Lukejohn Day, Section Editor

Steps Toward a Greener Endoscopy Unit

Djuna de Jong,[1] Adriaan Volkers,[1] Else de Ridder,[2] Myrte Neijenhuis,[3] and Marjolijn Duijvestein[3]

[1]Department of Gastroenterology and Hepatology, Amsterdam Gastroenterology Endocrinology Metabolism, Amsterdam University Medical Centers, University of Amsterdam, Amsterdam, The Netherlands; [2]MINT Zorgadvies, The Hague, The Netherlands; and [3]Department of Gastroenterology and Hepatology, Radboud University Medical Center, Nijmegen, The Netherlands

Climate change poses a major challenge for the global community. For example, increasing CO_2 concentrations in the atmosphere contribute to climate change. This has consequences on the environment including extreme weather, floods, and infectious diseases, all negatively impacting human health.[1] In Western countries, health care is estimated to contribute 6% to 8% of national greenhouse gas emissions.[2] Therefore, paradoxically, the health care sector has an adverse impact on public health. These emissions are caused mainly by the use of medications, medical equipment, energy usage, commuting by patients and health care professionals, and processing of waste.[3]

The gastrointestinal (GI) endoscopy unit is the second-highest, procedure-related, waste-generating department, with 0.50 to 2.1 kg per endoscopic procedure, the majority of which is incinerated.[4] In addition, with the increased use of disposables, ranging from single-use gowns to advanced equipment such as disposable endoscopes, the amount of waste created will expand in the future. However, in many endoscopy units, a recycling program is lacking, with most waste incinerated.

Here, we describe our experiences of implementing a plastic waste recycling program within the GI endoscopy department and discuss the incorporation of other green practices in endoscopy units.

Plastic Recycling Project

Our study consisted of a baseline waste measurement, followed by a training for employees of the endoscopy unit, and finally a post-training waste measurement. Results from the waste measurements were analyzed by using a previously developed and validated tool: the Healthcare Sustainability Mode and Effect Analysis.[5] This tool can be used to calculate the impact of recycling waste and how this impacts the CO_2 footprint, recycling percentage, and waste processing costs.

Phase 1: Baseline Measurement

Initially, we measured the amount and type of waste produced on February 24, 2020, in the GI Endoscopy unit of the Amsterdam University Medical Centers, a high-volume tertiary referral center with approximately 10,000 procedures performed annually. Waste from 15 procedures was collected and examined; an average of 0.97 kg waste was produced per procedure, of which 85% consisted of residual waste. Overall, the proportion of recyclable plastic waste was 9.6%. In contrast, 5% of waste consisted of plastics that are not suitable for recycling. These plastic products may be clean, but can be interpreted as contaminated by the waste processor (eg, empty syringes and tubes). These should be discarded with residual waste. If this potentially contaminated plastic waste is mixed with the recyclable plastic waste and exceeds a threshold of 5% to 10%, batches are unsuitable for recycling because they may be rejected by the local waste processor. The entire recyclable plastic waste batch will then be discarded as residual waste. However, because the possibly contaminated waste only consisted of 2 product groups (syringes and tubes), it is expected that this percentage will decrease to less than 5%.

Phase 2: Training

Endoscopy unit employees were trained on waste recycling, which included a presentation and question-and-answer session (Supplementary Figure 1 for different types of plastic waste that are accepted for recycling by the waste processor). An extra mobile waste bin was installed in every endoscopy room to separate clean plastic waste in a designated orange bag. Furthermore, a poster was designed with clear instructions on endoscopy waste management (Supplementary Figure 2).

Abbreviations used in this paper: **GI, gastrointestinal; IUS, intestinal ultrasound.**

Most current article

1542-3565
https://doi.org/10.1016/j.cgh.2023.06.007

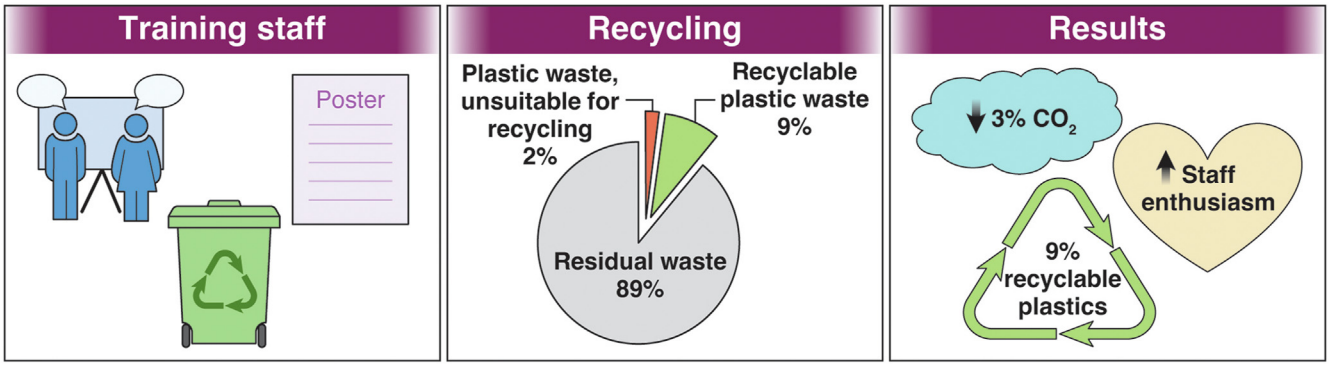

Figure 1. Study overview.

Phase 3: Post-Training Measurement

After implementing the waste recycle training, the post-training measurement was performed 1 year later. The waste separated by the endoscopy employees was checked for correct waste separation by the study team (E.d.R., D.d.J., and M.D.). The waste from 21 procedures was collected during half a day. In total, 0.89 kg waste was produced per procedure, with a proportion of recyclable plastic waste of 8.9% (Figure 1).

During both waste measurements, an equal amount of waste was produced per intervention (0.97 vs 0.89 kg per procedure). Also, the proportion of potentially recyclable plastic waste was similar in both measurements (9.6% vs 8.9%). This indicates that the endoscopy unit nurses are able to separate potential recyclable plastic waste after training.

CO_2 Reduction

The total amount of CO_2 emission of the baseline measurement amounted to 4.69 kg per procedure if no waste was recycled.[6] After recycling, this decreased to 4.55 kg per procedure, resulting in a decrease of 0.14 kg of CO_2 emission per procedure (3%). In our endoscopy unit this equates to a reduction of 1481 kg CO_2, which corresponds to driving a nonelectric car 6875 km, with an emission rate of 0.200 kg CO_2-e/km.[6]

Other Green Initiatives

To create a more sustainable GI endoscopy unit, the classic sustainability principles of reduce, reuse, recycle can be applied. First, one way to decrease waste is to limit (reduce) the amount of unnecessary or incorrect interventions within the department. Second, endoscopy units must critically appraise their current practice by investigating the use of materials and reusable alternatives when appropriate. Finally, waste that is still generated should be collected and recycled. Further illustrations of how to reduce your endoscopy unit's carbon footprint are described below.

Reducing unnecessary upper gastrointestinal endoscopies. The European Society of Gastrointestinal Endoscopy states that reducing the amount of endoscopic procedures is the most important step to reduce the environmental impact of the GI Endoscopic Department.[7] One method to reduce unnecessary upper endoscopies is through patient education. After online education on dyspepsia, there was a decrease in gastroscopies of 40% compared with the control group without education.[8] The online education tool is publicly available on the patient website of the Dutch organization for general practitioners.[9]

Switching to other diagnostic modalities. The recently published consensus agreement of the British Society of Gastroenterology reported that sustainable alternatives to endoscopies should be considered.[10] Fecal calprotectin is a useful biomarker that has been shown to decrease the number of diagnostic endoscopies in patients with suspected inflammatory bowel disease, as well as to accurately predict disease recurrence after surgical intervention.[9] Intestinal ultrasound (IUS) is another sustainable alternative to repeated colonoscopies for patients with inflammatory bowel disease as it can be used to monitor disease activity and response to therapy. The use of IUS is a novel and sustainable alternative on several levels: (1) no bowel preparation is necessary; (2) the procedure requires minimal equipment and therefore produces hardly any waste (ultrasound gel and towels); and (3) performing IUS at the outpatient clinic reduces the carbon footprint by reducing transportation by eliminating another visit. Ultimately, using IUS may lead to a decrease in the

number of (follow-up) endoscopies. However, long-term outcomes currently are being investigated, but it is hypothesized that tight disease monitoring with IUS may result in fewer complications, surgical interventions, and hospital admissions, all positively impacting the carbon footprint.

The role of the medical device industry. Endoscopic devices are provided as a standardized set, frequently containing abundant components. Naturally, these materials may be recycled as we have described in this article, but the industry should play a role in minimizing the environmental impact of their products, such as reducing the amount and size of packaging materials, offering biodegradable options, recycling their (unused) supplies, and providing separate supplies that are used most frequently (eg, separate sponges).

Lessons Learned

Sustainable waste management is relatively easy to implement in daily practice and is visible immediately. However, to implement a plastic recycling program successfully, close collaboration within a multidisciplinary team is essential. A waste management program involves a long chain of departments within the hospital (ie, endoscopic department, infection prevention, logistics personnel, waste processor, purchasing, and an environmental coordinator).

Furthermore, costs should be taken into consideration. In our project, total waste processing costs increased from €1.60 per kg waste processing (no recycling) to €2.08 if plastic waste was recycled (+30%). However, awareness of a more sustainable practice will reduce the number of procedures and use of materials, probably leading to similar or even lower costs in total.

After completing this project, we have experienced an increase in motivation and awareness toward a greener endoscopy unit. A key outcome of this work was the formation of a GI Green Team, which consists of endoscopy nurses, PhD candidates, residents, and gastroenterologists. Several projects have been introduced and completed since its inception, such as switching to reusable personal protection wear, decreased use of bedliners during endoscopy and IUS, introducing reusable mugs instead of paper cups, initiation of a bicycle challenge, and conference visit-by-train for employees. Evidently, all of these interventions are small in terms of impact on the carbon footprint, but can be implemented directly and further boosts the enthusiasm and support among our employees. Green initiatives should unite further on an international level to address these problems with health care systems and industry.

Conclusions

Recycling plastic waste is one example of a small but easily implementable step toward a more sustainable practice in the endoscopy unit. Approximately 10% of waste created in endoscopy rooms consists of recyclable plastic waste. After a short, directed training, our endoscopy unit employees were able to filter out all possible recyclable waste. Because of the visibility of the project, employees were enthusiastic to be involved and to start other green initiatives.

Supplementary Material

Note: To access the supplementary material accompanying this article, visit the online version of *Clinical Gastroenterology and Hepatology* at www.cghjournal.org, and at http://doi.org/10.1016/j.cgh.2023.06.007.

References

1. Watts N, Amann M, Arnell N, et al. The 2018 report of the Lancet Countdown on health and climate change: shaping the health of nations for centuries to come. Lancet 2018; 392:2479–2514.
2. Karliner J, Slotterback S. Health care's climate footprint: how the health sector contributes to the global climate crisis and opportunities for action. Health Care Without Harm; 2019.
3. de Bruin JHT, Merkus K. Een stuur voor de transitie naar duurzame gezondheidszorg. Gupta Strategists, 2019.
4. Namburar S, von Renteln D, Damianos J, et al. Estimating the environmental impact of disposable endoscopic equipment and endoscopes. Gut 2022;71:1326–1331.
5. Ridder E, ed. Healthcare sustainability mode and effect analysis: design, validation, and clinical application of the HSMEA tool to improve the environmental sustainability of healthcare [Master Thesis]. TU Delft, 2018.
6. Greenhouse gas reporting - Conversion factors 2016. Available at: https://www.gov.uk/government/publications/greenhouse-gas-reporting-conversion-factors-2016. Accessed July 13, 2023.
7. Rodriguez de Santiago E, Dinis-Ribeiro M, Pohl H, et al. Reducing the environmental footprint of gastrointestinal endoscopy: European Society of Gastrointestinal Endoscopy (ESGE) and European Society of Gastroenterology and Endoscopy Nurses and Associates (ESGENA) position statement. Endoscopy 2022;54:797–826.
8. de Jong JJ, Lantinga MA, Tan A, et al. Web-based educational intervention for patients with uninvestigated dyspepsia referred for upper gastrointestinal tract endoscopy: a randomized clinical trial. JAMA Intern Med 2021;181:825–833.

9. Maagklachten. https://www.thuisarts.nl/keuzehulp/maagklachten
10. Sebastian S, Dhar A, Baddeley R, et al. Green endoscopy: British Society of Gastroenterology (BSG), Joint Accreditation Group (JAG) and Centre for Sustainable Health (CSH) joint consensus on practical measures for environmental sustainability in endoscopy. Gut 2023;72:12–26.

Correspondence
Address correspondence to: Djuna de Jong, MD, MSc, Department of Gastroenterology and Hepatology, Amsterdam University Medical Centers, Academic Medical Center, PO Box 22660, 1100 DD Amsterdam Zuidoost, Amsterdam, The Netherlands. e-mail: d.c.dejong@amsterdamumc.nl.

Acknowledgments
The authors would like to thank Paul Fockens and Geert D'Haens in supporting this project, as well as all endoscopy employees who have made it possible for us to perform this project.

Conflicts of interest
These authors disclose the following: Djuna de Jong has received a speaker fee from Janssen; and Marjolijn Duijvestein has served as an advisor for Echo Pharma and Robarts Clinical Trials, has received nonfinancial support from Dr Falk Pharma, has received speaker fees from Galapagos, Janssen, Merck & Co, Pfizer, Takeda, and Tillotts Pharma, and has served on the advisory boards of BMS, Janssen, Galapagos, and AbbVie. The remaining authors disclose no conflicts.

Funding
Supported by the Ministry of Health, Welfare and Sport, "Most sustainable healthcare professional 2019" Award, awarded to Marjolijn Duijvestein.

TYPE OF PLASTIC	CHARACTERISTICS	EXAMPLE
HDPE (high-density polyethylene)	Hard plastics e.g., bottles for saline solution	
LDPE (low-density polyethylene)	Soft plastic foils (transparent or coloured)	
PET (polyethylene terephthalate)	Hard transparent plastics e.g. to protect the instrument	

Supplementary Figure 1. Plastic types that can be recycled in a plastic waste stream. HDPE, high-density polyethylene; LDPE, low-density polyethylene; PET, polyethylene terephthalate.

Supplementary Figure 2. Poster waste recycling in the endoscopy room. Reprinted with permission from Mint Zorgadvies.