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SPECIAL TOPIC

Four Ways Plastic Surgeons Can Fight Climate Change

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Background: The climate crisis demands that surgeons reduce their environmental impact. Operating rooms are resource-intensive and are often wasteful. This makes them fitting targets for climate-conscious decision making.
Methods: We searched for peer-reviewed literature describing how plastic surgeons might positively affect the environment through action in the operating room.
Results: Several evidence-based, pro-climate practices may be undertaken by plastic surgeons. These strategies may be grouped into 4 types: material, energy, technique, and dissemination. Each strategy is a way to reduce, reuse, recycle, research, or rethink.
Conclusions: Administrative obstacles to greener operating rooms are predictable and surmountable, especially because environmentally minded decisions are likely to save money. We anticipate a surge of environmental consciousness in healthcare. Plastic surgeons, as thought leaders, are well positioned to champion this cause.
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INTRODUCTION

The climate crisis threatens the well-being of every living thing. The consequences of unmitigated global warming are indeed so terrible as to seem beyond belief. A rise in sea levels will change the contours of nations.[1] Extreme weather will increase human mortality and force the migration of populations.[1] Ecosystems will vanish.[1] The Intergovernmental Panel on Climate Change is the United Nations' body for assessing the science related to climate change. The panel warns that limiting global warming to 1.5°C, thereby avoiding the worst effects of climate change, although possible, "[will] require rapid and far-reaching transitions in land, energy, industry, buildings, transport, and cities." Carbon dioxide emission, specifically, must be cut down roughly by half by 2030.[2]

The healthcare industry, designed to protect us, is harmful to the environment. American healthcare produces 4 million tons of trash annually, second only to the food industry.[3] This waste accounts for nearly one-tenth of United States's greenhouse gas emissions. A large portion of healthcare waste comes from operating rooms.[4] If surgeons are responsible for the waste their operating rooms generate, a plastic surgeon is likely to far exceed the 4.5 pounds of trash produced by the average American per day.[5,6] Because operating rooms are resource-intensive and often wasteful, we assumed they are prime targets for environmentally minded improvement.

METHODS

We surveyed literature related to climate change and operating room practices. The quality and quantity of source material would not support a meaningful systematic review.[7]

We searched PubMed for peer-reviewed publications using the following terms: climate, green, hand, operating room, plastic, orthopedic, surgery, and waste. In several cases, we used the PubMed "Similar articles" function to discover works not returned in the initial searches. We favored more modern articles and those most relevant to plastic surgery. Background information on climate change was derived from widely referenced, publicly available reports by scientific working groups with governmental charters, for example, The Intergovernmental Panel on Climate Change.

RESULTS

Based on peer-reviewed literature, we identified 4 types of interventions a surgeon may use to reduce their carbon footprint: material, energy, technique, and dissemination. All decrease the manufacture of new materials, the need to process waste, and monetary costs. With 2 exceptions,[8,9] our search produced no prospective, randomized, or controlled trials. The bulk of the source information is of level IV or V evidence.

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Intervention Type 1: Material

Potentially infectious operating room waste makes up only 10%–25% of the total waste but requires several times more energy to process.[10–12] Infectious medical waste is frequently incinerated, releasing greenhouse gases and carcinogens. Many healthcare workers do not understand what constitutes infectious waste, and as a result, "safe" trash is frequently overprocessed.[13] Up to 90% of waste placed in red bags is not visibly soiled, dripping, or caked with blood or body fluids, and therefore does not need to be regulated.[14] Dutiful segregation, that is, *reduction* of operating room waste, may be easily accomplished with education and a modicum of increased attention.

Concern for HIV and hepatitis transmission has resulted in the proliferation of single-use medical devices.[13] Even products designed or labeled as such may be safely *reused* in certain cases, according to the Food and Drug Administration. Among the otherwise single-use tools most eligible for *reuse* in plastic surgery are endoscopic carpal tunnel blades, biopsy forceps, burrs, and trocars.[15] Pneumatic tourniquets may also be sanitized and *reused*.

Namburar et al[16] compared the environmental impact of ophthalmologic procedures performed in India, where regulation of potentially *reusable* materials is less stringent, to that of a similar hospital in the United States. *Reuse* of material and different sterilization or sanitation procedures in India resulted in less cost, equal efficacy,[16] and reduced environmental impact.

The authors' home institution purchases durable surgical gowns and then washes and reuses them. This strategy is safe, cuts down energy consumption roughly by half, and *reduces* solid waste to less than one-seventh.[8,17]

Babu et al[18] recycled the blue wraps used to package sterile instruments. This material may be sold to *recyclers* and made into plastic products.[18] Alternatively, blue wraps may be replaced entirely with hard metal cases.[12]

Azouz et al[19] found that many people in an operating room do not know what may be *recycled*. Surgical setup produces plastic packaging material, for instance, that may be reprocessed. Operating rooms typically include a bin for used linens, contaminated waste, and unregulated waste. A fourth *recycling* bin for plastic and paper packaging seems in order.

Intervention Type 2: Energy

Energy consumption in an operating room is 3 to 6 times greater than in other parts of a hospital. Laminar air flow, temperature and humidity control, and specialized lighting are energy intensive, as is the provision of power to computer monitors, anesthetic equipment, fluoroscopy machines, and surgical tools.[12] Few operating rooms are constantly in use. Those that are idle should be powered down.[13,20] Simply turning off lights and equipment results in significant savings *(reductions)*.[21] Many centers use timers and motion detectors to limit energy waste.[22]

Surgeons might advocate for the installation of LED lights in their operating rooms. This technology *reduces* energy consumption and produces less heat, which must be managed by air conditioners.

A traditional, 3-minute, soap and water scrub may require 20 liters of water.[23] The use of surgical hand antiseptic *reduces* the need for millions of liters of water annually.[21]

Intervention Type 3: Technique

Safe use of epinephrine in the hand obviates a tourniquet, and because there is no tourniquet pain, general anesthesia is unnecessary.[24] Much of hand surgery can be safely performed without antibiotics and with field-sterility only.[25,26] In addition to *reducing* facility and material use,wide-awake-local-anesthesia-no-tourniquet (WALANT) and field-sterility surgery is substantially cheaper, especially when performed outside a traditional operating room.[27,28] This is perhaps most appropriate technique for hand surgery, but safe, effective minimalism is applicable elsewhere.

In Canada, laceration repair, skin lesion excision and reconstruction, and cosmetic procedures such as blepharoplasty are commonly performed with local anesthesia, field sterility, and in a procedure room[29](Personal communication, Don Lalonde, MD). Mohs surgery may be safely undertaken with clean rather than sterile gloves.[30] Evidence suggests that prophylactic antibiotics are not necessary in fat grafting procedures and rhinoplasty.[31–33] Several authors have argued that prophylactic antibiotics are not necessary in much of plastic surgery.[33–36]

Closed suction drains may be safely and effectively avoided in breast reduction[37–39] and abdominoplasty.[40,41] Avoiding a drain may *reduce* the length of a patient's postoperative admission.[39]

Preparation of green sets containing only necessary equipment decreases waste. In this way, Van Demark et al[6] *reduced* operating room trash per case by 5 pounds. Three tons of waste was prevented over a 2-year study period. A related study by Thiel et al suggest these efficiency gains are reproducible.[6] Unused material from traditional sets that would otherwise be wasted may be donated for *reuse* in the developing world.[42]

Intervention Type 4: Dissemination

The American operating room is a peculiar environment in which a surgeon can "buy" materials, on behalf of an unconscious payer, and ignore cost. Information alone disrupts this wasteful scenario. Okike et al[43] created a "Red-Yellow-Green" system to alert orthopedic surgeons to the relative cost of orthopedic implants before they were bought. The system consisted of charts posted on the wall of each operating room. The authors noted a significant utilization *reduction* and projected more than $200,000 in savings per year.[43] We imagine that a similar system might be used to *reduce* the use of a less-expensive but more common material—for example, an extra drape, another pack of towels, and an additional suture. Plastic surgeons would do well to know the cost of these items and share this information with their staff and trainees.

Department chiefs might allow surgeons to compare their operating costs with those of their peers. Guzman et al used such a program to *reduce* expenditure in a general surgery practice.[44]

CONCLUSIONS

We have focused on interventions that plastic surgeons can implement themselves or with minimal assistance. Nonetheless, logistical difficulty should be anticipated with certain tasks—for example, the creation of new instrument packs or an initiative to use washable surgical gowns. In these cases, surgeons may convince administrators to *rethink*. Where an environmental argument is less compelling, a monetary one may succeed. Material waste, conveniently, is synonymous with monetary waste. The start-up cost of instrument reorganization or the purchase of durable surgical gowns can be offset with long-term savings. Green awards, like the ones presented by Practice Greenhealth, use public recognition as an additional incentive.[12]

It should be anticipated that a move away from a traditional operating room may be resisted by services that profit from that traditional setting—for example, a hospital is likely to resist an ambulatory surgery center being built next door, or anesthesiologists may resist WALANT surgery being performed without them. Other larger-scale obstacles exist. We speculate that individual hospital policies, those of the Centers for Medicare and Medicaid Services, and those of the Joint Commission on Accreditation of Healthcare Organizations may, in certain cases, excessively and unnecessarily promote individual safety to the detriment of safety at large—that is, environmental safety. These programs are, at least, expensive and administratively burdensome. State-based regulation may be similarly effective.[45] Perceived regulatory obstacles may be challenging; however, surgeons need not think of them as insurmountable. Research, awareness, and dialogue evolve slowly but will ensure that administrative oversight serves the greatest possible good.

The current lack of high-quality data on climate change and healthcare is a pertinent negative. Conversation about climate action is not necessarily easy. As parts of increasingly complex healthcare machines, hospital workers may wonder, "What does it matter what I do?" People, in general, may be slow to *rethink* the connection between their behavior and the environment. (It is, in fact, possible to calculate the area of woodlands necessary to sequester the carbon footprint of a rhinoplasty or breast augmentation.)[32] Moreover, our experience suggests that concern is unappealing in a field that values assuredness. Fortunately, climate action is increasingly mainstream in the lay public, and concerned experts are bringing activism into their *research* and operating room. The American Association of Hand Surgeons has awarded Joshua Abzug, MD (2019), Peter Jebson, MD (2018), Peter Rhee, DO (2017), Robert Van Demark, MD (2017), and Mark Baratz, MD (2016) the Lean & Green Award. Don Lalonde, MD, is a plastic surgeon who has championed WALANT surgery. Although not the only surgeons legitimizing climate action, these 6 are excellent role models.

Surgeons are thought leaders. Plastic surgeons should be emboldened to discuss a climate-related consideration as they would at any other point of surgical decision making. Dissemination of the 5-R's (*Reduce, Recycle, Reuse, Rethink, and Research*) will erode apathy and disrupt norms.[46,47] For maximum impact, future research must focus on 2 outcome measures: tons of carbon emission prevented and money saved. These common denominators will facilitate systematic amalgamation of different works.

We anticipate an explosion of interest in climate action, especially as the lay public demands it, and trainees become accustomed to making environmentally informed decisions. Like the germ theory of disease, or any once-mysterious notion now taken for granted, climate action will be commonplace.

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