills occur, or when open immersion baths are used. OSHA has not defined a specific "permissible exposure limit" (i.e., a maximum allowable amount of exposure) for glutaraldehyde. Adverse health effects can occur following exposure to glutaraldehyde, including irritation of eyes, nose, throat, and respiratory tract, skin burns, nausea, headache, and dizziness. A safety fact sheet from OSHA regarding glutaraldehyde can be found at https://www.osha.gov/SLTC/etools/hospital/hazards/glutaraldehyde/glut.html. If glutaraldehyde is used in immersion trays, tight-fitting lids must be used in order to minimize exposure to glutaraldehyde fumes.[54] In addition, manufacturers typically recommend that the disinfectant be used in "well-ventilated areas," defined as a room with 10 or more air exchanges per hour.

Because glutaraldehyde is a hazardous chemical, OSHA's Hazard Communication Standard (HazCom) requires that information concerning any associated health or physical hazards be provided to employees. Any employee who may be "exposed" to

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glutaraldehyde must be provided information and be trained prior to working with the hazardous chemical. The training must include:

- Written Program – A written program that informs the employee of the hazard and ways to avoid harm. This document must include verification that each athletic trainer or staff member who uses glutaraldehyde has received appropriate training and has reviewed the written program.
- Labels – Containers of glutaraldehyde must be labeled, tagged, or marked with the identity of the material and appropriate hazard warnings.
- Material Safety Data Sheets (MSDS) – Employers must have an MSDS for each hazardous chemical they use. Each MSDS must be readily accessible to employees.

Glutaraldehyde remains toxic after use for high-level disinfection. Thus, personnel can be harmed if spills or splash exposures occur during disposal of used chemicals. In addition, glutaraldehyde can contaminate water supplies if it is poured into sink drains after use. Some states have specific regulations requiring the disposal of high-level disinfectants such as glutaraldehyde. For example, California now requires that glutaraldehyde be neutralized prior to disposal into sink drains. These neutralizers (which typically consist of glycine) are available from many chemical manufacturers.

G.1.x. Recommendation – Clean and disinfect "non-critical" items with standard EPA-registered hospital disinfectants.

Rationale: All "non-critical" medical equipment surfaces must be effectively and safely disinfected with an EPA-registered low- or intermediate-level disinfectant.[6] However, because contaminated non-critical medical equipment may also contain blood or body fluids and/or multidrug resistant bacteria in addition to dirt, debris and dust, we recommend the routine use of intermediate-level disinfectants. All EPA-registered, hospital-grade disinfectants described throughout this manual (e.g., quaternary ammonium-containing solutions or hypochlorite-containing solutions; see *Best Practice A.2.*) are intermediate level-disinfectants and thus are appropriate for cleaning and disinfection of "non-critical" medical equipment.

H. SEPARATION OF "CLEAN" AND "DIRTY"

H.1. Best Practice – Separate "clean" and "dirty" areas and materials at all times.

H.1.i. Recommendation – Use physically separated areas to store "clean" unused medical equipment and used medical equipment (that has not yet been cleaned and/or disinfected).

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H.1.ii. Recommendation – Do not store materials used for medical care (clean) in the same areas used to store cleaning materials (dirty).
H.1.iii. Recommendation – Do not store medical equipment under sinks.

Rationale: "Clean" areas are defined as areas where medical procedures or medical care are provided. For example, a "procedure table" that includes an area where skin disinfectants, sterile needles, syringes, and medications or injections are used or administered is considered a clean area. Similarly, areas where the above materials and equipment are stored are clean areas as well. Contaminated medical equipment should never be left or stored in these areas after use.

Similarly, equipment used for medical care should not be stored in the areas or locations where materials used for cleaning and disinfection are stored or located. These recommendations are strictly enforced in healthcare facilities by groups such as the Joint Commission. Given that space is at a premium in most athletic training facilities, advance planning and deliberation must be used to avoid this common error.

H.1.iv. Recommendation – Develop and use a policy to keep clean and dirty laundry separated at all times.

Rationale: Equipment managers can use various methods to keep dirty laundry separated from clean laundry. These methods include color-coded bins (e.g., black bins are for dirty laundry, yellow bins are for clean laundry) or the use of separate, clearly designated or labeled areas where clean and dirty laundry are stored. Either method is equally effective. Regardless of which method is used, we recommend that equipment managers specifically write a policy to guide this process. This policy may simply include a summary of current practices if it allows for easy review and education of new employees.

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