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Sustainability in anesthesia and critical care: Achievements, needs and barriers

The 6th report from the Intergovernmental Panel on Climate Change cautions that human activities have led to an unparalleled acceleration of global warming [1]. This rapid warming has led to alarming effects, including heatwaves, intense precipitation, droughts, air pollution, and biodiversity loss. The public health consequences of these disruptions are significant, including undernutrition due to lower agricultural yields, reduced access to drinking water, population displacement, and an upsurge in respiratory, cardiovascular, mental, and vector-borne diseases [2].

The “One Health” approach shows strong links between environment, plant, animal, and human health. Therefore, health journal editors worldwide have urgently appealed for action to limit average global temperature rises, put a stop to the production of greenhouse gases, destruction of nature, and environmental pollution, and to safeguard public health [3]. One paradox is that healthcare strongly contributes to this public healthcare problem by constituting a noteworthy portion (3–10%) of national greenhouse gas emissions in high-income countries [4]. In addition, the healthcare system plays an active role in environmental pollution, the use of increasingly scarce resources, and induced deforestation [5].

Operating rooms, anesthesia, and critical care units have a major environmental impact due to the mobilization of a large number of healthcare professionals, the uninterrupted operation to ensure continuity of care, the use of large quantities of drugs and medical devices, and significant waste production. They must therefore be one of the prime targets for action to preserve our environment.

This opinion paper aims to provide an overview of sustainability in anesthesia and intensive care medicine, highlighting accomplishments, requirements, and obstacles in several key areas (Table 1).

Claiming sustainable development in healthcare as a priority

Healthcare professionals have long had to consider economic aspects in their strategies, leading to extensive literature on the medico-economic impact of different approaches to patient management. It is now time to integrate ecological considerations into medical practices, in addition to economic considerations and actions that depend on policymakers to reduce the environmental impact of healthcare facilities [6], to achieve the United Nations’ sustainable development goals.

In particular, professional societies must adopt strong and clear positions, by publishing guidelines dedicated to reducing the environmental impact of medical care. The French Society of Anesthesiology and Intensive Care (SFAR) recently published guidelines for reducing the environmental impact of general anesthesia [7], while the European Society of Anesthesiology and Intensive Care (ESAIC) created a Declaration to emphasize the significance of swift action in achieving greater environmental sustainability in anesthesiology and intensive care across Europe [8]. This Declaration offers a shared European perspective on realistic and attainable goals within the field. Its purpose is to serve as a guide for European countries to incorporate into their healthcare plans. Such recommendations will help healthcare professionals in implementing more sustainable healthcare practices; they should now be followed by recommendations from other professional societies to drive the evolution of medical practices [9].

Promoting research in eco-design of healthcare

Research serves as the cornerstone for advancing eco-design in healthcare. Medico-environmental studies must incorporate life cycle assessments (LCA), which encompass the environmental impacts of all care stages: design, manufacture, distribution, use, and end-of-life recovery [10]. This approach enables personalized environmentally friendly practices while ensuring the delivery of high-quality care.

An illuminating example is found in the case of halogenated anesthetic drugs, which are hydrofluorocarbons with an intrinsic greenhouse effect. In particular, LCA studies have shown that desflurane has the highest global warming potential and its recapture is not a viable alternative [11,12]. Targeted information campaigns for anesthesiologists have successfully reduced the use of desflurane, leading to an impressive reduction in

Table 1
Achievements, needs and barriers in ten key areas of sustainability in anesthesiology and critical care medicine.

Common areas of healthcare			
	Achievements	Action or study needed	Limits/barrier
1. Claiming sustainability as a priority in medicine	Enhanced understanding of the impact of the environment on human health Enhanced understanding of the impact of healthcare systems of the environment	LCA studies comparing the environmental impact of medical strategies Guidelines from scientific societies	Insufficient human and financial resources attributed to this kind of studies Lack of shared knowledge about the environmental impact of healthcare systems on public health and possible solutions
2. Education of healthcare providers	Eco-designed care not part of initial or continuing training	Integration of sustainability education for all stakeholders in the healthcare sector	Lack of trainers Time constraints Not given high priority
3. Involving all stakeholders	Educational programs, mainly in anesthesia Institutional priority in some countries (e.g. NHS)	Multidisciplinary green teams Cross-functional initiatives between the operating theaters and intensive care units Creating eco-scores for healthcare products	Working in silos, specialty by specialty Lack of transparency from industry on drug and device LCA
4. Tackling over prescribing	Enhanced understanding of the impact of over-diagnosis and ineffective over-treatment	Assessment of the environmental cost of over-diagnosis and over-treatment. Guidelines / Preventive medicine	Numbers and profitability driven healthcare management
Specific areas to anesthesia and critical care medicine			
	Achievements	Action or study needed	Limits/barrier
5. Reducing and optimizing the use of halogenated gases	Life cycle assessments of hypnotic drugs Environmental guidelines Meta-analysis showing similar outcomes regardless of the hypnotic drugs used	End of desflurane use Sevoflurane and propofol environmental impact optimization studies	Marketing issues Resistance to change
6. Piped nitrous oxide waste reduction strategy	LCA of nitrous oxide Studies showing strong waste of nitrous oxide when used with piped systems Well-described side effects of nitrous oxide	Abandonment of the piped nitrous oxide system in current hospitals and in future projects	Resistance to change
7. Promoting reusability whenever feasible	Some LCA studies showing that use of reusable products is generally more sustainable	More LCA studies Professional guidelines Institutional policy More LCA studies	Sterilization and washdown capabilities Marketing issues
8. Favor oral route in anesthesia and critical care whenever feasible	Some LCA studies showing that oral route is more sustainable when it is feasible. For example, similar efficacy of oral vs intravenous administration of paracetamol	Guidelines	Resistance to change Lack of studies focusing on LCA and efficacy equivalence
9. Less is more in anesthesia and critical care	Evidence-based prognostic equivalence (low vs high transfusion threshold, early vs delayed renal replacement therapy. . .)	LCA studies assessing the environmental impact of each equal-efficiency strategy	Resistance to change Lack of LCA studies
10. Building climate resilient anesthesia and critical care units	Studies showing the benefits of telehealth and telemedicine in reducing greenhouse gas emissions Multidisciplinary green teams in some centers	Favor use of reusable devices Educational programs Simulation/ protocols scenarios Promote telehealth and telemedicine	Not given high priority Lack of equipment for videoconferencing consultations, inadequate financial support

LCA: life cycle assessment.

greenhouse gas emissions in these hospitals [13,14]. As a result, desflurane has been discontinued in some healthcare centers and banned in Scotland. The next step should be to evaluate the best use of the remaining desflurane alternatives (sevoflurane, Total Intravenous Anesthesia techniques) in all their environmental aspects.

Besides guiding healthcare professionals towards choices with a lower environmental impact, LCA studies can also emphasize the financial advantages of specific environmentally friendly actions, like transitioning to reusable equipment [15] or shifting from intravenous to oral drug administration.

Thus, one challenge lies in equipping physicians with the essential skills to conduct such research and perform precise and relevant LCA. Given these complexities, collaborative efforts with specialized engineering laboratories and securing sufficient funding are imperative to effectively support and expand these research projects.

Involving all stakeholders: competent authorities, healthcare professionals, and manufacturers

LCA of healthcare products requires the active involvement of both healthcare professionals and manufacturers. Unfortunately,

there is currently a dearth of transparency from manufacturers regarding the LCA of the devices and molecules they produce and market. Which intubation probe should be used to limit the carbon footprint of the procedure? Which antibiotic should be prescribed to limit the environmental impact of its disposal? What about endocrine disruptors in medical devices? The list of unanswered questions is long, and the lack of data makes it difficult for professional societies or public bodies responsible for healthcare products to take a position. The complexity stems from the fact that either (I) the LCA study is carried out by the supplier itself: in this case, the complete analysis data is difficult for practitioners to access under cover of industrial secrecy and therefore difficult to use and compare, or (II) the study is carried out by an independent medical team but access to the information is limited, again under cover of industrial secrecy. So, when will the competent authorities make transparency compulsory? Making environmental impact data a condition for the marketing authorization of a product or drug would have the dual advantage of forcing manufacturers to commit to the ecological transition and providing users with greater transparency. Another possible lever for action can be found at the level of purchasing decisions for health products, with the systematic implementation of a standardized environmental criterion based solely on the health product itself. This implies the standardization of analysis criteria and further research is needed in this area (e.g. to develop an eco-score).

Building climate-resilient anesthesia and critical care units

If LCA studies can help healthcare professionals choose the strategy with the least environmental impact, environmentally friendly care can already be based on the 'R' strategy in this order: Refuse, Rethink, Reduce, Reuse, Repair, Reuse, Recycle, and Recover [16]. Doing less does not mean doing less well, as illustrated by the recent French recommendations on low transfusion thresholds. The "right" prescription of supplies, medical devices or drugs is the one that is adapted to the expected clinical benefit, making it possible to improve our care while limiting the environmental impact, and the less the better.

Beyond medications and devices, the sustainability of the healthcare system also involves the establishment of "multidisciplinary green teams". Involving all staff members helps to legitimize and guarantee the continued implementation and success of the developed projects. It enhances the overall understanding of care practices by integrating care organization and quality of life at work.

Finally, the design of climate-resilient anesthesia and intensive care units is a crucial yet understudied area. The COVID-19 outbreak highlighted the importance of resilient healthcare systems, which integrate resource independence and promote environmental sustainability to prevent future crises. For example, the use of reusable devices enables both of these criteria to be met.

Education of healthcare professionals

The integration of environmental concerns into medical strategies should be taught to all healthcare professionals during initial training and should also be the subject of educational programs for practitioners, as well as for health policymakers and hospital managers. A recent study demonstrated that clinicians exhibited higher motivation to modify their behavior when they received education regarding the environmental impact of their practices, compared to being presented with information about monetary savings [17]. Some universities have started implementing educational interventions in their undergraduate curricula [18]. A consensus statement on planetary health and education for

sustainable health care has recently been published [9]. The identification of core objectives for teaching sustainable health education deserves further study [19].

Conclusion

In both high-income and low-income countries, considering the environmental impact in medical strategies should no longer be treated as optional. Instead, it must be viewed as an imperative, aimed at reducing morbidity and mortality secondary to environmental alteration [20]. Some actions, such as abandoning desflurane use, have been initiated and need to be further implemented using incentives and guidelines. To move up a gear, we need more LCA studies; we also need to rethink our approach to care by educating caregivers and addressing reluctance and resistance to change. This should be based on the comprehensive benefits of integrating sustainable care, which extend beyond environmental concerns to include cost reduction, ethical and equitable medical practices, and improved quality of life at work. On a broader scale, committing to sustainable development scenarios requires the mobilization of public policies that promote education, training, and research funding. It also requires the engagement of manufacturers, scientific societies, and international cooperation. The advantages of taking 'immediate' action are likely to outweigh the health and economic costs associated with a gradual transition.

Declaration of interest statement

Authors have no conflict of interest to declare.

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