The Relationship Between Climate Change and Healthcare Quality and Safety

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Climate change–related weather events are straining healthcare workers, disrupting physical infrastructure, and interrupting supply chains, making it more difficult to treat patients and threatening healthcare quality and safety.[1] Shortages of medications and hospital facilities unable to operate in extreme weather are recent examples of climate change's impact on health both in the United States and globally. For example, in July 2023, a tornado damaged a Pfizer drug warehouse in North Carolina. The tornado destroyed medications as well as pharmaceutical raw materials, worsening medication shortages for drugs used in surgery and cancer treatment. The shortage of these drugs may raise the risk of preventable harm and deaths.[2] U.S. healthcare is not immune to events outside our borders.[3] Flooding in India (one of the world's largest manufacturing locations of pharmaceuticals) has damaged healthcare infrastructure and affected patient care in the U.S. and around the world. Environmental changes have caused harm to human health at or beyond the scale of the healthcare systems' contribution to patient safety events, but approaches are emerging to address this form of preventable harm to human health. In this essay, we review human health issues commonly caused by climate change, discuss healthcare's contribution to climate change — arguably at or beyond the scale of patient safety events — and offer some approaches to address this.

Impact of Climate Change on Human Health

Climate change harms human health, for example, through increasing heat-related stress, acute myocardial events, and cerebrovascular events; worsening air pollution resulting in acute exacerbations of asthma and COPD; and increasing hospitable habitats for vector-borne diseases.[1] In 2021 in the US, a heat dome over Oregon caused 96 deaths over 3 days.4 On June 15, 2023, a cyclone in India caused the evacuation of more than 100,000 people, including 1,200 pregnant women who delivered 700 babies over 3 days during the active phase of the cyclone.[5] In Syria, droughts due to climate change have worsened the response to a cholera

outbreak[6] and have affected food security, contributing to political insecurity, armed conflict, and forced migration.[7]

Research shows climate change is worsening the health of individuals and populations, and the healthcare industry contributes to climate change, and therefore, indirectly, to harming human health. In September 2021, prior to the United Nations General Assembly and the UN Climate Change Conference in Glasgow (COP26), editors of 200 health journals around the world published an editorial noting current evidence that our health is already being harmed by climate change and calling for urgent action.[8] Among other alarming facts, heat-related mortality for people above age 65 has increased by more than 50% in just the past 20 years and a synthesis of systematic reviews showed that globally, climate change has worsened morbidity and mortality related to cardiovascular, respiratory, and infectious diseases.[9,10]

Contribution of Healthcare Industry to Climate Change

Although these findings describe the effects of climate change globally, environmental emissions contributing to climate change and pollution-related morbidity and mortality just from the United States healthcare industry is itself significant. Pollution associated only with the U.S. healthcare industry has been shown to account for the loss of 388,000 disability-adjusted life years in 2018 alone.[11] The magnitude of this impact is similar to the harm associated with premature deaths due to medical errors, which were first reported in 2000 in the landmark Institute of Medicine (currently the National Academy of Medicine) report To Err is Human, a seminal text for the patient safety movement.[11,12] Therefore, preventing healthcare pollution is just as significant as preventing medical errors to reduce patient harm. Unlike medical errors, which have a direct relationship between care provision and an individual patient, the harms from healthcare pollution have indirect effects that are difficult to attribute to any one patient, even as these harms become more difficult to ignore.

Governmental healthcare agencies and healthcare systems around the world are becoming increasingly concerned with the impact of climate change on health as well as the impact of healthcare-related pollution on climate change. These agencies are calling for decarbonization targets in alignment with the Paris Accord timeline of 45% reduction in emissions by 2030 and net zero emissions by 2050.[9] Evidence-based strategies are required to accelerate healthcare decarbonization and avert the worst predicted harms to

health and healthcare systems.[13] The Agency for Healthcare Research and Quality (AHRQ) has developed and released a decarbonization primer meant to help healthcare systems begin to set goals, measure their emissions, and strategically reduce healthcare-related pollution and waste. The AHRQ primer offers measures and strategies for reducing carbon, by, for example, establishing governance and dedicated staff to measure and guide decarbonization efforts.

How Healthcare Systems Can Mitigate Their Contribution to Climate Change

Worldwide, the healthcare industry contributes about 5% of total greenhouse gas emissions and similar fractions of toxic air emissions.11 The United States' healthcare sector emits about a quarter of total global healthcare emissions.11 These emissions result from healthcare facilities' onsite fuel combustion, emissions from purchased energy, and all other emissions associated with the healthcare supply chain of goods and services.[11] About 80% of healthcare emissions in the United States arise from the supply chain, notably from pharmaceuticals, chemicals, and medical devices.[11] These emissions could be reduced by understanding and then limiting causes of emissions, such as inhaled anesthetics and low-value care.

Inhaled anesthetics are one of the most well-known, high-impact, and feasible areas to mitigate emissions. Inhaled anesthetics are potent greenhouse gasses that are released directly from healthcare facilities. These substances can account for as much as 5% of a facility's carbon emissions.[14] Safe, effective alternatives exist for both waste reduction and selection of lower-polluting general anesthetic medications.[15] In a comparison of five inhaled anesthetics, researchers found that two anesthetics, desflurane and nitrous oxide (N2O), account for much of the greenhouse impact measured related to inhaled anesthetics.[15] These findings suggest that hospital systems can immediately improve their greenhouse gas pollution by removing desflurane from hospital formularies in favor of lower-emission alternatives such as sevoflurane. Some clinicians advocate for use of desflurane, arguing clinical superiority to sevoflurane in certain situations; however, professional societies are calling on their members to reconsider this position in the face of environmental impacts and changing data.[16] Hospitals can decommission centrally piped N2O in favor of portable tanks, where

recent research shows as much as 70% to 95% of N2O is leaked through central systems prior to use.[15]

Not many contributors to emissions in healthcare have been quantified in the manner of inhaled anesthetics. In the absence of information on other environmentally preferable choices or their availability, emissions may be reduced by limiting wasteful consumption of resources and reducing low-value care. Inappropriate or low-value care describes medical services in which the harms or costs of care outweigh benefits.[17] Overuse is one type of low-value care that can result in patient harms, such as unnecessary diagnostic tests that could result in false-positive findings and unnecessary treatments that can cause harm, all of which contributes to excessive resource consumption and avoidable pollution. Such wasteful, low-value care is estimated to account for up to one-third of total U.S. services.[18] Minimizing low-value care will reduce healthcare costs, emissions, and harm to public health.[20] Another opportunity to reduce waste and costs and to improve patient safety is by addressing oversized medication vials for infused medications. Medication vials for some medications are supplied in sizes too large for single-patient use, resulting in a higher risk of dosing errors and wasted medications that can cost billions of dollars in cancer drugs alone.[18] Instead, prefilled syringes and prefilled intravenous bags, whereby pharmacies or third-parties split vials into individual patient doses under sterile conditions, can reduce waste and costs, as well as prevent medication errors, by reducing the chance that a patient receives the wrong dose of medication.[19] Furthermore, without evidence of greater safety, disposable single-use items have been increasingly used in hospital settings. Disposable items, from blood pressure cuffs, pulse oximetry probes and bed linens can be cleaned and reused for cost savings, while wasteful overuse can impact patient safety by creating supply chain problems and shortages for just-in-time use, as occurred during the COVID-19 pandemic.[19] In these examples, improved patient safety can also result in reductions in the impact of healthcare on climate change.

Future Directions

In its present state, healthcare is a significant contributor to climate change. At the same time, it must respond to increasing disease burdens and address disruptions to infrastructure from a rapidly changing climate. Governmental agencies around the world and in the United States, along with the healthcare industry and hospital systems, are working together to mitigate climate change and to

conceptualize measures and strategies that hospitals can act upon to begin to reduce their emissions. However, continued research is needed. Beyond inhaled anesthetics, environmental impact assessments of pharmaceuticals, medical devices, and clinical care pathways that may lead to low-value care are required. Measures of resource consumption and emissions need to be paired with measures of clinical outcomes to better guide strategic mitigation of pollution while maintaining or improving care quality.[20]

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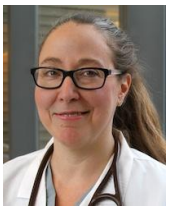

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