
Not As “Green” As It Seems: Reusable Sterilization Wrap

by Jane Hart

One of the biggest ongoing debates in the greening of Canada’s hospitals has to do with single-use versus reusable textiles in the operating room (OR); these products include surgical gowns, drapes and sterilization wrap for surgical instruments. It’s no small issue: the OR is one of the largest users of supplies within the hospital as well as one of the largest producers of waste. In fact, case studies have estimated that, despite its relatively small footprint, between 20% and 30% of the total waste generated by a hospital comes from the OR.¹

Proponents of reusable textiles claim that their approach is better for the environment because it generates less waste. However, when you examine what the laundering process (reprocessing) of these products actually entails, the “green” argument simply doesn’t stand up to scrutiny. Nor, with modern recycling and incineration methods, is waste disposal as burdensome an environmental issue as they would have you believe. What’s more, when you factor in the potential effects of laundering on the barrier performance, flammability and linting properties of reusable OR textiles – by far the most critical qualities when it comes to patient and OR staff safety – the risks of reusables outweigh their purported rewards.

Sterilization wrap is a case in point. While new reusable monofilament fabrics – which manufacturers claim possess better barrier properties than older cotton items – have entered the marketplace, they still have

drawbacks which can compromise performance. And recent testing⁷ proves it.

For OR professionals who are tasked with evaluating the relative costs and benefits of single-use and reusable sterilization wrap – and who aim to balance performance, sustainability and the bottom line in their purchasing decision – here are some facts to help you make an informed choice.

Reusables consume natural resources, pollute air and water

There is a common (mis)perception that reusable medical textiles, by their very nature, are better for the environment. The fact is, however, that the consumption of natural resources over a reusable textile’s life cycle has a greater environmental impact than that of single-use textiles. Research has shown that reusable textiles consume approximately 4.5 times as many resources as single-use textiles – even taking into account the manufacturing process – chiefly because of water usage in laundering.² In addition, the heating of wash water and drying of textiles consumes energy. To their credit, environmentally-conscious reprocessors recycle waste water and utilize heat reclamation techniques, but the initial water usage in laundering reusable textiles remains a significant issue.

What’s more, the heating of wash water and drying of textiles contributes to air pollution because carbon dioxide (CO₂) and nitrogen oxide (NO_x) are released into the atmosphere (these air emissions are a group

of highly reactive gases that have a deleterious effect on air quality). In addition, even if the laundry uses low-phosphate detergents, wash-water discharge contributes to water pollution. In fact, the chemical/biological oxygen demand (known as CBOD) and total suspended solids (TSS) in laundry water impose the greatest environmental burdens in the garment lifecycle.³ CBOD refers to the amount of oxygen required by aerobic microorganisms to decompose the organic matter in a sample of water, such as that produced by laundering; it is used as a gauge of the degree of water pollution.

Another point to consider: it takes multiple reusable textiles to do the work of one single-use product, according to INDA, the Association of the Nonwoven Fabrics Industry. This is because for every reusable textile currently in use, a hospital must purchase several more that are undergoing reprocessing for future needs. The National Association of Institutional Linen Management estimates that institutions should buy five to seven reusables for each item in use, depending on their laundry's turnaround time – which translates into five to seven times more laundering.³

Bottom line, based on resource consumption for and air and water pollution from the laundering process, the environmental burden has been found to be lower for single-use OR textiles than for reusable ones.⁴

The “green” argument about “blue wrap” waste disposal – a red herring?

Advocates of reusable sterilization wrappers also argue that their products help to reduce the volume of medical waste and the costs associated with disposal. Unfortunately, there are no reliable, current

statistics about the amount of medical waste in Canada, nor is there any national regulatory framework for medical waste disposal, due in part to Canada's provincial jurisdictions, making it difficult to quantify the scope of the waste disposal issue on a national basis.

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According to a recent article in the *Canadian Medical Association Journal* (CMAJ), however, Canada may be doing “too good a job of handling hazardous medical waste produced in the nation’s hospitals.”⁵ The article points to blurred or poorly understood definitions of what constitutes hazardous medical waste, improper segregation of hazardous and non-hazardous waste, and inadequate staff training about handling and disposal of hazardous materials as reasons. As a result, an inappropriate amount of non-hazardous waste winds up being treated (autoclaved, for example) – at a cost that is estimated to be five times more than regular waste disposal. Single-use sterilization wrap (“blue wrap”) often falls into this category because it is inaccurately sorted. Given blue wrap’s superior performance attributes (discussed in the next section), educating and training staff about proper segregation for disposal seems a more cost-effective – and clinically effective – solution than reverting to reusables.

There also is great hue and cry that, even when it is accurately sorted, single-use sterilization wrap is clogging Canada’s landfills because it cannot be recycled. This simply isn’t true; in fact, a growing number of environmentally-conscious hospitals are

adopting highly successful recycling initiatives.

For example, Chatham-Kent Health Alliance (CKHA) was one of the first hospitals in Canada to recycle instrument tray wraps, inspired by a Tennessee hospital's wrap recycling program. Although the Municipality of Chatham-Kent regularly recycles number five plastics, their waste service provider did not have the local capacity to recycle the blue polypropylene sterilization wrap. After further research, the CKHA team identified a Toronto-based recycling company, Turtle Island, with whom they could partner. Recycling receptacles were placed in all areas of the hospital that use instrument trays, and staff now dispose of wraps using these designated containers rather than regular trash bins destined for landfill. This initiative is diverting several tonnes of waste from landfill annually, and the hospital is saving money by not having to pay for dumping that amount of tonnage.

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"With the program now in full swing, wrap collection has become a lifelong commitment and our efforts towards a healthier environment are growing," said Beth Hall, Director of Support Services and co-chair of CKHA's Green Team, in a press release about the hospital's recycling initiative. "An undertaking of this magnitude could not be successful without the full support, cooperation and dedication of staff at CKHA. This is a prime example of what caring people and teamwork can accomplish."

At North York General Hospital (NYGH), which serves the north central Toronto and

southern York Region, a similar initiative has been underway for about five years, also in partnership with Turtle Island.

"When the City of Toronto started recycling, we wondered what we could do to foster the green initiative the city embraced," says Dawn Atwell, RN, BScN, CPN(c), the multi-site regional teaching hospital's OR/CSR resource nurse. "The representative from our vendor, Kimberly-Clark, explained that their blue sterile wrap is just like #5 bottles, so it can be recycled. So we set up two bins in the ORs - one for recycling and one for regular waste - and reeducated staff to put blue wrap into the recycle bins. By conservative estimates, this has cut OR waste by at least a quarter to a third," she notes.

NYGH's pollution prevention efforts earned them a Green Health Care Award from the Ontario Hospital Association (OHA) in 2007. The awards recognize hospitals and individuals who demonstrate leadership and excellence in reducing healthcare's environmental impact, and a significant organizational commitment to environmental sustainability.

In the US, Dominican Hospital (Catholic Healthcare West) in Santa Cruz, California, donates its sorted blue sterilization wrap to a local nonprofit recycling organization which uses the proceeds from the sale of recyclable commodities to buy and prepare hot meals for disadvantaged senior citizens. A company called Marathon Recovery of Oakland, California, purchases the material, which is re-used as a binding agent in making siding materials.

The four-hospital Legacy Health System in Portland, Oregon, which owns and operates its own recycling center, not only recycles sterilization wrap from its member

hospitals but also has begun accepting similar waste from other Portland-area hospitals. The system's sterilization wrap vendors are involved as well, providing transport of the recycled materials. Employees of a local non-profit organization that hires challenged individuals sort the material which is baled and transported to Marathon Recovery. This initiative diverts 3.5 tonnes of single-use wrap from the solid waste stream and saves \$400 in disposal costs per month.

Around the world in Australia, a company called Replas is collecting recycled sterilization wrap from several hospitals. The material is then granulated, moulded and manufactured into new products, including outdoor furniture and signage.

In the US and Canada, manufacturer Kimberly-Clark offers a "Blue ReNew" program to help hospitals align resources and systematize the recycling of used wrap in a sustainable manner.

Bottom line, blue sterilization wrap is not the environmental bogeyman that reusable proponents would have you believe, and innovative recycling programs can have a far-reaching, positive impact that's green on both the sustainability and economic fronts.

Where the rubber meets the road: Performance and safety issues

Because the safety of patients and OR staff is of paramount concern, product performance remains the single most important consideration when choosing sterile wrap for surgical instruments. Performance refers to such product qualities as barrier effectiveness, linting and flammability.

Barrier effectiveness, or how well a product does the job of providing an adequate barrier to microorganisms, particulates and fluids, is the core issue when it comes to selecting sterilization wrap. The bacterial filtration efficiency (BFE) test is the gold standard for validating barrier effectiveness. The BFE rate reflects the ability of a material to prevent the passage of aerosolized bacteria, and a rate lower than 98% is considered a low barrier class.⁶ Notably, the BFE of one of the newest reusable sterilization wraps to enter the Canadian market is only 70.1%,⁷ while that of the market leader in the single-use category is 99.5%.⁸

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Reusable medical textiles also undergo multiple wash cycles. While manufacturers claim that their reusable textiles can withstand 50 or 75 wash cycles or more before reaching a state of non-compliance, numerous studies have shown that repeated washing causes textiles to lose some of their barrier protection, increasing the risk of inadequate protection against blood-borne pathogens or microbial penetration in the OR.^{9,10,11,12} By comparison, by their very nature, single-use textiles do not lose their initial high level of barrier protection and integrity.

Linting is another major safety concern in the OR. Lint is recognized as a vector for causing surgical site infection (SSI), and airborne lint serves as a medium for the transport of microbes.¹³ Reusable woven textiles, such as polyester, have much higher lint values than single-use sterile wrap made of polypropylene.

“This means that fibers would have a much higher propensity to loosen from the weave, especially with reprocessing, which is a mechanical washing process,” says Jerry Jascomb, Senior Research Scientist at Kimberly-Clark Healthcare.

The Gelbo Lint Generation Test is an industry-recognized standard for objectively determining a textile’s propensity to generate lint particles when in use. In considering any sterile wrap vendor, it is vitally important to get verifiable Gelbo Lint Test results, in writing. The results should be less than 20 particles measuring 10 microns or larger per 100 square inches of fabric to ensure a low-linting material, Jascomb notes.

Flammability is another critical concern. The oxygen-enriched OR environment creates an increased risk of fire when electrosurgery, electrocautery or laser equipment is used. Alcohol-based skin prep and hand-sterilization products can further exacerbate this risk. Polypropylene (the material out of which most single-use sterilization wrap is made) has been shown to have the highest ignition temperature compared to other textile materials, including polyester and cotton.¹⁴ What’s more, it does not ignite in air under exposure to a surgical laser; rather, it

vaporizes or melts, diminishing further combustion.

Additionally, polyester has been shown to have a higher propensity than polypropylene to hold a static charge in a low-humidity environment like the OR¹⁵, and a spark during a procedure could lead to a fire – yet another factor that makes single-use textiles made of polypropylene a safer choice than woven reusables.

Conclusion

There are very good reasons why non-woven, single-use OR textiles – including sterilization wrap – are the first choice of healthcare professionals in North America (in the US alone, 75% to 80% of hospitals use single-use sterilization wraps).¹⁶ Well-informed, environmentally conscious hospitals understand that sustainability and single-use are not mutually exclusive when it comes to these products. Further, when you add the proven consistent barrier performance and other clinical quality advantages of single-use textiles, it is no wonder that they remain the first choice of safety-conscious hospitals as well.

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REFERENCES:

- ¹Roy K. Esaki, MD and Alex Macario, MD. “Wastage of Supplies and Drugs in the Operating Room.” *Medscape Anesthesiology*. Accessed on December 12, 2011 at: <http://www.medscape.com/viewarticle/710513>
- ²A White Paper on Performance, Cost Per Use, and Environmental Impact of Single-Use and Reusable Gowns and Drapes, the McIlvaine Company, 2009, p. 42.
- ³The McIlvaine Company, *op cit*.
- ⁴The McIlvaine Company, *op cit*.
- ⁵Walkinshaw, E. “Too much of a good thing?” *Canadian Medical Association Journal*, November 18, 2011. Accessed on December 13, 2011 at http://www.cmaj.ca/site/earlyreleases/18nov11_too-much-of-a-good-thing.xhtml
- ⁶A Triangle of Concern: Air Currents, Barrier Fabrics, and Bacterial Penetration, A Continuing Nursing Education Activity Sponsored by Pfiedler Enterprises. Accessed on November 6, 2011 at <http://www.pfiedler.com/ce/1173/1173.pdf>
- ⁷Data on file, Kimberly-Clark Health Care.

⁸ Kimberly-Clark Kimguard Sterilization Wrap Compliance to ISO11607-1:2006. Test data generated by Nelson Laboratories, Inc., Salt Lake City, Utah via lab # 421689.

⁹ S Smith JC, Nichols RJ: "Barrier efficacy of surgical gowns." *Arch Surg*, 26:756-761, 1991.

¹⁰ The McIlvaine Company, *op cit*.

¹¹ Wolf GA, Sidebotham GW, Lasard J, Charchafliet, JG: "Laser Ignition of Surgical Drape Materials." *Anesthesiology* 2004 May;100(5):1167-71.

¹² Source: Website of INDA, the Association of the Nonwoven Fabrics Industry. Accessed on December 15, 2011 at <http://www.inda.org/enduses/hlthbro/DrapesandGowns.html>.

¹³ Association of Surgical Technologists (AST) Recommended Standards of Practice for Surgical Drapes. Accessed on December 6, 2011 at http://www.ast.org/pdf/Standards_of_Practice/RSOP_Surgical-Drapes.pdf

¹⁴ The McIlvaine Company, *op cit*.

¹⁵ Data on file, Kimberly-Clark Health Care, *op cit*

¹⁶ "US Demand Offers Opportunity for Sterilisation Wraps." *Medical Device Network* online article. Accessed on December 15, 2011 at <http://www.medicaldevice-network.com/features/feature80279>