Reducing Medical Waste

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ABSTRACT

Medical waste is a necessary by-product of any hospital environment; however, the majority of regulated medical waste is produced in the OR from the use of disposable surgical supplies (eg, drapes, gowns, basins, gloves, sponges). We conducted a concept comparison project in the ORs of two large medical centers in Bethesda, Maryland, and Washington, DC, to evaluate the effects of using reusable surgical basins, gowns, and table and Mayo stand covers in place of disposable products. Survey results indicated that surgeons and surgical technologists found the reusable products to be preferable to the disposable products currently in use. In addition, using reusable products provided a means to decrease regulated medical waste generated in the OR by an average of 65% as well as reduce the cost of waste disposal. AORN recommends evaluating the environmental effects of using reusable, reposable, and disposable products; our findings provide evidence that may be useful to surgical facilities that seek to adopt a "green" approach. *AORN J* 91 (June 2010) 711-721. © AORN, Inc, 2010. doi: 10.1016/j.aorn.2009.12.029

Key words: *medical waste, regulated medical waste, waste management, reusable supplies, disposable supplies, gowning and draping material, surgical supply management, greening the environment.*

Medical waste is a necessary by-product of any hospital environment. According to Health Care Without Harm, 4 million tons of general waste are produced by health care facilities in the United States each year.[1,2] Disposing of this waste accounts for approximately 20% of a hospital's environmental services budget.[3]

The recommended standard for the percentage of regulated medical waste in health care facilities is 15% or less of overall waste[4]; however, researchers have found that many facilities dispose of up to 70% of waste as regulated medical waste.[4,5] A major source of the waste produced in the OR is disposable surgical supplies.[6] These supplies include surgical drapes, gowns, basins, gloves, and surgical sponges. In an effort to reduce the waste stream, AORN recommends evaluating the "environmental impact of reusable, reposable, and disposable products."[7(p534)] Perioperative personnel today primarily use disposable basins, towels, surgical drapes, table covers, and gowns packaged in custom packs and as individually packaged supplies. The majority of these supplies become regulated medical waste. Waste generation is directly related to the purchase and supply practices in each surgical treatment location. Surgical facilities that seek to adopt a green approach should meticulously examine purchasing practices, inventory delivery, and handling and

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space requirements, as well as the weight and volume of normal and regulated medical waste that leaves the OR.[5]

In an ever-changing surgical environment, perioperative leaders are charged with making sound decisions to establish a safe and fiscally responsible environment for patients and employees. AORN recommends that perioperative nurses actively promote and participate in resource conservation.[2,7] We conducted a project to evaluate whether reusable supplies would meet the same high standards as disposable supplies and reduce the regulated waste stream in two ORs.

THE ORIGIN OF THE WASTE STREAM

Waste issues begin in the purchasing department where materials are purchased that eventually become waste that requires disposal.[5,6] Reducing the amount of normal waste and regulated medical waste in an OR can appear to be an insurmountable task; however, there are numerous ways to reduce waste (eg, reducing, reusing, recycling). One option to consider for reducing regulated medical waste is to reduce the purchase of disposable surgical materials. Perioperative supply management includes considering the "impact of the item on the waste stream when purchasing supplies and equipment."[2(p713)] This is crucial to the reduction of regular and regulated medical waste and is one way in which AORN recommends conserving and managing supplies.

Practice Greenhealth, an organization that supplies information about environmental practices in health care, recommends adding the purchase price of an item to the cost of its waste disposal, occupational health costs, environmental impact, and warehousing costs to determine the ultimate cost of purchasing the disposable medical item.[8] In addition to proper segregation of waste materials, which can reduce costs, a method that aids in decreasing regulated medical waste is the use of reusable products, such as surgical gowns, linens, and basins.

SURGICAL DRAPES AND GOWNS

Surgical draping refers to practices used to create a sterile field during surgical procedures. Draping is based on aseptic principles[9] and includes the use of sterile drapes placed on the patient as well as surgical scrub gowns, back table covers, and Mayo stand covers. The proper selection of draping materials is an important aspect of surgical draping. The collective use of these materials creates a sterile barrier between the surgical field and possible sources of contamination, and protects the surgical team from exposure to bloodborne pathogens.[9] The choice of surgical gowning and draping materials should be grounded in the physical attributes of the materials; however, other factors must also be considered, including the environmental effects of disposable versus reusable products. AORN provides guidance on environmental responsibility[2,7] and recommended practices for the selection and use of surgical gowns and drapes[10] to help with this process.

Surgical drapes and gowns are manufactured as single use (ie, disposable) or multi-use (ie, reusable) products and are classified as medical devices by the US Food and Drug Administration (FDA).[11] As such, all surgical drapes and gowns chosen should be appropriate for the anticipated use and must meet strict FDA regulations and criteria to be used as surgical barriers. AORN's "Recommended practices for the selection and use of surgical gowns and drapes," states that "Surgical gowns should be selected for use according to the barrier quality of the item and the wearers' anticipated exposure to blood and body fluids."[10(p127)] The Association for the Advancement of Medical Instrumentation's (AAMI) liquid barrier performance standard for protective apparel and drapes[12] and technical information report on selecting and using protective apparel and drapes[13] are excellent tools to help perioperative personnel determine the level of protection required. The AAMI outlines four categories of barrier materials for surgical materials:

- Level 1 – liquid resistant (ie, inhibits penetration of liquid), used for simple procedures when blood loss is expected to be at a minimum;
- Level 2 – liquid barrier (ie, prevents visible penetration of liquid), used for procedures when fluids may present a problem;
- Level 3 – microbial barrier (ie, prevents penetration of microbes), used for procedures when bacterial contamination is expected; and
- Level 4 – liquid proof (ie, prevents penetration of liquids and microbes), used for procedures during which the surgeon's hands will be in a body cavity.[12,14]

These categories have proven useful in determining the barrier effectiveness of surgical draping and gowning materials. Two tests described by ASTM International (formerly the American Society for Testing and Materials) in standards ASTM F1670 and ASTM F1671 were developed to evaluate surgical linens for viral and liquid penetration, and are used to determine whether materials perform to Level 4 standards.[12,14] The tests are used to detect the penetration of synthetic blood and viruses, respectively.[12,14] The results of these tests are considered by both the AAMI and the FDA to be the only acceptable measurement for determining Level 4 barrier performance.[13]

Further guidance has been provided by the Occupational Safety and Health Administration's *Bloodborne Pathogen Final Rule* to reduce exposure through the use of barrier materials that do not allow penetration of blood or fluids.[15] By using these criteria, for our project we chose reusable products that could substitute for disposable products already in use, to determine whether we could reduce the amount of regulated medical waste.

CONCEPT COMPARISON PROJECT

We (ie, a group of one faculty member and three perioperative graduate students) conducted an exercise in two major medical centers in Bethesda, Maryland, and Washington, DC, to examine the effects of substituting reusable products for the disposable surgical gowns, back table covers, towels, Mayo stand covers and basins, bowls, and pitchers provided in the custom packs used at both facilities. We compared the amount of waste generated when disposable items were used with the waste generated when similar reusable items were used. We also compared the number of process steps required in the supply chain for disposable items with an alternative practice of using nondisposable supplies. In addition, we looked at the acceptability of alternative, nondisposable, sterile products to surgeons and surgical technologists who work at these two facilities. This exercise was an independent academic project and was not sponsored or endorsed by manufacturers of either disposable or nondisposable products.

Concept Comparison Questions

We asked the following questions:

- Could personnel efficiencies be improved through an alternative purchase practice for surgical packs that included nondisposable gowns, towels, Mayo stand covers, back table covers, and surgical basins?
- How would surgeons and surgical technologists rate alternative sterile, nondisposable products compared with the disposable products currently in use?

We measured the regulated medical waste from 12 surgical services at two hospitals. The surgical services that participated in the evaluation were cardiovascular, dental, general surgery, gynecology, ophthalmology, orthopedics, otolaryngology, pediatrics, plastic surgery, podiatry, urology, and vascular surgery.

Project Strategy

We used a convenience sample for the selection of the surgical procedures based on the daily schedules at the two hospitals. Fifty-nine surgical

TABLE 1. Participating Surgical Specialties

Surgical service	Number of procedures	
	Facility A	Facility B
Cardiovascular	0	1
Dental	1	0
General surgery	12	16
Gynecology	8	11
Ophthalmology	8	8
Orthopedics	10	13
Otolaryngology	1	4
Pediatrics	1	2
Plastic Surgery	3	3
Podiatry	5	0
Urology	5	1
Vascular	5	1
Total procedures	**59**	**60**

procedures were completed at Facility A and 60 surgical procedures were completed at Facility B, for a total of 119 procedures (Table 1). We measured the regulated medical waste from each surgical procedure.

We obtained consent from the surgical administrative staff at the two facilities before the comparative information collection phase. A local FDA-regulated facility that provided the nondisposable surgical products partnered with the student team to supply 120 sterile reusable packs for the purposes of the project. They provided daily pick up and delivery of the reusable products. We provided a precomparison opportunity for staff members to see and feel the gowning and covering materials at both surgical facilities. This provided an introduction to the reusable product and an opportunity for the students to explain the concepts of the data collection for the comparison. A representative from the nondisposable product facility was present and available to answer questions that pertained to the products and the sterilization validation process and to confirm that the products met the FDA requirements for sterilization at each facility.

The practice at both facilities was to use additional draping material over the disposable back table cover. When we asked staff members to describe the rationale for adding the additional disposable half-sheet on the back table, staff members stated that this practice was to prevent inadvertent puncture of the disposable back table drape. We asked staff members to change their current practice for purposes of this exercise and refrain from placing a second drape on the back table and Mayo stand. The reusable back table drape was impermeable and did not require additional draping material to prevent drape punctures.

During the precomparison procedures, we

- preweighed all disposable surgical custom packs before the start of each surgical procedure at each facility;
- preweighed single-use items, which included the back table cover, gowns, Mayo stand cover, a pack of hand towels, a disposable plastic emesis basin, a large basin, and a pitcher, to accurately reflect the added weight when these items were added to the sterile field during a procedure;
- assembled the contents of two nondisposable comparison packs and sterilized them at the FDA-approved facility;
- ensured that minor procedure packs (eg, for hernia repairs; minor ear, nose, and throat procedures) contained
  - Level 2 gowns,
  - towels,
  - a Level 4 back table cover,
  - a Level 4 Mayo stand cover,
  - a metal emesis basin, and
  - a metal pitcher; and
- ensured that major procedure packs (eg, for mastectomies, arthroscopic procedures) contained
  - Level 3 gowns,
  - a Level 4 back table cover,
  - a Level 4 Mayo stand cover,

Figure 1. Example of an open sterile nondisposable pack used for the concept comparison tests. *Photograph courtesy of Col George Nussbaum.*

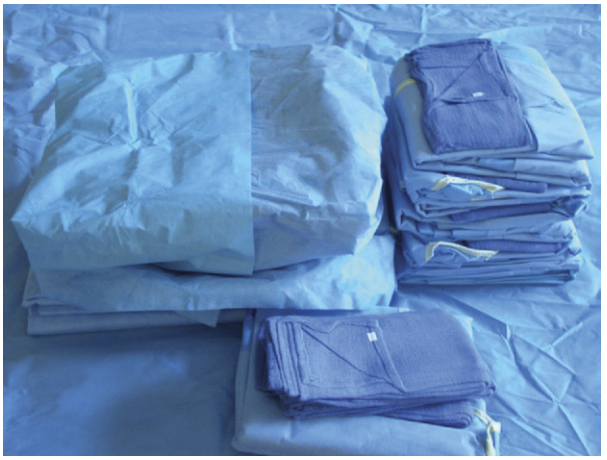

Figure 2. Example of an open sterile disposable pack used at the facilities. *Photograph courtesy of Col George Nussbaum.*

- towels,
- a metal emesis basin,
- a metal pitcher, and
- a large metal basin.

During the concept comparison exercise, we

- opened a sterile, reusable (ie, nondisposable) pack on to the back table (Figure 1) and opened a facility-specific custom pack of disposable products (Figure 2);
- asked the surgical technologist to transfer items that were needed for the surgical procedure from the disposable custom pack to the surgical back table in a sterile manner (Figure 3); and
- removed and weighed all remaining disposable gowns, towels, basin ware, and back table covers items (Figure 4).

We were present for all 119 comparative procedures and were available to provide direction in opening of the reusable products, clean up, and proper removal of the reusable products from the OR at the end of the procedures. We recorded all data at the end of each day to account for the amount of medical waste from each procedure.

After the comparative exercise, we administered a questionnaire to the surgeons and surgical technologists, which asked them to compare the current disposable products to those used during the exercise with regard to satisfaction with comfort, ease of use, and protective properties. The project team collected data from all participants and recorded all responses for each facility. On a scale of 1 to 5 in which 5 = superior, 4 = good, 3 = fair, 2 = poor, and 1 = unacceptable, surgeons were asked to rate the disposable surgical gowns for comfort, ease of use, and protective properties and to rate the comparison (ie, nondisposable) surgical gowns for comfort, ease of use, and protective properties. Surgical technologists were

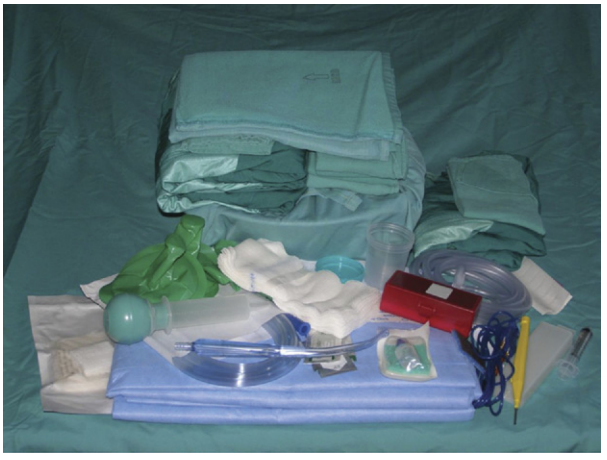

Figure 3. Required disposable items transported to the back table with nondisposable items. *Photograph courtesy of Col George Nussbaum.*

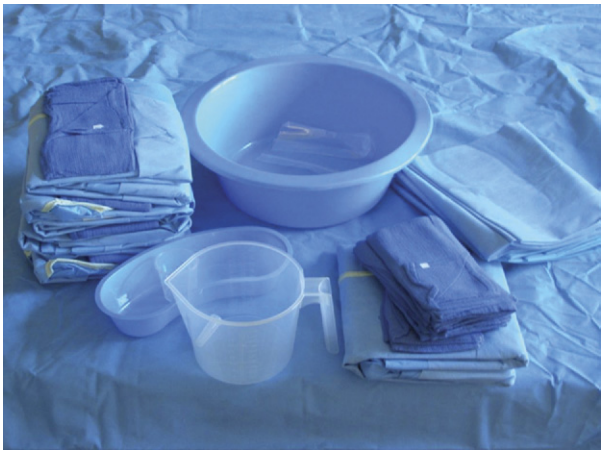

Figure 4. Disposable items replaced by reusable products. This represents the items that normally enter the surgical waste stream. *Photograph courtesy of Col George Nussbaum.*

also asked to rate the disposable and reusable gowns for comfort, ease of use, and protective properties, and, in addition, they were asked to rate disposable versus reusable back table covers, Mayo stand covers, and basins.

CONCEPT COMPARISON RESULTS

We weighed and recorded the surgical waste generated by both facilities. For the purposes of this concept comparison, we intentionally did not include liquid waste because it did not factor into the use of disposable or nondisposable gowning and draping materials. We calculated the weight that would have entered the waste stream for any additional disposable surgical item that was added to the procedure or substituted for a nondisposable product during each procedure performed, thus each procedure served as its own control.

Surgical Supply Inventory Process

We explored current practices in the surgical supply purchase and inventory process. The steps required at both facilities to obtain surgical products before surgical procedures were similar, with variances only in the names of the departments that ordered and provided supplies (eg, surgical processing department versus central supply). For the hospitals' current practice, we identified a total of 10 steps from the time of supply ordering to supply arrival in the OR for the surgical procedure (Figure 5). In contrast, there were only four steps required to order surgical supplies when using the alternative practice (Figure 6).

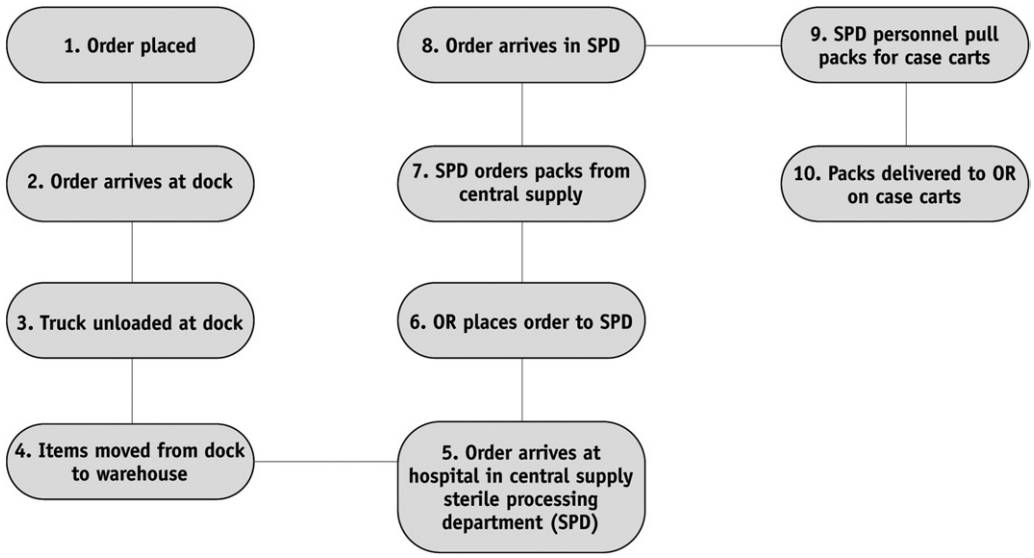

Figure 5. Ten steps required to order and deliver sterile disposable supplies to the OR when using the current practice.

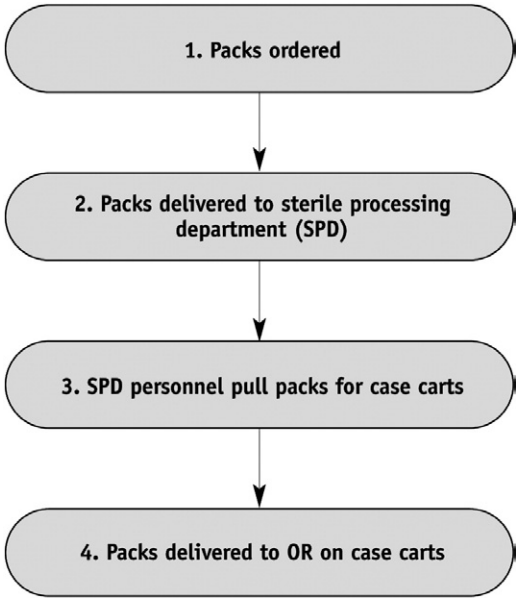

Figure 6. Four steps required to order and deliver sterile reusable supplies to the OR when using the alternative practice.

Acceptability Ratings of Products

One hundred eight surgeons and 64 surgical technologists participated in the comparative exercise (Table 2). We asked the surgeons to rate only the acceptability of the towels and surgical gowns.

- For comfort, 6% of surgeons rated the qualities of the surgical gowns currently in use as superior, 38% as good, 23% as fair, and 33% as poor. The surgeon's comfort rating for the nondisposable product was 86% superior, 10% good, 4% fair, and 0% poor.
- For ease of use, surgeons rated the qualities of the towels and surgical gowns currently in use as 33% superior, 47% as good, 19% as fair, and 1% as poor. The surgeon's ease of use rating for the comparative nondisposable products were 87% superior, 11% good, 2% fair, and 0% poor.
- For protective properties, surgeons rated the qualities of the surgical gowns currently in use as 30% superior, 45% as good, 20% as fair, and 5% as poor. The surgeon's ease of use rating for the comparative product (ie, nondisposable gowns) was 92% superior, 6% good, 2% fair, and 0% poor.

In addition to evaluating the surgical towels and gowns, we asked surgical technologists to evaluate basin ware and back table and Mayo stand covers. They evaluated both the current disposable products in use and the sterile, nondisposable products.

- For comfort, surgical technologists rated the qualities of the surgical gowns currently in use as 23% superior, 38% good, 30% fair, and 9% poor. The surgical technologists' comfort rating for the nondisposable product gowns was 83% superior, 9% good, 8% fair, and 0% poor.
- For ease of use, surgical technologists rated the qualities of the towels, surgical gowns, basin ware, and back table and Mayo stand covers currently in use as 53% superior, 20% good, 24% fair, and 3% poor. The surgical technologists' ease of use rating for the nondisposable towels, surgical gowns, basin ware, and back table and Mayo stand covers was 86% superior, 6% good, 8% fair, and 0% poor.
- For protective properties, surgical technologists rated the qualities of the towels, surgical gowns, basin ware, and back table and Mayo stand covers currently in use as 23% superior, 41% good, 33% fair, and 3% poor. The surgical technologists' protective properties rating for the nondisposable towels and surgical gowns, basin ware, and back table and Mayo stand covers was 94% superior, 3% good, 3% fair, and 0% poor.

Subjective written comments made by the participants included:

- "I loved the gowns, I wish we had these for all cases."
- "The back table and Mayo covers are very durable."
- "I did not need to double drape the back table."

TABLE 2. Gown Comfort and Ease of Use of Disposable and Reusable OR Supplies (Surgeons, n = 108; Surgical technologists, n = 64)

	Superior	Good	Fair	Poor	Unacceptable
Gown comfort					
Surgeons disposable	6%	38%	23%	33%	0%
Surgeons reusable	86%	10%	4%	0%	0%
Surgical technologists disposable	23%	38%	30%	9%	0%
Surgical technologists reusable	83%	9%	8%	0%	0%
Ease of towel/gown use					
Surgeons disposable	33%	47%	19%	1%	0%
Surgeons reusable	87%	11%	2%	0%	0%
Ease of towel, gowns, basin ware, and back table and Mayo stand cover use					
Surgical technologists disposable	53%	20%	24%	3%	0%
Surgical technologists reusable	86%	6%	8%	0%	0%
Protective properties of gowns					
Surgeons disposable	30%	45%	20%	5%	0%
Surgeons reusable	92%	6%	2%	0%	0%
Protective properties of towels, gowns, and basin ware and back table and Mayo coverings					
Surgical technologists disposable	23%	41%	33%	3%	0%
Surgical technologists reusable	94%	3%	3%	0%	0%

- "I love going green for the environment."
- "The gown moves better, much more comfortable."
- "I like the strength of the back table cover."
- "The gown is cooler."
- "I was pleasantly surprised, I had my doubts but I really like the gown, it breathes."
- "Of all the products trialed at this facility, I actually like this one."
- "Happy to see we are trying to save the environment."
- "I am for switching to these gowns."
- "Really liked the back table cover and happy we are saving the environment."
- "Do I have to give it back?"

Waste Reduction Outcome

The combined weight of the 59 total custom packs used at Facility A was 446.41 lb. The weight of the disposable gowns, towels, back table cover, and Mayo covers for the 59 custom packs replaced by the reusable gowns, towels, back table covers, and Mayo stand covers from the FDA-regulated facility was 311.05 lb. The use of reusable products demonstrated a 70% reduction in surgical waste. Facility B had a combined weight of 461.35 lb for the 60 total custom packs opened. The weight of the disposable items replaced by reusable items from the local FDA-regulated facility was 268.56 lb. In this instance, there was a 59% reduction in surgical waste with use of reusable products (Table 3).

DISCUSSION

During the course of the data collection, we noted several "incidental findings." The contents of custom packs at Facility A had not been updated to reflect the actual usage or needs of the surgeons or procedures. We discovered that several items in the custom packs were routinely unused and disposed of, often before the procedure started. The custom

TABLE 3. Surgical Waste Reduction

Facility	Total weight of disposable custom packs	Total weight of disposable items replaced by reusable products	Net change from use of reusable products
A	446.41 lb	311.05 lb	70% reduction in material entering the waste stream
B	461.35 lb	268.56 lb	59% reduction in material entering the waste stream

packs at Facility B were updated more frequently and were a more accurate reflection of the needs of the surgeon and the procedures; although Facility B required more single-wrapped items added to the sterile field than Facility A, the waste of unused items was minimal.

The segregation of regulated medical waste at both facilities was indiscriminate and varied from staff member to staff member, including surgeons and anesthesia personnel. When queried about the justification for separating regulated medical waste, staff members were not able to verbalize what is considered to be regulated medical waste and what is not. Staff members also stated that it did not really matter which bag the trash went into because "it all went out as trash anyway."

The average cost nationwide for the disposal of regulated medical waste is $0.28 per pound.[5] Facility A performs approximately 10,000 surgical procedures per year, and an average of 5 lb of waste was diverted per case during this comparative exercise. Facility B also performs approximately 10,000 surgical procedures per year, and an average of 4.5 lb of waste was diverted per procedure. At this rate, annual waste generation would equal 50,000 lb per year for Facility A and 45,000 lb per year for Facility B, which would result in a potential cost savings of $14,000 per year for Facility A and $12,600 per year for Facility B by converting to a purchase practice of using nondisposable surgical towels, gowns, Mayo stand covers, back table covers, and stainless steel basins (Table 4).

SUMMARY

This concept comparison supports AORN's recommendation to evaluate reusable, reposable, and disposable products.[7] The findings from this exercise illustrate the amount of waste entering the waste stream from the use of completely disposable custom surgical gown and drape packs versus a nondisposable pack that contains back table cover, towels, gowns, Mayo stand cover, and basins. The average weight reduction in medical waste per procedure was 5 lb from the use of the nondisposable items. The need to determine whether gowns, drapes, or towels are saturated sufficiently to warrant being considered regulated

TABLE 4. Potential Cost Savings

Facility	Number of annual procedures	Average waste decrease per procedure	Annual weight decrease	Cost savings at $0.28/lb
A	10,000	5.0lb	50,000 lb, 25 tons (US), 22,679.618 kg	$14,000
B	10,000	4.5lb	45,000 lb, 22.5 tons (US), 20,411.656 kg	$12,600

medical waste is eliminated because they are returned for reprocessing rather than leaving the facility as waste. This represents a 70% reduction in the waste that ultimately reaches a landfill or commercial incinerator. Cost savings will vary for each surgery center based on the habits of separating normal waste from regulated medical waste; the costs per pound for differing categories of waste; federal, state, and local regulations; and the potential fines for Occupational Safety and Health Administration violations.

Our project also illustrated the decrease in nonvalue-added process steps in the supply chain from the point of purchasing surgical packs to the use of the materials in the OR. A 10-step process of handling and moving surgical packs could be reduced to four steps if supplies were delivered to the sterile processing department daily, or a two-step process if supplies were delivered directly to the OR.

Our survey demonstrated the rapid acceptance and eagerness of surgeons and surgical technologists to convert to the use nondisposable products. Laustsen[16] proposed that the greening process in perioperative areas should occur in small steps and that acceptance by staff members will occur when changes take place gradually. This concept comparison exercise demonstrated a different perspective, in that the surgical staff members were eager to convert to a "greener" method in a very short period.

In a letter to the editor of the *AORN Journal,* Belkin wrote, "The amount of red bag medical waste can be reduced by judicious use of reusable items. Perhaps a mix of reusable and disposable products will prove to be the optimal choice."[17(p16)] In December 2008, a major supplier of disposable surgical products announced a partnership with a national FDA-approved company that provides reprocessing and sterilization of nondisposable surgical gowns, towels, table covers, drapes, and basin ware.[18] Collectively, this copartnership creates hybrid packs that supply both nondisposable and disposable products as one unit (Figure 7). In this bold effort to encourage truly "going green," industry leaders are advancing strategies that will help surgery centers reduce their purchase of medical waste and are leading the way in becoming more responsible for the environment. AORN

Figure 7. A hybrid pack, showing a mix of reusable and disposable sterile supplies. *Photograph courtesy of SRI Surgical, Tampa, FL.*

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