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LEARNING OBJECTIVES

1. *Define a "wet pack"*
2. *Describe three categories of factors that contribute to wet packs*
3. *Discuss techniques and best practices to prevent wet packs*

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SELF-STUDY SERIES

Ugh! Another wet pack. What's a technician to do?

by Chasity Seymour and Pamela Carter

It's another busy day in the sterile processing department (SPD) with case carts coming down left and right and the OR requesting immediate instrument set turnovers. The staff are working hard and keeping up with the demand, so far. Suddenly, the phone rings in SPD and the charge nurse says there's a wet set in OR 5. They need a sterile set ASAP and want to know how this happened. You rush to the room and find moisture inside a wrapped set needed for the procedure. With the case now delayed and everyone unhappy, you head back to the decontamination area with the set to begin reprocessing it, all the while asking yourself what you can do to prevent this in the future.

Defining wet packs

A wet pack is one of the most frustrating challenges we face as sterilization professionals. According to the Association for the Advancement of Medical Instrumentation (AAMI) guidance document ST79: 2017, ANNEX O, packs are considered "wet" when moisture in the form of dampness, droplets, or puddles is found on or within a package after steam sterilization and the proper cooling period.

External moisture would be visible immediately after the sterilization cycle and can be acted on immediately. However, internal moisture is not seen until the pack is opened at the point of use, at the start of a procedure. Though both external and internal moisture have consequences, internal moisture has a greater impact on the patient.

Why is moisture bad? The pack has just been sterilized, right? Unfortunately, moisture has the potential to provide a pathway for microorganisms to enter the just-sterilized package and contaminate it. If the moisture goes unnoticed, the resulting contaminated instruments create an opportunity for microorganisms to transfer to the patient during a procedure and potentially cause an infection.

Factors that contribute to wet packs

Wet packaging can indicate problems with a number of factors, such as package composition, loading procedures, sterilizer performance or operation, or the steam generation and distribution system. Many of the causes are directly related to sterile processing practices, so it's vital that sterile processing technicians do everything they can to prevent moisture in a pack.

The factors contributing to wet packs fall into three general categories: mechanical, operational (also referred to as clinical), and environmental. A review of the factors in each group can help a department identify specific issues they can address.

1. Mechanical factors

Mechanical factors include all aspects of steam sterilizer operation, the steam delivery system, and the steam generator/boiler operation. Steam sterilization happens when steam at a high temperature touches a colder item in the sterilizer. Steam condenses onto the colder item, transferring its heat to the item while at the same time turning into water. Items include the packages being sterilized, carts and racks in the chamber, the sterilizer door, and the chamber walls.

When all mechanical systems are performing correctly, the condensate formed during the cycle drains from the chamber through the drain. If any condensate remains, it is re-vaporized at the end of the exposure period and is exhausted or evacuated from the chamber at the end of the cycle. When mechanical systems fail, too much condensate is made, or drainage is insufficient to allow full vaporization of remaining water in the chamber and packages, wet packs can happen.

Most mechanical systems are outside the responsibility of the sterile processing technician. However, there are several key maintenance activities performed by technicians that are critical for supporting

Figure 1: Operational factors that contribute to wet packs are under the control of sterile processing technicians.

proper drainage of condensate and vaporization of residual moisture.

2. Operational factors

Operational factors include all the activities performed during instrument processing procedures, such as preparing and packaging the instruments, loading the steam sterilizers, and removing and cooling items before transport to storage. All operational factors are under the control of sterile processing technicians.

Preparation and packaging

Items should be prepared and packaged in a way that minimizes the pooling and creation of excessive condensate while also promoting drainage. When too many items are packaged together, are grouped into one area of the package, or have too much metal mass, excessive condensate and/or localized moisture can collect that is difficult to vaporize at the end of the cycle. Positioning items in a way that allows water to pool or that traps steam that condenses creates excessive moisture that is difficult to vaporize at the end of the cycle. Excessive moisture can also accumulate if heavy instrument sets are placed in inappropriate trays (those with no drainage holes, too few drainage holes, or drainage holes incorrectly placed for efficient drainage of condensate).

Sterilizer cart contents and loading configuration

Since condensate forms on all surfaces within the sterilizer, the contents in the load and the placement of items can create opportunities for condensate to pool and prevent drainage. Overloading the sterilizer cart/shelves with items can create a tight dense load that hinders steam and condensate evacuation from the items during the drying phase. Because all items drain and drip in the sterilizer, placing heavier items that produce a lot of condensate above lighter items can flood the lighter items with dripping condensate. Similarly, placing containers above wrapped items allows dripping condensate to pool on synthetic wrap surfaces.

Removing and cooling items

Even an item that is dry at the end of the cycle can form condensate if handled improperly. Items at the end of a steam sterilization cycle are hot and have moist hot air within. When cooler items touch the hot item, the sudden cooling causes condensate to form, and this leads to wet packs. Placing hot items right out of the sterilizer on a solid surface such as a metal counter is the most common way to create this type of wet pack.

3. Environmental factors

Environmental factors include air temperature and humidity. The environment works to create condensate in two ways. First, the temperature in a space can cool packs too quickly and allow the moist air within them to condense and pool. This happens when the room temperature is too cold, or when hot items are placed directly beneath an air conditioning vent that blows cold air onto the hot load.

Second, the environment creates condensate when cool packs are transported through an area of warm humid air. This can happen on the way to the point of use within the facility, but it is more likely to happen when sterile items move through the hot, humid environment of transport vehicles on their way to other buildings or facilities.

How can sterile processing technicians prevent wet packs?

Technicians can use techniques and best practices that reduce pooling and excessive condensate throughout the preparation, steam sterilization and storage process. Although this will not address every cause of wet packs, our decades of experience have taught us that technician activities, including improperly prepared and loaded items, are contributors.

Daily sterilizer inspection and testing

Wet pack prevention starts with the steam sterilizer. Technicians should always review sterilizer instructions for use (IFU) to properly perform daily testing and routine inspection. The sterilizers should be inspected and drain screens cleaned *at least daily*. An obstructed screen can cause moisture to pool in the chamber floor and impede steam removal at the end of the sterilization cycle, which can contribute to a wet pack.

It is important to keep the sterilizer chamber clean. Radiant heat from clean chamber walls supports effective drying, which aids in the prevention of wet packs. Chamber walls with scale build-up, rust, and load labels and other debris are less effective at transferring heat and drying loads.

Sterilizer performance testing is another important part of the quality assurance process. Some tests can help detect wet steam, which can lead to wet packs. Some daily air removal test packs (Bowie Dick test packs) indicate failing results in the presence of excessive moisture from the steam supply. Technicians should know which quality assurance tests, if any, help detect wet steam and should know who to alert when it does.

Preparation and packaging

Technicians can have a huge impact on wet pack prevention by optimizing how they assemble and package instruments after the cleaning process. In addition to inspecting instrumentation for functionality and cleanliness, technicians should inspect them for residual moisture. Residual moisture can create a "cold spot" that allows condensate to remain after steam sterilization. Instruments are dried using room air (air drying), instrument air (forced air), or a drying cabinet. Regardless of the method, ensuring that instruments are thoroughly dry will help prevent wet packs.

Next, the technician should choose the correct instrument tray or basket. Trays

Self-Study Test Answers: 1. C, 2. C, 3. A, 4. D, 5. C, 6. B, 7. C, 8. A, 9. C, 10. A

that hold instruments during steam sterilization should have holes in the bottom that allow condensate to drain away from the instruments. Using a tray with too few holes prevents good drainage and leads to excessive condensate collection and wet packs. The best practice is to use a "standard" surgical instrument tray that has multiple perforations or a wire-mesh bottom.

In addition, technicians should choose a tray that is large enough to evenly distribute the metal mass in a single layer without piling instruments on top of each other. Heavy metal mass caused by piling instruments leads to excessive localized condensate.

Furthermore, instruments should be disassembled for steam sterilization per the device manufacturer's IFU. Leaving instruments assembled if the IFU require disassembly may trap steam that can condense and contribute to a wet pack.

Each type of containment device plays an important role in condensate removal and device drying. Containment devices include sterilization wrap, pouches, and rigid container systems. Technicians must choose a containment device that's confirmed for a particular sterilization cycle and dry time. Consult the containment device's IFU for additional requirements that will ensure proper function of the packaging/container and drying of its contents. Examples of misuse include:

- Using a wrap too large for the tray, which creates excess layers and folds that trap condensate and can result in wet packs.
- Using non-validated silicone mats and inserts in containment devices, which can prevent good drainage.
- Loading instrument weight higher than recommended by the containment device and sterilizer IFU, which can create excessive condensate that may not dry. In calculating weight, include all accessories used with the containment device, including silicone mats, sterilization bags/holders, indicators, locks, filters, etc.

Loading the steam sterilizer

Sterilizer carts should be loaded and configured in a way that ensures proper condensate drainage and drying of the entire load. Instrument trays and rigid container systems should lie flat on shelves to ensure even distribution of metal mass and proper positioning of all available drainage holes. Overloading the shelves and compressing packages can trap steam during drying, causing condensate at the end of the cycle. It's important to ensure space between items on shelves.

Also, items should not touch the sterilizer chamber walls, and instrument tray(s) or other packages should not be placed directly on the floor of the sterilizer chamber because this can prevent drying. Allow at least three inches between the sterilizer's walls and ceiling and the containment devices and other items in the load, to facilitate steam removal and drying.

Peel pouches should be placed standing on their edges, with the plastic side of one facing the paper side of the one next to it. If necessary, technicians can use instrument trays, wire baskets, pouch organizers, or other sterilizable stabilizers to hold the packages in proper position for sterilization.

Items with concave surfaces and cup-like designs should be angled with the concave-side down for drainage. Placing curved surfaces, bowls and cups upright collects excessive condensate in those features that may not dry by the end of the cycle.

Steam sterilization produces condensation that drips from items, chamber walls and rack rails. Items on each level must be placed in ways that prevent drips from above from pooling on or in them. Configuring the load requires the technician to decide which items to include and where to place them on the sterilizer cart.

A general rule of thumb is to place items that produce the least amount of dripping condensate on top shelves and those the produce the greatest amount on the bottom. For example, heavy rigid container systems with a great deal of metal mass should be placed on the bottom sterilizer rack, and lighter sterilization pouches with little metal mass should go at the top.

Technicians should be aware of drainage points in the items. Some rigid container systems have bottom filters that promote draining. Aligning a bottom filter of one container over the top filter of the container below can cause condensate to drip directly into the container below, potentially creating excessive condensate. This is especially true when stacking items. Stacking should be avoided unless the containment device manufacturers have validated this practice.

Another general rule to follow is to place wrapped items above containerized items, especially when using synthetic wraps. It's better to sterilize wrapped textiles and instrument sets in separate loads, but if they are mixed, place textiles on shelves above instrument sets.

Absorbent shelf liners can absorb condensate from the items on that shelf and reduce condensate dripping to shelves below. However, *do not substitute nonwoven disposable wrap as a shelf liner* because it pools condensate instead of absorbing it.

It's also important to review all IFU for the sterilizer, instruments, and containment devices to determine the correct dry times for a particular load. Standard sterilizer drying times may differ from those required by specialty surgical instruments or containment devices. To prevent wet packs, it's imperative that technicians reconcile all related IFU to ensure that all devices in a load are properly packaged and thoroughly dried.

Removing and cooling steam sterilized items

Because hot items placed on or in a cold place causes condensation in packs, hot items and loading carts should be placed in a low-traffic area away from air conditioning or other cold air vents, to prevent quick cooling and condensate formation. Also, avoid placing hot items on cold surfaces or stacking them. These too can cause condensation.

Items must be cooled before moving them to storage. ANSI/AAMI ST79:2017 Section 10.3.1 states, "the time allowed for cooling should consider the type of sterilizer being used, the design of the device being sterilized, the temperature and humidity of the ambient environment, and the type of packaging used." Adequate cooling time could be two or more hours depending on these four variables. Consider using remote temperature-sensing devices to confirm that items have cooled sufficiently.

One final tip: to avoid trapping moist air that may convert to condensate as it cools, technicians should not place warm packages in plastic dust covers.

Knowledge and action prevent wet packs

Steam sterilization is a wet process, but it doesn't have to lead to wet packs. Sterile processing technicians who understand the steam sterilization process, know the causes of wet packs, and reconcile the requirements from all relevant IFU can prevent the factors that are creating a wet-pack risk. They can improve processes and employ best practices that discourage excessive condensate, pooling and poor drainage. The power to prevent most wet packs is in the able hands of sterile processing professionals. HPN

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Ugh! Another wet pack. What's a technician to do?

Circle the one correct answer:

1. **ANSI/AAMI ST79 considers residual moisture to be a wet pack when it is:**
   A. On the inside of a sterile package
   B. Only on the outside of the sterile package
   C. On the inside or outside of a sterile package
   D. None of the above

2. **Why is residual moisture a problem for steam sterilized items?**
   A. It damages sterilization pouches
   B. It discolors the instruments
   C. It creates a pathway for microorganisms
   D. It's okay to have residual moisture

3. **Which types of factors contribute to wet packs?**
   A. Operational factors
   B. Functional factors
   C. Delayed reprocessing factors
   D. Staffing factors

4. **Which is an example of an operational factor?**
   A. The temperature and humidity of the SPD
   B. The results of a Bowie Dick test
   C. The quality of the steam
   D. The preparation and loading of instruments into trays

5. **What should be inspected and cleaned daily to prevent wet packs?**
   A. Sterilizer safety valve
   B. Sterilizer racks and loading cars
   C. Sterilizer chamber drain
   D. Sterilizer chamber controls

6. **Nonwoven, synthetic wraps should be used to line your sterilizer shelves.**
   A. True
   B. False

7. **What type of tray should be used to assemble instrument sets?**
   A. Solid bottom and sides
   B. Solid bottom and mesh sides
   C. Mesh or perforated bottom
   D. Tray with a lid

8. **Where should a linen pack be placed within a mixed load?**
   A. The top shelf
   B. Under rigid container systems
   C. Between wrapped trays and rigid container systems
   D. On the bottom shelf

9. **Where should a hot sterilizer cart go for cooling?**
   A. Equipment corridor
   B. Beneath the air conditioning vent
   C. Low traffic area
   D. Sterile storage

10. **What happens when a hot steam sterilized item is placed on a solid work surface?**
    A. Condensation
    B. Slower cooling
    C. Drying
    D. Nothing happens

CONTINUING EDUCATION TEST SCORING

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