Global Survey of Anesthesia Breathing Circuit Reuse: A Neglected Opportunity for U.S. Health Care to Reduce Climate Impact

To the Editor:

Reusing anesthesia circuits—the external, flexible tubing used in anesthesia breathing systems—presents an opportunity to curtail health care's large carbon footprint by decreasing plastic waste and emissions generated by the consumption of single-use anesthesia circuits.[1–3] Anesthesia circuits may be used for a single patient and then disposed of (single use) or used for multiple patients by either replacing a bacterial and viral filter between each use (extended use) or reprocessing the circuit after each use (reusable). The introduction of breathing system filters with high bacterial and viral filtration efficiency has enabled anesthesia circuits to be safely reused across multiple patients, and this practice has been documented to generate cost, water, and energy savings.[4] Multiple studies have demonstrated the cost benefits and safety of reusable devices when compared against their single-use counterparts.[5] However, perceptions of increased infection risk associated with reusable anesthesia circuits appear to persevere due to historical outbreaks of infection linked to reused anesthesia circuits prior to the implementation of these filters.[6] Global information on the practices and perceptions of perioperative professionals is needed to understand the existing barriers to the adoption of modern anesthesia circuit reuse. Practices in the United States are under particular scrutiny, as healthcare *per capita* emissions are almost double the amount of those of other high-income countries without commensurate added benefits in health outcomes.[7]

We developed a novel survey instrument to assess international practice patterns and barriers to reusing breathing circuits, utilizing a snowball (or referral) convenience sampling strategy to distribute the English-language survey *via* email to anesthesia providers globally. Reuse was defined as use, with or without disinfection, on more than one patient, including both extended-use and reusable anesthesia circuit options. U.S. respondents further received a focused subset of questions to assess their knowledge about the practice of reusing circuits. Outcomes measured included (1) the percentage of providers who reuse breathing circuits of the total respondents from each country, (2) prevalence of concern for various perceived barriers to circuit reuse, and (3) knowledge gaps and level of readiness for change among U.S. providers who currently do not reuse circuits. The full survey is available in supplemental material 1 (https://links.lww.com/ALN/D926). All data were analyzed using R software version 4.1.1 and Microsoft Excel version 16.9.

Globally, 425 complete survey responses from 44 countries were included in the analysis. The distribution of the countries was stratified into four income groups, and the respondent role, practice setting, and location of the health facility were recorded (table 1). The high-income countries (excluding the United States), upper middle–income countries, and lower middle–income countries had similar percentages of breathing circuit reuse of 76%, 71%, and 76%, respectively. Low-income countries had the highest percentage of reuse at 100%. The United States was one of the anomalies among the high-income countries, with a reuse percentage of only 2.2%. The differences in the percentage of reuse between the United States and other high-, upper middle–, lower middle–, and low-income countries with 95% CI were 74% (95% CI, 64 to 83%), 69% (95% CI, 50 to 89%), 74% (95% CI, 65 to 83%), and 98% (95% CI, 94 to 102%), respectively, with $P < 0.0001$ for all comparisons. Among all the high-income countries, those in Western Europe and Oceania generally had higher circuit reuse percentages (fig. 1).

When asked whether they were aware of a national guideline on breathing circuit reuse, only 13% of the respondents were aware and certain that there is a national guideline on breathing circuit reuse in their country of practice. The majority of respondents were either not aware (38%) or unsure about the guideline (49%). When asked about what concerns they have for breathing circuit reuse, U.S. providers generally had more concerns than non-U.S. providers in every category, especially in institutional policy (56% *vs.* 18%) and litigation (24% *vs.* 7%). Only 8.9% of the U.S. providers did not have any concerns about reusing circuits *versus* 23% of the non-U.S. providers who did not have any concerns.

Among the 45 U.S. respondents, only 11% of the respondents were aware that there are U.S. Food and Drug Administration (FDA)-–approved breathing filters that can be used in conjunction with extended-use circuits, and 37.8% of the respondents were aware that other high-income countries use extended-use circuits or reuse circuits. When asked about their willingness to change their practice, 24% of the respondents said they would consider reusing breathing circuits for more than one patient with an

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<zdoi;10.1097/ALN.0000000000005462>

Table 1. Survey Respondent Characteristics

Overall (n = 425)	
Country	
Non-U.S.	380 (89%)
U.S.	45 (11%)
Income level	
High-income Country	187 (44%)
Upper middle–income country	31 (7%)
Lower middle–Income country	167 (39%)
Low-income country	40 (10%)
Respondent Role	
Attending	365 (86%)
Trainee	31 (7%)
Others	29 (7%)
Practice setting	
Academic center	263 (62%)
Private practice	73 (17%)
Public/community non-academic	86 (20%)
Other	3 (1%)
Location	
Urban	352 (83%)
Suburban	64 (15%)
Rural	9 (2%)

FDA-approved system; 51% of the respondents were unsure but were willing to learn more about circuit reuse.

The widespread use of reusable anesthesia circuits in other countries, including high-income countries, shown in our study demonstrates the feasibility of transitioning away from the single-use counterpart. These findings provide a promising opportunity for U.S. healthcare systems to adopt this evidence-based practice to significantly reduce plastic waste while promoting planetary and public health. The primary concern cited by survey respondents regarding reusing anesthesia circuits was the risk of infection transmission, indicating that concerns of cross-contamination and infection risks are very prevalent. The new generation of heat–moisture exchange filters have a bacterial and viral filtration efficiency greater than 99.999%,[8] and multiple independent microbiology studies have demonstrated that extended-use circuits do not impose additional infection risks on patients.[2–4] These commercially available products are safe and cleared by regulatory scrutiny. Thus, our survey revealed a significant education gap among U.S. providers surrounding the practice of reusing anesthesia breathing circuits and their safety profile. The majority of the U.S.

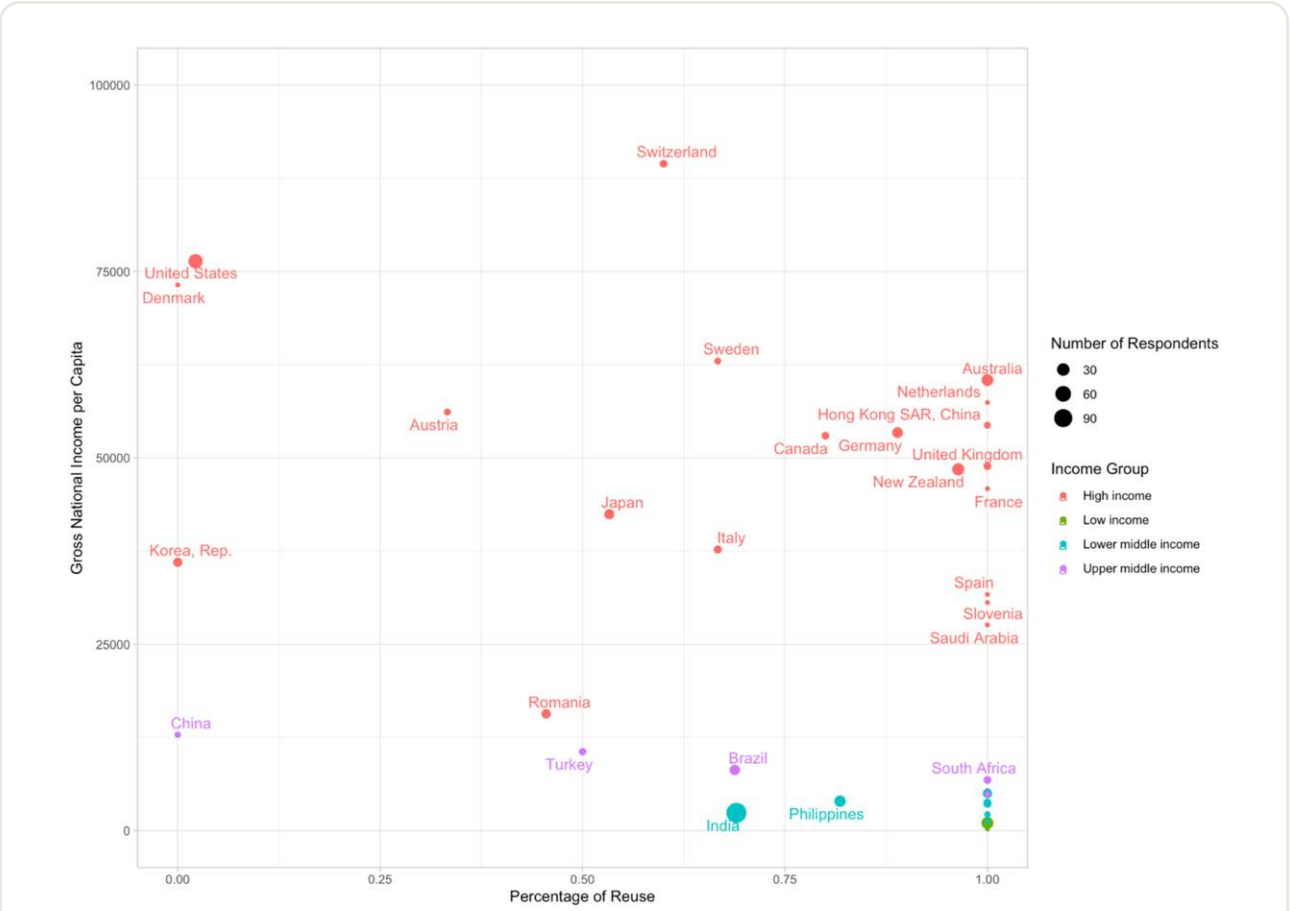

Fig. 1. Anesthesia breathing circuit reuse percentage by country and by income groups. The size of the *dots* represents the number of respondents from each country.

respondents were unaware of the current FDA-approved filters for circuit reuse and the regular practice of reusing anesthesia circuits across other high-income countries.

Our study identifies an untapped opportunity to increase knowledge among U.S. perioperative professionals and their related accrediting societies on the safety and environmental benefits of reusing anesthesia circuits. Additionally, administrators and policymakers would benefit from this information as they work to curb healthcare costs, prioritize patient safety, decrease waste production, and build resilient health systems. As healthcare systems continue to advance human health in parallel with environmental sustainability, healthcare systems, particularly in the United States, may find lessons in financial and environmental benefits from their peers who routinely reuse these devices safely. National and international anesthesia societies should provide strong guidance and endorse the routine practice of anesthesia circuit reuse to reduce healthcare-generated waste.

Research Support

Support was provided solely from institutional and/or departmental sources.

Competing Interests

Dr. Gropper received royalties from Elsevier (Amsterdam, The Netherlands) as editor of Miller's Anesthesia and is on the Board of Directors of the Foundation for Anesthesia Education and Research (FAER; Schaumburg, Illinois). Dr. Gelb has associations with Haisco Pharma Inc. (Bridgewater, New Jersey) and Medtronic (Minneapolis, Minnesota) and is a past President of the World Federation of Societies of Anaesthesiologists (London,United Kingdom).

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DOI: 10.1097/ALN.0000000000005462

Supplemental Digital Content

Supplemental Material 1. Survey of Global Anesthesia Breathing Circuit Usage Patterns, https://links.lww.com/ALN/D926

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(Accepted for publication January 31, 2025.)