

## REVIEW

# Climate Change and Value Based Medicine: Role of the Operating Room in Promoting Environmental and Financial Stewardship

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## ABSTRACT

Hospitals in general and operating rooms in particular exert a large influence on the environment through the production of medical waste and emission of greenhouse gases. Recently, a number of surgical procedures have come under increased scrutiny due to rising costs of care and expansion of value-based care models. As demands for environmental and economic suitability grow, operating rooms offer the potential not only to minimize the carbon footprint of hospitals but also to increase clinical efficiency and cost savings. This study informs healthcare industry leaders of the intricate interplay between health and climate change, presents proven examples of methods to reduce the healthcare sector's carbon footprint, and proposes further value-based and environmentally conscious strategies for implementation. Our institution has implemented a number of strategies to reduce waste production from the operating rooms. For the first three quarters of 2020 alone, those efforts resulted in elimination of 9,553lbs of medical waste corresponding to \$224,314 in savings. Our experience lends further support that interventions such as "green" or "environmentally conscious operating rooms" play an important role in promoting environmental and financial stewardship.

**Level of Evidence:** V; Expert opinion.

**Keywords:** Environment; Sustainability; Operating room; Climate change; Medical waste.

## INTRODUCTION

The detrimental effects of climate change on human health are becoming increasingly clear [1]. The World Health Organization (WHO) estimates that 250,000 lives per year will be lost between 2030 and 2050

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globally as a result of global warming-related increases in heat exposure, tropical diseases, and flooding [1]. It is likely that this projection dramatically underestimates deaths given that the methods utilized fail to account for the negative health outcomes caused by the inevitable disruption of medical services due to extreme weather [1]. Also, not included in the WHO projection model, were global warming-related increase in cardiovascular events, chronic renal disease, and antibiotic-resistant infections [2,3].

As physicians, we do not operate in isolation of our surroundings and climate change will likely to impact our practice [3]. Evidence to date suggests that climate change is a grave threat with broad health implications.

When discussing the effects of climate change on health, it is crucial to consider the impact of the healthcare sector on the environment—namely the creation of medical waste. Eckleman & Sherman [2] found that 10% of the total greenhouse gas emissions and 9% of air pollutants in the United States were generated by the healthcare system. These authors estimated the annual number of US deaths resulting from healthcare-associated pollutants to be 44,000–98,000 deaths per year. In another study, it was estimated that greenhouse gases produced by large healthcare organizations reduced the total life expectancy of the US population by 123,000–381,000 disability-adjusted-life years annually [4]. Medical services, tasked with the primary goals of improving human health and prolonging life, may inadvertently and unknowingly be harming those we dedicate ourselves to protect and serve. Lessening healthcare’s carbon footprint and resulting negative impact on climate change is essential to upholding the fundamental tenet of “first, do no harm.”

Recently, costs associated with surgical interventions have come under increased scrutiny as they alone accounted for \$175 billion in 2011 [5]. In an attempt to control spending, the Centers for Medicare and Medicaid Services (CMS) has rolled out a number of value-based payment models that bundle reimbursements based on an episode of care to include 90 days following surgery. While preliminary data showed promise in improving outcomes while decreasing costs of care for those value-based

payment programs [6], widespread adoption has been slow, in part due to the inherent financial risk and the limited guidance regarding patient eligibility. More alarming, however, has been CMS’ recent ruling to not only reduce the reimbursements for common procedures such as joint replacement but also reduce the work relative value units for surgeon performing them [6]. As alternative risk-sharing payment models continue to take hold, coupled with decreasing hospital and physician reimbursement rates, practical strategies to lessen operational costs while promoting quality and efficiency of care have never been more needed.

## **DISCUSSION**

Reduction in medical waste is critical to minimizing the healthcare sector’s carbon footprint. Medical facilities create 6,600 tons of waste per day, second only to that produced by the food industry, and this is estimated to increase by 15% every year [7]. Most non-hazardous waste, equivalent to everyday household waste, is transported to and buried in landfills. In contrast, hazardous waste requires special processing ranging from chemical treatment to incineration, processes that often produce toxic pollutants and heavy metal byproducts. Lee & Mears [7] found that 73% of incinerated waste at their hospital was produced in the operating room. The authors also found that most of contents in their institution’s “hazardous” waste did not meet the federal guidelines to be qualified as such. In particular, up to 90% of their hazardous waste was comprised of packaging material [7]. Processing regulated waste is both environmentally and financially costly. Regulated waste, on average,

is about 10 to 20 times more expensive to dispose of than general waste [7].

Hospital protocols aimed at regulating the production and processing of medical waste can reduce the healthcare system's contribution to the climate crisis while also reducing operational expenses. Our institution has recognized this opportunity and implemented various strategies to reduce waste production from its operating rooms. Examples include the use of sterilizable fabric gowns instead of disposable paper gowns, training surgical staff to immediately sort waste into designated bins located in the operating rooms, continuous monitoring of commonly unused items discarded after each operation, and regular check-ins with surgeons to make certain their preference cards are up-to-date and to offer cost- and environment-saving alternatives. For joint arthroplasty alone, preference card reviews and updates have eliminated waste and resulted in an estimated annual saving of \$11,000 per surgeon. In an analysis of 58 neurosurgical procedures performed by a single surgeon, Zygourakis et al. [5] quantified that the average cost of discarded unused supplies at \$653 per case, amounting for an estimated \$2.9 million per year in a single neurosurgical department.

Other strategies include: 1) substituting autoclaved paper used to wrap surgical trays for Chux pads to catch the overflow during skin preparation; 2) minimizing the number and contents of surgical trays; 3) repurposing unused components from sterile surgical drape kits, or alternatively, pre-fabricating the kits in-house to eliminate unnecessary items; 4) re-sterilizing surgical towels and linens; 5) participating in vendor-specific green programs to recycle implant packaging material; 6) performing regional anesthesia when suitable to avoid

inhaled greenhouse gases and associated plastic tubing; 7) using prefilled injectables to minimize unnecessary disposal of left-over medications from vials opened at the time of surgery; 8) donating batteries from single-use equipment; 9) using biodegradable casting material; 10) and eliminating use of unnecessary durable medical equipment when cheaper, reusable alternatives are available (eg, substituting a standard pillow with a sterilizable cover for the single-use abduction foam pillow). In 2019, our hospital reduced its medical waste by 2,328 lbs corresponding to \$177,580 in savings. For the first three quarters of 2020 alone, these figures increased to 9,553lbs and \$224,314 in savings. Additionally, we participate in campaigns such as The Products for the Planet Program, which donates trees to the National Forest Foundation in return to collecting disposable products such ECG leads, pulse oximeters, and harmonic scalpels that can then be recycled. Considering that such savings and waste reductions resulted from just one hospital over a relatively short period of time, it is easy to imagine the impact of a focused and scaled reduction in medical waste on operational costs.

## **CONCLUSIONS**

As concerns about climate change grow and as we increasingly move become value-conscious, green operating room strategies can promote both environmental and financial stewardship. This is an open opportunity for surgeons to lead the way for innovative solutions to a dual challenge that has tremendous implications on the well-being of our patients, stakeholders, communities, and the world.

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