Healthcare soils 101: Identifying and removing them

by Lisa Huber, BA, CRCST, CIS, ACE, FCS

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leaning and decontamination processes in healthcare facilities have come under intense scrutiny lately as a result of infection-related investigations. This should be no surprise to anyone involved with sterile processing, because most healthcare professionals are familiar with the adage, “You can clean without disinfecting, but you cannot disinfect without cleaning.” This scientific truth is supported by guidelines and standards from professional and governmental organizations such as APIC, AAMI, CDC, SGNA, IAHCSMM and AORN.

In order to properly clean medical devices, it’s important to understand the different types of medical soils found on them, and the most effective methods for removing these soils from the different surface materials and component configurations found in a hospital’s medical device inventory. It’s also important to understand that soils and decontamination processes can vary for devices used in various surgical and procedural specialties. These typically include general surgery, orthopedics, obstetrics and gynecology, and endoscopy.

For most devices, cleaning and decontamination processes are just the beginning of the processing cycle, and are followed by disinfection and/or sterilization procedures. Cleaning and decontamination generally happen simultaneously, and their purpose is to remove visible and non-visible soils along with most contaminating microorganisms. The wide variety of soils found during a single surgical procedure, the complexity of instruments and their components, and the variety of instruments used in a procedure all provide additional challenges to effective cleaning.

Getting the process started
Regardless of the surgical or diagnostic procedure being performed, the cleaning process for medical devices begins at their point of use. Gross soils should be removed and instruments kept moist to prevent the remaining soils from drying, which would make them much more difficult to remove from all internal and external surfaces of the device. Moisture can be maintained by placing a wet towel over the instruments, placing the instrument or tray in a package designed to maintain humid conditions, or using an instrument gel designed for pretreatment. Even with moisturization, thorough cleaning must begin as soon as possible to prevent the formation of biofilm. Once biofilm forms and attaches to a surface, it becomes difficult to remove and can interfere with disinfection and sterilization.

As a general rule, sterile processing technicians must always follow each device manufacturer’s written instructions for use, and the label instructions for the cleaning chemistry, to ensure that adequate cleaning is achieved and devices are not damaged during cleaning.

Surgical instruments
When instruments used in general surgery are sent for reprocessing, soils such as isotonic fluids, tissue, blood and subcutaneous fat may be present. Isotonic fluids include 0.91 percent sodium chloride, which is corrosive to metals. Calcium chloride, which can cause pitting on the instruments; sodium lactate, which can be sticky; calcium chloride, which can interact with lipids and carbohydrates and cause them to harden; and potassium chloride, which is corrosive to metals. Skin cells, hair and fat are not water soluble so they are not easily broken down during cleaning. Subcutaneous fat is the layer of fat just below the skin. It consists
of 87 percent lipids and other substances such as hormones, proteins and enzymes.

Blood is the most common surgical soil and is a very complex matrix of proteins, carbohydrates, lipids and minerals that create cleaning challenges. And to make things even more challenging, blood clots and dries when it’s exposed to air, which makes it even more difficult to remove.

To address these cleaning challenges, technicians should rinse and wipe off the devices at the point of use, flush any device lumens to rinse gross soils from internal channels, and keep all instruments moist until they reach the sterile processing department.

**Orthopedic tools and instruments**

As the population ages, total joint replacements account for more than 60 percent of surgeries in some parts of the country. In addition to proteins, lipids and carbohydrates found in other surgical procedures, orthopedic instruments are soiled with things unique to those procedures, such as bone, bone cement and synovial fluid. Bone is a complex substance made up of collagen, glycosaminoglycans (complex polysaccharides containing amino groups) and calcium phosphate. Other bone-related tissue includes bone marrow, nerves, vessels and cartilage. During procedures, bone tissue gets into box locks, reamers, drill bits, rongeurs, and other instruments, and is embedded with other soils. This combination can be very difficult to remove. Synovial fluid is a joint lubricant secreted by synovial tissue surrounding a joint. It feels greasy but primarily consists of proteins and carbohydrates. In the case of damaged joints, the synovial fluid has broken down and becomes more difficult to remove.

In addition, bone cement, a type of glue containing synthetic polymers, is designed to be very difficult to remove for medical reasons. If instruments are exposed to bone cement, they must be wiped down immediately at the point of use because if the cement hardens, instruments may be damaged or destroyed.

**Endoscopic devices**

Technicians face many challenges when cleaning endoscopes because the design of the devices makes them very difficult to clean. Some of the organic soils found on endoscopes include proteins, lipids, carbohydrates and various chemical salts that exist in blood and other body fluids.

An inorganic soil often found on endoscopes is simethicone. Simethicone is a hydrophobic substance (repels water), and it contains sugars and thickeners that can contribute to microbial growth and biofilm development. More studies are needed to assess the prevalence of residual water and simethicone in endoscopes and its impact on reprocessing efficacy. SGNA has recommended minimizing the use of simethicone pending further research into its safety.

**Labor and delivery equipment**

While the birth of a baby is a joyful event, the soils that are left behind can be difficult and frustrating for sterile processing technicians to clean. The placenta (afterbirth) contains proteins, triglyceride, enzymes, and electrolytes, an inorganic soil. Instruments may also be coated with vernix, the waxy white substance that coats the skin of newborns. Vernix provides fetal skin protection in utero as the skin is in a liquid environment for nine months. This insoluble quality makes it very challenging to remove.

Although a variety of different soils have been discussed, they can be grouped into two general categories; organic and inorganic. Organic soils include protein, lipids, carbohydrates and bone chips. Inorganic soils include saline, simethicone, bone cement, calcium and other minerals. Inorganic compounds can also be found in the wash and rinse water, which is an important factor in water quality and how it affects cleaning.

**Cleaning parameters and chemical agents**

In order to achieve a thoroughly clean outcome, there are four parameters that are important to understand and control: mechanical action ("elbow grease" or impingement); temperature; time; and chemistry (detergents/enzymes). Changing one parameter requires changes to another. For example, enzymatic chemistries work best at temperatures between 100-140°F. Enzymes used at their optimal temperature of 140°F will be faster acting than if used at 100°F (a word of caution; enzymes used at temperatures greater than 140°F are ineffective). High impingement wash cycles take less time than low impingement cycles, and aggressive chemistries take less time to clean than neutral pH chemistries.

Soil must be physically removed from devices by either manual (brushing, flushing, scrubbing) or automated means (washers, ultrasonic systems). Water alone is not an effective cleaner, so it is used as a universal solvent for enzymatics and detergents. Since it’s impractical to use different cleaning products for each type of soil, facilities typically develop a cleaning regimen that handles a broad spectrum of organic and inorganic soils.

There are specific enzymes for specific soils. For example, lipases are for lipids or fats, amylases for carbohydrates (starches) and sugars, and proteases for proteins.

Proteins are the most common soils in healthcare facilities. Protease enzymes speed up the cleaning process and require less physical action for cleaning. Their ability to break down large proteins into smaller, more water-soluble pieces makes the soil easier to remove.

**Enzymes**

Enzymes are often used as a pre-soak or the first step in the cleaning process. Enzymes and detergents are used in both manual and automated medical device cleaning. Effective
broad-spectrum cleaning chemistries also contain surface active agents (surfactants) that aid in the cleaning process. Surfactants provide wetting, emulsifying, solubilizing and anti-redeposition mechanisms. Depending on the cleaning system and the soil mixture, cleaning chemistries with the broadest spectrum of cleaning performance will contain all these capabilities.

Water helps and hinders

Water doesn’t wet well because of its surface tension, which causes water to bead up on surfaces. Making water “wetter” and overcoming surface tension allows the cleaning chemistry to penetrate the soil and get into all the crevices of the device where the soil or bioburden is hiding. Surfactants line up an air/water interface and lower the surface tension, which allows the water to sheet over the surface. Emulsifiers and solubilizers line up a soil/liquid interface to surround and penetrate soils and suspend them or bring them into solution, which allows the soil to be rinsed away. A good surfactant will also prevent soil from redepositing back onto the surface of the device. This ensures thorough cleaning and prepares the device for the next steps of disinfection or sterilization.

A good broad-spectrum chemistry must also be low-foaming. Surfactants can cause cleaning chemistries to create foam during both manual and automated cleaning processes. Foaming affects impingement by lowering the pressure in the washer and slowing the washer arms. Foam also interferes with visualization and thorough rinsing, which can prevent the complete removal of soil or cleaning chemistry. Chelating agents hold hard water minerals in suspension and prevent detergents from reacting with the minerals. Using a cleaning chemistry without a good chelating agent can result in discoloration and staining of surgical instruments and automated cleaning equipment.

Water, regardless of its quality, can be damaging to surgical instruments. In some cases, it can be so damaging that the instrument must be discarded. Rust can begin forming in as little as three hours at temperatures as low as 120°F, which is well within temperatures in automated washer cycles. Rust and corrosion can hide soil in pits and crevices, protect microorganisms from sterilization and serve as a growth point for biofilm. Corrosion is much easier to prevent than to remove; neutral pH chemistries can protect instruments against the damaging effects of water.

Cleaning verification

An effective cleaning protocol requires verification of the cleaning process. The American National Standard AAMI ST79:2017 states that healthcare facilities should test their cleaning equipment daily. After cleaning, technicians should visually inspect all devices for residual organic and inorganic soil. But visual inspection (even with a lighted magnifying glass) may not be enough to assess the efficacy of the cleaning process, and will not allow a technician to see inside a lumen or channel or other hard-to-clean areas of a device, or to detect invisible soils or microorganisms. For these reasons, cleaning verification testing is recommended as part of a sterile processing department’s quality management system.

The only way to ensure that medical devices are completely clean and ready for further processing is with a quality management system that includes defining the cleaning process, establishing written policies and procedures, training, and observing and assessing staff during the cleaning process to assure thorough, accurate and consistent completion. In addition, facilities must follow device manufacturers’ written instructions for use, use good quality, broad-spectrum cleaning chemistries, test the efficacy of automated cleaning equipment, and use a cleaning verification method that ensures and documents consistent cleaning levels.

References:


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Circle the one correct answer:

1. What is not considered a challenge to the cleaning process?
   a. Variety of soils
   b. Complexity of instrumentation
   c. Variety of instruments used for the procedure
   d. Type of procedure performed

2. The optimal temperature for enzymes to work is
   a. 140°F
   b. 130°F
   c. 120°F
   d. 110°F

3. The most common soils in healthcare facilities are
   a. Fats
   b. Proteins
   c. Starches
   d. Sugars

4. The reason water doesn’t wet well is because of its surface tension.
   a. True
   b. False

5. Rust and corrosion on surgical instruments can
   a. Hide soil
   b. Protect microorganisms
   c. Provide growth point for biofilm
   d. All the above

6. Corrosion is easier to remove than to prevent.
   a. True
   b. False

7. Verification of the cleaning process will include
   a. Performance testing of automated cleaning equipment
   b. Following manufacturer IFUs
   c. Sharpness testing of scissors
   d. Assessing staff competencies

8. Soils can be grouped into two general categories
   a. Wet and dry
   b. Organic and inorganic
   c. Biofilms and microorganisms
   d. Soluble and insoluble

9. Hard water minerals are held in suspension by
   a. Emulsifiers
   b. Solubilizers
   c. Wetting agents
   d. Chelating agents

10. Surfactants line up with an air/water interface to
    a. Surround and penetrate soils
    b. Emulsify and dissolve soils
    c. Blend and mix soils together
    d. Filter soil from water

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