

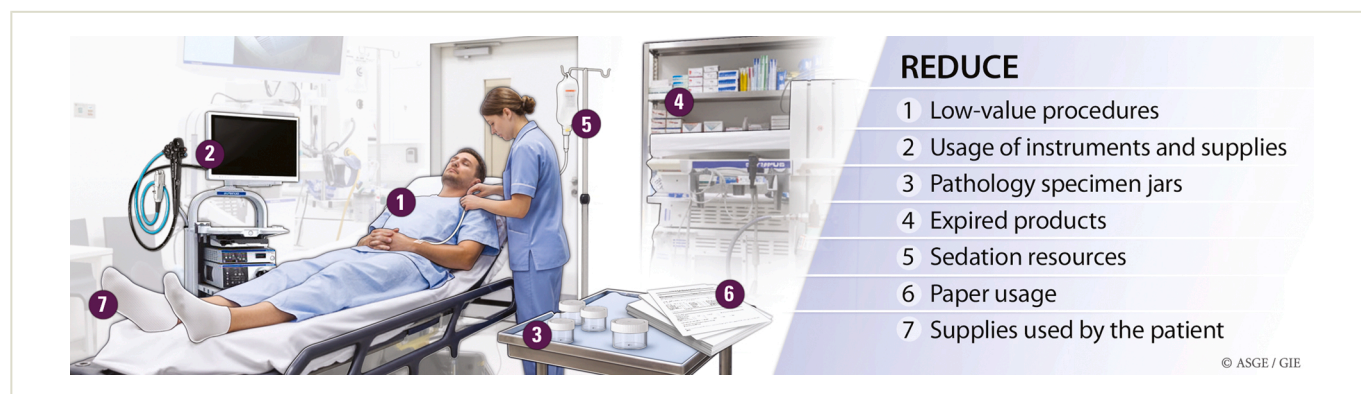


Practical steps to green your endoscopy unit: Reduce!

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GRAPHICAL ABSTRACT



INTRODUCTION

This is the third paper in the series entitled “Practical steps to green your endoscopy unit.” This series provides actionable tips to reduce the use of equipment, supplies, and procedures and thereby lower the environmental impact of gastrointestinal (GI) endoscopy. An introduction to the series includes suggested reading and a glossary of terminology.¹⁻³ Previous articles from this series addressed the topics “How to get started”² and “Appropriate waste management.”³ The topics and practical steps were selected by the members of the American Society for Gastrointestinal Endoscopy (ASGE) Task Force on Sustainable Endoscopy. The selection followed an iterative process of identifying available data, generating a comprehensive list of potential practice changes, discussion, and rating. Throughout the series the selection of tips has been guided by the following principles:

- Practical: Feasible and straightforward to implement with accompanying guidance.
- Impactful: Capable of meaningfully reducing carbon footprint, waste, and other environmental metrics.
- Balanced: Neutral or beneficial concerning quality of care, patient safety, and cost.

- Scalable: Practice changes that can be expanded within and beyond local settings.

The value of “reduce”

“Reduce” is one of the key principles to lower the environmental impact of GI endoscopy. The 4 R’s, rethink, reduce, reuse, recycle, may be expanded to include research, repurpose, repair, or remanufacture. Figure 1 illustrates the hierarchy of waste management strategies, prioritizing actions based on their potential to minimize waste.⁴ Reduce is the most impactful strategy when considering relative cost (effort) and benefits.^{1,4,5} It involves not only decreasing the use of instruments and supplies but also reducing unwarranted procedures and eliminating nonessential activities while maintaining quality. This is particularly relevant for our high-volume subspecialty that predominantly uses single-use supplies.

It should be noted that the endoscopy team is not capable of achieving net zero emissions or eliminating all waste. Endoscopy (and health care in general) will come at an environmental cost. Being green means performing endoscopies of the highest quality (high value) at the lowest environmental cost. Therefore, the emphasis is not only on

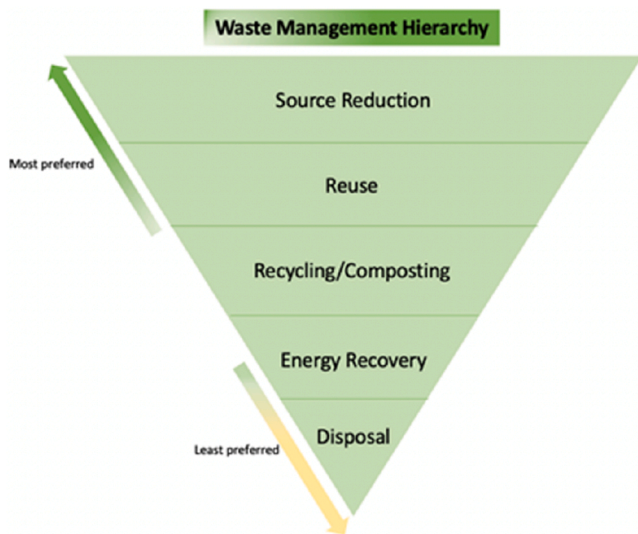


Figure 1. Waste management hierarchy.

reducing unnecessary supplies but also on minimizing low-value procedures.

REDUCE—PRACTICAL STEPS

Reduce low-value procedures

Inappropriate procedures increase costs and overload waiting lists without appropriate diagnostic or therapeutic yield (Table 1). For example, adherence to colonoscopy surveillance guidelines is low, with 17% to 25% of patients undergoing colonoscopies too early.^{6,7} As for esophago-gastroduodenoscopies or upper endoscopies (EGDs), up to 50% of repeat procedures are not appropriate or of low yield and could be omitted, especially when previously performed for the same indication without symptom changes.⁸⁻¹⁰ In Europe, inappropriate EGDs and colonoscopies contribute to an estimated annual carbon footprint of 30,804 metric tons.¹¹

Strategies to reduce low-value procedures include using triaging systems that ensure guideline adherence and defer those of low value as outlined by the recently updated ASGE/American College of Gastroenterology guidelines.¹² In addition, Canadian and U.S. gastroenterology societies provide endoscopy recommendations within their Choosing Wisely initiatives to minimize low-value procedures (Table 2).^{13,14} Because various providers (including GI advanced practice providers) can directly order procedures, educating them about best practices is important. We suggest partnering with other specialties to help reduce overall resource utilization, for instance to minimize overuse of imaging in the emergency department setting that may lead to unnecessary or low-yield endoscopic procedures. Patients also benefit from avoiding low-value and guideline-discordant endoscopic procedures, though clear communication is key to convey risks and benefits.

Low-carbon, low-waste alternatives, when feasible, may be considered. For instance, fecal immunochemical tests reduce the carbon footprint by 60% relative to screening colonoscopy based on waste and travel alone.¹⁵ Other examples include the use of calprotectin and intestinal ultrasound for assessing disease activity in inflammatory bowel disease or the use of non-EGD tissue sampling for Barrett's screening.¹⁶

Finally, using text message reminders initiated up to 7 days before appointments helps minimize "no-shows," last-minute cancellations, and inadequate patient preparation, thereby reducing underutilization of the endoscopy unit and ineffective procedures.¹⁷ In addition, you may institute calls (or text messages) the morning of a colonoscopy to ask about colon preparation adequacy and to offer rescheduling if not clean.

Appropriate selection of procedures is also relevant for the inpatient setting. Best-practice guidance related to indications can be discussed with hospitalist or admitting groups. Most elective endoscopic procedures can be performed on an outpatient basis to avoid overnight hospital stays and hence reduce environmental impact.

Implementation tips

- Establish a triage review system that identifies high-value procedures and defer those that are not indicated, guideline-discordant, or not yet due.
- Engage with referring physicians to ensure appropriate referrals.
- Consider alternative tests to endoscopic procedures when appropriate.

Reduce usage of instruments and supplies

Instruments and supplies can be reduced by effective scheduling, making green purchasing decisions, reusing supplies when possible, and carefully choosing interventions and instruments during a procedure. Scheduling an EGD and colonoscopy for the same patient on 1 day will decrease the need for equipment (including personal protective equipment, intravenous [IV] tubing, and sedation supplies), may allow for the use of only 1 endoscope for both procedures, and reduces patient travel. Notably, up to 45% of endoscopy-related greenhouse gas emissions stem from patients and staff traveling to and from the endoscopy unit.¹⁸

An example for reusing single-use supplies is facemasks, which may be used throughout a day. A review of prepackaged kits may show that some items are rarely used, and purchasing decisions may be modified to only include essential supplies.¹⁹ Similarly, planning ahead and using only instruments that are essential to perform a high-quality endoscopy will further reduce waste. For instance, when a diminutive polyp is detected during a colonoscopy, use a snare as the initial instrument (instead of a forceps), thereby avoiding the need for a second instrument if another larger polyp is found.^{20,21} Furthermore, perform interventions of proven benefit. For instance, prophylactic clip closure is not indicated for polyps less than 20 mm, for ≥ 20 mm in the left side of the colon, or for any polyp that was removed

TABLE 1. Practical steps to reduce carbon footprint in the endoscopy unit

Steps	Description	Impact and effort
1. Reduce low-value procedures	- Review your current practice, assess the proportion of procedures that are not indicated or of low value - Establish a system to appropriately triage requests and patient preparation (decrease no shows, minimize poor prep)	
2. Reduce usage of instruments and supplies	"Rethink" and plan ahead when scheduling patients or when performing an intervention. What intervention is justified? What instruments and supplies are needed to perform a high-quality endoscopy?	
3. Reduce pathology specimen jars	- Obtain biopsy specimens only when indicated. - Consider one jar for multiple biopsies/polyps	
4. Reduce expired products	- Regularly review expiration dates and use products that are closest to the expiration date first. - Consider reducing the number of various instruments and supplies; and adapt your ordering according to your needs.	
5. Reduce sedation resources	- Choose moderate sedation over MAC and MAC over general anesthesia if no clear indication for deeper sedation. - Minimize medication waste (adapt vial size) and use IV fluids only as needed (not routinely).	
6. Reduce paper usage	- Transition to digital documentation as much as possible - If printing is needed, review and optimize current print materials, print double sided in the most economic printer setting possible	
7. Reduce supplies used by the patient	- Encourage patients to bring their own reusable products, including cups, socks, box for denture. - If needed, use reusable, recyclable, or compostable products.	

 Environmental savings
  Cost savings
  Effort by the team

If data are not provided in the text, these estimates represent the authors' opinion.

IV, Intravenous; MAC, monitored anesthesia care.

by cold resection.²² Simplifying interventions may further reduce the need for instruments ensuring that quality is maintained. For instance, submucosal injection can be omitted for nonpedunculated ≤ 15 mm polyps,²³ and margin ablation can be performed with the same snare that was used for resection, instead of using argon plasma coagulation.^{22,24} Finally, only open supplies when they are ready for use. Sometimes it is clear what instrument is needed and opened, and for whatever reason, the procedure is canceled or aborted before it is used.

Implementation tips

- When multiple endoscopic procedures are indicated for 1 patient, schedule them on the same day.

- Perform interventions only if indicated (avoid taking biopsies of low yield and clip only if indicated).
- Simplify interventions when appropriate.
- Avoid opening unnecessary equipment by choosing 1 instrument at a time (eg, start with a cold snare for polypectomy).

Reduce pathology specimen jars

A single biopsy jar generates approximately 0.29 kg CO₂ equivalent.²⁵ Moreover, tissue samples are obtained during the majority of the 22 million endoscopic procedures performed annually in the United States.²⁶ Formaldehyde, which constitutes formalin, is classified as a group 1

TABLE 2. Choosing Wisely campaign: American Gastroenterological Association (AGA) and Canadian Association of Gastroenterology (CAG) related to GI endoscopy

Choosing Wisely campaign in GI endoscopy (AGA and CAG recommendations)
1. Colonoscopy: Do not repeat average risk colorectal cancer screening (by any method) for 10 years after a high-quality colonoscopy that does not detect neoplasia (AGA) ¹⁴
2. Colonoscopy: Avoid performing a colonoscopy for constipation in those younger than 50* years without a family history of colon cancer or alarm features (CAG) ¹³
3. Colonoscopy: Do not routinely perform colonoscopy in patients with irritable bowel syndrome younger than 50 years without alarm features (CAG) ¹³
4. EGD: Avoid performing an endoscopy for dyspepsia without alarm symptoms for patients younger than 60 years (CAG) ¹³
5. EGD: For a patient who is diagnosed with Barrett's esophagus, who has undergone a second endoscopy that confirms the absence of dysplasia on biopsy, a follow-up surveillance examination should not be performed in less than 3 years per published guidelines (AGA) ¹⁴

EGD, Esophagogastroduodenoscopy or upper endoscopy; GI, gastrointestinal.

*In accordance with Canadian guidelines. Corresponding age in the United States would be <45 years.

carcinogen, and its improper disposal poses environmental and health hazards.²⁷ Avoiding and reducing unnecessary biopsies, therefore, yields meaningful environmental benefits.²⁸⁻³⁰ When appropriate, combining specimens from different sites into 1 container will further reduce the number of jars. For instance, you may place multiple small colonic polyps less than 10 mm in 1 pathology jar, provided that surveillance interval assignment is not compromised (eg, when an additional large polyp defines the interval).²⁸⁻³⁰ Use the smallest jar (ie, 20 mL) available corresponding to the biopsy size to minimize waste.

Implementation tips

- Avoid biopsies that are of low yield (not indicated).
- Collect multiple specimens in 1 pathology jar, when appropriate.
- Use the smallest available pathology jar appropriate for the size of the tissue specimen.

Reduce expired products

Some essential instruments are rarely used and thus more likely to expire (eg, stents). Minimizing the number of expired products will have an environmental benefit and decrease cost.³¹ To reduce the number of expired items, we suggest monitoring expiration dates. Items can be stocked using the "First In, First Out" (FIFO) method, which places products with the closest expiration date at the front to ensure that they are used first. You may further review your inventory to optimize its content, identify essential items, and minimize optional products, which can decrease the number of expired items. In addition, elective ordering in larger quantity with regular shipping (ground transportation) instead of short-term urgent overnight orders (air freight) will reduce emissions from transportation. Explore if infrequently used items can be shared between institutions, or between units within the same system. Work with manufacturers to get infrequently used products on consignment so that products can be returned before their expiration.

Some residual expired supplies may be used for teaching, research, or patient education. Charitable organizations

including Project C.U.R.E. accept donations of expired equipment for use in developing nations and under-resourced settings.³² The World Health Organization provides guidelines for medical device donations.³³

Implementation tips

- Monitor expiration dates of supplies and instruments.
- Use the FIFO method in storage and endoscopy rooms.
- Review inventory, identify essential and optional items, and optimize acquisition.
- Avoid overnight ordering, plan ahead, and order in advance.
- Coordinate with nearby institutions to share rarely used supplies.
- Consider repurposing of expired products for donation, research, or education.

Reduce sedation resources

The use of monitored anesthesia care (MAC) using propofol has increased over the past 20 years.³⁴ MAC requires more supplies than moderate sedation (eg, procedural oxygen mask, infusion pump and syringe, or additional IV tubing) and overall generates more carbon emissions than moderate sedation (yet unpublished data). For endoscopy units that use both MAC and moderate sedation, patients who do not require MAC can be offered moderate sedation. Similarly, the need for general anesthesia should be considered carefully. If general anesthesia is needed, avoid inhaled anesthetics in favor of total IV anesthesia because of a much greater carbon footprint (particularly desflurane).³⁵

If your institution performs moderate sedation using midazolam and fentanyl, evaluate the average doses of these medications that patients receive for sedation and purchase vials that have doses close to the used ones. For example, if most patients get between 3 and 5 mg of midazolam for EGDs, use 5 mg vials instead of 2 mg or 10 mg ones. If your institution stocks multiple options, consider reviewing in the patient's chart what the sedation requirements were in a previous procedure and try to match the dose of the vial that approximates the dose that was used in the past. Similarly, be aware that the residual amount within 1 vial will be disposed and try to minimize disposal.

Finally, instead of routinely using IV fluids, use them as needed. Limited data do not show a safety benefit for its routine use.^{36,37} If IV fluids are given, use 250 or 500 mL bags instead of 1 liter bags to minimize waste and cost.

Implementation tips

- Use moderate sedation instead of MAC when possible.
- Select vial size for sedation based on previous sedation needs.
- Consider using IV fluids as needed (not routinely); if given, use ≤ 500 mL instead of 1 liter bags.

Reduce paper usage

A transition to digital record and documentation will reduce reliance on paper in endoscopy units. A large proportion of health care waste is paper, and it has been estimated that health care is one of the largest paper consumers globally.³⁸ In the United States, pulp and paper production is the third-largest industrial polluter, releasing 100 million kg of toxic pollution each year.³⁹ Recycling may reduce the impact; however, only 68% of paper is successfully recycled.⁴

Going paperless may improve health care efficiency, data security, accessibility, and patient safety.⁴⁰ It can also decrease hospital costs related to paper, printers, ink, storage, and document management and enhance patient engagement and satisfaction.^{41,42} Opportunities to go paperless depend in part on local digital technology that may allow for patient access to medical records, review of procedure and pathology results, and other communication pathways. Digitalization with its increasing need for data storage and energy has its own growing environmental footprint that needs to be considered. Where paper is needed (eg, appointment letters), we suggest to review your current practice (content and layout) and identify opportunities to reduce paper use and printing. These may include using recycled paper and printing in monochrome, double-sided, and economy modes.

Implementation tips

- Transition to digital documentation wherever possible (eg, prep instructions, informed consent, sedation and procedure reports, and discharge instructions).
- Simplify and minimize printed materials when appropriate.
- If paper is needed, use recycled paper and print in double-sided, monochrome, and economy modes.

Reduce supplies used by the patient

Patients are often provided with single-use items such as socks, cups, denture boxes, or bags for personal belongings. After the procedure, they are typically offered food and beverages from disposable containers. As part of the scheduling process you may inform patients of your endoscopy unit's commitment to lowering waste in endoscopy and encourage them to bring their own reusable supplies. If needed, you may provide reusable, recyclable, or compostable products. You may also offer to keep some of the items (eg, denture box or socks), to bring them to the next ambu-

latory procedural or diagnostic appointment, or to keep them for home use.

Implementation tips

- Encourage patients to bring their own socks, denture boxes, reusable cups, or drinking bottles.
- Minimize postprocedure waste by providing reusable, recyclable, or compostable items.
- Offer patients the option to take home some of the products to reuse them.

POTENTIAL PITFALLS AND CONCLUSION

Reducing the number of procedures that are not indicated and the overall use of instruments and supplies in endoscopy may be challenging. It starts with a re-examination of one's own practices: what procedure is truly indicated, what intervention is needed, and what instruments are essential or optional to perform a high-quality endoscopy? Collective efforts are needed to transition to green practices (eg, establishing a triaging system for procedure referrals or reviewing inventory needs). Changes may be needed at an institutional level promoting education and establishing built-in scheduling aids to minimize overuse. In addition, it may be helpful to partner with other specialties to reduce overall resource utilization that can eventually lead to unnecessary or low endoscopic procedures (eg, overuse of imaging in the emergency department setting).

These proposed changes will not only lead to an environmental benefit but also afford cost savings. As outlined in the introductory article to the series, greening the endoscopy unit is a team effort that invites all team members and patients. Providing training and fostering a culture valuing environmental responsibility may encourage adoption of sustainable practices, keeping in mind that quality of care remains the highest priority.

ETHICS APPROVAL

This article was reviewed and approved by the Governing Board of the American Society for Gastrointestinal Endoscopy.

DISCLOSURE

The following authors disclosed financial relationships: S. Crockett: Clinical trial agreements with Guardant, Exact Sciences, and Freenome. L. Hernandez: Stock options in Iterative Health and Liguiglide. H. Pohl: Consultant for Pentax and Olympus. All other authors disclosed no financial relationships. The views expressed in this article are those of the authors and do not necessarily represent the views of the Department of Veterans Affairs or the United States Government.

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Abbreviations: ASGE, American Society for Gastrointestinal Endoscopy; EGD, esophagogastroduodenoscopy or upper endoscopy; FIFO, First In, First Out; GI, gastrointestinal; IV, intravenous; MAC, monitored anesthesia care.

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