HEALTH CARE'S CARBON FOOTPRINT

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My first run in Forest Park was a memorable one. Most people in their first few weeks of moving to St. Louis take the time to explore Forest Park and all that it has to offer—a free zoo, swan-shaped paddle boats at the boathouse, and Art Hill that boasts a beautiful view of the Emerson Grand Basin fountain. The park is also famous for hosting the first summer Olympics on American soil in 1904. I was excited to make my way through the park and enjoy its history while getting my daily recommended dose of at least 30 minutes of moderate physical activity. But within the first few minutes of my run. I could feel my chest tighten, and every breath seemed more and more difficult to catch.

I was diagnosed with asthma. It came as a surprise, given I had lived 21 years without the slightest wheeze or cough—not even the usual seasonal allergies. Something about moving from the suburbs of Michigan to St. Louis triggered my newfound diagnosis. I suspected the air. In talking with my classmates who had moved to the city from smaller Midwest towns, it became clear that I was not alone. Many had experienced worsening of their allergies or asthma. There must be something in the air.

In 2020, the American Lung Association gave the city of St. Louis an F rating for ozone levels.[1] Also known as "smog," ground-level ozone is made when sunlight reacts with nitrogen oxides and volatile organic compounds (VOCs), end-products of fossil fuel combustion.[2] However,

it's not just sunlight that affects the rate of ground-level ozone formation; high temperatures also can accelerate its formation.[2] As average global temperatures continue to rise, as a result of our increasing carbon footprint, it's likely that the air quality of major cities in the United States in and around the world, will continue to worsen. Given that air pollution prematurely kills more than seven million people each year, or roughly twice as many people as HIV/AIDS, malaria, and tuberculosis combined,[3] it becomes important for health care professionals to start thinking about the impact of climate change on our patients.

Climate change and health

The impact of climate change on health is undeniable. There are some fun facts that I like to pull out during family dinners or in the first few minutes of a zoom meeting while waiting for attendees to trickle in. For example, poison ivy has become more potent because the plant compound that causes contact dermatitis, urushiol, has become more toxic as a result of higher concentrations of carbon dioxide in the environment.[4]

In addition, rising global temperatures have caused changes in the distribution of vector-borne diseases as northern regions become increasingly warm. Also, extreme heat has caused an uptick in heat stroke and heat-related deaths. In certain regions, there have been more reports of flooding which has led to increased exposure to water-borne illnesses.[5] The number of large wildfires has doubled since the 1980s, leading to increased air pollution, and increased deaths related to exacerbation of lung and cardiovascular diseases.[5,6]

Seeing the substantial effect of climate change on our health, it makes sense that we should as a nation prioritize mitigation efforts, and decrease the amount of carbon that we produce. Doing so could prevent us from reaching the dreaded 1.5° C change in average global temperatures—the point of no return as deemed by the Intergovernmental Panel on Climate Change (IPCC).[7]

A starting point

The majority of total carbon emissions in the U.S. can be attributed to three sectors: industry, transportation, and electricity.[8] Mitigation efforts in these sectors may take the form of increased renewable energy consumption and/or strengthening outdated building codes to make office spaces more energy efficient.

In my initial research into climate change policies, I was determined to find a small area in which I could make a difference, where I could advocate for the health of our

patients. It was during this research that I found a shocking statistic: the health care system contributes 10 percent of the total carbon emissions in the U.S. each year.[9] On a global scale, if the health sector were to be its own country, it would be the fifth largest emitter on the planet.[3]

Anesthetic gases

There was a day when I was a third-year medical student when I had a particularly nasty asthma exacerbation. I remember going into the operating room (OR) the next morning, still recovering, and feeling the weight of the surgical mask against my face. Just upstream of where I was standing was the certified registered nurse anesthetist and the anesthesiologist. Hovering over the patient's head, they began to prep for surgery, placing a mask over his face, and getting ready to administer anesthesia. The patient soon slipped into a deep sleep-like state, confirming that his body was metabolizing the inhaled anesthetics, a process that would continue for the remainder of the surgery. Only five percent of the administered anesthesia was actually metabolized by the patient's body. The remaining 95 percent was expired, transmitted through a series of lines, and finally vented directly into the outside air.[10]

Unmetabolized anesthetic gases have some of the highest global warming potentials (GWP). To put this into perspective, carbon dioxide has a global warming potential over 100 years (GWP100) of one. Sevoflurane has a GWP100 that is 130 times that of carbon dioxide. Nitrous oxide, the same compound that we berate the automobile industry for emitting, has a GWP100 of 298.

However, desflurane takes the gold medal, with a GWP100 of 2,450.[11] Administering desflurane for one hour is equivalent to driving a car for 230 miles.[12]

While treating patients, the health care industry unknowingly contributes to rising global temperatures, to the very environmental conditions that are exacerbating our patients' chronic illnesses.

Regulated medical waste

There was a time on my surgery rotation when I was helping a resident change the dressings on a patient. With the used dressing in one hand, I looked around the area to secure its proper disposal. There wasn't much of anything on the gauze, but I decided to put it in the red bag just in case. This is an all too familiar scenario for medical students who often find themselves unsure of what to do with a gown, waste from a procedure, or a partially soaked dressing. In many of these scenarios, the red bag is the safest, a catch-all. Other times, the red bag ends up being the closest trash bin in a busy emergency room, so employees place their waste in it instead—the worst-case scenario being that a non-biohazard waste would be treated with more caution than it needed to be.

These small day-to-day miscalculations in medical waste categorization add up. In order to prevent the spread of pathogens, biohazardous waste must be treated, usually with autoclave or incineration, before it can be disposed. However, the incinerators used to treat biohazardous wastes emit more carbon dioxide per megawatt-hour than coal-fired power plants.[13] A simple decision to place medical waste in a red bag, just to err on the side of caution, ironically leads to more harm by increasing the carbon footprint of the hospital, and releasing toxic substances into the air.

The carbon footprint of health care

Anesthetic gases and medical waste are just the tip of the iceberg when it comes to health care's carbon footprint. More than half of the industry's emissions can be attributed to energy, specifically the distribution of electricity, gas, heating, and cooling. Agriculture accounts for a surprising 10 percent of emissions, while business travel and operational transport account for seven percent.[3]

Though the health care industry is riddled with greenhouse gas (GHG) emissions, many are so far removed from our day-to-day activities in the hospital that we rarely acknowledge them in our reporting. Health care systems are mandated to report on Scope one emissions, or direct combustion of fossil fuels at health care facilities. Yet, 70 percent of emissions originate from the health care supply chain, also known as Scope 3 emissions.[3] For a catheter, Scope 3 emissions would include everything from the electricity supplied to the building where it was manufactured all the way to its transportation to the hospital where it is used.

In order to make a meaningful impact through carbon emissions reductions, hospital systems first have to quantify the full range of emissions related to its operations. A few hospitals have already undertaken this tremendous task, or are currently setting course. Others have gone even further and have made public commitments to carbon emission reductions. In 2014, Gundersen Health System in Wisconsin became the first U.S. health system to attain energy independence by producing more energy than it was consuming. In 2020, Kaiser Permanente in California became the first U.S. health system to go carbon-neutral.[13] And recently, the United Kingdom National Health Service pledged to carbon neutrality within its hospitals by 2040, and within its supply chain by 2045.[14] It is the first national health system in the world to make such a commitment.

The way forward

There are many ways forward, many ways for the health care industry to decrease its carbon footprint.

A 2017 study in the *Lancet* found anesthetic gases comprise 51 percent of a U.S. OR's GHG emissions. In the UK, it only comprises four percent of OR emissions. This difference can be attributed to the selection of anesthetic gases by providers.[15] Recently, the American Society of Anesthesiologists hosted an Inhaled Anesthetic Challenge, calling on physicians to utilize low fresh gas flows, avoid inhaled anesthetics such as desflurane and nitrous oxide, and invest in waste anesthetic gas trapping or destroying technology. These strategies have been proven to reduce

GHG emissions from anesthesia, while also maintaining a high standard for patient care.[16]

To reduce red bag waste, Practice Greenhealth, a national organization aimed at sustainable practices in health care, has challenged hospitals to train staff on the proper categorization of medical waste. Signs serving as reminders and strategically located red bag waste is also encouraged. In addition, hospitals are encouraged to decrease red bag waste to less than 10 percent of their total waste, or less than five pounds per adjusted patient day.[13] Not only does this lead to GHG reductions, but it also creates significant savings for the hospital system, allowing funds to be directed to other care improvement initiatives. Inova Fairfax Hospital in Virginia was able to reduce its red bag waste by 14 percent, saving more than $200,000 in waste removal fees.[17]

The supply chain is another large source of carbon emissions. To address this, Kaiser Permanente launched sustainability scorecards for its suppliers. These scorecards request detailed information on the percentage of recycled content in products and packaging, and, multi-use design and presence of harmful chemicals.[13] These scorecards signal to the supplier market that sustainability is valued by the hospital system. Given the large collective bargaining power of hospitals, these scorecards, if adopted by multiple systems, could essentially transform the supplier market's environmental standards and practices.

Other carbon footprint reduction strategies include new hospital construction designed to be LEED (Leadership in Energy and Environmental Design) certified, ensuring that they are energy and cost-efficient; medical device reprocessing by FDA-certified vendors; and/or reformulation of OR kits to remove repeatedly unused components.[13]

Students and employees can also advocate for a transition to renewable energy sources, which have become more affordable in recent years. Given that a majority of health care emissions result from energy consumption, this effort could result in considerable emission reductions.[13]

A plethora of strategies

It is easy to get overwhelmed with the sheer number of emission mitigation strategies in the health care industry. The important point to remember however, is that there is no need to reinvent the wheel. Many organizations, like Practice Greenhealth and Health Care Without Harm, publish case studies detailing emission reduction projects. All we need now are champions at each hospital system who can apply these tried and true methods to their own institution.

The next decade will be an exciting time for environmentalism in medicine. As a community, health care professionals possess tremendous advocacy power to shape a carbon-neutral future.

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