Addressing Air Quality and Health as a Strategy to Combat Climate Change

Poor air quality contributes to and is a consequence of global warming. The burning of fossil fuels to power our homes, businesses, and automobiles contributes to air pollution. When released into our atmosphere, some forms of pollution trap heat, leading to temperature elevation, and air pollution has direct effects on health, such as worsening cardiopulmonary disease (1). In this week's *Annals*, the American College of Physicians calls for action to combat climate change and its effects on health, including governmental action to reduce greenhouse gas emissions, health care sector implementation of environmentally sustainable and energy-efficient practices, physician advocacy for policies and practices that reduce emissions, and expanded education and research funding on climate change and its effects on health (2).

Combating climate change is a geopolitical issue involving the highest levels of government, with complex international negotiations and treaties. Can individual health care providers and institutions really do something meaningful?

We began asking ourselves this question not long ago. Because of Utah's mountainous geography, our region (the Wasatch Front) is subject to winter "temperature inversions," where the trapping of colder air below a warmer cap impedes atmospheric flow and results in the accumulation of air pollutants (**Figure**). Levels of particulate matter, nitrogen oxides, sulfur dioxide, carbon monoxide, and ground-level ozone increase, frequently exceeding the "safe level" designated by the U.S. Environmental Protection Agency, as reflected in an elevated Air Quality Index (>100). Winter inversions last an average of 14 days but can range from 1 to more than 30 days. In the summer, sunlight drives the creation of ground-level ozone from nitrogen oxides and volatile organic compounds; it is generally worse in hot, sunny weather and later in the day.

Ozone exposure results in airway inflammation and places patients with established respiratory disease at particularly high risk for harm. Particulate matter causes pulmonary and systemic inflammation and oxidative stress and is associated with adverse cardiovascular effects, including vascular and endothelial dysfunction, alterations in heart rate variability, coagulation, and cardiac autonomic function (3). Thus, changes in air quality are routinely palpable in our community. What could we do?

Mounting evidence linking poor air quality with adverse health outcomes, coupled with the distinctly visible effect of air pollution on our community, prompted our health care system to form the Intermountain Air Quality and Health Workgroup in 2014 to achieve 3 aims: support ongoing research to further our understanding of air pollution exposure and health outcomes, expand sustainability efforts to reduce Intermountain's environmental impact on the community, and address physician and patient education about outdoor air quality and health outcomes.

Figure. Inversion layer over Salt Lake City, Utah.

Studies in the Wasatch Front community by members of our workgroup have further evaluated the effect of air pollution on cardiovascular outcomes in our patients; specifically, the likelihood of myocardial infarction and unstable angina increases by 4.5% for every 10-μg/m^3 increase in fine particulate matter level. Of note, this risk was primarily identified among patients with existing coronary artery disease (4). The occurrence of ST-segment elevation myocardial infarction and decompensated heart failure requiring hospitalization also seems to be increased in association with increasing fine particulate matter levels in our community (5, 6).

The second prong of our system's efforts, aimed at addressing climate change and air quality, began with a charge from our chief executive officer: We must limit our own health system's effect on our environment. In response, Intermountain is transitioning its automobile fleet from gasoline to natural gas, hybrid, and electric. Driver tracking devices on fleet vehicles have reduced idling by more than 500 hours per year. Employee use of public transportation has contributed to a reduction in emissions of 3.5 million pounds. The addition of rooftop solar panels has saved an additional 45 tons of carbon. In addition, Intermountain set a goal for all new facilities to achieve Leadership in Energy and Environmental Design Silver certification and be Energy Star–certified. The Office of Sustainability also addresses

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medical waste, water quality, and water conservation—all areas of concern for the local community (7).

What can we teach individual physicians about air quality that can be used to protect individual patients? Educating our physicians and patients about our community's air quality and the actions that might help maintain good health has involved a multidisciplinary team of physicians, researchers, administrators, and writers working together to develop the Outdoor Air Quality and Health care process model (CPM) (https://intermountainphysician.org/_layouts/Custom/KnowledgeRepository/KrDocumentFetch.aspx?target=document&ncid=527926681&tfrm=default). The CPM provides evidence-based guidelines on the health effects of air quality and is primarily intended to help providers counsel patients about outdoor physical activity when air quality is poor. It is based on guidelines from the U.S. Environmental Protection Agency, current research on air quality and health, and advice from Intermountain experts. Included are an overview of common air pollutants, the health effects of poor air quality, and specific patient counseling recommendations. The CPM includes patient fact sheets for many conditions (https://intermountainhealthcare.org/health-information/health-library/patient-handouts/search-results/?SearchTerm=air%20quality) that are intended for distribution to patients at the point of care or community members accessing our patient education Web site. For example, a physician seeing a child with asthma could review the CPM to learn that even short-term exposure to air pollution is associated with disease exacerbation. If the Air Quality Index enters the moderate zone (51 to 100), the recommendation is to limit outdoor play time (or to play indoors if the child is symptomatic) and consider keeping a fast-acting inhaler nearby. If the Air Quality Index tops 100, the recommendation is to play indoors.

Our research efforts, our initiatives to reduce our own carbon footprint, and the educational tools and programs represent the practical actions that one health care system—and the people within it—can take to address climate change and poor air quality. Success has been possible due to the support and encouragement from our highest level of leadership, a passionate and committed Air Quality and Health committee, and deliberate collaboration and alignment with community partners. Future efforts will focus on dissemination of patient and provider educational materials along with adoption and implementation of the CPM and fact sheets across the continuum of care. Finally, we hope that efforts focused on energy conservation will serve as an example to other businesses in our local community and in the broader health care community to reduce the effect of health care on the environment while adapting to the challenges of climate change.

Combating climate change requires initiatives beyond the control of individual health care systems, clinicians, and patients, but we, as health care systems, clinicians, and patients, can bring about meaningful change if we act locally.

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References

1. **Centers for Disease Control and Prevention.** Air Quality. Atlanta, GA: Centers for Disease Control and Prevention; 2014. Accessed at www.cdc.gov/air/air_health.htm on 19 February 2016.
2. **Crowley RA; Health and Public Policy Committee of the American College of Physicians.** Climate change and health: a position paper of the American College of Physicians. Ann Intern Med. 2016;164:608-10. doi:10.7326/M15-2766
3. **World Health Organization Regional Office for Europe.** Review of evidence on health aspects of air pollution–REVIHAAP project: final technical report. Copenhagen: World Health Organization Regional Office for Europe; 2013.
4. **Pope CA 3rd, Muhlestein JB, May HT, Renlund DG, Anderson JL, Horne BD.** Ischemic heart disease events triggered by short-term exposure to fine particulate air pollution. Circulation. 2006;114:2443-8. [PMID: 17101851]
5. **Pope CA, Muhlestein JB, Anderson JL, Cannon JB, Hales NM, Meredith KG, et al.** Short-term exposure to fine particulate matter air pollution is preferentially associated with the risk of ST-segment elevation acute coronary events. J Am Heart Assoc. 2015;4. [PMID: 26645834] doi:10.1161/JAHA.115.002506
6. **Pope CA 3rd, Renlund DG, Kfoury AG, May HT, Horne BD.** Relation of heart failure hospitalization to exposure to fine particulate air pollution. Am J Cardiol. 2008;102:1230-4. [PMID: 18940298] doi:10.1016/j.amjcard.2008.06.044
7. **Intermountain Healthcare.** Intermountain Healthcare Sustainability Annual Report 2014. Salt Lake City, UT: Intermountain Healthcare; 2015. Accessed at https://intermountainhealthcare.org/annual-report/pdf/sustainability-annual-report-2014.pdf on 29 February 2016.

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