

Greening the Operating Room: Improving Surgical Sustainability through Assessment of Biohazard Bag Use and Environmental Impact at a Major Medical Center

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INTRODUCTION:

With each passing year, climate change due to greenhouse gas emissions has escalated extreme heat waves, lengthened droughts, brewed up destructive storms, precipitated food shortages, eroded biodiversity, worsened air quality, and threatened human health worldwide. As we approach a mean global temperature increase of 1.5°C, likely within the next decade, many of these effects may become irreversible.

The healthcare industry is a significant contributor to the climate crisis. Our sector produces more than 4 billion tons of garbage per year, second only to the food industry. Healthcare alone is responsible for 8% of the United States carbon footprint. Producing at least half of most hospitals' trash, operating rooms are uniquely positioned to reduce hospital waste and carbon emissions. A single surgery, particularly in orthopaedics, can produce 100 to 200 pounds of waste. Most medical waste is not truly biohazardous, but up to 90% of operating room waste is still deposited in biohazard bags and sent for unnecessary processing and disposal. Biohazard waste may be neutralized via incineration or steam sterilization prior to deposition in a landfill. Unnecessary use of the biohazard bin due to incorrect sorting of medical garbage increases organizational costs, releases environmental pollutants, and wastes energy.

Medical waste reduction and appropriate disposal has been identified as one of the most simple and cost-effective practices for improving operating room sustainability. The purpose of this multidisciplinary quality improvement study was to assess the volume of medical waste produced by our level I trauma center, educate staff on appropriate biohazard waste disposal, and track the response to this education over time.

METHODS:

Institutional disposal practices and costs were identified through collaboration with our institution's operating room and environmental services leaders. Daily sterilizer cycles were tabulated from temperature graphs recorded from December 2017 through August 2021. Average daily cycles and water requirements for sterilization were calculated. A plain-language visual guide (Figure 1) reflecting the institution's regulated medical waste policy was created by a multidisciplinary team and was posted in all operating rooms. Operating room nurses and surgical scrub technicians participated in an interactive educational training on the policy and provided feedback.

RESULTS: Analysis of sterilizer cycles identified that six sterilizer cycles occur per day on average, requiring 300 gallons of water. Each sterilizer cycle uses 50 to 60 gallons of water per cycle to create 300 pounds of steam. The industry average cost for steam is \$10.00 per 1,000 pounds, indicating an average steam cost of \$3.00 per cycle and approximately \$5.00 worth of electricity per cycle. On average, sterilizer costs were \$48 per day (\$17,520.00 per year) per sterilizer machine. Each machine has an average lifetime of 10-15 years and costs \$1,500.00 to \$2,000.00 per year to maintain. A new sterilizer machine costs between \$125,000.00 and \$250,000.00. The sign represents our institution's regulated medical waste policy and provides plain-language guidance for operating room staff, who expressed during training they felt the guidance was easy to understand and adhere to. Some participants noted these actions were not sufficient due to additional Operating Room practices they identified as unsustainable.

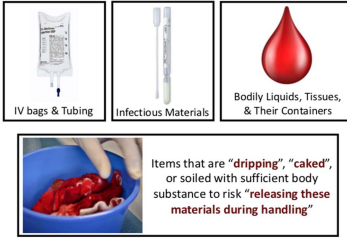
DISCUSSION AND CONCLUSION:

Educating staff about appropriate use of the biohazard bins is a simple way to both save money and decrease the environmental impact of surgery, particularly in institutions that still rely on incineration for treating regulated medical waste. Through multidisciplinary collaboration, we identified methods for quantifying the waste produced at our level I trauma center and developed this initiative for simple, efficient communication to staff regarding best practices for the sustainable disposal of medical waste (Figure 1). Other institutions have implemented similar initiatives and achieved success in staff participation and financial improvement for the institution, with one institution reporting reducing their biohazard waste by 75% and saving \$60,000 annually, and another decreasing biohazard waste by 47% through proper waste sorting, thereby saving \$89,000. Future directions for our work include a multi-year assessment of sterilizer cycles, energy usage, and associated costs after implementation of this program.

Staff education on our initiative led to enthusiasm for improving sustainability in the Operating Room and identification by staff of multiple methods through which sustainable practices could be improved in health care. Other institutions have identified appreciation and enthusiasm for sustainability efforts among healthcare teams when implementing similar changes. Additionally, the Environmental Protection Agency has shown an interest in creating energy-efficient healthcare systems, indicating that governmental priorities are aligned with sustainability in health care. This indicates significant buy-in among personnel for improving sustainability in health care, and that improving sustainability in the Operating Room is a key future goal for environmentally and socially conscious orthopaedic physicians and other healthcare professionals. It is our hope that ongoing sustainable efforts in the healthcare system, such as this work in reducing inappropriately sorted

medical waste in Operating Rooms, can help reduce the healthcare sector's contribution to our looming climate crisis and will inspire others to act.

What Belongs in the Biohazard Bin?



- Items placed in the **red bins** are processed in a sterilizer before going to the landfill.
- Sterilizers consume electricity and an average of **300 gallons of water per day**.
- You can **help reduce environmental footprint** by only placing **the above items** in the **red bins**.