Estimation of Air Travel–Related Greenhouse Gas Emissions for the In-Person Anesthesiology Oral Board Examination

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ABSTRACT

Background With an increased focus on climate change in graduate medical education (GME), the environmental implications of travel for board certification examinations remain poorly described. The return to the mandatory in-person applied examination (AE) for board eligible anesthesiologists presents potentially sizeable greenhouse gas (GHG) emissions when compared to the virtual format administered during the COVID-19 pandemic.

Objective To estimate the GHG emissions from air travel to the in-person AE and discuss its implications for various specialties as they return to in-person examinations.

Methods An estimate of the GHG emissions was conducted using data from the 2023 NRMP Main Residency Match: Match Rates by Specialty and State report, utilizing residency training site as a proxy for anesthesiologists' home. An alternative estimate was made using the anesthesiologists' predicted state distribution postgraduation. We estimated annual GHG emissions, expressed as metric tons of carbon dioxide equivalent (MTCO2e), produced from graduating residents flying to The American Board of Anesthesiology testing center in Raleigh, North Carolina, USA. We collected emissions using the International Civil Aviation Organization emissions calculator.

Results Annual emissions of examinee travel from their respective residency training state was estimated to be 517.37 MTCO2e. The alternative estimate using anesthesiologists' predicted postgraduation state was 568.05 MTCO2e. This estimate of CO2e roughly equates to the average annual emissions produced by 112 passenger vehicles.

Conclusions The AE in-person format results in an estimated 517 to 568 MTCO2e.

Introduction

Anthropogenic greenhouse gas (GHG) emissions drive global climate change, with the health care sector being a significant contributor.[1] The Accreditation Council for Graduate Medical Education (ACGME) recently joined the National Academy of Medicine (NAM) Action Collaborative on Decarbonizing the US Health Sector, with ACGME President and Chief Executive Officer Thomas J. Nasca, MD, encouraging graduate medical education (GME) programs to seek ways to reduce their environmental impacts.[2] However, one contributor to emissions is the required travel of board-eligible anesthesiologists to the in-person applied examination (AE), which includes the standardized oral examination and objective structured clinical examination.

The AE, required for full board certification, is administered 6 times per year in Raleigh, North Carolina. This examination is typically taken after the completion of an accredited 4-year anesthesiology residency program and successful passing of the testing center–based basic and advanced written portions of The American Board of Anesthesiology (ABA) examination.[3] Advancements in video conferencing enabled the transition to virtual AE for the 2021-2022 cycle during the COVID-19 pandemic, and pass rates during this period remained largely consistent with prior (in-person administration) years.[4,5] With the end of the federal COVID-19 Public Health Emergency, the ABA has resumed in-person testing, despite the successful administration of the virtual examination.

This study estimates the GHG emissions, expressed as CO2 equivalents (CO2e), generated by board-eligible anesthesiologists' air travel to the in-person AE. Understanding the GHG's emitted for in-person examinations will provide valuable information to specialties that are considering the costs and benefits of oral examination formats.

Methods

We estimated the CO2e produced from air travel using 2 methods: first, by assuming all graduating anesthesiology residents travel from the location of

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their residency, and second, by assuming examinees distribute across the United States according to current physician practice patterns.

For the former scenario, we assumed all graduating residents living outside a 300-mile radius from Raleigh, North Carolina, would travel by plane to take the examination while still living in their residency training state. The number of residents in each state was attained from the 2023 NRMP Main Residency Match: Match Rates by Specialty and State report, which identifies postgraduate year (PGY) 1, PGY-2, and reserved residency seats filled in each state.[6] We utilized the United Nation's official tool for quantifying air travel's CO2e, also known as the International Civil Aviation Organization (ICAO) emission's calculator, to quantify the CO2e produced.[7] This calculator allows individuals to estimate CO2e attributed to air travel based on beginning and destination airports for a single passenger. Due to the mixed availability of airports with nonstop flights to Raleigh in the calculator, all travelers in each state were assigned a single route or a value equal to the average of all the state's direct routes. A single route was assigned for the 16 states that had exactly one airport available in the calculator which could directly be connected to Raleigh. For the 9 states with multiple routes, the CO2 emissions were averaged, and a single value was used to represent all travelers from that state. Twenty states did not have a direct route, in which case we incorporated an additional stop at an airport with a connection to Raleigh while maintaining the shortest possible flight path.

For the latter scenario, we assumed that residents would spread across the country to begin their medical careers in a proportion similar to the existing distribution of currently practicing physicians. Using data from the Kaiser Family Foundation report on Professionally Active Specialist Physicians by Field,[8] we calculated the percentage of practicing anesthesiologists in each state. This percentage was applied to the total number of filled anesthesiology residency seats that was obtained from the 2023 NRMP Main Residency Match: Match Rates by Specialty and State report. This calculation provides an estimate of the number of residents who will go on to practice in each state after training. We thus calculated an alternative estimate where all graduating residents would take the examination while living in the state where they will be working as an attending physician. As before, emissions created from air travel were estimated using the ICAO emissions calculator. Travel routes were assigned using the same methodology as the first estimate.

This study was approved by the Institutional Review Board of the University of Utah (00171919) and received a category 4 exemption classification.

Results

Using 2023 NRMP Main Residency Match: Match Rates by Specialty and State report, we compiled the number of filled PGY-1, PGY-2, and reserved residency seats in each state to acquire a nationwide total of 2044 eligible examinees. Assuming everyone outside a 300-mile radius from Raleigh, North Carolina, would fly, 517.37 metric tons of carbon dioxide equivalent (MTCO2e) is estimated to be produced each year. In the alternative analysis model, which utilized assumed first state of practice, we estimated that 568.05 MTCO2e would be produced each year.

Discussion

Our study evaluated the CO2 emissions impact of transitioning the ABA AE from virtual to in-person after the end of the federal COVID-19 Public Health Emergency. We estimated that air travel related to mandatory in-person examination generates a minimum of 517 MTCO2e emissions annually. According to Environmental Protection Agency estimates, the CO2 emissions amount to more than the yearly output of 112 US passenger vehicles (each emitting 4.6 MTCO2e) or over 52 000 gallons of gasoline.[9]

These results align well with similar data evaluating the reduction in CO2 emissions as a result of the United States Medical Licensing Examination Step 2 Clinical Skills in-person examination discontinuation in 2020.[10] Although virtual test administration for the AE is not assumed to be carbon neutral compared to the in-person format, and the associated electricity emissions as well as regional travel emissions are outside the scope of this analysis, having a single in-person testing location impacts examinees in terms of travel burden and CO2 emissions. Given the alternative of virtual examinations for oral board examinations, these findings should be considered by the ACGME and specialty boards in light of the goals of the NAM Action Collaborative on Decarbonizing the US Health Sector.[11]

Our data are limited primarily by unknown precise origins of physicians taking the examination and the estimated nature of our methods and results. The ABA did not release any candidate location information to our research team, resulting in the need for several assumptions to determine travel origins. All flights were assumed to follow the route predetermined by the creators of the ICAO emissions calculator; therefore, alternate routes may alter the actual CO2e emissions. We also did not account for ground travel, including shared (ie, carpooling) or public transit that travelers will likely be taking to and from the airport. Furthermore, the 2024 examinees reflect the number of residency spots filled in 2023

and is assumed to vary slightly compared to the actual number of test takers in any given year. Actual MTCO2e produced will likely fall between our estimates given that there is expected to be a mix of examinees traveling to the AE from the state where they completed residency training and those traveling from the state of their first post-residency practice. Furthermore, the potential savings in CO2e from virtual examinations are nonlinear, and therefore a complete transition to virtual examinations may result in other unaccounted for CO2e emissions.

Although other medical specialty boards have utilized similar virtual examinations formats during and post-federal COVID-19 Public Health Emergency, it is beyond the scope of this study to analyze or compare their success given the differences in content and virtual administration structure. While generalized commentary on the execution of virtual examinations extends outside the focus of this analysis, within the field of anesthesiology, there was transient, but successful, administration of virtual AEs in 2021, demonstrating similar pass rates.[5]

Conclusions

As a result of the recent anesthesiology applied examination transition from a virtual format back to mandatory in-person testing, our analysis estimates that air travel to the examination generates a minimum of 517.37 MTCO2e emissions annually.

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