

COMMENTARY

Working Toward the Triple Bottom Line in Surgery

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The health care industry is responsible for significant greenhouse gas emissions and waste production annually, with operating rooms producing a disproportionate share. The triple bottom line is a framework that helps organizations to consider the environmental, social, and financial “costs” of their actions. Surgical departments can incorporate this model to reduce environmental impact and achieve financial savings while still providing excellent patient care.

The Unintended Impact of Health Care

Health care providers are constantly striving to deliver the best care to patients while working within the fiscal and organizational constraints of the health care system. However, one area of needed change in health care — unbeknownst to many — is the impact of current care-delivery models on the environment and the global climate.

Although not often a major focus in reporting or advocacy regarding climate change, the process of delivering health care contributes significantly to our changing climate and the pollution of our land, water, and air.¹ As such, deliberate efforts are needed to address the role of the health care industry in the global climate crisis. Without taking steps to counter the detrimental effects of health care delivery on the environment, the industry risks harming the health of the very people it aims serve: patients, employees, and communities.

One particular area in which important changes can — and must — be made is in the delivery of surgical care in many hospitals. Operating rooms (ORs), which occupy a small physical space in a hospital, produce >30% of a facility’s waste and two-thirds of its regulated medical waste. They can consume three to six times more energy per square foot than any other part of a hospital and contribute disproportionately to greenhouse gas emissions through the release of anesthetic

gases, dependence on single-use devices, and strict heating, ventilation, and air conditioning requirements.² Yet at the same time, surgical departments contribute significantly to hospital revenue and provide invaluable clinical benefits to patients. Thus, it is important to consider how these benefits can be achieved while mitigating the environmental costs that are incurred in achieving them. The triple bottom line offers a solution to this tension.

Bringing the Triple Bottom Line to Surgery

The triple bottom line is a conceptual framework that incorporates the financial, social, and environmental costs of an activity. First described by economist John Elkington in 1994, this framework has been embraced by companies across a wide range of industries and settings.³ Numerous physicians, citing a commitment to beneficence and non-maleficence, have claimed that addressing these costs is part of the moral imperative of health care.^{4,5}

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Curiously, very little has been said about the role of surgeons and ORs in this transformation. How can surgical departments be motivated to consider such a holistic perspective of “cost”? Here, we explore why surgical departments should care about each aspect of the triple bottom line when thinking about making sustainability-oriented changes to their OR practices.

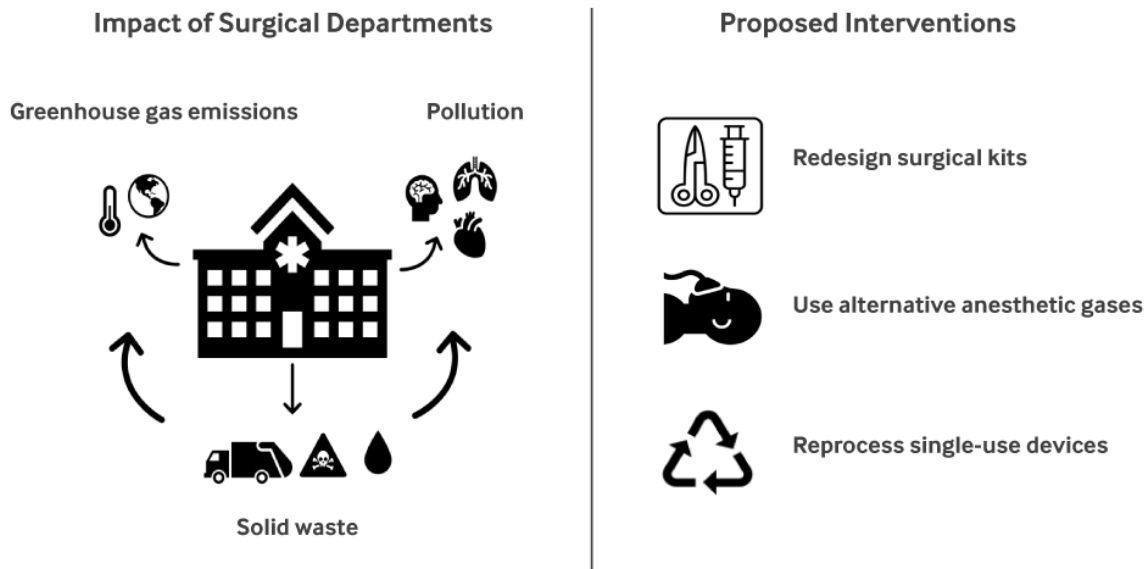
The U.S. health care industry is a top producer of greenhouse gases, accounting for 8%–10% of the national total and twice the volume of CO₂ per capita in comparison with other industrialized nations.^{1,6} U.S. health care produces >4 billion pounds of solid waste annually, and the pollution that it produces leads to an estimate loss of 470,000 disability-adjusted life years annually as a result of pollution-related diseases such as asthma and malignancy.⁷ Surgical departments contribute disproportionately to the greenhouse gas, solid waste, and pollution generation of the health care industry (Figure 1).

FIGURE 1

Environmental Impacts of Surgical Departments and Proposed Interventions

Left panel: Producing energy to power lights and equipment creates carbon dioxide, methane, and ozone as byproducts. Additionally, unmetabolized anesthetic gases, when released into the atmosphere, are potent greenhouse gases. These greenhouse gases absorb and emit energy in the atmosphere, contributing to climate change. Pollutants such as particulate matter, ozone, nitrogen dioxide, and sulfur dioxide are emitted during biohazard incineration and can have direct negative effects on human health. Solid waste from hospitals can contain toxic materials or produce liquid waste breakdown that pollutes ground water, and anaerobic breakdown of organic materials produces methane, a potent greenhouse gas.

Right panel: Potential immediate and long-term opportunities to achieve the triple bottom line in surgery.



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The social bottom line represents a surgical department's obligation to the health and well-being of its people, including both employees (through fair compensation and a safe workplace) and patients (through adherence to strict patient safety standards). As such, any action to promote environmental sustainability must be aligned with this commitment to individual safety. For instance, reusing surgical instruments can greatly reduce the environmental impact of waste generated in the OR, but many have expressed concern about the quality of reprocessed and reusable surgical instruments.

However, single-use device reprocessors are held to strict decontamination, sterilization, and functional testing by the U.S. Food and Drug Administration (FDA). In fact, while the FDA allows original equipment manufacturers to perform "batch" medical device testing, reprocessing manufacturers must test all of their devices. In one study comparing surgical team-reported defects

in original and reprocessed products, the authors found fewer reported defects for the reprocessed equipment (2.01% vs. 0.41%; $p < 0.001$).⁸ In addition, for employees who already care about sustainability, these changes offer an opportunity to align their workplace practices with their values, generating a sense of workplace pride while promoting employee satisfaction and retention.

Financial incentives are plentiful in sustainability success stories. Kaiser Permanente reported that their “Sustainability Scorecard,” which promotes progressive environmental standards for \$1 billion in medical products and equipment, yielded tens of millions of dollars in annual savings.⁹ On a smaller scale, individual hospitals also see financial gains in association with sustainability efforts. For instance, Wormer et al. reported that the multidisciplinary surgical “Green Committee” at Carolinas Medical Center saved an estimated \$158,000 annually through steps such as reusing foam padding, reprocessing single-use devices, and powering down equipment overnight.¹⁰

Opportunities for Adopting the Triple Bottom Line in Surgery

There are many opportunities to promote a surgical triple bottom line through collaboration with colleagues in other service delivery lines. The following suggestions represent “low-hanging fruit” for rapid implementation:

Reusing and redesigning surgical kits. Sterile surgical kits contain supplies for a single procedure but often have unused components. In most circumstances, all supplies must be discarded after the kit has been opened. Surgical departments can routinely evaluate these kits to remove often-unused items. This process of redesigning surgical kits can save carbon emissions that result from the creation of disposable items that go unused and limit water and energy use resulting from the sterilization of reusable items while decreasing overall tray cost.

Considering alternatives to certain anesthetic gases. Anesthetic gases such as desflurane are 1,500 times more powerful than CO₂ in terms of trapping heat, and >95% of gases that are administered to patients remain unmetabolized and are released to the atmosphere.¹¹ By encouraging anesthesia staff to use sevoflurane or isoflurane, which have lower heat-trapping potential and lower expense, ORs can achieve drastic decreases in total CO₂ emission equivalents and cost with no decline in clinical quality.

Reprocessing single-use devices. Single-use devices can be properly decontaminated, sterilized, and repackaged (i.e., reprocessed), thereby reducing the mining of new metals and the production of new plastics. Reprocessing is an FDA-approved, regulated practice that ensures proper functionality of the devices. On average, reprocessed devices provide 49% savings in direct costs without compromising quality.¹²

Creating a Triple Bottom Line–Minded Culture in Surgery at Michigan Medicine

Michigan Medicine is an academic medical center consisting of three hospitals, with 1,000 licensed beds and >60 operating rooms, that performed 51,442 surgical procedures in fiscal year

2020. Within Michigan Medicine, we have begun a grassroots effort to promote a triple bottom line framework, guided by committed medical students and faculty. Here, we offer recommendations and lessons from our experiences that may be useful as other institutions, surgical departments, and health care systems attempt to implement their own frameworks. Two actionable insights for how these sustainability efforts can be deployed include (1) assessing stakeholder engagement and (2) creating and empowering an oversight committee.

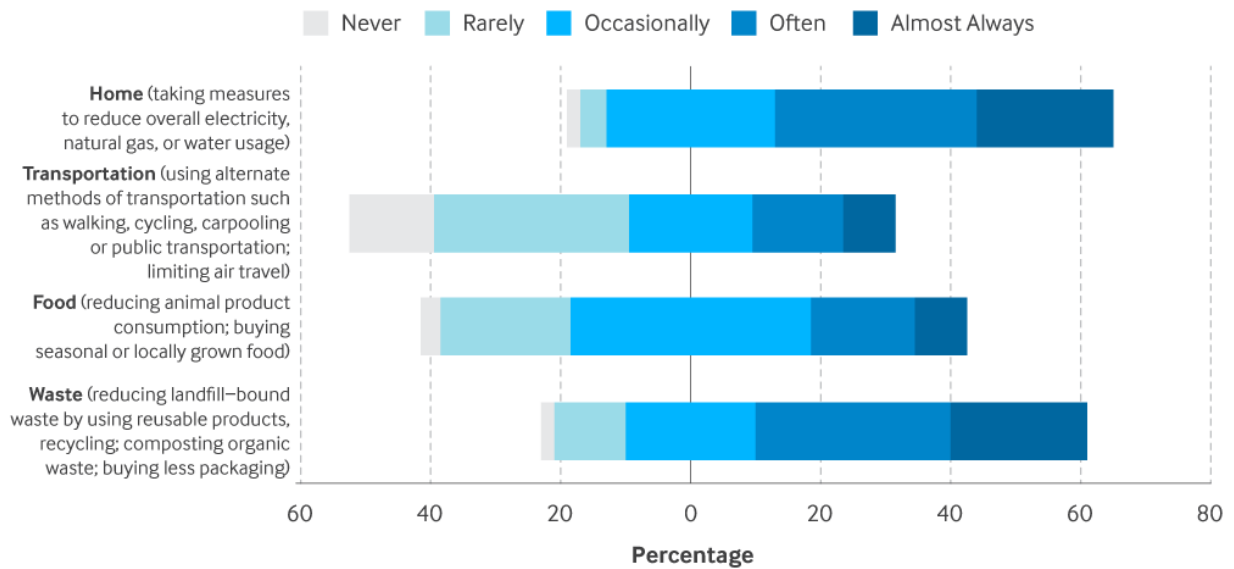
Buy-in from key stakeholders is critical in order for any initiative to succeed. As such, we conducted a survey to characterize the perspectives of the OR staff and to gauge their support for OR-based sustainability initiatives. The survey was distributed electronically to 115 employees who attended a required in-person training session in August 2019. Participation was optional and anonymous. The survey asked employees about their individual behaviors and opinions related to environmental sustainability, support for specific OR-based initiatives being considered by management, and measures of self-efficacy and response efficacy. Eighty-six employees with a median employment duration of 18 months, including nurse circulators (58.8%), surgical technicians (25.9%), perioperative staff (8.2%), and other staff (7.1%), completed the survey.

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In general, staff supported environmental protection, with most engaging in at least some behaviors outside of work to reduce their personal environmental impact and most claiming a commitment to environmental sustainability overall (Figure 2, Figure 3).

FIGURE 2

Employee Behavior in Terms of Environmental Sustainability Outside of Work.

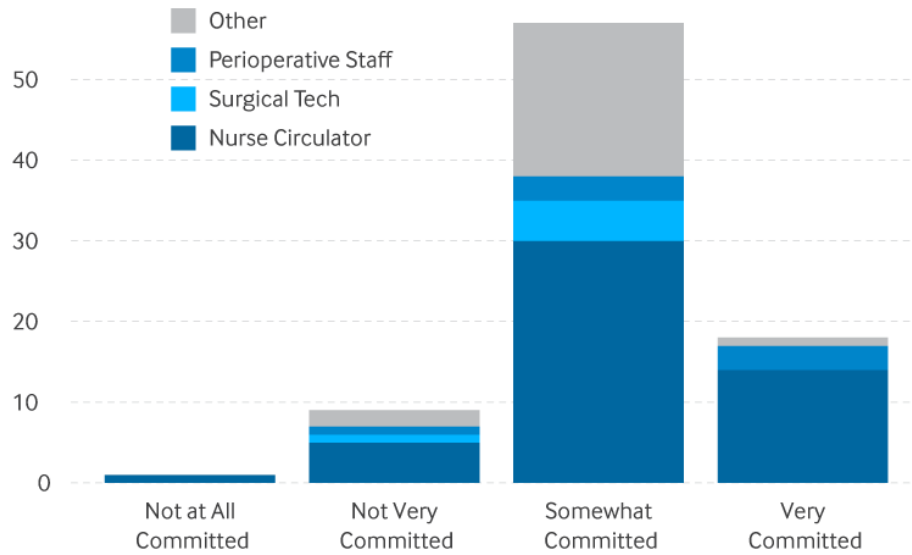


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FIGURE 3

Overall Employee Commitment to Environmental Sustainability.



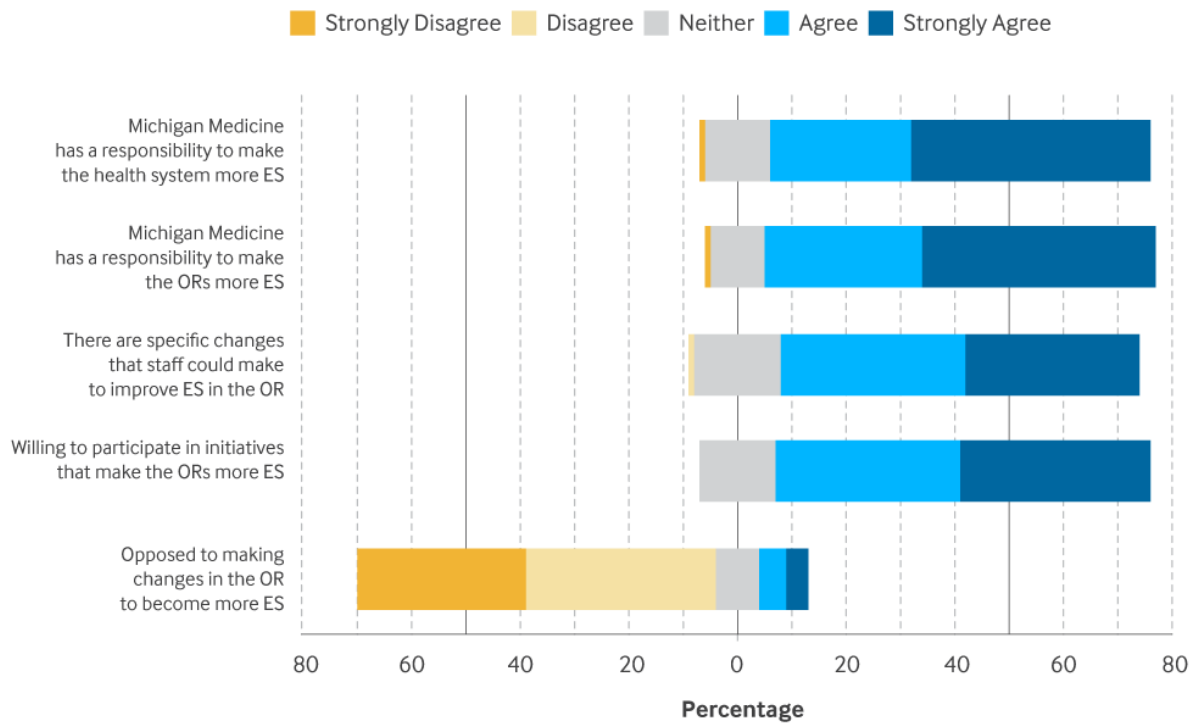
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Moreover, a majority of the respondents agreed that Michigan Medicine has a responsibility to make its health system (83.5%) and operating rooms (87%) more environmentally sustainable (Figure 4).

FIGURE 4

Employee Opinions on Environmental Sustainability (ES) at Michigan Medicine.



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Employees were asked to rate their support for various initiatives that could be undertaken in the OR to help improve sustainability. Collecting opened but unused sterile items for donation received the most staff support (91.8%), followed by reformatting instrument trays (90.6%), reprocessing single-use devices (82.4%), using reusable personal eye protection (82.4%), and recycling surgical polymers (78.8%). Converting blue-wrapped surgical trays to reusable rigid trays received the least staff support (77.7%) but still received support from a majority of survey participants.

Among OR staff, an overwhelming majority of respondents believed that they could help to implement many of these initiatives and agreed that implementing these small changes would “make a difference” in helping the environment. By equipping people with a means of taking personal action that they perceive to have benefit, institutions can motivate new behaviors that favor the triple bottom line.

The triple bottom line framework offers surgical departments an opportunity to minimize environmental impact while reducing cost and limiting harm to employees and patients, yet many surgical departments are not incorporating easily implementable sustainability measures. Surgical departments across the globe make decisions every day about which equipment should

be purchased and stored. Creating guiding principles and formal procedures for instrument value analysis can allow a surgical department to incorporate the tenets of the triple bottom line framework.

“ *Environmental degradation will have devastating financial and social consequences for people and institutions around the world, but because of its pace, those same people and institutions continue to make choices in favor of short-term financial prosperity rather than long-term financial and environmental sustainability.* ”

At Michigan Medicine, for example, the Perioperative Value Analysis Team is tasked with evaluating all new surgical instruments requested by surgeons and staff in the institution. In recent years, the criteria to assess surgical equipment value have been expanded to include cost, quality, safety, innovation, and environmental sustainability. In theory, all instruments must exceed their existing alternatives in these categories in order to be approved for purchase. However, in practice, objectively assessing an instrument according to each of these categories is challenging and requires significant time and effort.

The Challenge of Systemic Change

One challenge that we have encountered is convincing stakeholders to commit to sustainable choices. The truth is that there is very little incentive for hospitals and surgical departments to embrace the triple bottom line because there are limited short-term gains. Environmental degradation will have devastating financial and social consequences for people and institutions around the world, but because of its pace, those same people and institutions continue to make choices in favor of short-term financial prosperity rather than long-term financial and environmental sustainability. While leadership at Michigan Medicine has endorsed sustainable changes, endorsement alone rarely translates into real progress amidst the innumerable competing priorities within the health system. Instead, individual employees have pushed for these changes on the basis of their own personal convictions.

At the broader societal level, many prominent climate and economic leaders have endorsed proposals for a tax on carbon emissions as one way to create short-term incentives.¹³ But rather than waiting for these external regulations to stimulate sustainability efforts, health systems can lead by example, actively implementing coordinated systems that align departments with a larger goal and incentivizing sustainable choices in the short term. Assigning real value on hospital balance sheets to nonfinancial benefits, such as reduced CO₂ production or improved employee well-being, will be needed to help drive the culture changes necessary to achieve the triple bottom line.

The health care industry is ready and willing to introduce innovations that can contribute to the long-term efficacy and efficiency of care organizations. The time is now for the leaders of these organizations to invest in sustainable surgical practices in support of these critical innovations.

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