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Exploring the Knowledge, Attitudes, and Perceptions of Hospital Staff and Patients on Environmental Sustainability in the Operating Room: A Quality Improvement Survey Study.

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Abstract

Background: In Canada, the healthcare system has been estimated to generate 33 million tonnes of greenhouse gas emissions annually. Healthcare systems, specifically operating rooms (ORs), are significant contributors of greenhouse gas emissions, using three to six times more energy than the hospital's average unit.

Objective: This quality improvement study aimed to investigate the knowledge, attitudes, and perceptions of staff and patients on sustainability in the OR, as well as identify opportunities for initiatives and barriers to implementation.

Methods: Two surveys were developed, consisting of 27 questions for staff and 22 questions for patients/caregivers. Topics included demographics, knowledge, and attitudes regarding environmental sustainability, opportunities for initiatives, and perceived barriers. Multiple choice, Likert-scale, and open-ended questions were used.

Results: A total of 174 staff and 37 patients participated. The majority (88%) of staff had received no/minimal training on sustainability, while 93% cited practicing sustainability at work as important. Among patients/caregivers, 54% often/always noticed when a hospital is being eco-friendly. Both staff and patients agreed that improving sustainability would boost satisfaction (71.8%;59.4%) and hospital reputation (89.5%;69.5%). The staff's highest rated environmental initiatives included transitioning to reusables, education, and improved energy consumption, while patients prioritized increased nature, improved food sourcing, and education. Perceived barriers to these initiatives included cost, lack of education, and lack of incentive.

Conclusions: Staff and patients/caregivers in a large academic healthcare center acknowledge the significance of environmental sustainability in the OR. While they do not perceive a direct impact on patient care, they anticipate positive effects on satisfaction and hospital reputation. Aligning initiatives with staff and patient/caregiver preferences can help drive meaningful change within the OR and beyond.

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Abstract

Background: In Canada, the healthcare system has been estimated to generate 33 million tonnes of greenhouse gas emissions annually. Healthcare systems, specifically operating rooms (ORs), are significant contributors of greenhouse gas emissions, using three to six times more energy than the hospital's average unit.
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Conclusion: Staff and patients/caregivers in a large academic healthcare center acknowledge

the significance of environmental sustainability in the OR. While they do not perceive a direct impact on patient care, they anticipate positive effects on satisfaction and hospital reputation. Aligning initiatives with staff and patient/caregiver preferences can help drive meaningful change within the OR and beyond.

Keywords: environmental sustainability, operating room, hospital, recycling, climate change, global warming.

Introduction

The World Health Organization labeled climate change as “the single biggest health threat facing humanity” [1]. In Canada, the healthcare system has been estimated to generate 33 million tonnes of greenhouse gas emissions annually [3,4]. Within the healthcare sector, operating rooms (OR) are a significant portion of a hospital’s environmental footprint, using three to six times more energy than the hospital’s average unit [5-7]. Major sources of OR emissions stem from the reliance on single-use materials, biohazardous medical waste, and energy consumption [8,9]. Focusing on transforming the OR into a sustainable space presents a strategic opportunity to reduce the healthcare sector’s environmental footprint.

With this goal in mind, a multi-disciplinary committee called the Operating Room – Planetary Health Intervention Team (OR-PHIT) was created at London Health Sciences Center (LHSC) in London, Ontario, Canada. The team works to re-engage the hospital in environmental initiatives and propose new ideas to reduce the environmental footprint of the OR. To drive effective change, the OR-PHIT must first understand the current perspectives of hospital staff and patients. Despite some progress in related studies, the area remains relatively unexplored. A study conducted by the Department of Otolaryngology- Head and Neck Surgery at LHSC found that Canadian otolaryngologists strongly believe in climate change, but there was some ambivalence surrounding ORs being a strong contributor [10]. Other studies found varied barriers, such as lack of support from leadership and inadequate knowledge or education [11,12]. However, the mentioned studies were limited to specific departments and physicians.

As such, two surveys were created to characterize the knowledge, attitudes, and perceptions of hospital staff, patients, and caregivers regarding environmental sustainability in the perioperative areas. This quality improvement initiative aimed to explore if improving the sustainability performance of the OR may impact workplace satisfaction and overall patient experience, aspects that have not been previously explored. It also aimed to identify opportunities for initiatives that will engage both staff and patients while effectively reducing the OR’s environmental impact.

Methods

Survey Development

The survey was part of a larger OR environmental sustainability project granted Ethics Board Exemption as a quality improvement project. Separate surveys were developed for hospital

staff (i.e. nurses, physicians, OR aids) and patients/caregivers with input from members of Western University Sustainability, Child and Youth Advisory Council, and OR-PHIT. The surveys were pilot tested on a small group from the OR-PHIT. Surveys consisted of 27 staff questions and 22 patient/caregiver questions, and were distributed only to individuals in perioperative areas at all four hospital sites in London, Ontario, Canada. The surveys were launched on April 1, 2023 and remained open for four months for voluntary participation. No incentives were provided. Participants were informed of the study purpose, estimated length, confidentiality, and intended use of data. Data collected remained anonymous, and no identifiable participant information was collected. Questions were displayed over one screen in a set order. Categories included demographics, knowledge, attitudes, opportunities, and barriers. There was a combination of multiple choice, Likert scale, and open-ended questions (see Appendix A for full surveys), with participants able to skip and modify their answers before submission.

Survey Dissemination

The survey was developed and administered anonymously using Research Electronic Data Capture (REDCap) hosted at London Health Sciences Centre (LHSC) [13,14]. The surveys were promoted within the perioperative areas using QR codes and at booths during hospital events such as Earth Week.

Data Analysis

Descriptive statistics, including median, interquartile range (IQR), and frequency of outcomes, were calculated. Differences between surgical and non-surgical staff and gender differences were explored using chi-square tests for categorical outcomes. An alpha level of 0.05 was used to determine statistical significance. All statistical analyses were completed using SAS software (version 9.4; SAS Institute Inc., Cary, NC). All data including only partial responses were included in the analysis. For the open-ended questions, participant responses were analyzed by multiple research team members. Similar responses were grouped, and common themes were determined.

Results

Out of 314 participants, 211 completed any part of the survey, including 174 were staff (73 surgical, 101 non-surgical). Median age was 40 (IQR: 33-51), 74% women. Majority were from Victoria/Children's Hospital (77.0%), followed by University Hospital (39.1%) and St. Joseph's Hospital (10.3%). Staff had varied experience, with most <5 years (29.1%) or 10-19 years (27.9%).

A total of 37 patients/caregivers participated; 81.1% were women. Most were from Victoria/Children's Hospital (78.4%), followed by University Hospital (37.8%) and St. Joseph's Hospital (18.9%). Most patients/caregivers had four or more surgeries at London hospitals (40.5%).

Knowledge and Awareness

Staff

Approximately half of staff (51.4%) had no/minimal knowledge about the causes of greenhouse gas emissions, with more surgical staff (59.0%) having some/moderate/strong knowledge compared to non-surgical staff (41.0%; *P*=.015). Most staff (87.9%) have received no/minimal training regarding environmental sustainability in the workplace, with no significant differences between the surgical staff (19.4%) indicating minor/moderate/plenty of education compared to non-surgical staff (6.9%; *P* =.085). Despite 57.5% dissatisfaction with current sustainability performance, 93.1% of staff indicated that practicing environmental sustainability at work was moderately/very/extremely important, and 82.2% agreed that they would like to learn more.

Patient

Over half (54.0%) of patients/caregivers rated that they often/always notice when a hospital is environmentally friendly, and 47.3% often/always think about how the hospital could improve its sustainability during their stay. Half (50.0%) of patients/caregivers have no/minimal knowledge of environmental sustainability in the perioperative areas. However, 62.1% strongly/somewhat agree that they would like to learn more.

Attitudes/Perceptions

Staff

Most staff (86.6%) consider the environment in daily decisions, and 89.4% prioritized improving environmental sustainability. Most staff strongly/somewhat agreed that improving sustainability would lead to improved satisfaction (71.8%) and work culture (69.5%) (Figure 1). Fewer staff felt that it would lead to better patient care (40.2%) or improve patient experience (56.0%), which was significantly favored by the non-surgical staff (65.4%) compared to surgical (43.1%; *P*=.045). A higher proportion of staff (89.5%) believe improving sustainability would strongly/somewhat improve the hospital's public reputation, with more non-surgical staff (93.1%) agreeing compared to surgical staff (84.6%; P<0.001). In addition, 67.8% think it would help save the hospital money, with no significant differences between surgical and non-surgical staff (*P*=.11)

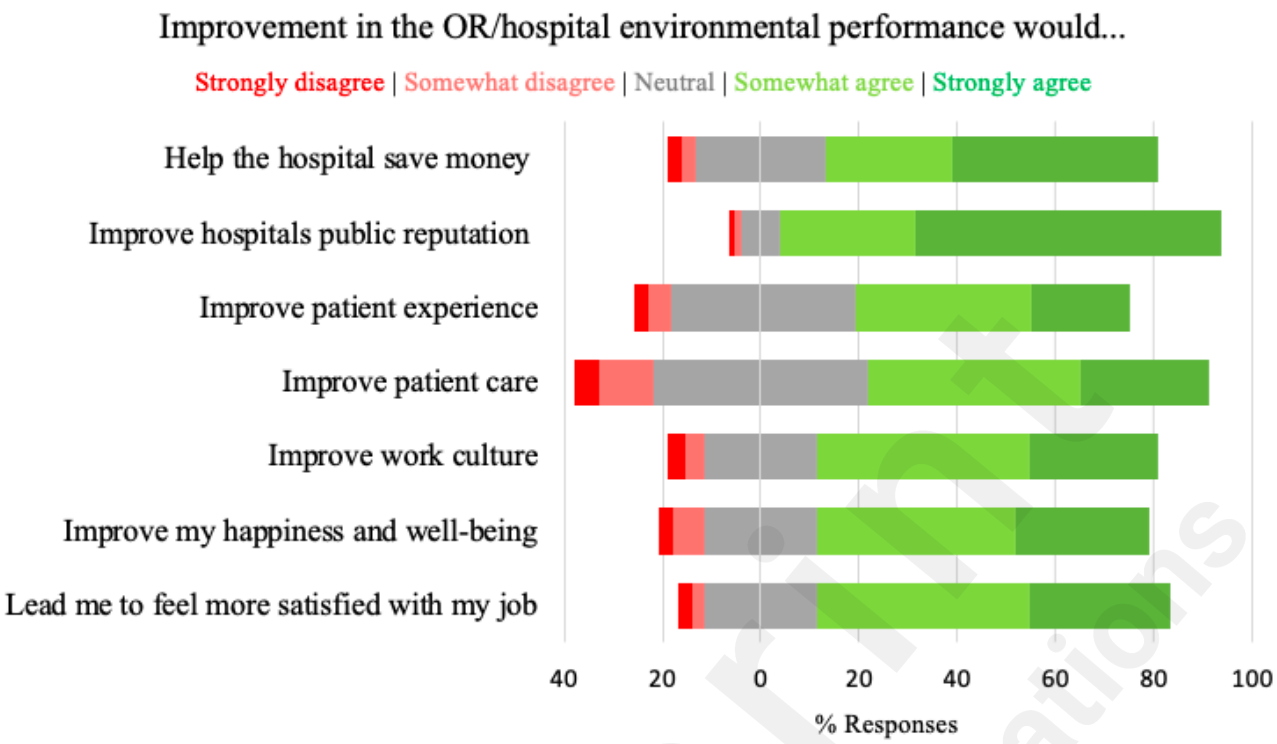

Figure 1. Attitudes and perceptions of staff on the anticipated outcomes of improving operating room and hospital environmental sustainability performance.

Patient

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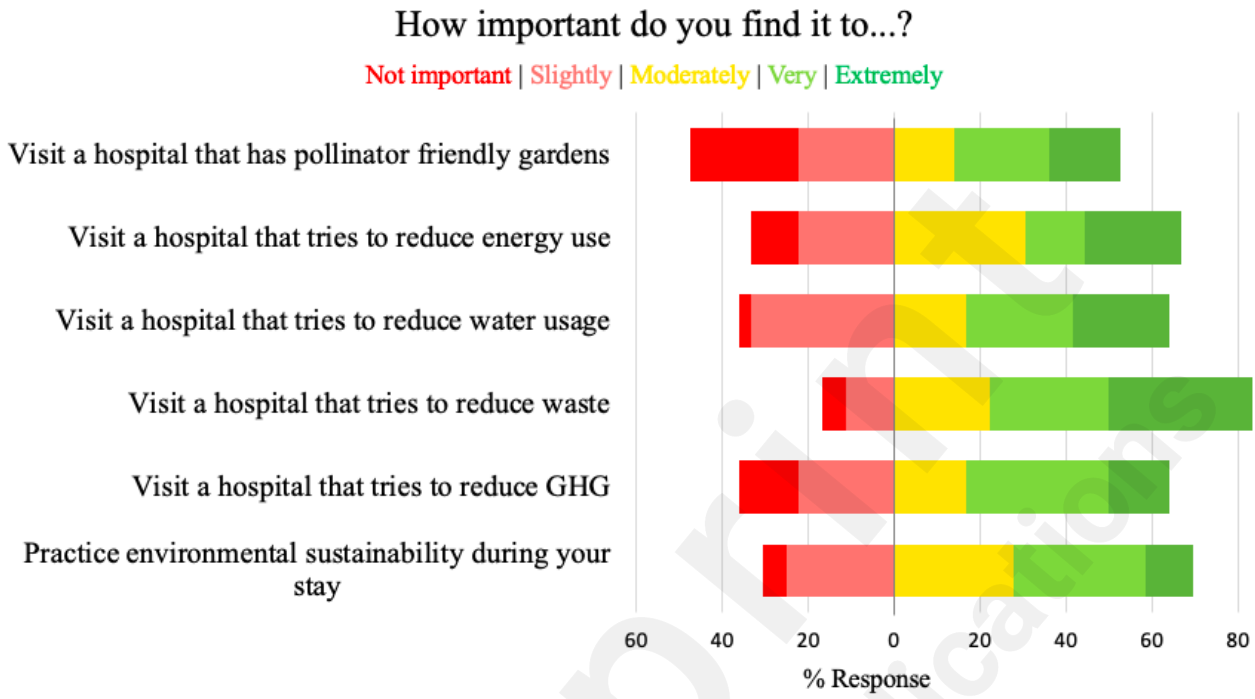
Patients and caregivers somewhat/strongly agreed that environmental sustainability was important (80.6%), considered it when making daily life decisions (82.9%), and thought it should be a priority (77.8%). More specifically, 69.5% of patients/caregivers found it moderately to extremely important to practice environmental sustainability during their hospital stay. Of note, 83.3% rated physical waste as moderately to extremely important,



compared to 66.7% electricity usage, 63.9% water usage, and 52.8% pollinator-friendly gardens (Figure 2).

Figure 2. Patients' perspectives on key values in hospital environmental practices.

When asked how satisfied patients/caregivers were with the hospital's current sustainability performance, most respondents were neutral (62.2%), with 16.2% stating they were dissatisfied/very dissatisfied. However, 59.4% of patients/caregivers somewhat/strongly agreed that knowing that the hospital/OR prioritizes sustainability would make them feel more satisfied with their visit, and 50.0% somewhat/strongly agreed that this would improve their happiness (Figure 3). In contrast, patients/caregivers did not feel that improved sustainability would impact patient care (27.1%) or their trust in hospital staff (40%). Patients agreed/strongly agreed that improving environmental sustainability would improve the hospital's reputation (69.5%) and help the hospital save money (55.6%).

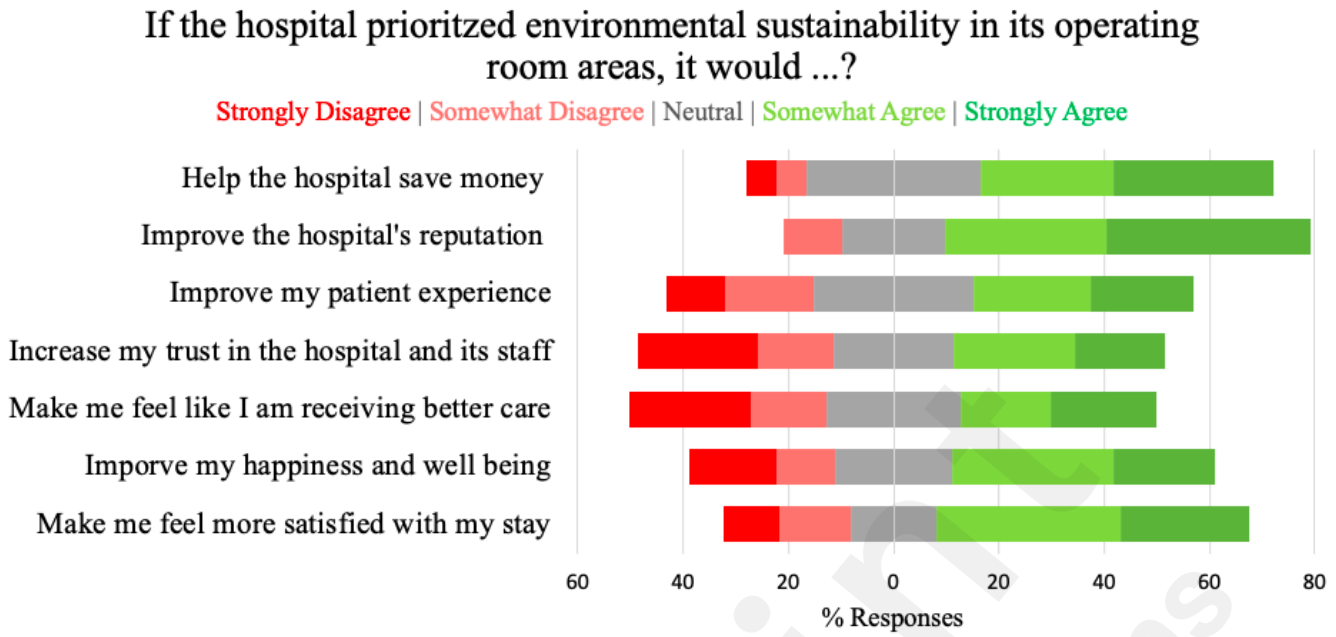


Figure 3. Attitudes and perceptions of patients on the anticipated outcomes of improving operating room and hospital environmental sustainability performance.

Opportunities and Barriers Identified by Staff and Patients

Staff

A full list of environmental opportunities rated by staff can be found in Table 1. The highest rated project was switching single-use items to reusable items (74.7%). Education (48.9%) and reducing the amount of energy used (39.7%) were also highly rated, closely followed by reducing the amount of unused surgical instruments (39.1%). To increase education, staff would like to see an increase in email updates (55.8%), posters/signage (54.6%), and grand rounds/in-services (51.7%). Although it should be noted that e-mails were significantly favored by the non-surgical staff group (P=.007), whereas grand rounds were favored by surgical staff (P =.026).

A total of 11 surgical and 31 non-surgical staff participated in the open-ended portion, where they were invited to comment about alternative opportunities. For surgical staff, the most common themes were recycling, with 10/11 responses mentioning this domain, as well as education (4/11). For non-surgical staff, recycling was also the most common theme (12/31), as well as switching to reusable items (9/31), and decreasing transportation (6/31). Other themes included opportunities to improve education, food sourcing, or energy usage. The top three rated barriers identified by staff were cost (66.1%), lack of education (60.9%), and lack of incentive (60.9%).

Table 1. Opportunities rated by staff for environmental sustainability initiatives.

Variables	Overall (N= 174)	Surgical Staff (N= 73)	Non-Surgical Staff (N= 101)	P-Value
	N (%)			

"Which of the following would you like to see to help increase education/awareness of environmental sustainability efforts?":					
	Posters/signage	95 (54.6)	43 (58.9)	52 (51.5)	0.332
	Learning modules	80 (46.0)	25 (34.3)	55 (54.5)	0.008
	Social media	60 (34.5)	20 (27.4)	40 (39.6)	0.095
	E-mail updates	97 (55.8)	32 (43.8)	65 (64.4)	0.007
	Grand rounds/in-services	90 (51.7)	45 (61.6)	45 (44.6)	0.026
	Other (please specify)	17 (9.8)	5 (6.9)	12 (11.9)	0.270
"Please select the top 3 sustainability projects you think should be most prioritized":					
	Education/training of staff and patients	85 (48.9)	37 (50.7)	48 (47.5)	0.681
	Switching single use items to reusable items (ex. plastic garment bags, surgical gowns/caps)	13 (74.7)	57 (78.1)	73 (72.3)	0.385
	Increasing exposure to nature (ex. Nature for Healing)	39 (22.4)	8) (11.0)	31 (30.7)	0.002
	Optimizing drugs and devices (ex. switching to low carbon anaesthetic gases)	59 (33.9)	29 (39.7)	30 (29.7)	0.168
	Optimizing food sourcing (ex. improving patient provided food sourcing, plant-based foods)	43 (24.7)	9 (12.3)	34 (33.7)	0.001
	Reducing the amount of unused surgical instruments (i.e., less unnecessary sterilization)	68 (39.1)	44 (60.3)	24 (23.8)	<0.001
	Reducing the amount of energy used (i.e., lighting, heating/cooling)	69 (39.7)	23 (31.5)	46 (45.5)	0.062
	Increasing leadership to create a culture of sustainability and meet goals	31 (17.8)	14 (19.2)	17 (16.8)	0.690
	Better labelling of products and waste bins	57 (32.8)	22 (30.1)	35 (34.7)	0.531

Patients

Several opportunities were rated by patients/caregivers (Table 2). The top-rated initiatives were increasing exposure to nature (59.5%), improving food sourcing (56.8%), education (54.1%), and better waste labeling (54.1%). In addition, 50.0% of patients/caregivers would like to get involved in initiatives that improve environmental sustainability. Five patients participated in the open-ended section, with the main theme being improved food sourcing (3/5).

Table 2. Opportunities rated by patients for environmental sustainability initiatives.

Variables	**Overall (N= 37)**	**Non-Surgical Patient (N= 5)**	**Surgical Patient (N= 32)**
	N (%)		
"Please select sustainability initiatives you would like to see during your hospital stay"			
Education/training of staff and patients	20 (54.1)	2 (40.0)	18 (56.3)
Switching single-use items to reusable items (ex. plastic garment bags, surgical gowns/caps)	19 (51.4)	3 (60.0)	16 (50.0)

	Increasing exposure to nature (ex. Nature for Healing)	22 (59.5)	4 (80.0)	18 (56.3)
	Optimizing drugs and devices (ex. Switching to low carbon anaesthetic gases)	11 (29.7)	2 (40.0)	9 (28.1)
	Improved food sourcing (ex. patient provided food sourcing, plant-based foods)	21 (56.8)	4 (80.0)	17 (53.1)
	Reducing the amount of unused surgical instruments (i.e., less unnecessary sterilization)	18 (48.7)	3 (60.0)	15 (46.9)
	Reducing the amount of energy used (i.e., lighting, heating/cooling)	11 (29.7)	1 (20.0)	10 (31.3)
	Better labelling of products and waste bins	20 (54.1)	2 (40.0)	18 (56.3)

Discussion

Perspectives and opportunities identified by staff:

Survey findings reveal knowledge gaps on greenhouse gases and environmental projects, paralleling Canadian and American anesthesiologist experiences [11,12]. Limited workplace education contributes to this, but staff express eagerness for more training. Dissatisfaction with the current sustainability performance within the OR is evident, with beliefs that enhancing sustainability can boost job satisfaction and influence work culture. While less believe environmental efforts will impact patient care, a larger proportion perceive benefits in the hospital's reputation, sustainability, and cost savings.

Staff propose transitioning to reusable items, which has potential to reduce the carbon footprint by 38% to 50% [15-17]. Switching to reusable gowns and masks offers a promising reduction in energy use and waste production [18,19]. Replacing disposable plastic for instrument trays with reusable alternatives and minimizing medical product packaging are suggested. Education initiatives are also crucial, with preferences for email updates, posters, and grand rounds. Staff proposed “lunch and learns” and a “Green Team Newsletter'' in the open-ended section. There is also potential for leveraging social media and learning modules, though they ranked lower. Incorporating modules early in medical and nursing education has previously been shown to be successful [20]. Lastly, reducing energy consumption is prioritized, given the OR’s higher energy intensity [21]. A previous study done in 30 ORs in North Carolina showed that turning off all anesthesia and OR equipment not in use saved 234.3 metric tonnes of CO_2 emission per year and $33,004 annually [22].

Additional initiatives include optimizing drugs/devices, such as adopting low carbon anesthetic gases. A single OR anesthetist’s daily routine can emit the equivalent of ‘driving over 1000 kilometers per day’ depending on the chose volatile agent for balanced general anesthesia [29]. The OR-PHIT has used educational efforts to decrease desflurane use by 24.5% across London hospitals in two years, cutting 473 tonnes of CO_2e, equivalent to ~2.3 million km driven by car [30]. Improving recycling and waste bin labeling is another opportunity as 90% of non-clinical waste is misclassified as hazardous waste and 50% of materials in sharps containers are non-sharps [31-33]. Strategies like increasing bins, designing signs, and educating staff can result in

cost savings [34]. Staff suggest waste management process tours, with one stating, “we had a great in-service recently about waste management, and I would love to see it further expanded”.

Perspectives and opportunities identified by patients:

This study sheds light on previously unexplored patient perspectives on environmental sustainability in the perioperative setting. Most patients have minimal knowledge about environmental sustainability but express interest in learning more. A significant percentage regularly notice when a hospital makes efforts to be environmentally friendly. Patients emphasize the importance of hospitals actively measuring and reducing greenhouse gas emissions, with a focus on waste reduction. Only a minority express satisfaction with the environmental performance of hospitals they visit.

The top opportunity identified by patients was exposure to nature, suggesting strategies like mimicking natural environments and enhancing access to outdoor gardens [23,24]. A program at LHSC, Nature for Healing, works on increasing patient and family experience through nature exposure [25]. Patients also prioritize improving food sourcing and reducing waste. Indeed, ~50% of patients leave most of their meals uneaten while in hospital [26]. In our survey, patients commented, “hospital food waste troubles me a lot,” and suggested, “changing food suppliers to decrease waste of food and [single-use] containers would increase patient satisfaction”. Existing initiatives have redesigned menus to be healthier and created local gardens for patient use [27, 28]. Lastly, educational initiatives through pamphlets, posters, and social media, as well as avenues for feedback can increase awareness. Allowing avenues for feedback and suggestions can also foster a sense of involvement and ownership while increasing awareness.

Perceived Barriers

The top three staff-identified barriers included cost, lack of education, and lack of incentive. Cost concerns involve expenses for new infrastructure, equipment, and staff training [35]. However, certain initiatives, like reducing desflurane gas use, can yield potential savings [36]. Despite higher upfront costs for sustainability initiatives like reusable gowns, long-term savings make them cost-effective [37]. Lack of incentives and education were also identified barriers. Education initiatives, such as an in-service tour, can enhance staff understanding. One respondent suggested, “if staff knew recycling and being sustainable can lower our costs, they may be more incentivized to help out”.

Moving Forward

This survey reveals staff and patient views on environmental sustainability opportunities and barriers in the OR. An intriguing question arises: do highly rated initiatives align with those proven to have the most substantial impact on reducing greenhouse gas emissions? Sergeant et al. uses a peach tree diagram to compare the impact of interventions on greenhouse gas emissions and costs across seven different categories [36]. While effective interventions like low-carbon buildings tend to be costly, others, such as desflurane reduction, achieve significant greenhouse gas emission reduction with $18,000 in annual savings. Optimizing plant-rich diets, adding an energy manager, and switching to reusable gowns offer lower-cost carbon emission reductions. Hospitals prioritizing sustainability should evaluate effectiveness, costs, and

savings when choosing initiatives. Considering staff and patient perspectives is crucial, given their significant role. Hospital leadership can use this information with existing action guidelines to make decisions about reducing their carbon footprint [38].

Limitations

Self-selection bias may exist as participants voluntarily chose to participate in the study, potentially skewing the sample towards those more interested in environmental sustainability. Challenges in estimating the total OR staff limited the ability to accurately calculate response rate. Limited patient/caregiver participation resulted in a small sample size. Due to using the anonymous public survey in REDCap, IP addresses were not captured, therefore, we did not have the capacity to determine if each participant was unique. Finally, the study exclusively captures perspectives from London, Ontario hospitals, potentially limiting generalizability.

Conclusion

This quality improvement study explores patient and provider perspectives on environmental sustainability in perioperative areas. It reveals that while sustainability is not perceived to impact patient care directly, participants anticipate positive effects on sustainability performance, staff/patient satisfaction, and hospital reputation. We also identified opportunities and barriers to inform decision-making on initiatives aimed at reducing the hospital's environmental impact.

Acknowledgements

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Conflicts of Interest

None declared

Abbreviations

LHSC: London Health Sciences Centre
ORs: Operating rooms
OR-PHIT: Operating Room – Planetary Health Intervention Team

Multimedia Appendix 1

(Full surveys uploaded online)

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Supplementary Files

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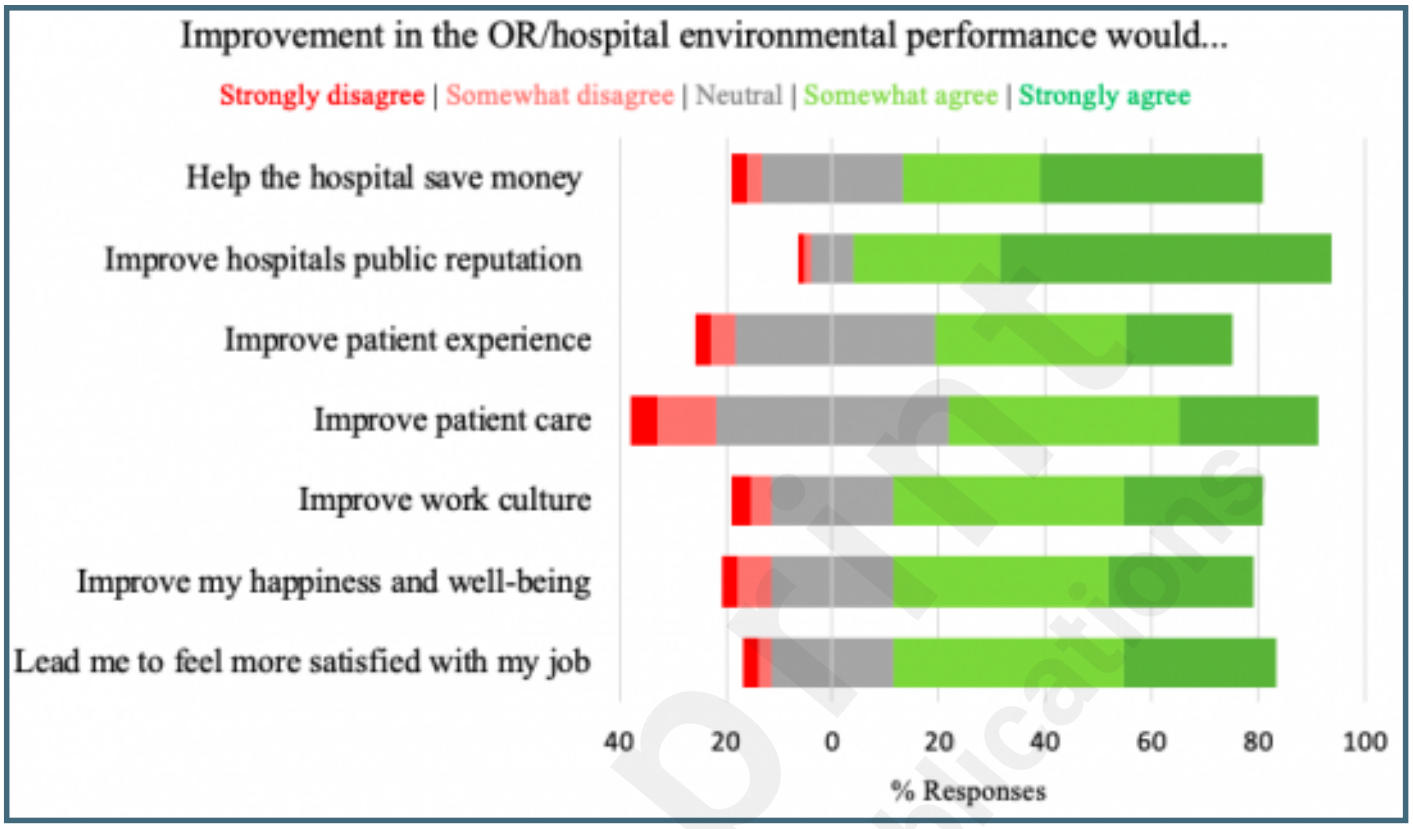
Figures

Preprint JMIR Publications

Attitudes and perceptions of staff on the anticipated outcomes of improving operating room and hospital environmental sustainability performance.



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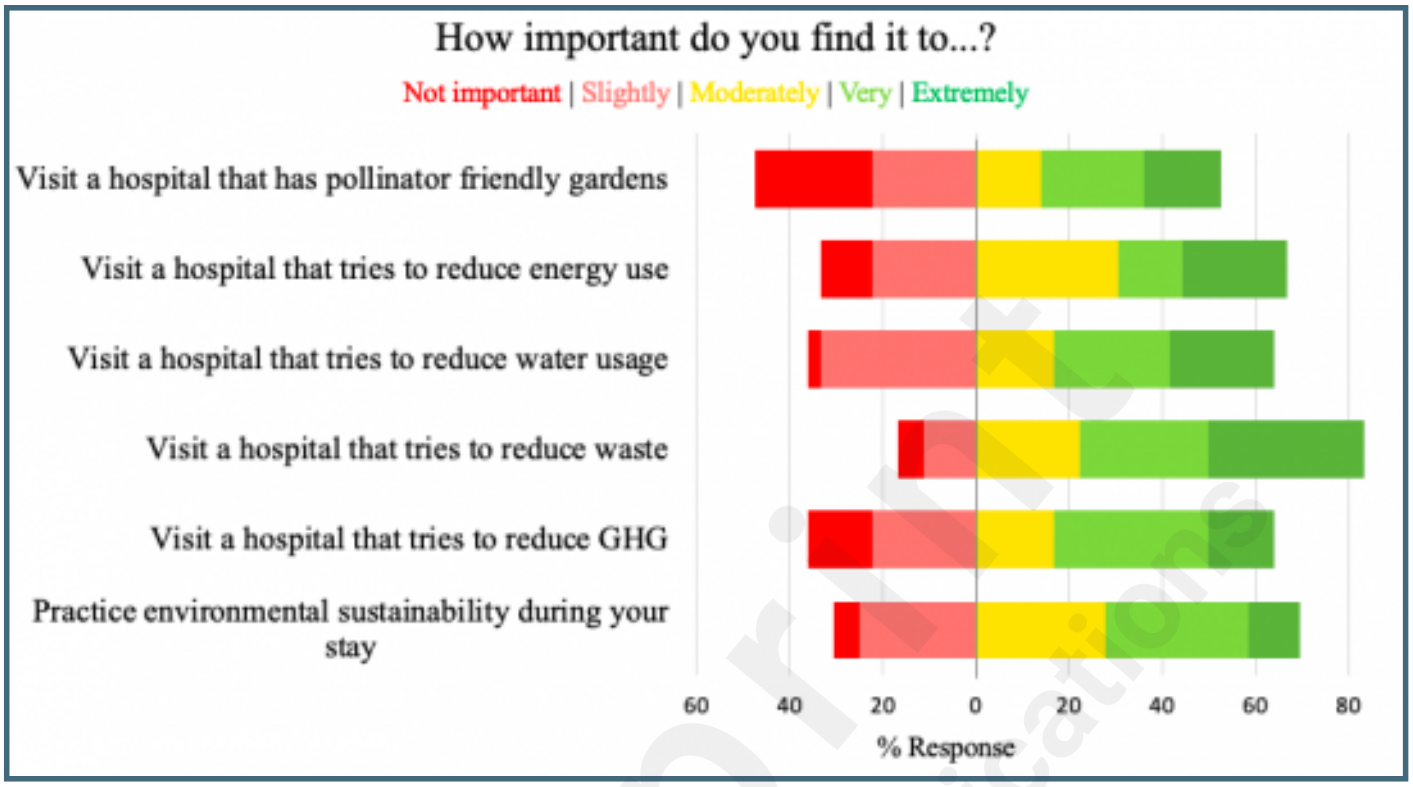
Patients' perspectives on key values in hospital environmental practices.



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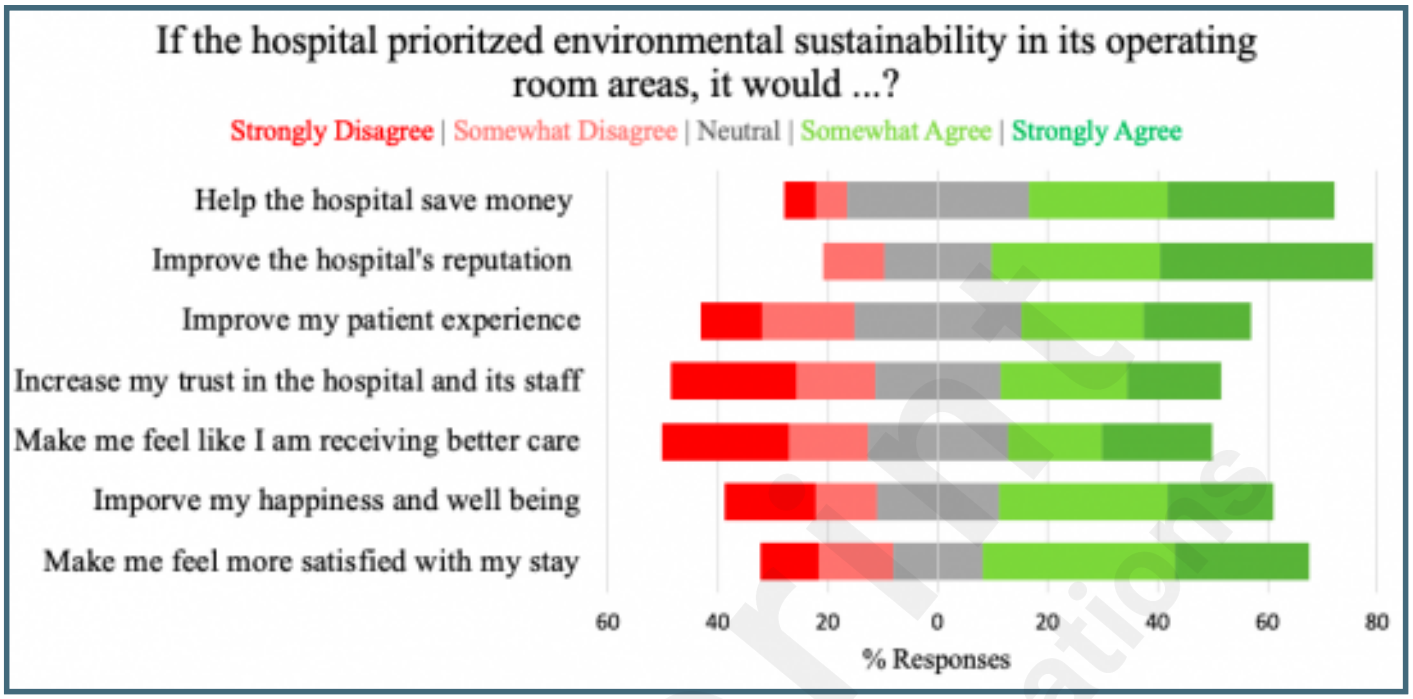
Attitudes and perceptions of patients on the anticipated outcomes of improving operating room and hospital environmental sustainability performance.



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