IMPLEMENTATION MODULE:

Fluid Management Systems in the OR

Liquid Waste Management in the OR

A large portion of surgical waste is liquid waste—blood and body fluids diverted during surgery. This waste stream is typically collected in disposable plastic suction canisters. A Minnesota study found that suction canisters comprise 25% of regulated medical waste at hospitals,[1] while another estimated that up to 40% of surgical waste is related to suction canister disposal.[2] A single canister can hold up to three liters of fluid. In a single surgery, often 3-4 three-liter containers can be filled with fluids bound for disposal—weighing approximately 6-8 pounds apiece.[3]

Suction canisters containing liquid waste have historically been disposed of in one of two ways. The first option involves having clinical staff manually open the canisters and pour the contents down the drain. This practice can pose a significant risk of splashing or aerosolization of bloodborne pathogens for OR –or in some cases, EVS—staff. A 2004 Healthcare Purchasing News article estimated that between 30-65% of hospitals have continued to use drain disposal, despite the exposure risks.[4] It is hard to quantify the cost of treating employees who have had exposures related to disposal of liquid medical waste but even using a conservative numbers based on a 1990 study estimating $500-$3000 for initial treatment and follow-up for exposed workers, one can understand the financial and safety implications.[5] Hospitals utilizing this practice also run the risk of OSHA citations, as even with personal protective equipment, this practice may be interpreted as violating OSHA's Bloodborne Pathogens Standard. And as a 2004 OR Business Manager article aptly stated: "*Harder to quantify are the anxiety and fear plus the obviously high costs if there is a seroconversion.*"[6] Also important to note is that suction canisters that have been emptied to the sanitary sewer are often still considered regulated medical waste due to perceived risk and are disposed of accordingly, adding the weight of each empty container to RMW disposal costs, which are typically 6-10 times higher than the cost of solid waste disposal.

A second option involves opening the container and adding chemical solidifiers (or isolyzers) to the contents. Once the solidifier has made the canister contents immoveable, it is then placed in the regulated medical waste stream for treatment and disposal. Several things should be taken into consideration with this practice. Solidifiers can take up to 10 minutes to solidify completely, though many claim a two-minute solidification process.[7] Some hospitals report that solidifiers aren't entirely solid and can still splatter if container is dropped. In terms of OR turnover time, at an estimated cost of $17/minute,[8] estimating just five minutes per case for suction canister solidification and disposal over eight cases a day can translate to $680 per day in lost OR time. From a waste perspective, in a hospital that performs 7000 surgeries per year, use of solidifiers could be roughly equivalent to $35,280 in RMW disposal costs (estimating three 6-lb suction canisters per surgery being disposed of as RMW at $0.28 per pound each) with an additional supply cost estimated conservatively at $105,000 for the solidifiers themselves (estimated to cost between $5-$30 apiece).[9] Additionally, some solidifiers contain disinfectant chemicals such as chlorine and glutaraldehyde that may allow a solidified container to go to regular trash rather than RMW, depending on state RMW regulations. But these chemicals bring additional exposure risks to workers. Glutaraldehyde, for example, is known to cause throat and lung irritation, asthma, headaches, nausea, rash-contact and/or allergic dermatitis, nosebleed, burning eyes, nose irritation, sneezing and wheezing.[10]

Hospitals are finding that a third option—fluid management systems that empty liquids directly to the sanitary sewer—are safer for staff, better for the environment and offer long-term cost-savings. In 2010, 62% of Practice Greenhealth award winners reported they were utilizing fluid management systems.[11] Hospitals use one of several enclosed liquid management systems available on the market to dispose of blood and body

Suction canisters can comprise a large portion of OR infectious waste—up to 40%.

fluids. Fluid management systems are either stationary and hard-plumbed into the sanitary sewer or portable, on a cart that employs a docking station for automated drainage to the sanitary sewer. Some utilize a reusable canister that is disinfected and reused, while others use an integrated canister system that is completely closed, lowering ongoing supply costs for disposables as well. There is an initial capital cost for equipment ranging from approximately $20-25,000 for each system and some smaller costs for disposable manifolds or lids for some models ranging $15-20 per procedure as well as occasional container replacement when reusable canisters wear out. Other less expensive fluid management systems empty directly to the sanitary sewer but utilize disposable canisters that are able to be placed in regular trash after a rinse with an enzymatic cleaner. These systems still confer dramatic waste reduction benefits but don't ameliorate the basic canister purchase and disposal costs. They also do not have the ability to accurately measure fluid loss—a key benefit to anesthesiology staff concerned about patient safety.

How then does a facility make the business case for investment in fluid management systems in the OR and operationalize this technology? There are several finite steps an organization can follow to set up and implement a fluid management system in the OR.

Step 1. Assess Current Practice

Fluid management systems do typically require an upfront financial investment, despite having typical financial payback periods ranging from just 1 to 3 years and immediate workplace safety improvement. (Note: payback periods don't factor in a host of intangibles such as efficiency gains and exposure reductions, for example.) However, most companies have responded to the capital cuts in healthcare by offering a lease option that converts the capital costs into payments over the life of the equipment, therefore eliminating the upfront capital investment. Therefore it is important to be able to demonstrate to leadership the volumes of waste that would be diverted, any improvements in staff safety and health, and averted disposal costs that are a result of fluid management systems. There are several steps you can take to calculate that baseline:

- **Determine volume of suction canisters used by OR over set period of time.** Determining the volume of suction canisters currently being used and disposed of is the first critical element in data gathering. Check with materials management or the OR Director and find out how many suction canisters the OR orders monthly or annually—ranging from small graduated canisters up to the bulk "omni-jug" style containers. This should provide you with an estimate of how many containers are being disposed of during the same time period, unless you are holding significant inventory.
- **Determine estimated price per suction canister.** Ask materials management staff for estimated price per suction canister or if they have a total costs for all suction canister purchases in the OR over a set period, that works as well.
- **Determine what method your OR is currently utilizing for suction canister disposal.** The three most typical responses will be (1) manual pour to sanitary sewer, (2) use of a solidifier and dispose to RMW, or (3) use of disinfectant solidifier and dispose to either RMW or solid waste, depending on regulations.
- **Determine weight of container (either full containing solidifier or empty after pour).** Get an estimated weight for a full suction canister. There are several ways to do this. If the OR is typically using 3-liter containers, you can estimate a weight between 6-8 pounds per full canister based on manufacturer estimates. Or you can actually have Environmental Services (EVS) weigh a full container to get a more accurate estimate. For most accurate results, check how full OR staff usually let a suction canister get before disposing of it—it may be less than full, and this should be adjusted in your estimate.

- **Determine price the organization is paying for disposal of RMW per pound or ton.** Check in with the Environmental Services Director. The Director should have an accurate cost per pound or ton of RMW disposal fees if the organization uses a commercial hauler. This can get a bit more complicated if the hospital is treating their own RMW onsite. But EVS should be able to assist in coming up with an average cost for disposal as RMW.
- **Determine price of solidifying agent per canister.** Again- check with either materials management or with Environmental Services. It may also make sense to inquire with circulating nurses about effectiveness of the solidifying agent. Many hospitals find that their staff members are pouring more than one package of solidifying agent into each container because they don't feel one package is effective enough. This could significantly increase the cost per procedure.
- **Multiply number of canisters used by OR x weight of container (in lbs) x price of RMW per pound x cost for individual solidifier (if applicable) to get total disposal costs.**
- **Multiply number of canisters used by OR x estimated price per canister to get total supply costs.**
- **Add those two figures for total current costs for fluid management in the OR.**
- **Add in any employee health costs related to fluid management if available.** Check in with Infection Prevention or Employee Health to identify any exposures incurred from the existing system for managing fluid waste.

Note: If using a solidifier that contains a disinfectant and your state allows you to dispose of fluid canisters utilizing a solidifier+disinfectant as regular trash, use the cost for SOLID WASTE in the equations above rather than RMW costs. If your facility is doing this, consideration should be given to the perceived risk and potential negative press associated with this material in the regular waste stream

Step 2: Evaluate Your Hospital's Needs Relative to Fluid Management

Before selecting a fluid management system for cost evaluation, there is a need to determine what kind of a system would work best with the current OR set up. This involves looking at several factors. How much floor space is available in the OR— is space always at a premium? Check with engineering—how complicated would it be to plumb in the fluid management system? How old is the hospital plumbing system? Adding new equipment to a faltering plumbing system may not be an ideal solution. Poor suction and drainage may persist. The answer to these questions may point toward either a hard-plumbed version or a portable version. Does "suction power" matter to the surgeon or staff? If so, this may also determine which type of system the organization decides upon. Wall-mounted units use existing medical vacuums, meaning fluid waste will be drained to the sanitary sewer but suction will not improve. Cart-based systems often have onboard vacuum pumps and can significantly improve suction. Does the hospital perform a lot of orthopedic surgeries? Which fluid management system has the capacity needed to handle complicated orthopedic surgeries? How many ORs does the department have? This is relevant in that if one has multiple surgeries happening simultaneously, the OR may need multiple pieces of equipment to manage suction. While it may not be a one-for-one count of equipment to ORs, more equipment means a greater capital investment. The organization also may want to consider whether it is looking for a solution for just the OR or a facility-wide solution. Different kinds of equipment lend themselves to the OR—where they may be measuring fluid loss more accurately and have the need for larger capacity as compared to patient floors you have small volumes of liquid but a large number of canisters. Some companies offer solutions that meet both needs and in other cases, hospitals have even chosen to use two different models—one for the OR and a different system for patient care areas. As the hospital begins to look at the different models available on the market, keep the answers to these questions in mind.

Step 3. Invite Vendors to Provide a Demonstration

Many suppliers are willing to come onsite and demonstrate their product, as well as provide some basic level of cost-benefit analysis. Pull together a small group—the OR manager, a few key nurses and perhaps even one of the "doubters" (these folks may not want to hear stories about new equipment benefits but seeing it with their own eyes may turn them into believers). While the project team will already have done its homework on some of the basic waste baseline data for suction canisters, vendors often have sophisticated tools and calculators to help run the numbers and estimate the payback period. Ask about the useful life of the equipment. Is this a three year investment, a 5-year or a 10-year? Be sure that the hospital's finance people will want to know these answers.

Step 4. Ask About Ongoing Supply Costs

The unifying element that separates "fluid management systems" from conventional suction canister systems is that they all have some mechanism to drain fluids directly to the sanitary sewer, therefore reducing RMW volume by diverting fluids and dramatically reducing worker exposure risks to bloodborne pathogens from fluid management. Yet different fluid management systems

utilize different parts and supplies. Some systems are canisterless, some have reusable canisters and still others utilize disposable canisters. Some require a disposable manifold or lid that must be replaced for each patient, most require an enzymatic cleaning solution to ensure no build up of residue in containers, while some also require a disinfectant. Even the reusable canister systems have to replace the canisters occasionally. It is important early on to figure these disposable supply costs into future operational costs to run the equipment.

Step 5. Review Local and State Regulations and Permits

The Guidelines for Environmental Infection Control in HealthCare Facilities from the Centers for Disease Control and Prevention, issued in 2003, say sanitary sewers may be used for safe disposal of blood and suctioned fluids, provided local sewage discharge requirements are met, and the state has said this is an acceptable disposal method.[12] Ask vendors to help the organization understand local or state rules pertaining to bulk disposal of blood and body fluids to the sanitary sewer. Vendors will likely be able to walk through the process to contact local or state officials for the permitting or other regulatory oversight guidelines, if applicable. It is important to double check regardless of what vendors say. While these systems are in use all over the country and are a well accepted technology, before the hospital makes any purchase, ensure the local and state water officials have vetted and approved the practice of disposing of bulk blood and body fluids into the sanitary sewer.

Step 6. Business Case and Payback Period

Once the project team has assessed the different fluid management systems, vetted the regulatory requirements, have a sense of the auxiliary supply figures and the lifecycle of the equipment, it will have the data it needs—set against the baseline data—to make the business case to leadership. Help leadership understand the ROI through avoided RMW disposal. While the waste disposal numbers do not typically appear as line items in the OR budget (as waste management is typically billed centrally to EVS or Facility Management), the executive team needs to know there are bottom line savings somewhere in the organization. Point out the avoided supply costs for disposable canisters, tubing and/or solidifiers. Work with the vendor to establish the ROI and payback periods for the equipment and highlight any multi-equipment discounts or rebates. And don't forget to help administrators understand the potential risks and liabilities that manual pouring of suction canister waste may present from an OSHA or worker safety standpoint.

Step 7. Train Staff on How to Use Equipment

Once the purchase has been approved, the equipment will delivered and/or installed. Ensure that the team works with engineering to properly utilize drainage hook-ups and power sources. OR staff will require appropriate training on how to use the equipment appropriately for maximum waste reduction benefit. Likewise, purchasing staff will need to be informed about new ordering practices for fluid management system equipment (canisters, manifolds, tubing or the like). Hold In-Services at the beginning of each shift to demonstrate how the new equipment works. Make the nursing or anesthesia staff practice either reloading the equipment, docking the equipment or other functionality testing that demonstrates comprehension. Suction intensity may be different than previous equipment—some models have adjustable suction levels and independent vacuums, making practice and testing critical from a patient safety standpoint. Hold a more in-depth training and troubleshooting session with a volunteer from each shift to ensure each knows how to operate equipment and can continue to teach and/or correct other staff. Partner with the vendor to provide the most comprehensive and useful training to staff. Additionally, some vendors offer training for service and biomedical personnel as well. Vendor training capacity and support should be written into the sales contract where possible.

Step 8: Troubleshoot Implementation Issues

Fluid management systems are typically an easy equipment upgrade with very few issues related to implementation. There may, however, be occasional setbacks with the new equipment—trouble with docking or drainage or canister replacement. All of that is to be expected when you integrate new equipment and occasionally have training gaps. By following these steps, you've done your best to prevent these minor setbacks, but be prepared. If staff is having difficulty, take the time to retrain and capitalize on the learning opportunity. Make sure staff understand the benefits—both financially and environmentally—of the new equipment. And develop a mechanism to report concerns or problems and appropriate solutions back to all OR staff, so other staff won't encounter the same issues.

Step 9. Track Improvements and Recognize Success

Work with Environmental Services in advance to set up a system to track improvements in RMW reduction coming from the OR. This can be as exact as data from a waste tracking or bar-coding system that specifically identifies OR RMW volumes and fluctuations or an estimate, based on a bi-monthly audit where OR waste is pulled aside and weighed separately. EVS can be very helpful in determining how best to track or estimate waste reductions. Run the math of avoided supply costs due to the transition. Report cost reductions, waste diversion volumes and other environmental or other benefits back to leadership and OR management and keep a running tally of savings to demonstrate payback. Celebrate success! If possible, provide staff with real-world estimates of reduced environmental impact or waste reductions. I.e. avoided disposal of one day's worth of suction canisters translates to a certain number of cars off the road—or other real world examples with which they can connect. Make sure the organization's sustainability leader or green team (if applicable) knows about the success the OR is having, and includes it in any award applications or recognition opportunities.

For More Information: Go to www.GreeningTheOR.org for a list of key resources that an assist you in this program area. Because this list is updated often, we keep it online, so as not to date this implementation module. Also available are case studies on fluid management efforts in the OR. Learn from your peers!

Endnotes

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