The Need to Emphasize Inhaler Education in Residency and Fellowship Training in the Era of Climate Change

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As health care professionals, we have witnessed both the direct and indirect impact of climate change on the health of our patients. Exacerbations of many respiratory diseases and conditions, including asthma and chronic obstructive pulmonary disease, have been closely tied to air pollution and extreme weather events.[1-5] Escalating global temperatures can further amplify environmental allergens and facilitate the spread of respiratory infections.[2,6,7] Yet, we must acknowledge that the health care sector alone accounts for nearly 9% of all greenhouse gas emissions in the United States[8] and 4% to 5% of all greenhouse gas emissions worldwide.[9,10] Therefore, it becomes imperative as health care professionals to recognize not only the detrimental health effects posed by climate change but to also reflect upon our role in contributing to it.

One area for improvement is in medication prescribing. In the treatment of respiratory diseases, metered-dose inhalers (MDIs) allow for aerosolization of a drug to be directly administered to the airways for the treatment of respiratory diseases.[11,12] From its discovery in 1956, MDIs have become the most prescribed aerosolized medication delivery system in the United States, accounting for 88% of prescribed inhaler devices.[11-13] However, MDIs are dependent on hydrofluorocarbons (HFCs) that act as the propellant for the stored drug within these devices. These HFCs exhibit extremely high global warming potential (GWP), a measure of the degree of energy that emissions of a particular gas will absorb in relation to carbon dioxide. Notably, the prevalent propellant formulations in MDIs, namely HFC 134a and HFC 227ea, possess GWPs of 1430 and 3220 times that of carbon dioxide, respectively.[13] In 2020, the amount of HFCs propellant used by MDIs in the United States was roughly equivalent to the greenhouse gas emissions produced by driving 562 000 gasoline powered vehicles for one year.[14,15] Use of MDIs is anticipated to escalate with rising incidences of respiratory diseases linked to climate change that can potentially lead to a self-perpetuating, vicious cycle. Shifting away from routinely prescribing MDIs offers a simple, yet effective step to measurably reduce our impact on climate change.

What are the alternatives? Since its inception in 1967, dry powder inhalers (DPIs) are propellant-free delivery systems that take advantage of the energy expended by the user's inspiratory flow during inhalation to break up a compacted drug mixture containing micronized active drug particles mixed with larger inactive carrier molecules (eg, lactose) through a process called deagglomeration.[11,16] The result is a separation of active drug delivered to the lungs and larger carrier molecules that often end up in the oropharynx or become ingested and subsequently cleared.[16] All major classes of inhalers have DPI formulations. Additionally, soft mist inhalers (SMIs) offer another propellant-free strategy using energy release from a compressed spring, activated by twisting, to mechanically power and force a drug solution through a sophisticated nozzle system for generating an aerosolized cloud for inhaled delivery.[11,17]

Compared to MDIs, DPIs and SMIs have a significantly smaller carbon footprint. Switching from an MDI to a DPI can reduce greenhouse gas emissions as much as choosing not to eat meat for one year.[18] These inhalers are not only better for the environment, but they are also equally effective at managing respiratory diseases. Studies have not shown a difference in the clinical effectiveness between MDIs and DPIs.[19,20] Patients transitioning from an MDI to a DPI do not experience any negative impact on their asthma control.[19] Moreover, among patients with poor inhaler technique, SMIs may be more effective than MDIs at delivering medications.[20] With effective and environmentally friendly options available, clinicians are empowered to adopt more sustainable health care delivery practices.

While MDIs dominate inhaler usage in the United States, they are not a global standard. For instance, in Sweden, only 13% of all sold inhalers were MDIs.[21] This difference may be explained by the inexpensive cost of MDIs in the United States and clinician familiarity with these devices. DPIs can be more expensive

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than their equivalent MDIs in the United States.[22] MDIs may become more expensive in the future as HFC production is phased down in compliance with new international regulations.[22] Patients are becoming increasingly more concerned about their environmental impact and may prioritize selecting an inhaler with a low carbon footprint.[23] The cost of DPIs may decrease in the future as adoption increases, and physicians and patients should advocate for more affordable DPIs.

Concurrently, there is a need to educate trainees about DPIs and SMIs. Unfortunately, across all levels of medical training, there exists a sizable knowledge gap when educating patients on proper inhaler techniques. For example, one study found that only half of medical residents were able to demonstrate correct inhaler technique for DPIs,[24] posing a significant obstacle to environmentally conscious prescribing. While long- and short-acting DPIs are safe and effective inhalers, they might not be appropriate for all patients (eg, older adults or those with muscle weakness that cannot generate sufficient negative inspiratory flow, children, many adolescents, and hospitalized patients). A thorough understanding of inhaler mechanisms is necessary for health care professionals to effectively counsel patients in selecting the most suitable inhaler option. Especially in the United States where MDIs are commonly prescribed, decreased familiarity with DPIs and SMIs may result in hesitation among clinicians to explore other alternatives. Similar sentiments have been expressed even among clinicians aware of the environmental benefits of DPIs.[25] More broadly, there is an overall lack of educational resources and training for resident physicians on the impacts of climate change.[26] Within undergraduate medical education, a large percentage of medical schools still do not require courses on climate change.[26,27] However, this knowledge gap presents an opportunity to reevaluate and enhance current curricula for trainees, who are pivotal in promoting a more informed and environmentally conscious health care community.

Fortunately, addressing gaps in inhaler knowledge can be accomplished through several interventions. These include didactic sessions, which could be given at noon conference or prior to continuity clinic sessions, and have been shown to be beneficial to learners, even several months after the intervention.[28,29] Likewise, interactive use of smartphone applications supplemented with educational videos can also help fortify inhaler learning.[30] Existing educational resources can also be revamped to include information about environmental considerations. The inhaler decision aid published by the National Institute for Health and Care Excellence provides a useful framework on how to incorporate climate change into clinical decision-making.[31] These resources can be integrated into the electronic health record and easily accessed during patient visits. Likewise, the electronic health record can help track prescribing patterns pre- and post-intervention. These and other efforts to raise awareness of prescribing practices, which can be modified to reduce our carbon footprint as health care professionals, must start in undergraduate and graduate medical education.

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