From ESS to L-ESS waste in the operating room*

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Dear Editor:

The detrimental effects of climate change on global health are becoming increasingly evident, also within rhinology. Climate change has been shown to cause a longer and more intense pollen season, while the prevalence of allergic rhinitis is expected to rise due to de novo sensitizations caused by the migration of plants [(1)]. Chronic rhinosinusitis patients will be affected by increasing air pollution as well as changes in spread of potent pathogens and vectors associated with upper airway infections [(2,3)]. Meanwhile, healthcare is an evident contributor to climate change [(4)]. Operating rooms (ORs) have been identified as carbon hotspots due to their high energy consumption [(5)] and the use of anaesthetic gases with high Global Warming Potential [(6)]. Also, ORs have been estimated to generate up to 33% of all hospital waste [(7)].

The "L-ESS waste" project was launched in the Amsterdam University Medical Centre in the Netherlands to reduce the amount of waste produced by endoscopic sinus surgery (ESS), while maintaining surgeon satisfaction and low incidence of post-operative wound infections. In this longitudinal study, baseline measurements were obtained by performing a waste audit following ESS. Surgical waste was collected from the preoperative area, OR and scrubbing area. Surgical waste was categorised per material (paper/cardboard, metal, glass, absorbent pads, polyvinyl chloride, plastic foils, other plastics (incl. polypropylene, polystyrene, nitril and latex) and miscellaneous) and weighed. Derived carbon emission factors were applied per material category to calculate the carbon footprint per ESS in CO_2 equivalent (CO_2e) [(8)]. Consequently, surgical protocols were revised in collaboration with all rhinologists and the chief scrub nurse (Table S1), followed by another waste audit. Additionally, post-operative wound infections were assessed retrospectively in all patients undergoing ESS 21 months before and after implementation of the new protocol. Antibiotic prophylaxis for the duration of nasal packing was standard in both protocols.

As the majority of OR waste consists of disposable materials [(7)], adjustments of the surgical protocol were primarily focused on "refuse" and "reduce", in accordance with the ladder of circularity [(9)]. To prevent overage, the use of a standard procedural tray was refused and the preoperative briefing was utilised to discuss necessities [(7)]. The use of sterile draping, surgical gowns and gloves was discontinued in accordance with ESS guidelines published by the Dutch national committee on hospital hygiene in 2024. Single-use items (e.g. absorbent pads, known to have a high carbon footprint [(5)]) were replaced with reusable alternatives. Blue wrap was repurposed as coverage for tables.

Six waste audits were performed following limited to full-house ESS: four pre-revision and two post-revision of the surgical protocol. Implementation of the new protocol yielded an average reduction of 2.4kg of waste (46%) and 6.8kg CO_2e (39%) per ESS (Figure 1). The contribution of plastics to the total waste was reduced from 86% to 64%. Yearly, this amounts to a reduction of 434 kg waste and 1231 kg CO_2e (on average 181 ESS/year). This can be compared to driving 6006 km in a medium-sized petrol car. Additionally, per ESS a cost reduction could be achieved of €55.3 (87%), totalling up to €10,009 per year. Implementation of the new protocol did not lead to increased post-operative wound infections (n=0/325 vs n=0/363 ESS).

We have demonstrated that simple interventions can lead to evident reductions in waste, carbon footprint and costs of ESS. Seeking collaboration with all relevant stakeholders allows for critical assessment of the existing protocols and subsequent smooth implementation of changes. A waste audit can support quantification of positive impact of interventions. A more extensive life-cycle assessment is necessary to account for emissions of anaesthetic gases and energy consumption, including sterilization and disinfection of reusable materials.

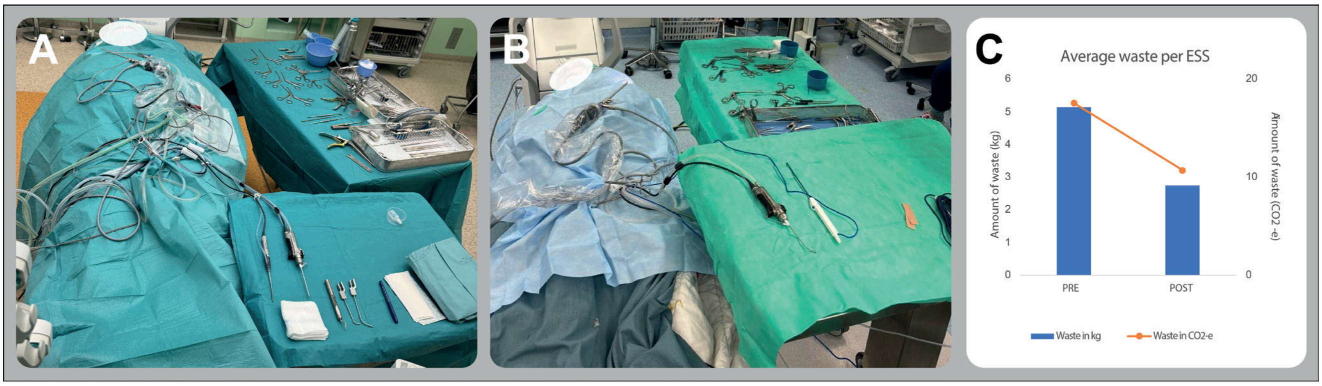

Figure 1. (A, B) Photographs illustrating the contrasting conditions: sterile (left) and non-sterile (right), including repurposing of blue wrap as patient drape and table coverage, and (C) average waste reduction per ESS, presented in kilograms (kg) and kg of CO2e, achievable through the implementation of the new protocol.

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Authorship contribution

MCE: conceptualization, methodology, investigation, formal analysis, writing - original draft, writing - reviewing & editing; LBLB: conceptualization, methodology, investigation, writing - reviewing & editing; NSW: conceptualization, writing - reviewing & editing; SR: funding acquisition, conceptualization, methodology, writing - reviewing & editing.

Conflict of interest

None declared.

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References

1. D'Amato G, Chong-Neto HJ, Monge Ortega OP, Vitale C, Ansotegui I, Rosario N, et al. The effects of climate change on respiratory allergy and asthma induced by pollen and mold allergens. Allergy. 2020 Sep 5;75(9):2219–28.
2. Peeters S, Wang C, Bijnens EM, Bullens DMA, Fokkens WJ, Bachert C, et al. Association between outdoor air pollution and chronic rhinosinusitis patient reported outcomes. Environ Health. 2022 Dec;21(1):134.
3. Uwishema O, Masunga DS, Naisikye KM, Bhanji FG, Rapheal AJ, Mbwana R, et al. Impacts of environmental and climatic changes on future infectious diseases. Int J Surg. 2023 Feb;109(2):167–70.
4. Karliner J, Slotterback S, Boyd R, Ashby B, Steele K. Health Care's Climate Footprint [Internet]. Health Care Without Harm. 2019 Sept [cited May 2024]. Available from: https://noharm-global.org/sites/default/files/documents-files/5961/HealthCaresClimateFootprint_092319.pdf
5. Rizan C, Steinbach I, Nicholson R, Lillywhite R, Reed M, Bhutta MF. The carbon footprint of surgical operations: a systematic review. Ann Surg. 2020 Dec;272(6):986–95.
6. Sherman J, Le C, Lamers V, Eckelman M. Life cycle greenhouse gas emissions of anesthetic drugs. Anesth Analg. 2012 May;114(5):1086–90.
7. Wyssusek KH, Keys MT, van Zundert AAJ. Operating room greening initiatives – the old, the new, and the way forward: a narrative review. Waste Manag Res J Sustain Circ Econ. 2019 Jan 22;37(1):3–19.
8. CO_2 emissiefactoren (Dutch website on carbon emmisionfactors) [Internet]. Online collaboration Milieu Centraal, Stichting Stimular, SKAO, Connekt and Rijksoverheid Nederland. Updated yearly [cited May 2024]. Available from: https://www.co2emissiefactoren.nl/
9. Cramer J. Building a circular future: ten takeaways for global changemakers. Amsterdam Economic Board and Holland Circular Hotspot; 2022.

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This manuscript contains online supplementary material

SUPPLEMENTARY MATERIAL

Table S1. Summary of interventions, in accordance with guidelines published by the Dutch national committee on hospital hygiene in 2024 concerning endoscopic sinus surgery (ESS).

Initial ESS protocol	Revised ESS protocol
Separate pre-operative set for local anaesthesia	Speculum and forceps utilized from surgical instruments set
Pre-operative use of scrub brush for surgical hand preparation	Use of soap and water
Standard Bairhugger	Bairhugger on indication
Standard procedural tray	Specific necessities discussed during pre-operative briefing
Standard surgical instruments set	Reduced surgical instruments set
Multiple gauze packets opened	Reduction of gauzes where possible
Sterile draping for patient and tables	Blue wrap repurposed as patient drape and table coverage
Sterile gowns	Discontinued
Sterile gloves	Non-sterile gloves
Absorbent pads	Reusable towels
Individual 500ml NaCl bags	One large NaCl container
Monopolar suction diathermy	Monopolar suction diathermy on indication