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Endo Infection Prevention Newsletter

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A CRITICAL READ: BEING A CONSUMER OF RESEARCH LENDS TO A DEEPER UNDERSTANDING

Dr. Alfa and her associates wanted to explore if there is a difference in the efficacy of detergents used to clean flexible endoscopes and how the cleaning methods impacted a simulated biofilm formation on flexible endoscopes.

▶ READ MORE, PG 2

HIGH LEVEL DISINFECTION: SAFETY AND EFFICACY BEST PRACTICES

In the most recent newsletter, we discussed flexible endoscope cleaning and the many challenges that it can have. In this edition we discuss where and how we should use high-level disinfection (HLD).

▶ READ MORE, PG 3

NOT ALL DETERGENTS GIVE YOU THE SAME KIND OF CLEAN

INTERCEPT™ Detergent has chemical properties that help it match those ideal properties more completely than any other commercially available medical device detergent.

▶ READ MORE, PG 8

HOW TO ENSURE A DETERGENT FITS YOUR NEEDS

Soap has been around in some form for nearly 5000 years; archaeologists found a recipe from ancient Babylon that advised boiling animal fats with ashes to make soap.

▶ READ MORE, PG 11

A CRITICAL READ: BEING A CONSUMER OF RESEARCH LENDS TO A DEEPER UNDERSTANDING

Alfa, M. J., Singh, H., Nugent, Z., Duerksen, D., Schultz, G., Reidy, C. DeGangne, P., & Olson, N. (2017). Simulated-Use polytetrafluorethylene biofilm model: Repeated rounds of complete reprocessing lead to accumulation of organic debris and viable bacteria. Infection Control & Hospital Epidemiology, 38(11), 1284-1290. doi: 10.1017/ice.2017.215

Objective: To assess differences in methods of reprocessing organic tissue after repeated rounds of biofilm formation and a final full reprocessing.

Methods: Biofilm was inoculated in polytetrafluroethylene tube channels for five successive days using ATS-2015 test soil containing 5-8 log10 colony forming units of *Enterococcus faecalis* and *Pseudomonas aeruginosa*. Each day full pump-assisted cleaning using bristle brushes or pull-through channel cleaning devices in combination with enzymatic or non-enzymatic detergents was followed by fully automated endoscope reprocessor disinfection using peracetic acid. Residuals were visualized by scanning electron microscopy (SEM). Destructive testing was done with adenosine triphosphate (ATP; <200 relative light units), protein (<2 ug/cm^2) and viable bacteria count (0 CFU, colony forming units).

Results: Protein residuals were above 2 ug/cm^2, but ATP residuals were <200 RLUs for all methods tested. SEM revealed some residual debris remained after all reprocessing methods, but more residuals were detected when a non-enzymatic detergent was used. No viable bacteria were detected after disinfection for both brush and pull-through channel cleaning devices.

Conclusion: Surviving E. *faecalis* and *P. aeruginosa* were only detected when the non-enzymatic detergent was used. Preventing biofilm formation is critical because not all current reprocessing methods can reliably eliminate viable bacteria.

Dr. Alfa and her associates wanted to explore if there is a difference in the efficacy of detergents used to clean flexible endoscopes and how the cleaning methods impacted a simulated biofilm formation on flexible endoscopes. She selected Renuzyme Plus® Enzymatic Detergent (Getinge, Rochester, NY), and a non-enzymatic detergent, INTERCEPT™ Detergent (Cantel, Minneapolis, MN). The exploration of this difference would have been more effective if the reporting was presented in a consistent manner. One significant challenge for the reader in interpreting the study results was the unequal concentrations used for the testing, both with a brush and with a pull-through channel cleaning device.

The non-enzymatic INTERCEPT™ Detergent was used in a 0.25 percent concentration, considered the lowest acceptable level of concentration for a worst-case contamination of a dirty medical device. No concentration is given for the Renuzyme Plus. Outcomes are reported as less than the limit of detection for the enzymatic detergent, but numbers are given for the non-enzymatic detergent that insinuate it is above the limit of detection, although it isn't. To gain a true picture of the results, they should be reported the same for each factor so comparisons can be made visually without having to hunt for the lower limit of detection numbers. Another challenge is the wide variance of the standard deviation, which suggests this study would be very difficult to replicate.

The outcome for the article was identifying how important friction is for the breakup and removal of biofilm. The pull-through channel cleaning devices were able to remove more bioburden than the bristle brushes, however, it was not mentioned in the study method if more than one pass with the bristle brush was completed. Usually with bristle brushes the instructions for use say pass the brush until the channel is clean. The choice of the word "reprocessing" can be confusing in the article, since cleaning is not definitively identified as distinct from reprocessing. Reprocessing is most frequently identified with the full process for cleaning and high-level disinfection, while cleaning is identified with point of use treatment and manual or automated cleaning.

The article provides evidence resources for the reader to explore and possibly gain a better understanding of how cleaning impacts flexible endoscope cleaning and reprocessing.

— *Cheri Ackert-Burr, DPN, RN, BAEd, CNS, CNOR, AGTS*

HIGH LEVEL DISINFECTION: SAFETY AND EFFICACY BEST PRACTICES

In the most recent newsletter, we discussed flexible endoscope cleaning and the many challenges that it can have starting at "point of use" or pretreatment, going on to contaminated transport — making sure the universal biohazard symbol is present — and finally through the leak testing and manual and automated cleaning requirements. Once those steps are successfully completed we can proceed to the next step: visualization.

Visualization

The Society of Gastroenterology Nurses and Associates (SGNA) has specifically listed visualization as a "safety timeout" step. The purpose of this step is to get staff members to truly look at the endoscope so that they can determine if there is any damage present, or if there is any residual bioburden still attached to the endoscope tip, insertion tube, working knobs, around the air/water, suction, and biopsy port or with the light guide connector. The recommendation from all professional guidelines is to use a lighted magnifying glass to look at each of these sections — this is a minimum requirement for visualization.

Additionally, staff may be asked to use a borescope. A borescope is a lighted scope without lumens used to view the internal lumens of the scope. You simply "scope the scope" looking for residual debris, retained procedure device pieces such as "clips" or damage to the endoscope itself. Borescope inspection is an additional way to visualize, but is not required by guidelines.

High-Level Disinfection

High-level disinfection (HLD) is the use of a chemistry cleared by the Food and Drug Administration (FDA) to kill bacteria and other pathogenic (disease-producing) and nonpathogenic (non-disease producing) microorganisms. This process is used for medical devices that do not enter a sterile body cavity but do come in contact with mucous membranes and non-intact skin.

Definition

A high-level disinfectant must be able to kill all bacteria including most — but not all — endospores. They must be able to achieve a $\log^6$ reduction of bioburden during the disinfection process. The Association for the Advancement of Medical Instrumentation (AAMI) uses the definition by Rutala (1990) for a disinfectant as "a germicide that inactivates all microbial pathogens, except small numbers of bacterial endospores, when used according to labeling."[1]

Why we use HLD

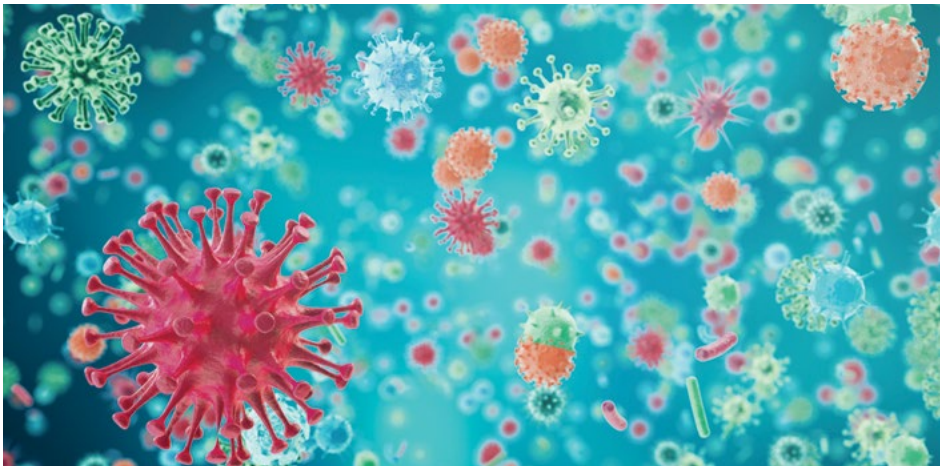
In 1969, Dr. Spaulding suggested that not all medical devices needed to be disinfected to the same level. He developed a risk assessment identifying three categories of equipment and devices: **non-critical**, **semi-critical** and **critical**.

A high-level disinfectant must be able to kill all bacteria including most — but not all — endospores.

The lowest level, or first tier, includes environmental surfaces and medical equipment that may come in contact with intact skin. This tier requires an Environmental Protection Agency hospital approved low-level disinfectant usually known as a virucidal and bactericidal disinfectant.

The next level, semi-critical, includes medical instruments that come in contact with mucous membranes, but do not cross the blood barrier. Flexible endoscopes fit in this category. HLD at a minimum is required for these instruments after cleaning and before use in the next procedure. The FDA has a list of cleared high-level disinfectants on its website.

Critical is the final category for medical devices. These reusable medical devices require sterilization because they enter sterile body cavities and cross the blood barrier. Surgical instruments are examples of medical devices for this category.[2]



When we use HLD

HLD is used primarily with flexible endoscopes, transesophageal probes, ultrasound probes, dilators and any number of other heat-sensitive reusable medical devices. Due to the material composition of these devices they cannot be reprocessed in high-temperature sterilization.

> High-level disinfection is the current benchmark for reprocessing long flexible endoscopes.

When should you use sterilization? Many bronchoscopes, intubating scopes, laryngoscopes, etc. can be sterilized in low-temperature processes such as hydrogen peroxide gas or ethylene oxide. If you are considering sterilization of flexible endoscopes, you need to consider several factors: the number of lumens in the endoscope, the length of the lumens and the diameter of the lumens — all must meet the sterilizer parameters. Low-temperature sterilizers have very specific parameters that must be met or the endoscope will not be sterilized correctly. Obviously, incomplete sterilization means putting your patients at risk.

Can longer scopes be sterilized using low-temperature processes? Generally, the short answer is: "Longer scopes — no, not so much." Most long endoscopes such as gastroscopes, duodenoscopes and colonoscopes are still being high-level disinfected. HLD is the current benchmark for reprocessing long flexible endoscopes.

Where we use HLD and how we use HLD

HLD can be used in any number of places. Most frequently, it is used for flexible endoscope reprocessing in the reprocessing area of a GI clinic, central sterile processing department of a hospital and in a physician's office setting. How it is used depends on the type of chemistry being used and whether automated or manual disinfection is occurring.

Automated endoscope reprocessors (AERs) provide a way to ensure consistency for HLD and help control worker exposure to chemistry fumes.

There are many types of AERs on the market with different capabilities. Staff members need to be thoroughly educated and become competent on all HLD processes they use, manual or automated, and often, both.

Types of HLD

There are two primary families of HLDs, aldehydes and oxidative chemistries. Each type presents unique advantages and challenges.

HLD Comparison Table

CHEMISTRY TYPE	ADVANTAGES	CHALLENGES	SAFETY CONCERNS
Glutaraldehyde	Long history of use as HLD Wide range of material compatibility Can usually be used for manual or automated HLD processing Wide range of products available for use	Can fix residual tissue to the surface of the endoscope Staff can become sensitized to it Contact time is increased with manual use Strong odor	Requires adequate ventilation in the work room May need to be neutralized before disposal
Orthophthalaldehyde (OPA)	Can usually be used manually or automated Has a faster contact time for manual than glutaraldehyde Wide range of material compatibility	Contraindicated in post-bladder cancer patients Can cause staining of protein tissue if not rinsed completely Still produces fumes even though the smell is not as strong as glutaraldehyde	Contraindicated in post-bladder cancer patients Requires adequate ventilation in the work room May need to be neutralized before disposal
Peracetic Acid (PAA)	Newer chemistry, some can be reused, most are single shot — each cycle gets the same amount of new PAA Oxidative — can work through small amounts of residual organic matter Does not act as a fixative for residual bioburden	May show degradation or cosmetic changes to the endoscope — depends on the concentration and buffering agents used Contains a smell of vinegar	High concentrations can cause acidic burns Buffered PAA is less reactive

Safety

Any time you are handling any type of chemistry you need to protect yourself. This means wearing the proper personal protective equipment (PPE). When working in the decontamination room you will need to wear a hair covering, a water-resistant gown (level II or III — not the yellow one), face shield or goggles, general purpose utility gloves, a mask that covers both the nose and the mouth, and finally, shoe covers. Exam gloves are not acceptable as they may be too short or may not stay in place over the sleeve cuff. Most people working in the decontamination and reprocessing area are very good about wearing all of the PPE — except for the hair and shoe coverings. A recent study measured how much exposure occurs during the procedure while the endoscope is being used. The researchers found that if you are the endoscopist or assisting the endoscopist, you had a 6.7 percent chance of facial exposure splashes with contaminated fluids for every 100 half days of procedure time — without realizing it happened. If you are only working in the room during the procedure, you still had a chance of being exposed to aerosolized fluid splashes about 3.5 percent of the time. If you are working in decontamination all day and are constantly washing, brushing and flushing, you may have an untold amount of exposure. Why not cover your hair? You certainly don't wash it before you go home for the day. You protect your eyes and airway — you should protect your hair so you don't transport all the bioburden in aerosolized splashes home with you.

Another area of concern is your eyes. Because you work with chemistry and there can be splashing with contaminated medical devices, make sure you know how to locate and operate the eyewash station. Flooding the eyes with water is the first step in decreasing any damage to the eye that may occur. Finally, PPE standards definitely recommend frequent hand washing, not just sanitization.

Once the cleaned endoscope is put into the AER or manual soak bin it is time to change your PPE. If you have double gloved, remove the outer pair before putting the endoscope into the AER. It is acceptable to leave the inner pair on while you do this.

Manual HLD

Minimum Recommended Concentration (MRC) of the chemistry should be tested before you use it. If you are doing manual HLD for a flexible endoscope you need to make sure you air purge the channels of the endoscopes and wipe any remaining moisture from the surface of the endoscope before you place it in the chemistry. If there are air bubbles, they will prevent contact of the endoscope surface with the chemistry. If your chemistry evaporates to the point where you can no longer completely submerge the endoscope, you can add additional chemistry only if the chemistry manufacturer provides guidance for doing so. Not all chemistries can be "topped off." Topping off does not increase the use life of the original chemistry, it only adds volume.

> You protect your eyes and airway — you should protect your hair so you don't transport all the bioburden in aerosolized splashes home with you.

Automated HLD

AERs take the guesswork out of HLD. Ofstead and Associates found when AERs are used there are fewer human errors.[3] Automated channel connectors make sure the disinfectant and rinse water reaches all surfaces of the internal channels while external fluid comes in contact with all surfaces of the medical device or endoscope. Learning the correct placement and how the connectors work is an important part of using an AER correctly. As a user you need to be familiar with how the machine works, what chemistries have been validated, and what instruments have been validated for that particular machine. Do not attempt to make repairs or fix your connectors; if you do, the connectors will no longer be validated for use with the machine. Remember, not all machines can reprocess all endoscopes or other medical devices requiring HLD.

The chemistry still needs to be tested according to the manufacturer's recommendation and documented. This may happen before or after the cycle has completed.

Manual rinsing

After doing manual HLD you must do the recommended rinsing with sterile water. This usually requires three separate sterile water rinses. Each rinse is separate and used only once. It can be time-consuming, expensive and labor intensive.

Automated rinsing

Rinsing is built into the process in most AERs. One of the best things about using an AER is the ability to use highly filtered water to rinse the instruments. Ideally, there would be a series of two filters used in the rinse water lines. The first is a particulate filter measuring 0.45 microns. This first filter catches minerals and large bacteria, while the final filter can be 0.20 or 0.10 microns. This filter size means it will filter particles and bacteria as small as 0.01 microns. Viruses may be smaller than that but rarely survive in this environment. Filters are changed on a regular schedule or may be changed more often depending on the quality of the water. You need to document the filter changes.

Documentation

A data management system in the AER should include all the required documentation for HLD as this will allow for reporting. Manual documentation requires a log book or paper trail system. Some of the units will only offer printouts, which need to be kept in a log book.

Drying

An alcohol purge may be used to facilitate the drying process after manual or automated HLD and rinsing.

The drying process after manual HLD and rinsing requires the use of low-lint or non-linting cloths, and low-pressure instrument-grade air for drying the channels and the ports before being sent for storage. Syringes are not recommended for channel drying as they do not provide enough pressure to ensure drying.

If you are using an AER it should have a drying cycle which may include an alcohol purge with forced air drying. However, the endoscope will still have moisture where it has had contact with the basin and connectors. You will need to use low-pressure, instrument-grade forced air to purge the channels until as dry as possible. You will get more information on drying in the next installment of reprocessing of flexible endoscopes.

Conclusion

Visualization and HLD are two additional steps required for endoscope reprocessing. Remember, each step builds on how well the previous steps were completed. Reprocessing flexible endoscopes is challenging, and is among the most important steps we can take to prevent infections in patients undergoing an endoscopic procedure. Knowing how to do it right — and then doing the right thing — helps keep patients safe.

In our next newsletter we will review drying, storage, clean transport and special challenges you may see in your practice.

— *Cheri Ackert-Burr, DPN, RN, BAEd, CNS, CNOR, AGTS*

HOW TO ENSURE A DETERGENT FITS YOUR NEEDS

Anyone who's worked with detergents, whether at home or in a decontamination room, has probably had an occasional moment of wishing there were some solution out there that performed better — faster, cooler, with less brushing, with fewer irritating fumes, without burning skin or causing allergic reaction or in a more environmentally sensitive way. In fact, that person may have a wish list that includes more than one of those improvements.

In this product spotlight, we will highlight several formulations of Cantel's INTERCEPT™ Detergent Family.

Back to that wish list. In our view, the ideal properties of a medical detergent are:

- low foaming
- neutral or slightly alkaline pH
- bactericidal
- designed for use specifically on medical devices
- fast-acting and able to remove debris from a variety of surface materials
- able to solubilize all biologic and organic bioburden found on medical devices
- non-allergenic
- biodegradable
- environmentally responsible

INTERCEPT Detergent has chemical properties that help it match those ideal properties more completely than any other commercially available medical device detergent. INTERCEPT Detergent is highly concentrated, which means that you use 67 percent less INTERCEPT Detergent to achieve the same outcome as an enzymatic detergent in perfect conditions (at specified temperature, contact time and concentration for the type of enzyme). Because INTERCEPT Detergent contains no enzymes, it is able to work quickly at lower temperatures than enzymatic detergents typically require — and there is no risk of sensitization for the people who work with it.

INTERCEPT Detergent contains no enzymes, so it is able to work quickly at lower temperatures than enzymatic detergents typically require.

INTERCEPT™ Detergent products available in the U.S. are at a neutral pH, so there is low risk of damage to devices or to the humans working on those devices.
INTERCEPT Detergent's mode of action is different from an enzymatic detergent as well; it acts by separating the bonds between soil and a surface, instead of penetrating debris. It contains quaternary ammonia and performs like a spatula to lift the debris up, sequester it in water and move it away. Like most detergents formulated specifically for use on medical devices, INTERCEPT Detergent is low foaming, so as not to obscure visibility in the sink. Finally, INTERCEPT Detergent can aid in the prevention of biofilm formation and adherence on your medical device.

> A delay in cleaning has historically meant a vastly extended period of cleaning preparation, perhaps as much as 10 hours.

There's an INTERCEPT Detergent Family product to meet the workflow requirements in different stages of cleaning your flexible endoscopes. Let's begin in the endoscopy procedure room. Pre-treatment of the endoscope after the procedure is a key step in decreasing bioburden. In fact, with a one log reduction, the quantity of colony forming units (CFU) of bacteria per square centimeter could decline from 10 billion to 1 billion. Clearly, with a huge quantity of CFUs, you want to remove as much as possible in order to prevent soil hardening, sticking and developing a biofilm.

INTERCEPT™ Wipes
There are two options for using INTERCEPT Detergent in pre-treatment. INTERCEPT™ Wipes are pre-saturated with detergent to immediately start loosening gross bioburden from the surface. These wipes are available in a dispensing container for easy access as soon as the procedure is done.

INTERCEPT™ Bedside Kits
INTERCEPT™ Bedside Kits are comprised of three components: a tray, a sponge and a packet of INTERCEPT Detergent. Users simply empty the pre-measured detergent into the prescribed volume of water and use the sponge and solution to wipe down the surface and flush the channel(s), confident in the knowledge that they have the right amount of detergent and the optimal cleaning tool.

Once the pre-treatment has been done, the endoscope and accessories should move directly to the decontamination room so the cleaning process can start right away. Most of the time, that's what happens. Although sometimes there's a delay in the start of processing. Maybe the scope was used in a remote location, at night, on a weekend or the staff had an emergency and didn't have time to transport it — so you might know ahead of time that the cleaning isn't going to get done right away.

INTERCEPT™ Foam
A delay in cleaning has historically meant a vastly extended period of cleaning preparation, perhaps as much as 10 hours. With the introduction of INTERCEPT™ Foam, a ready-to-use detergent foam spray, these issues can be resolved at the press of a nozzle. INTERCEPT Foam envelopes your scope in a highly stable foam that maintains a moist environment to prevent organic debris from drying and hardening. It is pH neutral, biodegradable, easy to rinse off due to its surfactant base and will remain in a foam state for up to three days if it's kept in a sealed container.

That long period of stability gives your staff a bit of breathing room to begin the manual clean when it's convenient, without worrying about biofilm formation and microbial overgrowth on the scope. Workflow becomes more manageable, transport is simplified, protection against microbial proliferation is consistent and concern about delays becomes a thing of the past. Is it miracle? No, it's just a variation on the foam protection that the operating room has used for years.

INTERCEPT™ Detergent

Once the decontamination and cleaning process begins, there is a highly concentrated liquid INTERCEPT™ Detergent option. This detergent can be used in automated systems and in manual cleaning. Its unique formula will rapidly penetrate and solubilize blood, proteins, cellular mucosal debris, carbohydrates, lipids and mucopolysaccharides. Laboratory tests demonstrate its effectiveness at removing both biological and organic residues from a variety of medical devices and surface materials.

With its neutral pH, this formulation is safe to handle and meets the criteria set by endoscope manufacturers to protect their devices from degradation. It works rapidly (one-minute contact time) at a low use concentration, which will save you both money and time. It can be used in water ranging from cool to warm (20-35 degrees Celsius, or 68-95 degrees Fahrenheit) — i.e., room temperature to warm water from the tap.

The chemical ingredients, including quaternary ammonia, are biodegradable. In the sink it is low foaming, as recommended by all American professional societies. And it's ideal for hard-to-remove soils such as biofilm and mucus.

INTERCEPT™ PLUS Detergent

Facilities that use automated endoscope reprocessors such as ADVANTAGE PLUS™ Pass-Thru may also use INTERCEPT™ PLUS Detergent. An alkaline formulation in the INTERCEPT Detergent Family, this detergent has an alkaline pH which is particularly effective in eliminating bioburden with a very high blood and/or fecal content — what you might find in a poorly prepped or an unprepped, emergency colonoscopy.

When the chemical effectiveness of a detergent is increased, there will be a corresponding decrease in time and/or effort necessary to get a scope clean. No matter what your stage in cleaning your flexible endoscopes and accessories, there is an INTERCEPT Detergent product that will give you efficient, lower-cost, reliable outcomes without the risks of sensitization and inconsistency inherent in enzymatic detergents.

— Ann Hewitt, MBA, BSN, RN

HOW TO ENSURE A DETERGENT FITS YOUR NEEDS

If you know someone who was old enough to watch television in the 1960s, then you know someone who regularly saw "Madge the Manicurist." Madge was the spokesperson for Palmolive® dish washing soap; her shtick was to promote Palmolive as so gentle on skin that you could wash dishes with it to improve the beauty of your hands — all while getting your dishes sparkling clean.

Anyone who's ever worked with detergents when cleaning endoscopes knows that "gentle" and "easy on hands" is not typical of a solution that cleans well.

And why not? Why can't you use something that's gentle on you as well as gentle on your endoscopes?

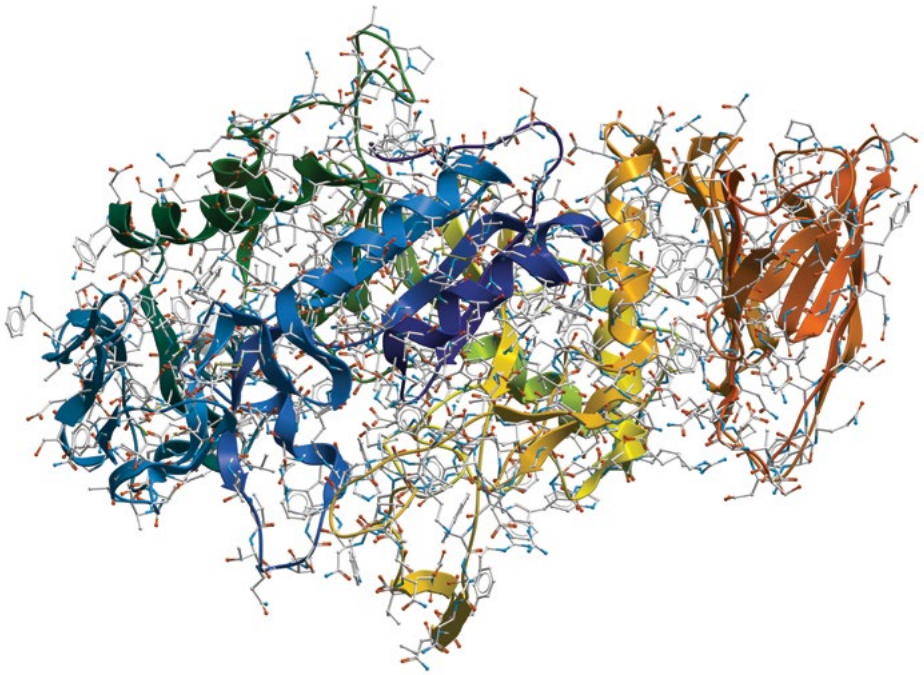
Water is the most well-known solvent of all. Water can help dissolve or break down many materials: sugar, dirt, even rocks if given enough time. But there's one thing water doesn't dissolve well, and that's fats. (You know that old saying that two people who don't get along are "like oil and water"?) And if you want to clean something that has greasy soil on it, you need more than water — that leads us to soap.

According to soapstory.net, soap has been around in some form for nearly 5000 years; archaeologists found a recipe from ancient Babylon that advised boiling animal fats with ashes to make soap. Later, the Greeks and Romans developed soap from plant materials like olive oil or sesame seed oil mixed with an alkali. Liquid soap was first patented in 1898 — that soap was Palmolive, just like Madge recommended to her customers.

Soaps are now made commercially, of course, but they still are made from naturally occurring fats and oils, which is one of the reasons they're gentle enough to use on the body. Soap is a "surface active" agent, often called a surfactant. (Surfactants help decrease surface tension so that debris can be removed easily.) Soap is able to solubilize particles and grime to remove them. At the same time, minerals in soap react with minerals in water, leaving an insoluble gray film on surfaces — like your bathtub or your clothes. Gentle as it may be, that's a key reason we don't use soap to clean medical devices.

Detergent, on the other hand, is usually made from synthetic ingredients that are more soluble in water than soap. Detergents assist in wetting of and penetrating into soil, followed by containment of the removed material in suspension. In other words, it's a cleaning agent that loosens debris from surfaces and holds the debris in suspension so it doesn't re-deposit on a surface, and allows for the debris to be rinsed away. **One benefit: no more sticky gray film left behind.**

Detergent is usually made from synthetic ingredients that are more soluble in water than soap.



A German scientist in the early 1900s explored how the addition of enzymes to cleaning solutions could remove blood stains from cloth. Enzymes are naturally occurring proteins that accelerate chemical reactions. Since the enzyme he used came from ground up pancreases of slaughtered hogs, the result was successful removal of the original stain — and creation of new stains. The ability to create enzymes from bacteria on an industrial basis was many years in coming. It took another 60 years to develop viable enzymatic additions to detergent.[4, 5, 6]

The first U.S. detergent to include enzymes was Tide®, a laundry detergent that is still a leading brand. Enzymes in laundry detergent revolutionized domestic cleaning, and eventually this innovation reached the world of medical devices.

Enzymatic medical detergents introduced in the 1980s revolutionized the cleaning of surgical devices. Each type of enzyme has a specific type of material against which it is effective; this material is called a "substrate." The three most common enzymes are lipase, amylase and protease. Lipase is active against fats like triglycerides. Amylase is active against carbohydrates, starches and sugars. Protease is active against proteins. Protease is the most commonly employed enzyme in medical detergents, since protein is a common contaminant and is present in almost all types of biological debris, including pus and blood. Obviously, the human body contains a lot of protein, a lot of sugars and, regrettably for most of us, a lot of fat. When a procedure is performed, those human proteins, sugars and fats make their way onto the medical devices used in the procedure.

Enzymes work by breaking down the essential components of a specific soil type so it can be washed away as tiny particles — basically, eating through the layer of soil to break it up and digest it. While there are single enzyme detergents, it is not uncommon to find dual or even triple enzyme solutions.

Enzymes are effective, do not need friction to do their work and are compatible with many materials. Because medical devices are often complex, delicate and expensive, cleaning with enzymes became the standard very quickly.

Unfortunately, enzymes are also fussy about their environment. They each prefer a specific and different temperature, pH level and exposure time to work optimally. As a general rule, warmer and longer is better.

A neutral pH is not as effective as the specific pH for each enzyme. Additionally, since they break down the ingredients of organic soil into digestible bits, they could inadvertently be creating "food" for microorganisms which are not removed during the cleaning process.

What is the significance of those facts? Using an enzymatic detergent at 68 degrees Fahrenheit when it works best at 98 degrees means you are not achieving an optimum clean. Failing to allow sufficient detergent contact time because the endoscope is needed for the next case would also mean you're not getting an optimum clean. Without full cleaning, there's the risk that the enzymatic byproducts will fuel rapid replication of remaining microbes. On top of those concerns, enzymes are known sensitizers that can cause allergic reactions in people who work with them.

Fortunately, there are non-enzymatic detergents that are also surfactant-based. Prepare yourself for a little chemistry here. There are three kinds of surfactants: **1. anionic (negatively charged); 2. non-ionic (neutral, with no charge);** and **3. cationic (positively charged).** Many detergents will use neutral and anionic together. (Anionic and cationic should not be used together; they cancel each other out, since one is negatively charged and the other is positive). A different detergent formulation uses neutral and cationic surfactants. The most common cationic ingredient in detergent would be quaternary ammonium (commonly called "quats"), which also has antimicrobial properties. Non-enzymatic detergents are not as temperature-dependent as enzymatic detergents, so typically will work effectively more quickly.

Now that you know there's more to detergent than you ever dreamed of, how do you choose the best one for your process?

The ideal properties of a medical detergent are:

- low foaming so you can see what you're working on
- neutral or slightly alkaline pH so it doesn't damage your device or your skin
- bactericidal so it kills bacteria at the same time it removes them
- formulated specifically for medical devices
- fast penetrating and able to remove debris from a variety of surface materials
- able to solubilize blood, protein, mucus, carbohydrates, lipids and mucopolysaccharides
- non-allergenic
- biodegradable

It could contain enzymes, surfactants, buffering agents and, not surprisingly, that all-purpose solvent, water.

If you know you're going to be working with just one type of soil, you may want a simple enzymatic detergent that addresses that soil type — say, amylase if you never deal with proteins or fats. If, however, you are cleaning complex soils that have blood, mucus, tissue and fecal material, you probably want a multi-faceted detergent that removes and washes away all the components. If you're in a busy department where fast turnaround is a priority, you will want to work with a non-enzymatic, surfactant-based detergent to maximize efficacy and minimize the amount of time spent cleaning. If you are worried about biofilm formation, you would want to select a detergent with cationic surfactants that prevent biofilm attachment and proliferation.

Who knew that the solution to getting something clean was literally so complex? Not the ancient Babylonians. But now that you've had a detergent tutorial, you are armed with information that can help you make a wise decision about the best way to address your cleaning problems. Maybe you should plan for a long soak in your favorite bubble bath with emollients and surfactants galore — while you put your mind to new ways to improve your facility's cleaning activities.

— Ann Hewitt, MBA, BSN, RN

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