

Wastage of Supplies and Drugs in the Operating Room

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Introduction

Anyone visiting an operating room would be impressed by the staggering amount of garbage produced even after a simple 90-minute surgery. In fact, a routine operation in a hospital often produces more waste than a family of 4 might produce in an entire week. One reason operating rooms generate so much waste is the need for absolute sterility of surgical supplies and equipment, which creates the need for extra packaging and creates an impetus for the use of disposable equipment. There is a large environmental and financial cost to such waste, however, and it is especially important in these times to be mindful of such concerns. As such, this article will review what is known about waste generation in the hospital and operating room and will discuss various waste management strategies.

Hospital Waste

A landmark study from almost 2 decades ago (performed at a 385-bed private teaching hospital) found that 6.6 kg of waste was generated per patient per day, and estimated that 41 tons of operating room waste (compared with 11 tons from the wards) could be saved if reusable alternatives were available.^[1] The main components of hospital waste include plastics (46%), paper (34%), liquids (12%), glass (7.5%), metals (0.4%), and anatomic waste (0.1%).^[2] Waste management strategies should be implemented hospital-wide, and beyond patient-care areas. For example, cafeterias may produce more than twice the amount of plastic waste than that generated by anesthetic tubing used in the operating room.^[3]

Surgical Waste in the Operating Room

Based on anecdotal reports in the United States, it has been estimated that operating rooms generate 20%-33% of total hospital waste,^[4,5] even though the surgical suite represents a proportionally smaller area of the hospital (Figure).



Figure. Waste generated from blood and other fluids administered to a patient undergoing a major surgical procedure.

In addition to packaging and intentionally disposable supplies, surgical waste can also involve more costly medical devices. A study of joint replacement surgery found that the knee or hip implant, each of which may cost thousands of dollars, was wasted in 2% of the procedures.^[6] The reasons for the implant waste included potentially avoidable causes such as improper trialing, failure to check implant size and model before opening the package, and dropping of the implant.

Anesthesia-Related Waste in the Operating Room

Potential anesthesia-related waste might include items such as syringes, bottles and vials for anesthetic drugs, and airway equipment and hoses. Historically, the waste of anesthetic gases (eg, nitrous oxide and inhaled anesthetics) has been of concern, as less than 5% of the inhaled anesthetic is metabolized by the patient, with the majority being eliminated by patient breathing.^[7] Modern scavenging systems minimize the exposure of operating room personnel to these waste gases, but the waste gases are ultimately emitted into the environment. Reducing expired anesthesia gas would reduce the greenhouse gas nitrous oxide and its potential effect on global warming. Fortunately, the two most commonly used anesthesia gases, sevoflurane and desflurane, contain neither chloride nor bromide, and thus should not pose a threat to stratospheric ozone and are less likely to be potential greenhouse gases.^[8]

Another anesthesia-related concern is drug waste, which occurs when medications are drawn up but are unused and discarded at the end of the day. In one study, all opened but unused or unusable intravenous anesthesia drugs left over at the end of the day were collected for 2 weeks.^[9] Thirty different drugs in 57 syringes and 139 ampules were collected from 166 cases, amounting to an average cost per case of \$10.86 for discarded drugs. The medications contributing to the greatest cost of waste were phenylephrine (21%), propofol (15%), vecuronium (12%), midazolam (11%), labetalol (9%), and ephedrine (9%).

A separate study of 25,481 surgical patients calculated the percentage of drug actually administered to patients relative to the amount dispensed.^[10] Only 33% of the succinylcholine prepared for a patient was administered, meaning that two thirds of the prepared drug was wasted. Similarly, 51% of propofol, 47% of midazolam, and 39% of rocuronium was prepared but not administered. The most common reason for drug waste was need to dispose of full or partially full syringes. A separate study of

pediatric anesthesia found that 80% of epinephrine, naloxone, flunitrazepam, ephedrine, and cisatracurium were wasted, with rocuronium and nalbuphine having the highest waste cost.^[11]

Given these findings, it may be beneficial to use prepackaged anesthesia drug syringes that can be saved for subsequent cases if unopened. This may be most useful in situations where many medications need to be drawn up at the beginning of the day. Drug waste and cost of the syringe disposal could be reduced if full but unused syringes could be saved and reused.^[12]

In addition to medications, anesthesiologists commonly use various devices that are potential sources of waste. Interestingly, some medical products (eg, the laryngeal mask airway) are brought to market in a reusable form, and eventually evolve into a disposable, single-use unit. This can be attributed to the marked reduction in the cost of the disposable airway, and elimination of the need to clean and sterilize a multiuse device.^[13] In contrast, other supplies that have traditionally been disposable may eventually switch to a reusable form. For example, reusable warming blankets are being tested as an alternative to disposable forced air warming blankets.^[14]

Reduce, Reuse, Recycle, Restrict

An approach incorporating green practices to ongoing waste management for the operating room is to apply the standard triad of resource conservation: reduce, reuse, recycle. To these Rs we also add "restrict," which is the appropriate separation of regulated medical waste into the appropriate containers.

Reduce

The simplest way to reduce waste is to look for ways to reduce its production from the very outset when the hospital contracts for and acquires materials that will later become trash. Individually packaged components generate more packaging waste than prepackaged disposable kits. However, such grouped packages may increase waste if not all items in the kit are routinely used, or if extra kits are regularly opened to obtain only a single component that is not available individually. Many facilities carefully analyze the contents of surgical and anesthesia kits to avoid the routine inclusion of disposable items that are infrequently used.

In the United States, surgical items made ready for a particular case but not actually used during the particular surgery are often discarded. This is because these items are deemed "unsterile" even if there has been no contact at all with the patient.^[15] Because of legal concerns and US Food and Drug Administration regulations, prepared supplies designated for a patient are not usable on another patient. However, such medical equipment can be collected and donated to hospitals in developing countries.^[16,17]

Reuse

In a study published in 1997, the term "overage" was used to quantify surgical inventory that is readied but not used and thereby wasted.^[18] The acquisition costs of such overage ranged from \$5-\$13/case, with neurosurgical cases having the highest overage dollar value. To address the overage problem, investigators studied the effect of an intervention that consisted of several elements including: (1) an education program, (2) reduction of surgical setups that created undue amounts of overage (while ensuring ready availability of potentially needed supplies), (3) redesign of surgeon-specific supply pick lists to correctly identify those items needed for a surgery, and (4) introduction of prepackaged supplies for cardiac surgery. These interventions reduced overage costs by 45%.

If unused surgical and anesthesia items cannot be eliminated prior to unnecessary opening, then one strategy can be to replace disposable items with reusable items as appropriate. For example, a hospital that used reusable operating room attire saved \$152,000 adjusting for inflation compared with another hospital that used disposable scrub suits and gowns.^[19]

One of the foremost concerns about reusable items is the potential infectious risks posed by inadequate cleaning and sterilization. There can also be great associated negative public relations for the hospital if such a thing occurs. This was recently highlighted in the national news when thousands of patients were thought to be exposed to HIV and hepatitis because the tubing, pump, and reservoir used for colonoscopy procedures were rinsed after use but not disinfected as required.^[20]

Plastic anesthesia breathing circuits that are replaced after every surgical case also represent waste. However, because of differences in regulatory culture and practice patterns, the reuse of breathing circuits (with single-use filters to prevent cross-contamination) is common in many European countries but is rare in the United States.^[21]

Recycle

When surgical or anesthesia items cannot be reused, recycling is another important mechanism to decrease waste. Recycling bins can be placed in operating rooms and other perioperative areas where regular trash bins are located. One barrier to this is that operating rooms are already quite full with other equipment, and there may not be enough space for additional bins. A program at an Australian operating room suite was able to recycle 200 kg per week of non-infectious polypropylene, polyethylene and polyvinyl chloride.^[22] Similarly, a labor and delivery suite recycled glass bottles used for local anesthetics.^[23] The actual money saved, however, was only a few dollars per week. To have a major impact, these types of recycling programs would have to be one component of a portfolio of hospital-wide green initiatives.

Restrict (Segregate)

When medical waste is inevitable, the appropriate restriction, or separation, of different classes of waste can still be beneficial. Placing the waste into the correct bin can result in cost savings and environmental benefits. A study published in 1996 described a program that disassembled and sorted breathing systems (including circuits, masks, gas sampling lines, and breathing bags) into constituent components for recycling instead of discarding them as regulated medical waste.^[4] The authors estimated that this reduced the regulated medical waste generated by the operating room suite by 22.5%. A more recent study from Seattle Children's Hospital found that replacing hazardous medical waste bags with anesthesia waste bins produced \$20,000 savings over 6 months.^[24]

Nonsharps waste is also commonly found in sharps containers, perhaps indicating uncertainty about what items (such as uncontaminated needleless syringes) should be considered a sharp. Rigid sharps boxes in the operating room may contain as little as 14% appropriate sharps by weight and less than 50% appropriate sharps by volume.^[25] Given that disposal costs for sharps containers can be several times the cost of other OR waste disposal, considerable cost savings may result from more stringently restricting the usage of sharps containers to appropriate sharps waste.

Conclusion

Medical waste is directly relevant to the practice of medicine, as it represents a misuse of resources that could otherwise be spent on patient care. Operating rooms produce a disproportionately large portion of total hospital waste. Much more can and should be done to better manage supply and drug waste resulting from surgical procedures.

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