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Environmental Sustainability Abstracts

Contents

Environmentally sustainable measures for regional anesthesiologists and beyond: a quality improvement initiative

Submission ID

73

AUTHORS

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INTRODUCTION

Imaging modalities used by the health care industry have a significant environmental impact and cost associated with their use.[1] A report by Natural Resources Canada details that ultrasound machines are one of the top five most energy-consuming medical devices in hospitals and that up to 80% of the energy used by imaging devices is consumed when not scanning.[2] At our provincial health service, scope 2 emissions (purchased electricity) contribute to just under half of total greenhouse gas emissions. Ultrasound machines play an integral role for anesthesiologists, and any measures to help combat the climate crisis are urgently required.[3] This quality improvement study aims to identify energy-saving strategies to decrease the impact of ultrasound usage at our institution. We hypothesized that turning the ultrasound machine off overnight and when not in use would significantly decrease the energy consumption.

METHODS

Ethics was waived by our institutional research ethics board. Energy consumption data was collected by a portable data logger (ONSET HOBO®, Montreal, QC, Canada) connected to a single ultrasound machine (Sonosite LX®, Bothwell, WA, USA) in the hospital's regional nerve block room, where ultrasound-guided nerve blocks are performed perioperatively. As per usual practice in our department, the typical use of the ultrasound machine without energy-saving interventions was logged over three weeks (control). For the following four weeks, we implemented the energy-saving intervention by turning off the ultrasound machine when not in use, which included overnight (intervention). Scanning time and number of scans were charted for each period. The primary outcome was energy consumption in kilowatt-hours (kWh) in both the control and the intervention group. The secondary outcomes were ultrasound machine usage and the energy cost. Mean and standard deviation were used for normally distributed

data. The Chi square test was used to compare the difference between the two groups, with the *P* value of 0.05 being statistically significant.

RESULTS

After implementing the simple intervention of turning the machine off between scans and while not in use, we observed an 80% relative energy saving between the control and intervention group. The ultrasound machine was in use a total of 600 min during the control period and 1,186 min during the intervention period. To account for any effect of the difference in usage, we computed the energy usage per minute of scanning, by dividing the daily energy usage (Wh) by the daily usage time (minutes) and estimated an energy saving of 87% per minute of active scanning. The absolute energy saving per day is equal to 1.55 kWh. Given that an average of 110 g CO_2 is emitted per kWh of electricity consumed in Canada, the wastage was equivalent to 62.07 kg CO_2 emissions per year.[4] This yearly energy saving is equivalent to $108.34 for a single ultrasound machine.[5]

DISCUSSION

Actively switching off an ultrasound machine when not in use is a simple, convenient, and effective opportunity to significantly reduce energy consumption, minimize carbon footprint, and save costs. This intervention is a valuable strategy to reduce scope 2 emissions, which play a large part in the carbon footprint in health care. Taking into account the growing number of ultrasound machines in an average hospital, this represents a promising area for a simple intervention for planet health.

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Table Energy consumption and savings of control and intervention

	Control	Intervention
Total Energy Consumption (Wh): mean (SD)	34,062: (0.6)	9167.0: (0.6)
Total Hours Recorded (hours)	413.3	571.7
Total Active Scanning Time (minutes)	600	1186
Average Active Power (Watts): mean (SD)	80.56: (33.09)	18.02: (33.01)
Energy Consumption Per Day (Wh)	1930.83	384.87
Energy Savings Per Day (Wh)		1545.96
Energy Savings Per Day (%)		80
Energy Saving Per Minute of Scanning (%)		87
CO2 Emission Reduction Per Year (Kg)		161.27
Cost Savings Per Year (CAD$)		108.34

Public perception of health care, anesthesia, and climate change

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46

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INTRODUCTION

'Code Red for Humanity' was declared by the World Health Organization in 2021,[1] and climate change-related cardiovascular and respiratory conditions are predicted to increase worldwide.[2] Moreover, USA and Canada's health care industries, with particularly resource-intensive operating rooms, are significant contributors to national greenhouse gas emissions.[3] In the perioperative arena, anesthetic gas use and energy consumption are the largest sources of emissions.[4] Hence, it is vital to promote environmentally sustainable anesthesia choices through informed decision-making, with crucial consideration of patients' attitudes and knowledge of such issues.

With this background, the aim of this observational study was to investigate the perception and attitudes of patients and family members surrounding the intersectionality of climate change and health care and their willingness for action. Additionally, we investigated whether perceptions and attitudes translated into choosing anesthesia options with different environmental footprints. We hypothesized that < 30% of our study population were aware of health care's contributions to climate change.

METHODS

Following institutional review board ethics approval and obtaining written informed consent from patients and/or their family members who met inclusion and exclusion criteria, participants were interviewed using a standard set of questions. The completion of questionnaires was conducted on the surgical wards and day-surgery ward. A research assistant explained the purpose of the study before administering the questionnaire to participants, and remained available throughout its completion to provide any necessary clarification. Participants could choose to individually complete the paper survey or have the research assistant conduct the survey verbally. The survey consisted of nine questions that queried participants on their demographic information, perceptions of climate change, perceptions of health impacts of climate change, knowledge of health care and its impact on climate change, and willingness to learn more about climate change and their health/health care system. For normally distributed continuous data, mean and standard deviation were used. Ordinal and

interval data including survey responses were analyzed using Chi square tests to determine if significant associations existed between perceptions of health care's carbon footprint and age group, sex, education, income, choice of anesthesia or request for further information. All analysis was performed on SPSS (SPSS version 26, IBM Corp., Armonk, NY, USA) and *P* value < 0.05 was considered significant.

RESULTS

A total of 320 participants completed the survey. Results showed 32% of participants acknowledged health care 'greatly contributes to climate change,' and a large majority (82.5%) thought 'health care contributes to climate change in some form.' Nevertheless, perceptions did not necessarily translate to choices, as many still opted for general anesthetic (45%). As shown in the Figure, participants were more likely to choose a greener option if they perceived that health care 'somewhat or greatly contributed to climate change' (*P* = 0.002). Many participants believed urgent action should be taken (46%), which again, did not translate to choosing the greenest anesthetic option—a regional technique with relaxing background music (21%). A strong association existed between perception of health care's environmental impact and level of education (*P* = 0.015); no association was found with income, age, or sex.

DISCUSSION

Over 80% of our study population was aware that health care impacts the environment and climate change, but many continued to choose the more carbon-intensive anesthetic. A traditional view of perception and action assumes the causal flow between the two is linear, and they are merely instrumentally related. A two-level interdependence view argues that perception and action co-depend on dynamically circular sub-personal relations.[5] Our study highlights that public education regarding health care and climate change is required, however, education alone is not enough. Thus, perhaps health care needs to focus on cultural change towards climate resilience for a healthier and more sustainable planet.

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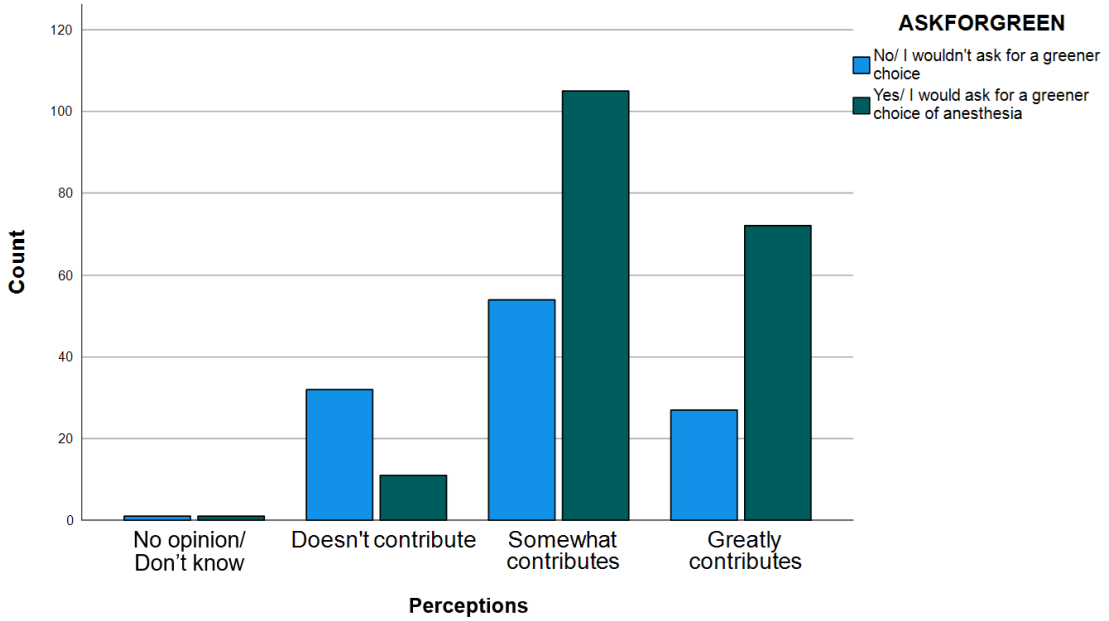
Figure Bar chart showing the number of participants that would or would not ask for a greener choice of anesthesia with different perceptions of health care contributing to climate change



Waste generated by different types of anesthesia: a randomized controlled trial

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43

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INTRODUCTION

As climate change poses a threat to human health,[1] it is imperative to look at major carbon contributors such as health care, an industry contributing nearly 5% of global greenhouse gas emissions.[2] Within the operating room, anesthesia is the largest carbon contributor, and may have potential to reduce carbon contributions by modifying and optimizing anesthesia techniques.[3] Prior research comparing different anesthesia techniques, namely regional anesthesia (RA), general anesthesia (GA), and a combination of both RA and GA failed to show a difference in carbon contributions between the techniques, however it was suggested that reducing oxygen flow with regional anesthesia is a possible factor to reduce emissions.[4] Our study aims to assess recycle and nonrecyclable contributions from RA, GA, and a combination of RA and GA among patients undergoing wrist surgeries, while titrating oxygen flow per patient requirements.

METHODS

Ethics approval has been approved by the institutional review board committee, and written, informed consent was obtained from patients. In this prospective, randomized control trial, patients > 18 yr of age undergoing open reduction and internal fixation wrist surgery were randomized to one of three groups: 1) GA, 2) RA, or 3) combined GA + RA.

Patients in the GA group were induced with propofol and airway devices used were either reusable LMA or endotracheal tube with reusable laryngoscope under the discretion of the anesthesiologist. Sevoflurane was used as maintenance, alongside medical air/oxygen.

Patients in the RA group received a brachial plexus block and had the option of receiving light sedation with midazolam. When required, anesthetists were instructed to titrate O_2 to maintain O_2 saturation > 95%.

Patients in the GA + RA group received both of the previously described techniques.

Groups were compared using one-way analysis of variance. In all groups, the primary outcomes were recycle, nonrecycle waste production (in grams). Secondary outcomes were

oxygen use (in liters) between the three anesthetic techniques. Data on gaseous and volatile consumption was collected on the anesthesia machines, and recyclable and nonrecyclable waste was collected and weighed on a digital scale with a precision of 0.01 g.

RESULTS

There were eight patients in the GA group, nine in the RA group, and ten in the GA + RA group for a total of 27 patients. For nonrecyclable waste, the RA only group generated the least amount (Table). For recyclable waste, the GA + RA group generated the highest amount, and by each group was GA > RA > RA + GA (Table). Nevertheless, the difference was not statistically different. For oxygen used, the most was in the GA group, and by each group was GA > GA + RA > RA and upon examining the data, two cases in the RA only group left the oxygen delivery on default mode of 10 $L \cdot min^{-1}$ on the anesthetic machine, rather than switching the oxygen flow to 'pause,' while monitoring capnography. When these two data were excluded, the average oxygen volume was lowest in the RA group which was statistically significant (Table).

DISCUSSION

Among anesthetic techniques, RA on average had the lowest nonrecyclable waste contributions. More strikingly, the oxygen use (which has a significant carbon footprint)[4] markedly reduced in the RA-only group when excluding two outliers, which had oxygen flow rates of 10 $L \cdot min^{-1}$ of oxygen as capnographic monitoring was used without pausing the oxygen flow. This suggests an impactful strategy to reduce environmental impact within RA, defaulting lower gas flow on the anesthetic machine, or having a mode on the anesthetic machine reminding anesthetists to turn off the anesthetic machine fresh gas flow when only using its capnography monitoring function.

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Table

Mean Values	GA	RA	GA+RA	P-Value
	N=8	N=9	N=10	
Oxygen Use (L)	232.38	52.43	167.6	0.00025
Recyclable Waste (g)	42.25	64.3	73.1	0.99015
Non-Recyclable Waste (g)	249.25	203.4	227.2	0.99015