Article published online: 2023-10-09

Environmentally Sustainable Endoscopy Practices

Mayank Jain[1]

[1] Department of Gastroenterology, Arihant Hospital and Research Centre, Indore, Madhya Pradesh, India

J Digest Endosc 2023;14:144–148.

Address for correspondence Mayank Jain, MD, DNB, Department of Gastroenterology, Arihant Hospital and Research Centre, Indore 452009, Madhya Pradesh, India (e-mail: mayank4670@rediffmail.com).

Abstract

Climate change affects each and every one of us and has far reaching consequences. As healthcare providers and responsible citizens, it is our duty to make our practices environmentally sustainable. Endoscopy practice involves frequent use of single-use items, resource-heavy decontamination practices, water consumption, patient and staff travel as well as high electricity consumption. The present review highlights the measures that can be taken to reduce the carbon footprint of endoscopy practice. Proper waste management, judicious use of electricity, proper selection of cases for anesthesia and biopsy, and appropriate use of noninvasive tests in practice are discussed in the review.

Keywords

- biopsy
- endoscopy
- waste management

Introduction

Climate change affects each and every one of us and has far reaching consequences. As healthcare providers and responsible citizens, it is our duty to make our practices environmentally sustainable. The healthcare sector is responsible for significant greenhouse gas emissions worldwide. Gastrointestinal (GI) endoscopy practice involves frequent use of single-use items, resource-heavy decontamination practices, water consumption, patient and staff travel as well as high electricity consumption. With the awareness that there is an urgent need to reduce environmental impact of healthcare, there is considerable interest in reducing the carbon footprint of GI endoscopy practice. However, this change should not adversely affect the desired patient care, training needs, and clinical standards. Recently, green endoscopy practices have been highlighted in various publications from the West.[1–3] The present review discusses how we can make endoscopy more environmentally sustainable in the Indian milieu.

Magnitude of the Problem

The carbon footprint of endoscopy practice is considerable. It is attributable to high patient load, travel by patients and staff, single-use consumables, waste generation, and resource-heavy decontamination processes. Studies from United States have highlighted that endoscopy is the third highest generator of waste in healthcare. The estimated carbon footprint of endoscopy in the United States is at 85,768 metric tons of CO2 emissions annually, equivalent to more than 9 million gallons of gasoline consumed, 94 million pounds of coal burned, and 212 million miles driven in average nonelectric car. Sequestering these CO2 emissions would require an additional 112,000 acres of new forests per year.[4] Studies have shown that each endoscopy bed-day creates nearly 3 kg in waste, and 13,500 tons of plastic waste in the United States per year are generated by endoscopy practice.[5,6] The West has woken up to the serious environmental consequences of endoscopy practice. Several societies have proposed guidelines and position statements for environmentally sustainable endoscopy practices.[2,7]

Endoscopy Planning

Planning of endoscopy procedures in advance and giving same-day appointments if the patient has two procedures help in reducing travel and sedation related costs. This preprocedure planning also minimizes use of accessories like peripheral lines and tubings. Same-day procedures reduce consumption of water, energy, and personal protective equipment.[8] Upper GI endoscopy before colonoscopy has

article published online
October 9, 2023

DOI https://doi.org/10.1055/s-0043-1775873.
ISSN 0976-5042.

Thieme Medical and Scientific Publishers Pvt. Ltd., A-12, 2nd Floor, Sector 2, Noida-201301 UP, India

been shown to be the optimal sequence since it leads to reduced sedation levels and shorter recovery time.[9,10] Another important aspect is to reduce re-procedure rates. This can be done by proper patient education to assure good bowel preparation and optimization of patient condition before planning the procedure. Re-procedures can be avoided by having a multidisciplinary team planning in complex cases, for example, large polyps, complex endoscopic retrograde cholangiopancreatography, to place patients in appropriate specialist lists.

Rationalizing Endoscopy Workload

Studies have shown that up to 56% of referrals for upper GI endoscopies and between 23 and 52% for colonoscopies may be inappropriate.[11,12] Moreover, endoscopic evaluation seldom helps in guiding management in patients with some chronic scenarios like dyspepsia and constipation.[13] Proper patient selection for endoscopy is, therefore, needed, for example, endoscopic evaluation for patients with dyspepsia/constipation only if alarm symptoms are present or recurrent symptoms are noted, using stool test for *Helicobacter pylori* antigen.

Regular screening endoscopic procedures like surveillance programs lead to significant increase in workload and unnecessary procedures. These can be replaced with noninvasive methods like stool test, colon capsule study, and virtual colonoscopy.[14–20]

Waste Generation and Segregation

Proper waste management involves waste reduction, proper segregation, and disposal. Waste reduction strategies will be discussed later. Proper segregation of waste is important as it reduces the amount of waste going to the landfills. As endoscopy units generate significant amount of waste,[5,6] it is useful that proper waste disposal bins and recycling bins are placed in every unit (►**Fig. 1**). Biohazardous waste products like blood or blood products, soiled materials from patients, suction canisters, and sharp bin material need to be disposed properly as per institutional practices. Disposable gloves and gowns used for endoscopic procedures should not be placed into these containers. It is important to note that nonsoiled plastic waste from accessories and other sources can be diverted to recycling and thereby reduce waste generation (►**Fig. 1**). Repeated education and training of staff are important to make waste management more efficient.[21–23]

The coronavirus pandemic can be regarded as the watershed moment in terms of endoscopy practice. The high-volume use of single-use plastics in personal protective equipment resulted in enormous waste generation. Use of reusable rather than disposable gowns has shown to reduce carbon footprint by two-thirds. Environmental impact of gloves can be reduced by using powder coating gloves rather than chlorination to reduce stickiness.[24] It is important to follow all infection control measures, yet remain aware of the sustainability practices.

Minimizing Paper and Plastic Use

A significant proportion (30%) of all hospital waste is paper. Paper is used for printing reports, taking consent, recording patient vitals, and postendoscopy instructions. Additionally, a lot of departmental activities and communication use paper. Comprehensive use of electronic records for all administrative, nursing, and endoscopic documentation can go a long way in creating paperless endoscopy units.[25] Using recycled paper and printing in black and white should also be considered.[26]

Minimizing Water Wastage

Installation of low flow devices on taps and toilets and using sensor activated taps help in reducing waster wastage. In endoscopy, full hand disinfection is not required and use of

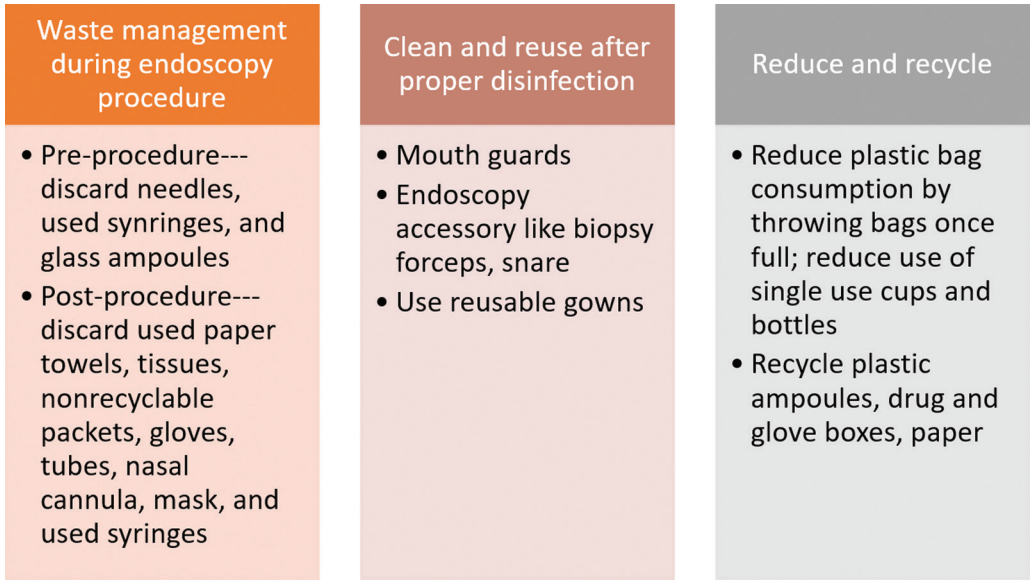

Fig. 1 Proper waste management in endoscopy practice—suggested model in Indian setting.

alcohol rubs instead of hand washing may be done when hands are not visibly soiled or in contact with potential spore-forming pathogens.[27,28] Both alcohol-based gels and petrochemical soaps are not environmentally safe as they contaminate water sources.[29] Use of natural and environment friendly products may be the way forward.

Preventing Electricity Misuse

Endoscopy units use electricity for lighting, air conditioning, computers, printers, and endoscopy equipment. Sources of electricity wastage include usage of energy inefficient bulbs and lack of attention to whether lights and devices such as computers are switched off when not in use and at the end of the working day.[30] Heating, ventilation, and air conditioning are responsible for the greatest proportion of end-use energy in hospitals. Judicious use of these devices and proper implementation of energy saving interventions can go a long way in making endoscopy departments more environmentally sustainable.

Limiting Use of Single-Use Plastics

Majority of the patients who undergo endoscopy are given food and beverages after endoscopy in plastic or polystyrene cups. All single-use disposable cups have significant environmental impact and contribute to carbon footprint. Encouraging patients to bring their own glasses and water bottles may help to curb use of single-use plastics.

Endoscope Cleaning and Disinfection of Equipment—Points to Ponder

Post-procedure cleaning and reprocessing of endoscopy equipment are labor and resource intensive. There is a need to make all steps more energy efficient and environment friendly. The chemicals used in cleaning should have clinical efficacy but minimal environmental impact with suggested characteristics of pH neutrality, biodegradability, and marine life safety certification. In addition, consideration of safety of the chemicals used for the personnel involved in decontamination should also be considered. Research is needed to make such innovative products.[2,7]

Endoscope manufacturers' guidance specifies the use of sterile water in decontamination and through auxiliary water-jet channels. Further, sterile water is used in intraprocedural mucosal washing of colon with pump irrigation, water-assisted colonoscopy, filling syringes, and endoscope reprocessing. Industrial production of sterile water incurs energy consumption and environmental impact at several stages. It is packed in plastic containers and packaging, transported to sites and eventually these containers are discarded into a nonrecyclable waste stream. Use of sterile water can be minimized by proper efforts and using hospital-based system enabling the production of "sterile" water like local reverse osmosis, ultrafiltration or autoclave–sterilization systems. With proper and stringent local infection control and water quality monitoring, use of industrially produced and packaged sterile water can be significantly reduced.[2]

Reuse of Endoscopy Accessories

Endoscopic procedures require multiple accessories like biopsy forceps, hold and cold snares, diathermy pads, and others. In view of risk of cross-contamination and patient safety concerns, these are used as single-use accessories in the West.[2,31–33] The cost of these devices is unrealistic compared to procedural costs and reimbursement rates in Indian setting. Moreover, their disposal after each procedure generates tremendous plastic waste. Whenever such single-use devices are reused, there should be proper guidance as per hospital policies.[34] In India and other resource-constrained areas, majority of the centers use accessories and mouth guards multiple times after proper disinfection. Sterilization is required for reusable accessory that breaches mucosal contact like biopsy forceps.[35] Innovation in equipment design and sterilization techniques is the need of the hour as this may help to facilitate waste minimization.

Reducing Biopsy Load

The carbon footprint of routine histopathology from GI biopsies is immense and processing of every three histology pots is equivalent to the carbon emissions of driving 2 miles in an average car.[36] It is important to discourage use of routine biopsies and avoid biopsies when they are unlikely to change patient management. It is important to use alternative investigations if available and when endoscopy is not a "must," for example, fecal calprotectin for assessing disease activity in inflammatory bowel disease, liver stiffness measurement to identify risk of advanced fibrosis and varices, and use of serological tests to make diagnosis of celiac disease. Research has shown that upper GI endoscopy itself influences the clinical management of patients in approximately only one-sixth of cases.[37] Use of mucosal enhancement techniques, optical biopsy, and artificial intelligence can help in better assessment of polyps and reduce the need for biopsies.[38,39] Further workup is required before the impact of such interventions can be judged.

Anesthesia during Endoscopy

Use of anesthesia/sedation during endoscopy alleviates anxiety and makes patient more comfortable. However, it is associated with significantly higher environmental impact with use of anesthesia equipment, electricity, prolonged hospital stay, and use of inhalational gases like oxygen. It is important of counsel patients properly and create a patient friendly atmosphere so that majority of the diagnostic procedures can be done without anesthesia. Anesthesia should be used only if patient is unwilling for diagnostic procedure without sedation or if a therapeutic procedure is planned.

Single-Use Duodenoscopes—Uses and Carbon Footprint

Of late, there has been considerable interest in single-use endoscopes for GI endoscopy.[40] The advantages of single-use endoscopes include lower acquisition costs, no reprocessing

Table 1 Summary for measures needed for green endoscopy practice

Endoscopy planning—appointments, planning the use of accessories, same-day appointment for multiple procedures, reduce re-procedures, proper preparation for colonoscopy
Rationalizing workload—proper patient selections, use noninvasive tests more frequently
Post procedure cleaning—minimize water wastage, use environment friendly alternatives
Minimize plastic and paper use—discourage use of single-use plastic, recycle plastic and paper, digital repository for reports, electronic records
Minimize water wastage—use filtered water in place of sterile water, low water flow devices, sensor activated taps
Proper waste segregation—proper disposal of waste, dispose plastic bags when full, segregate recyclable waste separately
Reuse endoscopy accessories—whenever feasible
Reduce biopsy load—use image enhanced endoscopy, biopsy only when needed
Reduce anesthesia use

costs, and no risk of cross-contamination. However, to meet ever growing demands of endoscopes, this would lead to increased risk of plastic pollution and increase in net waste.[41,42] Carbon dioxide emissions associated with single-use scopes are 24 to 47 times that of reusable scopes[43] with major emissions being related to manufacturing. In the present scenario, use of single-use duodenoscopes has been restricted to highly selective indications like when infectious risk is of heightened concern; safe and effective decontamination represents a significant challenge; the risk of not performing endoscopy is an overriding concern.

Conclusion and Future Directions

►**Table 1** summarizes the key elements in environmentally sustainable endoscopy practice. Each center needs to identify its challenges, seek support of like-minded people, educate staff, and follow a selective approach for endoscopy practice. A recent single-center study from India has highlighted that despite increasing workload, with proper planning and action, it was possible to cut down on electricity bills, paper use, use of plastics, and number of biopsies taken per month.[44]

Various endoscopy societies in Europe have recommended inclusion of sustainability in the training curricula of GI endoscopy and as a quality domain. There is urgent need to conduct high-quality research to quantify and minimize the environmental impact of GI endoscopy. Industry partners and GI endoscopy companies need to assess, disclose, and audit the environmental impact of their value chain. The final aim is to make GI endoscopy a net-zero greenhouse gas emissions practice by 2050.[7] The dictum for green endoscopy practice today is "reduce, reuse, recycle, research and rethink."

Apart from the measures discussed above, certain practices like use of solar electricity, solar water heating, waste water management, use of recycled paper, and electronic records can be initiated at hospital level. These practices can reduce carbon footprint of hospitals. This appears to be the way forward.

Conflict of Interest
None declared.

References

1 Donnelly L. Green endoscopy: practical implementation. Frontline Gastroenterol 2022;13(e1):e7–e12
2 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(01):12–26
3 Maurice JB, Siau K, Sebastian S, et al; Green Endoscopy Network. Green endoscopy: a call for sustainability in the midst of COVID-19. Lancet Gastroenterol Hepatol 2020;5(07):636–638
4 Siau K, Hayee B, Gayam S. Endoscopy's current carbon footprint. Tech Innov Gastrointest Endosc 2021;23:344–352
5 Vaccari M, Tudor T, Perteghella A. Costs associated with the management of waste from healthcare facilities: an analysis at national and site level. Waste Manag Res 2018;36(01):39–47
6 Gayam S. Environmental impact of endoscopy: "Scope" of the problem. Am J Gastroenterol 2020;115(12):1931–1932
7 Rodríguez 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(08):797–826
8 Triadafilopoulos G, Aslan A. Same-day upper and lower inpatient endoscopy: a trend for the future. Am J Gastroenterol 1991;86 (08):952–955
9 Jowhari F, Hookey L. Gastroscopy should come before colonoscopy using CO_2 Insufflation in same day bidirectional endoscopies: a randomized controlled trial. J Can Assoc Gastroenterol 2020;3 (03):120–126
10 Chen SW, Cheng CL, Liu NJ, et al. Optimal procedural sequence for same-day bidirectional endoscopy with moderate sedation: a prospective randomized study. J Gastroenterol Hepatol 2018;33 (03):689–695
11 Sheffield KM, Han Y, Kuo Y-F, Riall TS, Goodwin JS. Potentially inappropriate screening colonoscopy in Medicare patients: variation by physician and geographic region. JAMA Intern Med 2013; 173(07):542–550
12 de Jong JJ, Lantinga MA, Drenth JP. Prevention of overuse: a view on upper gastrointestinal endoscopy. World J Gastroenterol 2019; 25(02):178–189
13 Badgery-Parker T, Pearson SA, Chalmers K, et al. Low-value care in Australian public hospitals: prevalence and trends over time. BMJ Qual Saf 2019;28(03):205–214
14 Shandro B, Chang V, Mathur J, et al. Real-life cost savings and capacity improvements on implementation of the new BSG post-polypectomy surveillance guideline. Clin Med (Lond) 2020;20 (01):116–117
15 Rutter MD, East J, Rees CJ, et al. British Society of Gastroenterology/Association of Coloproctology of Great Britain and Ireland/Public Health England post-polypectomy and post-colorectal cancer resection surveillance guidelines. Gut 2020;69 (02):201–223
16 Hassan C, Antonelli G, Dumonceau J-M, et al. Post-polypectomy colonoscopy surveillance: European Society of Gastrointestinal

Endoscopy (ESGE) Guideline - Update 2020. Endoscopy 2020;52 (08):687–700
17 Spada C, Hassan C, Bellini D, et al. Imaging alternatives to colonoscopy: CT colonography and colon capsule. European Society of Gastrointestinal endoscopy (ESGE) and European Society of Gastrointestinal and abdominal radiology (ESGAR) guideline - update 2020. Endoscopy 2020;52(12):1127–1141
18 MacLeod C, Hudson J, Brogan M. ScotCap—a large observational cohort study. Colorectal Dis 2022;24(04):411–421
19 Bjørsum-Meyer T, Baatrup G, Koulaouzidis A. Colon capsule endoscopy as a diagnostic adjunct in patients with symptoms from the lower gastrointestinal tract. Diagnostics (Basel) 2021;11 (09):11
20 Cash BD, Fleisher MR, Fern S, et al. Multicentre, prospective, randomised study comparing the diagnostic yield of colon capsule endoscopy versus CT colonography in a screening population (the TOPAZ study). Gut 2021;70(11):2115–2122
21 Azouz S, Boyll P, Swanson M, Castel N, Maffi T, Rebecca AM. Managing barriers to recycling in the operating room. Am J Surg 2019;217(04):634–638
22 Mosquera M, Andrés-Prado MJ, Rodríguez-Caravaca G, Latasa P, Mosquera ME. Evaluation of an education and training intervention to reduce health care waste in a tertiary hospital in Spain. Am J Infect Control 2014;42(08):894–897
23 Wong KFV, Narasimhan R, Kashyap R, Fu J. Medical waste characterization. J Environ Health 1994;57:19–25
24 Patrawoot S, Tran T, Arunchaiya M, et al. Environmental impacts of examination gloves made of natural rubber and nitrile rubber, identified by life-cycle assessment. SPE Polym 2021;2:179–190
25 Siddhi S, Dhar A, Sebastian S. Best practices in environmental advocacy and research in endoscopy. Techniques Innovations Gastrointest Endoscopy 2021;23:376–384
26 Aydemir C, Ayhan Özsoy S, Ozsoy SAIstanbul University Cerrahpasa, Vocational School of Technical Sciences, Printing and Publication Technologies Program, Istanbul, Turkey. Environmental impact of printing inks and printing process. J Graph Eng Des 2020;11:11–17
27 Jehle K, Jarrett N, Matthews S. Clean and green: saving water in the operating theatre. Ann R Coll Surg Engl 2008;90(01):22–24
28 Duane B, Pilling J, Saget S, Ashley P, Pinhas AR, Lyne A. Hand hygiene with hand sanitizer versus handwashing: what are the planetary health consequences? Environ Sci Pollut Res Int 2022; 29(32):48736–48747
29 Daverey A, Dutta K. COVID-19: Eco-friendly hand hygiene for human and environmental safety. J Environ Chem Eng 2021;9 (02):104754
30 Ravindran S, Bassett P, Shaw T, et al. National census of UK endoscopy services in 2019. Frontline Gastroenterol 2020;12 (06):451–460
31 Rizzo J, Bernstein D, Gress F. A performance, safety and cost comparison of reusable and disposable endoscopic biopsy forceps: a prospective, randomized trial. Gastrointest Endosc 2000; 51(03):257–261
32 Deprez PH, Horsmans Y, Van Hassel M, Hoang P, Piessevaux H, Geubel A. Disposable versus reusable biopsy forceps: a prospective cost evaluation. Gastrointest Endosc 2000;51(03):262–265
33 Pasquale L, Maurano A, Cengia G, et al. Infection prevention in endoscopy practice: comparative evaluation of re-usable vs single-use endoscopic valves. Infect Prev Pract 2021;3(02):100123
34 Bhatia V, Bharadwaj V, Tevathia H. Reprocessing and reuse of endoscopic accessories. J Dig Endosc 2021;12:214–220
35 Rai P. Disinfection of endoscopy and reusability of accessories. J Dig Endosc 2022;11(01):61–66
36 Gordon IO, Sherman JD, Leapman M, Overcash M, Thiel CL. Life cycle greenhouse gas emissions of gastrointestinal biopsies in a surgical pathology laboratory. Am J Clin Pathol 2021;156(04):540–549
37 Ching H-L, Hale MF, Sidhu R, McAlindon ME. Reassessing the value of gastroscopy for the investigation of dyspepsia. Frontline Gastroenterol 2018;9(01):62–66
38 Dekker E, Houwen BBSL, Puig I, et al. Curriculum for optical diagnosis training in Europe: European Society of gastrointestinal endoscopy (ESGE) position statement. Endoscopy 2020;52(10):C10
39 Abu Dayyeh BK, Thosani N, Konda V, et al; ASGE Technology Committee. ASGE Technology Committee systematic review and meta-analysis assessing the ASGE PIVI thresholds for adopting real-time endoscopic assessment of the histology of diminutive colorectal polyps. Gastrointest Endosc 2015;81(03):502.e1–502.e16
40 Darak H, Giri S, Sundaram S. Review: disposable duodenoscopes in the era of climate change—a global perspective. J Gastrointest Infect 2022;12:11–17
41 Shimpi RA, Spaete JP. Quality assurance in endoscopic infection control, disposable duodenoscopes, and the environmental impact of endoscopy. Tech Innov Gastrointest Endosc 2022;24:290–299
42 Dhar A, Hayee B, Wesley E, Stableforth W, Sebastian S. Reducing low risk of transmissible infection in duodenoscopes: at what cost to the planet? Gut 2022;71(03):655–656
43 Le NNT, Hernandez LV, Vakil N, Guda N, Patnode C, Jolliet O. Environmental and health outcomes of single-use versus reusable duodenoscopes. Gastrointest Endosc 2022;96(06):1002–1008
44 Jain M, Agrawal V. Making endoscopy practice environmentally sustainable-Early experience from Central India. Indian J Gastroenterol 2023. Doi: 10.1007/s12664-023-01361-9