International Health Trends and Perspectives

Environmental stewardship in healthcare: Use of bio-plastics in surgery

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ABSTRACT

The Covid-19 pandemic has contributed to a significant increase in the amount of waste generated by the healthcare industry. Due to a lack of ecologically conscious options and policies, much of the healthcare industries' waste ends up in landfills or incinerated, contributing to landmass pollution and methane gas production and the release of toxic chemicals into the air. Environmental pollutants have been contributing to worsening climate conditions for decades, and the planet is facing a dire climate emergency in the coming years. Surgical departments produce a significant portion of healthcare-generated waste (HCGW) but can positively influence the health sector to pursue ecologically protective adaptations. Procedural and product changes to environmentally friendly products, like bio-plastics, can help limit plastic waste produced by surgical departments and reduce overall waste created by the industry. By integrating bio-plastic alternatives into hospital surgical practices, surgery departments can demonstrate how environmental stewardship can be prioritized within the healthcare industry.

KEYWORDS

Bio-Plastic, Community Development, Health Plan Implementation, Medical Waste, Surgical Products

BACKGROUND

Environmental Stewardship in Healthcare

Concern for planetary welfare has been at the forefront of public attention in recent years. There is a consensus in the literature that the ongoing climate crisis is the most significant threat to human welfare, and without intervention, it will have catastrophic implications for life on earth (Ahmed, 2020; Costello et al., 2009; Hensher, 2020; WHO, 2019). As a result, a notable shift in focus is occurring across various professional landscapes to incorporate aspects of environmental sustainability in business models, corporate values, and services administration (Hensher, 2020; Sherman et al., 2020). However, the recent onset of the Covid-19 pandemic has caused unforeseen challenges and setbacks in implementing ecologically protective practices. It has generated excessive additional waste in the form of disposable personal protective equipment and exacerbated the threat to the environment (Patrício Silva et al., 2021).

Moreover, non-recyclable, non-biodegradable products are disproportionately utilized in the health sector, most significantly by hospital surgical departments, which account for 1/3 of hospital waste despite representing a far smaller physical presence in the healthcare system (Wyssusek et al., 2019). This literary review will contribute new analyses and recommended solutions to the literature's emerging ecological

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concepts in the health sector including, the importance of industry accountability and environmental stewardship and sustainable surgical practices in healthcare. Furthermore, a discussion will be included regarding the integration of ecologically protective products, such as bio-plastics, into hospital surgical departments and the potential impact of these changes.

REVIEW OF LITERATURE

Global Pollution and Climate Crisis

Carbon emissions

There is undeniable scientific evidence that we are amidst a global environmental emergency for which humans are responsible. The anthropogenic climate emergency is a multifaceted issue caused by various human activities on the planet, ranging from plastic waste production, utilization of fossil fuels and their associated pollution, and deforestation (Costello et al., 2009). Through decades of research, scientists have discovered the unintended consequences of our actions, including, most notably, the greenhouse gas effect (GHGE) from carbon dioxide (CO2) emissions (Australian National University ANU, n.d.; Costello et al., 2009).

Overall, little action was taken to significantly limit or reduce carbon emissions and waste production in these early years of environmental research (ANU, n.d.). The GHGE is causing a rise in global temperatures far beyond pre-industrial levels and what has been deemed a safe threshold of 2°C (Costello et al., 2009; NASA, 2021). International agencies and governments are working to reduce global GHGE in the hopes of remaining below a 2°C global temperature increase, which could still have potentially dangerous consequences (Buis, 2019; United Nations Climate Change Conference, UNCCC, 2021). Drastic changes to rainfall patterns, resulting in intense drought or flooding, are potential consequences of a 2°C global temperature increase (Buis, 2019; NASA, 2021). Even within the limits of a safe global 2°C temperature rise, oceans and forests will be drastically impacted (Buis, 2019). Oceans will undergo an increase in acidity, posing a risk to the diversity of marine life, and forests are likely to experience greater loss secondary to fires (Buis, 2019). Additionally, rising seawater levels could cause up to 70% of all coastlines to rise by approximately 0.7 feet, consequently impacting freshwater drinking supplies and risking displacement of coastal region populous (Buis, 2019; NASA, 2021). As temperatures continue to rise, so does the risk-associated severity of environmental consequences. Should temperatures rise to 4-5°C, consequences will include the melting of glaciers, a further rise to sea levels, unpredictable and extreme weather patterns, a disrupted natural state, and the eventual extinction of millions of species (Costello et al., 2009; Hensher, 2020; Sherman et al., 2020).

The United Nations Climate Change Conference, UNCCC (COP26), is a meeting of more than 200 nations in a unified effort to halt climate change by reducing CO2 emissions globally (UNCCC, 2021). Despite goals set by the COP26 group, global emission levels continue to rise and are falling short of the necessary reductions to maintain the planet below the 2°C thresholds. The UNCCC has recognized that pledged modifications to current carbon emissions from major emitting countries worldwide, will only moderately reduce carbon dioxide pollution, from 50 to 47 gigatons of CO2 per year (UNCCC, 2021). Annual worldwide emissions would need to fall below 35 gigatons to effectively limit a global temperature increase to 1.5C (Briggs, 2021; UNCCC, 2021).

The worrying trend of a continuous rise in CO2 emissions is primarily related aspects of modern life in industrialized nations (Chang et al., 2019). The coming decades could be highly volatile for human life if urgent interventions are not prioritized to slow CO2 production and planetary warming (Costello et al., 2009; Hensher, 2020; Steffen et al., 2015). A shift in global culture is needed to prioritize the planet's welfare and mitigate the climate crisis on a more significant scale. Developing new carbon-neutral technologies for transportation, product development, and manufacturing in industrialized and developing nations is needed to reduce CO2

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production and halt the global temperature rise effectively and drastically.

Plastic Pollution

Plastic waste is a severe problem affecting the health of terrestrial animals, marine life, and, subsequently, humans (Chatterjee & Sharma, 2019). Plastic waste accumulation has reached extreme levels due to excessive manufacturing of non-decomposing plastic products and a lack of sufficient recycling methods, facilities, and resources and irresponsible disposal (Chatterjee & Sharma, 2019). Humans' overconsumption of plastic has resulted in gross waste accumulation in oceans with a plastic collection twice as large as Texas now found in the Pacific (Chatterjee & Sharma, 2019; Wetzel, 2021).

Plastics are vulnerable to degradation in ocean waters but are not considered biodegradable, as they do not break down into harmless particles (National Geographic, 2019). Small plastic pieces, 5mm and less, are categorized as microplastics, either manufactured or secondarily created through environmental breakdown (Chatterjee & Sharma, 2019; National Geographic, 2019). Emerging studies examine the extent of micro-plastic contamination of marine life and ocean waters due to human activity (Costello et al., 2009; Chatterjee & Sharma, 2019). Plastic pollutants in ocean waters pose extreme health risks for marine animals and can be fatal when consumed in large quantities or may cause obstruction of fins, flippers, or airways and absorb other contaminants found in ocean water (Chatterjee & Sharma, 2019). Without intensive large-scale interventions, the ongoing climate crisis will have increasingly devastating consequences for humanity and impact those in developing countries the hardest (Costello et al., 2009; Steffen et al., 2015).

Moreover, humans will suffer under current practices, and global ecosystems and biodiversity will be severely compromised (Buis, 2019). It is no longer viable to continue current practices that further contribute to the climate problem with extreme outcomes. All global industries are implicated in climate emergencies and have an ethical responsibility to adjust and reduce emissions and waste production.

Relevance to the Healthcare Industry

Healthcare has an intricate relationship with climate change due in part to the complexity of the industry. A further scientific examination of this relationship, specific to a region, is needed to develop thorough mitigation strategies to combat the climate crisis. However, two distinct trends appear commonly represented in the literature. Firstly, the existing correlation between pollution, climate change, and poorer health outcomes are well documented (Ahmed, 2020; Hensher, 2020). GHGE, plastic, and airborne pollution will worsen natural resource availability in the coming decades without intervention (Costello et al., 2009; Hensher, 2020; Sherman et al., 2020). Therefore, public health and well-being will be threatened by climate change as the planet experiences the consequences of mass industrialization, such as carbon emission pollution, plastic waste accumulation, and the excessive consumption and contamination of natural resources.

Access to fresh water and sufficient food, mass population displacement, mutating viruses and disease patterns, and conflict are factors that will potentially compromise public health (Costello et al., 2009). Those with poorer socioeconomic status and those living in poorer countries are more at risk for experiencing climate-triggered health problems (Costello et al., 2009). Presently, 90% of the world's population is exposed to harmful air pollutants, for which consistent exposure can lead to respiratory illness (WHO, 2019).

Populations living in developing countries often bear the burden of industrialized nations' wastefulness and consumer lifestyles that contribute to far more significant pollution production, carbon emissions and the underlying climate crisis. Those living in developing nations are at greater risk for experiencing adverse climate-triggered health impacts than those living in industrialized nations (Heshner, 2021). Geographical location is considered a significant risk factor for climate-related displacement, lack of access to resources, and an increased population density, which correlates to the associated risk for virus transmission (Costello et al., 2009; WHO, 2019).

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Pollution and poor environmental conditions are the leading cause of non-communicable environmental propagated illnesses worldwide (Landrigan et al., 2018). Environmental pollution, which is projected to increase over the coming decades, is presently responsible for 16% of deaths worldwide and may account for an additional 250,000 lives lost per year by 2050 (Landrigan et al., 2018). Public health concerns secondary to the effects of climate change are innumerable, and the fallout may potentially cause enough illness in the human population to overwhelm global healthcare systems.

Secondly, recent publications examine how the healthcare field is adding to the climate problem through carbon emissions, plastic waste, and air and water contamination (Hensher, 2020; Lenzen et al., 2020; Sherman et al., 2020, Wyssusek et al., 2019). Developing research has illuminated the reality of the healthcare industry's wasteful practices. Healthcare contributes to the global climate crisis, accounting for 1-5% of total global carbon emissions through the production of plastic waste, elevated energy consumption, and air, soil, and water pollution (Ahmed, 2020; Lenzen et al., 2020). As anticipated, the highest producing healthcare sectors belong to industrialized countries with high emission rates in other sectors (Karliner et al., 2019). The health sectors in industrialized nations inclusive of China, United States, and India generate the most carbon emissions, producing >400 megatons of CO2 annually (Hensher, 2020).

The COVID-19 pandemic has substantially affected the amount of waste generated by the healthcare industry and caused delays in developing healthcare-focused environmental protection. The global pandemic has threatened public health and forced nations to prioritize the wellbeing and safety of the human population over sustainable environmental practices (Patrício Silva et al., 2021). The prioritization of human health over planetary wellness is evident by the increase in single-use plastics in the healthcare sector, such as PPE and individual packaging (Patrício Silva et al., 2021). For example, single-use disposable medical masks are ten times more damaging to the environment than reusable masks (Patrício Silva et al., 2021). At the height of the pandemic, medical-generated plastic waste increased by as much as 370% beyond the typical annual average in Spain and China resulting in inadequate disposal methods due to plastic waste far exceeding these regions' processing capabilities (Patrício Silva et al., 2021; Klemes, 2020).

As the pandemic continues to be present in many parts of the globe, researchers anticipate an overall 17% increase in the production of medical purposed plastics, contradictorily to ecological needs of the planet and goals of the UNCCC (Patrício Silva et al., 2021; Prata et al., 2020; UNCCC, 2021). To create ecologically innocuous protocols and zero carbon emissions in the health sector, transparent healthcare accountability in the climate crisis is necessary, and HCGW during the Covid-19 pandemic is no exception.

Significance to Surgical Discipline

Surgical departments generate 33% of all hospital waste but occupy only a fraction of the industry's physical space (Wyssusek et al., 2019). At present, surgical department practices are largely non-sustainable and rely on ecologically damaging products to function (Wyssusek et al., 2019). There are several reasons why the surgical field accounts for a disproportionately high amount of pollution and waste production within the healthcare system (Wyssusek et al., 2019). First, sterilized instruments needed in surgical areas account for many packaging and single-use plastic consumption (Wyssusek et al., 2019).

Second, not all plastic products are recyclable, and recyclability may vary by location depending on regional resources, policies, and waste management capabilities (Wyssusek et al., 2019). Third, recycling and other ecological waste management processes have higher associated costs than waste disposed directly to landfills, and some organizations are not inclined to spend additional funds for environmental preservation (Southorn et al., 2013; Wyssusek, 2019).

Furthermore, Foran (as cited in Wyssuek, 2019), recognized that workplace culture may be negatively influenced by financial motivation causing tentativeness in surgical employees to

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properly dispose of recyclable materials due to associated costs and fear of reprimand. Negative workplace culture and attitudes towards recycling may cause an excessive number of materials disposed of under hazardous material protocols, which has more significant environmental impacts than standard recycling (Southorn et al., 2013; Wyssusek, 2019). Additionally, mandatory PPE needed during the Covid-19 pandemic has generated further waste in surgical areas in the form of gloves, gowns, and masks (Patrício Silva et al., 2021).

Moreover, strict hospital guidelines for equipment sterilization and packaging are another factor that contributes to the excessive use of plastic in surgical areas. Sterilized equipment must be kept free from contaminants and any possible exposure to elements through effective impenetrability of packaging (CDC, 2016). Plastic has long served as an inexpensive option to fulfill these requirements.

SOLUTION: USE OF SUSTAINABLE PRODUCTS

Bio-plastics

The development of sustainable plastic alternatives is underway. Many researchers are examining the variations of biodegradable plastics, or bio-plastics, as a realistic option to replace the harmful products currently in circulation. The term biodegradable applies to products with varying characteristics depending on location and existing legislation.

Generally, biodegradable signifies that environmental microorganisms will help the product decompose naturally (Bano et al., 2018). For example, the United Kingdom requires that any product labelled as biodegradable plastic must completely dissolve in an industrial landfill within two years (Carlson, 2020). Various bio-plastic formulas exist and could replace traditional plastic (Bano et al., 2018). For example, plant cellulose, and polylactic acid have been developed as alternative biodegradable plastics, with a lower carbon footprint than traditional polymer plastics (Bano et al., 2018). Polyethylene glycol is an additive which can alter certain properties found in bio-plastic such as rigidity (Bano et al., 2018). Additionally, new bio-plastics are under development by repurposing waste, which furthers ecological advancement and benefits the planet (Folino, 2020).

Researchers have begun to examine the applicability of bio-plastics in the medical field and to what extent these biodegradable formulas can replace current products. Many of the current known bio-plastic options have desirable physical characteristics like bio-absorbability, structural density, and dynamic modulus that make bio-plastics feasible for use in the medical field (Bano et al., 2018). Bio-plastics can replace current plastic packaging in surgical areas as they could offer similar impermeable and protective qualities for sterile and single-use items (Allen, 2018). Engineered bio-plastics that dissolve in industrial landfills may be the most suitable for the health sector. They would require very little change to existing procedures or waste management resources. Bio-plastic that can decompose in an industrial landfill may be disposed of with regular refuse and will not have the ecologically damaging effects of petrochemicals found in traditional plastics (Folino, 2020).

Informative, educational campaigns for staff to understand the objectives of using bio-plastics and the proper way to dispose of these items would be beneficial in creating a workplace culture focused on environmental protection. Options for replacing products in surgical areas include sterile equipment packaging and drapes, wrappers for single-use items like suction, PPE packaging, garbage bags, cups, cutlery, and other daily use products for inpatients.

While concern over the economic impact of transitioning to ecologically protective products and policies may cause hesitancy and lack of action in the health sector, some hospital facilities have found alternative methods to offset costs associated with these changes (Allen, 2018; Wyssuek, 2019). For example, alternatives to standard municipal waste exist, and some health facilities have adopted bio-plastics that require compost treatment for proper decomposition. Onsite composting would require facilities to create an anaerobic waste processing area where all organic materials, including bio-plastics, can be

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decomposed without exposure to oxygen (Allen, 2018). Several hospitals in the Netherlands have created similar facilities and process all their facilities HCGW using this anaerobic compost system (Allen, 2018).

Decomposition of bio-plastics and other organic waste materials creates biogas consisting primarily of methane, which has been used as supplementary power generation in Dutch hospitals, effectively capitalizing on economic opportunities from these environmentally protective adaptations (Allen, 2018). With opportunity for further revenue streams, initial investments in ecologically protective changes may be more feasible for many organizations.

IMPLEMENTATION

No single model or framework in the literature perfectly fits the implementation process for transitioning healthcare facilities to environmentally protective products and policies. Further development of a more comprehensive framework encompassing various aspects of program changes, implementation planning, community development, and economic considerations is needed to help guide industry professionals through environmentally protective changes.

The development of an environmental task force is a recurring theme in the literature, recognized as a starting point for meaningful change towards ecologically beneficial practices (Ahmed, 2020; Saber, 2020). Saber's model describes how nurses can encourage environmental stewardship in the health sector through a three-step process, including creating a task force, reducing biohazardous waste, and municipal solid waste reduction (2020). Critical aspects of Saber's model are facility-wide education, promotional campaigns, and reassessment approaches for PPE (2020).

Building upon Saber's model, the following recommendations incorporate community development theory, and participative leadership approaches to effect bio-plastic product changes within surgical areas. This recommendation uses the core concepts of community development, focusing on unity and a collaborative effort to achieve meaningful change (Brown & Hannis, 2012; Minkler, 1990). Additionally, participative leadership theory, which allows all team members to express opinions and contribute to projects, has been recognized as a well-received and successful leadership style within the health sector (Al-Sawai, 2013). Through professional multidisciplinary collaboration and the prioritization of stakeholder involvement, task forces may ensure the long-term success of this change initiative through sustained community interest (Brown & Hannis, 2012; Chaskin, 1999; Minkler, 1990).

RECOMMENDATION

Phase One: Establish an Environmental Task Force

A task force group should represent the population that is impacted by the development changes, including a professional multidisciplinary team of organizational management, front line workers, surgical department employees from various professions, and community stakeholders, such as patients or the public (Brown & Hannis, 2012; Chaskin, 1999; Minkler, 1990; Saber, 2020).

Tasks

Using participatory data collection methods to accurately reflect the organization's perceptions, needs, and challenges and those of the invested stakeholders, the task force would complete the following responsibilities (Brown & Hannis, 2012; Saber, 2020).

- Assess stakeholder perception of the recycling needs of the organization's surgical department. Assessment may be completed through targeted interviews, surveys, and group discussions.

- Examine total waste production and plastic consumption per quarter, focusing on inpatient and short-stay surgical areas (Saber, 2020).

- Discuss potential barriers to change and examine the organizational culture towards recycling, environmental protection, and HCGW using employee engagement meetings, interviews, or surveys. This information is valuable to counter

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resistance and develop a tailored change effort that reflects the culture and values of the organization or responds to a lack of knowledge amongst team members.

• Examine disposal processes and waste management agency contracts in place for all surgical department areas. This includes all general waste processed by municipal disposal collection, sharps and biohazard material for incineration, medication disposal, and recycling of workplace products (Saber, 2020).

• Nominate a secondary team responsible for the economic evaluation of the surgical department's current products and disposal processes (Saber, 2020). An organizational accountant, economist, or other financial experts may complete this in conjunction with other task force members.

• Compare initial stakeholder perceptions of the surgical departments recycling needs to the assessments of actual product usage and cost analysis. This comparative analysis will clarify the differences between public perception and the reality of the organization's waste management needs. The information obtained in this step can be synthesized for presentation to stakeholders in phase two.

• Examine realistic options for changes to surgical products, suppliers, and disposal methods, such as onsite anaerobic composting, change to biodegradable products while maintaining municipal disposal methods, or collaborate with local waste management agencies offsite composting.

• Determine which products used in the surgical department can be exchanged for bio-plastics. Increase the use of reusable items that may be sterilized and protected with a bio-plastic barrier (Saber, 2020).

• Connect with bio-plastic suppliers and organize departmental product transition based on budgetary and timeline goals established by the task force.

• Coordinate a transition of waste management systems to enhance organizational recycling, municipal waste or composting to match change initiative objectives.

Phase Two: Presentation of Findings

Create detailed information campaigns to improve awareness and generate support for the initiative (Saber, 2020). Using the data collected from participative data collection methods informs all identified stakeholders of the organization's ecologically protective policy adaptations (Brown & Hannis, 2012). Create additional targeted information campaigns within surgical department areas to inform staff of current products and policies, upcoming changes, and the benefits these changes will offer the environment and the organization. Address areas of concern, barriers to change, or lack of knowledge as identified through data analysis to optimize efficacy of the information campaign.

Phase Three: Initiate Product Exchange

• Following the task force's product and waste management transition process, implement changes to all identified products and disposal methods within surgical departments.

• Complete longitudinal studies examine the impact of these products and policy changes.

• Continue to inform all stakeholders of the progress made throughout the change initiative as frequent follow-ups with impacted community members, including surgical staff, can contribute to better long-term outcomes and easier transition processes (Rosenheck, 2001).

• Quarterly revisions of organizational needs, product usage, waste production, and associated costs should be conducted to generate an overview of all change initiative costs.

Phase Four: Correction or Expansion

Task force groups should meet quarterly to discuss successes and failures of the change initiative process. The implementation plan may be revised to address weakness. Alternatively,

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when successful, the project may expand to other departments or incorporate further ecologically protective products or methods into the existing program. All evaluation results and data should be shared with stakeholders to retain public interest and ensure the longevity of the project (Rosenheck, 2001).

CHALLENGES

Environmental studies concerning healthcare have made significant progress; however, specific limitations exist within the literature. Authors and healthcare experts are just beginning to acknowledge the contributory role of healthcare to the climate crisis prompting generalized studies linking these fields. Research studies on HCGW remain broadly defined, focusing on emission totals per continent, country, or capita and occasionally reviewing individual departmental contributions.

Research studies with more targeted objectives to assess HCGW and local waste management resources are needed to determine to what extent the health sector's waste production is being mitigated by local agencies, governments, and regional health authorities. Specific departmental studies within the health sector, such as a surgical department waste assessment, can help individual organizations recognize their waste production and reduce outputs effectively. These statistics are instrumental in acknowledging the health industry's role in climate change and waste production and illuminate the shortcomings of existing policies and environmental protective plans unique to the health sector.

Furthermore, while some studies have begun to evaluate the economic impact of incorporating ecological policies and practices into healthcare industries, specific reviews regarding departmental changes and ecological product integration remain poorly represented in the literature. Completing a thorough cost analysis of new ecological product integration by the hospital department, including product cost, shipping, stocking, or sterilization fees, and required disposal processing costs, should be completed in various countries. This assessment would provide a realistic overview of all associated costs for changing to ecologically adapted products within a department, such as switching to bio-plastics within surgery across multiple nations.

Economic projections for short-term investment requirements will allow organizations to anticipate financial needs to make changes and budget accordingly during the implementation planning phase of this paper's proposed model. Long-term economic assessment will be helpful to demonstrate how changes may impact, positively or negatively, healthcare spending per department following ecological protective changes. Moreover, special consideration for alternatively continuing current practices has been partially elaborated in future environmental projections with similar or elevated global emission rates. Developing healthcare-specific projections will help incite meaningful change within the

Moreover, few studies have examined in-depth why healthcare agencies have not willingly begun to make progressive changes to more ecologically sustainable practices. Therefore, qualitative studies surrounding healthcare workers' resistance to ecological adaptations should be prioritized. Understanding the underlying factors contributing to the health sector's reluctance or idleness on this topic is essential for the future integration of environmentally protective policies and products within the health sector. Industry and specific departmental culture may play a pivotal role in accepting and overall sustainability of environmental policy change within the healthcare field. Further social studies examining this aspect and change resistance are needed to effectively prepare organizations for transitional processes.

CONCLUSION

Anthropogenic climate change is an urgent threat to human life and planetary wellbeing (Ahmed, 2020; Costello et al., 2009; Hensher, 2020). Left unmitigated, the effects of global warming and climate instability will present insurmountable challenges for the healthcare industry. Media coverage during the Covid-19 pandemic has illuminated how global healthcare has substantially contributed to climate change and pollution. As the health sector acknowledges its involvement in the climate emergency, healthcare

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leaders must prioritize policies to limit further environmental damage (Sherman et al., 2020).

Presently, many surgical departments rely on single-use products that favor monetary savings rather than sustainability. Additionally, health organizations' mislabeling of non-hazardous materials, excessive incineration of surgical refuse, a lack of local recycling methods, and underdeveloped implementation plans continue to contribute to surgical-generated pollution (Wyssusek et al., 2019). A participative leadership approach, known to be successful within the industry, and innovative implementation plans to incite changes in policy, procedure, and supplies within surgical departments are methods to reduce healthcare-generated waste and pollution.

Although surgical field practices alone are not enough to decrease planetary pollution or carbon emissions sufficiently, these modifications may influence healthcare culture towards creating a more sustainable industry. In addition, the public recognizes the health sector as reliable, intelligent, and a prominent figure in community development through which a plan of sustainability could be promoted (Costello et al., 2013; Sherman et al., 2020). Overall, a more environmentally conscious surgical field can contribute to a positive public perception of ecologically sustainable practices and inspire a global movement towards environmental stewardship in all industries.

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