I Scream, You Scream, We All Scream for the Effective Management of Micro-organisms!

Dominic Dongilli, AAZK Safety Committee

Introduction

The field of animal care has a long history. It is accompanied by a number of traditional practices that were established in good faith and with the available research evidence. However, without consistent reevaluation that considers updates in the field and research, these "good-faith practices" can be ineffective or even detrimental to the health and welfare of the animals under our care. Containing the spread of micro-organisms within the zoo is one such foundational practice; the most ubiquitous piece of zoo technology used to do this is… the footbath. Footbaths have long been used to prevent cross contamination and the spread of any potential pathogens amongst zoo animals and exhibits. Using them appropriately and effectively is tantamount to accomplishing this goal.

Requirements for animal health, including husbandry and cleaning, are a part of the "Animal Welfare Act" (7 U.S.C. § 2131 et seq.) and its subsequent regulations. Enforcement of these standards is administered by the U.S. Department of Agriculture's (USDA) Animal and Plant Health Inspection Service (APHIS). All decisions regarding disease management and health and chemical use should be made in light of these regulations and under the guidance of certified animal health and safety personnel designated and trained to fulfill these roles.

Furthermore, the "Federal Insecticide, Fungicide, and Rodenticide Act" (7 U.S.C. §136 et seq. (1996)) as administered by the Environmental Protection Agency (EPA) governs the registration and labeling of substances labeled "antimicrobial pesticides," which are "intended to disinfect, sanitize, reduce, or mitigate growth or development of microbiological organisms or protect inanimate objects, industrial processes or systems, surfaces, water, or other chemical substances from contamination, fouling, or deterioration caused by bacteria, viruses, fungi, protozoa, algae, or slime" (EPA, "Antimicrobial Pesticides" 15 November 2016, "Antimicrobial Pesticide Registration" 01 Feb 2018).

Speaking the codes of cleaning

Colloquial discussions most often use the words "clean", "sanitize" and "disinfect" interchangeably. However, their differences are significant. Confusing their meanings when attempting to contain the spread of microorganisms is of legitimate concern and can be of serious consequence.

"Cleaning," "sanitizing," and "disinfecting" are accomplished by the proper use of compounds designated as "cleaners," "sanitizers," and "disinfectants." Understanding the appropriate use and properties of these compounds enables animal care staff to best understand these processes.

A cleaner is a compound that physically removes organic materials or loose particles from a given surface and enables them to be washed away with water (USDA "Cleaning" 14 Sep 2017). Common cleaners include soaps and detergents. Cleaners must be physically applied and worked into a surface, often through a form of agitation, and then rinsed away with water. Application of the cleaner and subsequent rinsing with water are essential in order to complete the act of cleaning. The most common act of cleaning is washing hands with soap and water. Hands are wet, soap is applied and worked onto the surface through sufficient scrubbing, and then the suds are rinsed away.

A sanitizer is a compound that reduces the number of microorganisms present to an acceptable level as designated by a given health code regulation. The sanitizing process is often used in regards to food prep tasks or with items that will be in close contact to orifices and mucous membranes. Some chemical compounds are safe and effective for use as either a disinfectant or a sanitizer if stated on the label, which is determined by the dilution ratio of chemical compound to water. The decision to sanitize versus disinfect is often made when considering the risks posed by the targeted microorganism compared to the risk of chemical contact and toxicity as a result of the chemical's use. Since zoo keepers clean surfaces that are regularly contaminated with bodily fluids and organic waste, sanitizing is generally inappropriate.

A disinfectant is a compound that kills or destroys microorganisms present on a non-living surface. When used properly, disinfectants significantly destroy the number of microorganisms targeted. However, they do not completely eliminate the presence of these microorganisms nor do they eliminate spores (USDA "Disinfection" 14 Sep 2017). Generally speaking, porous materials cannot be properly sanitized or disinfected and the presence of organic materials inhibits the efficacy of disinfectants and sanitizers that are not also designated cleaners. As a result, one cannot disinfect or sanitize muddy boots or an animal holding space contaminated with smeared fecal matter. In order for disinfectants to be the most effective, organic material MUST be removed through the process of cleaning prior to the disinfection process (USDA "Disinfection" 14 Sep 2017).

Sterilization is the process of completely destroying all forms of biological life present (USDA "Disinfection" 14 Sep 2017). This process can be done physically or chemically with devices such as autoclaves or gas sterilizers. Sterilization is commonly used in laboratory and healthcare settings where the integrity of experimental methods or medical procedures is of paramount importance. It is not often employed in the routine husbandry and care of zoo animals.

Table: The Codes of Cleaning

Term	Definition	Example
Cleaning	Physically removes organic materials	Hand soap and water, power washer, brush
Sanitizing	Reduces the number of microorganisms present	Hand sanitizer, diluted bleach
Disinfecting	Kills or destroys microorganisms	Bleach, alcohol, hydrogen peroxide
Sterilizing	Completely destroys all forms of biological life	Autoclave (steam sterilization)

Footbaths – Or trying to keep shoe bottoms clean

In order to safely and effectively utilize a footbath, the general process and considerations of disinfection should be followed. If all steps of the disinfection process are not given due consideration, then the process will be ineffective.

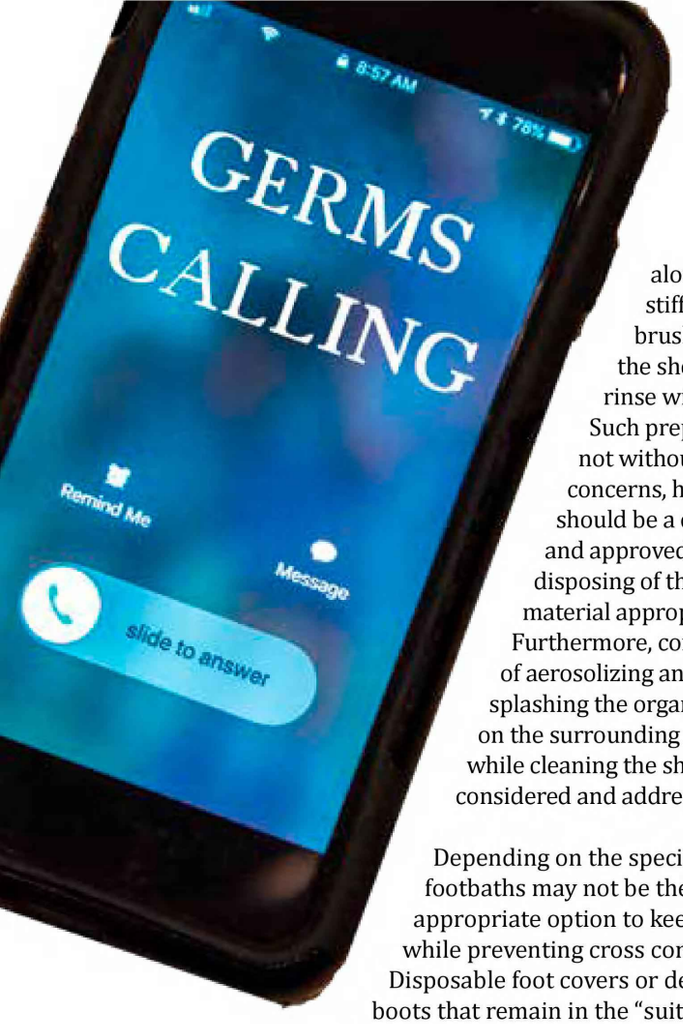
All relevant information regarding chemical disinfectants can be found on the chemical's label and SDS sheets. This information should include the disinfectant's approved spectrum, active ingredient, instructions for proper use and relevant first aid measures. This information MUST be thoroughly read and followed.

1. Starting points and materials:

The cleaning and disinfection process should always be contextualized by the relevant situation(s) being considered.

- Is there a specific micro-organism of concern or is the goal to prevent cross-contamination? There are different classes of disinfectants with different abilities to target specific micro-organisms.
- What are the relevant species of animals and their zoonotic risk? Do they have any specific chemical or sensory sensitivities?
- Is a footbath the most appropriate option? Are disposable shoe covers or individual pairs of shoes that can only be stored and worn in designated areas a safer and more effective option?

As discussed above, it is generally true that organic materials cannot be effectively disinfected (USDA "Disinfection" 14 Sep 2017). Some disinfectants are also labeled "cleaners" meaning they contain chemical compounds able to cut through organic material. However, the majority of disinfectants do not contain cleaning compounds, so contaminated shoes should be "prepped" for the footbath. This preparation normally includes some type of cleaning. Depending on the organic material, a dry clean may be appropriate where the material can be removed with a stiff-bristled brush. A solution of cleaner may need to be used



along with a stiff-bristled brush to clean the shoes and then rinse with water. Such preparations are not without their own concerns, however. There should be a designated and approved process for disposing of this organic material appropriately. Furthermore, considerations of aerosolizing and/or splashing the organic material on the surrounding environment while cleaning the shoes must be considered and addressed.

Depending on the specific concern, footbaths may not be the most appropriate option to keep shoes clean while preventing cross contamination. Disposable foot covers or designated boots that remain in the "suit-up" area of buildings could be a better option.

2. The context - what are we dealing with?

Even if a disinfectant footbath is the appropriate option, are the relevant environmental variables present to enable effective use?

- Certain disinfectants are rendered ineffectual outside of set temperature parameters. Specific formulations of water (hard vs. soft, filtered) may be required for dilution.
- What are the maintenance parameters of the chemical? Certain disinfectants can evaporate or loose effectiveness after a certain time has passed - is that maintainable in the given situation? How many times can the disinfectant solution be used? Are there indication signs of contamination or spent usage so that the footbath can be serviced as needed or does a regular schedule need to be maintained? Are there sufficient record keeping or accountability systems in place to ensure this maintenance is taking place?
- What is the required contact time of the disinfectant? A certain chemical may be extremely effective at targeting a specific micro-organism, however, it could have a lengthy contact time. Generally speaking, surfaces must remain wet/saturated with the disinfectant solution for 10 minutes or longer in order to be effective. Are zoo keeping staff standing in footbaths for the appropriate amount of time?

3. When it's all over:

Appropriate disposal is paramount to maintaining the cleanliness and integrity of the space. Appropriate disposal protocol should be listed on the disinfectant's label or SDS sheet. If the footbath is contaminated with organic material such as feces or bodily fluids such as blood, additional disposal guidelines may be applicable.

The Trifecta: "Planes, Trains & Automobiles..." also known as "Shoes, Keys & Radios"

What's on the bottom of shoes is often of utmost concern and what is commonly targeted as animal care staff move amongst different areas of the zoo. However, the bottoms of shoes are not the only objects that move amongst animal exhibits with the potential to serve as vectors of disease. What about the keys and tools and approved communication devices that travel on belts that are used in exhibits and holding spaces throughout the day?

Some institutions utilize key washes to prevent cross contamination as zoo keepers take keys on and off their belts and enter animal holding spaces throughout their day. A small bowl of disinfectant solution is placed alongside foot baths or mounted on the wall next to appropriate doorways for keys to be cleaned. All protocol for disinfection as discussed prior still apply. Further considerations include the metallic composition of keys. Make sure the disinfectants are safe for use on metal and/or do not leave significant residue on the keys that will inhibit safe padlock function.

Cleaning pieces of communication technology may be important as well. Unless zoo keepers are consistently washing hands or removing PPE such as gloves whenever answering those unplanned and unexpected radio calls, handhold radios have the potential to be extremely contaminated. Not only are these devices held on the body and close to the mouth when speaking, they are carried around from animal space to animal space. Follow the manufacturer's instructions for appropriate cleaning and select a disinfectant and subsequent application method appropriate for use on electronics.

Cellphones carried on the body, either personally owned or company provided, are also a point of consideration for cleaning and disinfection as they leave the confines of the zoo and travel into public and personal spaces. It should be noted, however, that cellphone use in the animal care setting can pose a serious safety risk. Institutional safety guidelines should be strictly adhered to at all times including the appropriate use, or rather disuse, of cellphones. The AAZK Safety Committee firmly believes in minimizing any potential distraction from the animal care work environment to minimize unnecessary safety risk.

Conclusion

There's no "one-size-fits-all" solution to managing microorganisms. Facilities should review their good-faith practices and think critically about their health and management goals. If footbaths are used to avoid cross contamination, the efficacy of the methods and the materials used should be assessed by trained animal health and safety staff members with overall goals in mind. Additional practices,

including cleaning other items beyond the bottoms of shoes, should also be considered. Finally, the facility should discuss if their footbath and microorganism management practices should vary between species or exhibits. There is no simple answer for microorganism management, and every facility should be thoughtful and flexible when implementing footbaths and other similar protocols.

References and Useful Links

EPA. "Antimicrobial Pesticide Registration." 01 February 2018. https://www.epa.gov/pesticide-registration/antimicrobial-pesticide-registration. Accessed 26 July 2018.

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