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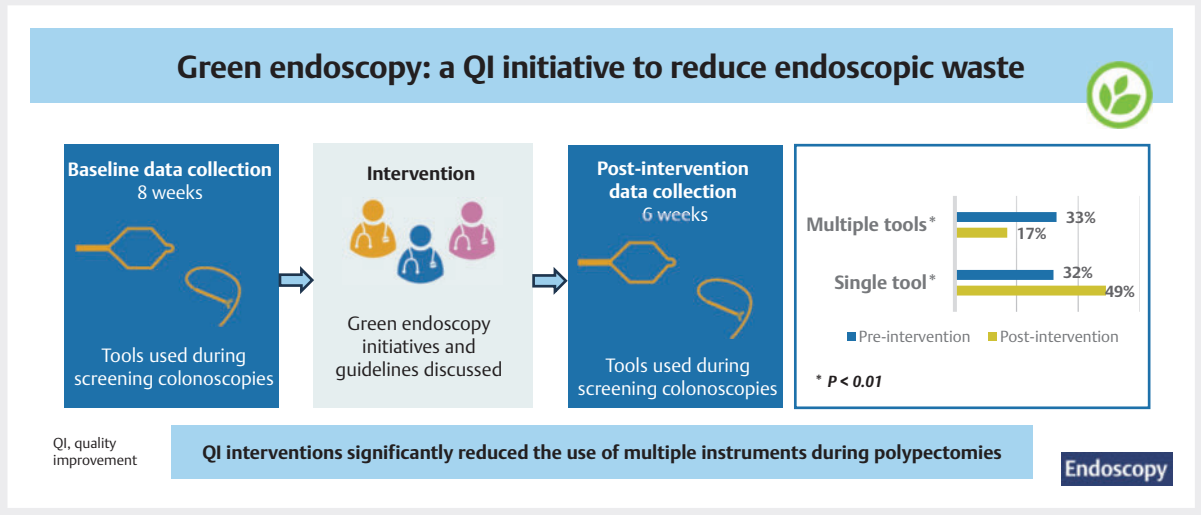
First step to environmentally sustainable endoscopy practice: a prospective study of minimizing multiple device use during screening colonoscopy at a large tertiary center

GRAPHICAL ABSTRACT



Authors
Prateek S. Harne[1], Vaishali Harne[2], Asad Rehman[3], Nirav Thosani[4], Madhav Desai[4]

Institutions
1 Gastroenterology, Hepatology, and Nutrition, Allegheny Health Network, Pittsburgh, United States
2 Pediatric Gastroenterology, The University of Texas Health Science Center at Houston, Houston, United States
3 Gastroenterology, The University of Texas Health Science Center at San Antonio, San Antonio, United States
4 Interventional Endoscopy, The University of Texas Health Science Center at Houston, Houston, United States

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Corresponding author
Prateek S. Harne, MD, Division of Gastroenterology, Hepatology and Nutrition, Allegheny Health Network, Federal North Building, 1307 Federal Street Suite 305, Pittsburgh, PA 15212, USA
prateekharne17@gmail.com

ABSTRACT

Background The healthcare sector generates 8% of greenhouse gas emissions in the USA, of which gastrointestinal (GI) endoscopy is the third largest contributor. Single-use tools are a major contributor to modifiable waste generation during GI endoscopy. Through a quality improvement initiative, we aimed to reduce endoscopy waste by urging gastroenterologists to be mindful of tools used during polypectomies by avoiding using multiple tools.

Methods We discussed green endoscopy initiatives in monthly journal club and business meetings. Over 14

weeks, 210 patients were included in the pre-intervention group and 112 in the post-intervention group.

Results At baseline, 34% of colonoscopies required no intervention, 32% required one tool (either biopsy forceps or a snare), and 33% required multiple tools. After the intervention, the use of just one tool increased (17 percentage point increase; $P=0.003$) and the use of multiple tools decreased significantly (16 percentage point decrease; $P=0.002$). The odds ratio for use of a single tool compared with multiple tools after the intervention was 3.0 (95%CI 1.6 to 5.5; $P=0.005$).

Conclusion This single-center quality improvement study noted a significant change in practice patterns favoring the use of a single tool over multiple tools during colonoscopies after an environmentally conscious practice intervention was applied. This intervention can be readily applied to reduce endoscopy-related waste.

Introduction

Climate change has a devastating impact on human civilization. Healthcare systems contribute 4%–5% of the total greenhouse gas emissions globally [1], of which the USA contributes 7.9%, second only to the Netherlands [2]. Within the healthcare sector, gastrointestinal (GI) endoscopy is the third largest contributor to waste generation [3].

The four major GI societies in the USA – the American Association for the Study of Liver Diseases (AASLD), the American College of Gastroenterology (ACG), the American Gastroenterological Association (AGA), and the American Society for Gastrointestinal Endoscopy (ASGE) – created a strategic plan for environmentally sustainable endoscopy advocacy to curtail the environmental impact of GI endoscopy with the following domains: clinical setting, education, research, society efforts, intersociety efforts, industry, and advocacy [4].

Within endoscopy, the use of disposable, single-use instruments such as biopsy forceps is ubiquitous owing to concerns about cross-contamination and the spread of infection with reusable forceps, which leads to increased waste generation. Careful consideration while using endoscopic accessories and pre-procedure planning have been recommended to minimize waste generation [5]. To establish an environmentally conscious endoscopy practice, we designed a quality improvement initiative to reduce the use of multiple disposable instruments in colonoscopies by gastroenterologists in a large tertiary healthcare center.

Methods

The study was conducted at a large tertiary healthcare academic center in the USA. Patients undergoing screening or surveillance colonoscopies were included in the study. To ensure the standardization of adequate quality, only patients with Boston Bowel Preparation Scale (BBPS) scores of ≥7 were included.

We collected baseline data regarding the patient's age and sex, the number of polyps removed, and the number and type of instruments used during polypectomies in screening/surveillance colonoscopies for 8 weeks before the intervention. Colonoscopies for all other indications were excluded from this study.

Our intervention involved a discussion of green endoscopy initiatives during our monthly meeting with the gastroenterology faculty in an open-ended forum, followed by their implementation in day-to-day practice during our monthly administrative meeting. The meetings took place 3 days apart. In particular, during the course of the two meetings, we presented data showing the contribution of healthcare in general, and gastroenterology in particular, towards the global carbon footprint. We discussed the GI Multisociety Strategic Plan on Environmental Sustainability, specifically the "clinical practice," "education," "research," and "advocacy" domains, to encourage gastroenterologists to reduce waste and make environmentally conscious decisions during their day-to-day practice. We especially highlighted the need for appropriate patient selection and strong adherence to endoscopy guidelines for the resection of polyps to prevent excessive use of single-use instruments, and "team briefs" when applicable. The final decision to use the preferred device was at the endoscopist's discretion after discussing best practice for polyp resection based on the US Multisociety Task Force (USMSTF) and European Society of Gastrointestinal Endoscopy (ESGE) guidance.

The intervention involved six practicing gastroenterologists with varied experience in independent practice (<2 years, n = 2; 2–5 years, n = 2; >5 years, n = 2). All of the gastroenterologists were performing over 500 colonoscopies per year. They were unaware that the use of instruments during colonoscopies was being monitored to prevent the Hawthorne effect. Data on patient's age and sex, the number of polyps removed, and the number and type of instruments used during polypectomies in screening/surveillance colonoscopies was recorded for 6 weeks after the intervention.

The differences between the pre-and post-intervention use of accessories were analyzed using chi-squared tests for categorical values and odds ratio (OR) to demonstrate the association of the exposure and the intervention, with a level of significance of P <0.05. The statistical software STATA 14.2 (Stata Corp., College Station, Texas, USA) was used to perform the analysis.

Results

Over 14 weeks, 210 patients were included in the pre-intervention group and 112 in the post-intervention group. The populations before and after the intervention were comparable regarding indication, demographics, and number of polyps found (▶ **Table 1**).

▶ **Table 1** Characteristics of the pre- and post-intervention groups.

	Pre-intervention (n = 210)	Post-intervention (n = 112)	*P* value
Age, mean (SD), years	56.9 (11.0)	55.3 (13.0)	0.47
Male:female ratio	0.42	0.46	0.45
Polyps per colonoscopy, mean (SD)	1.8 (2.4)	1.6 (2.0)	0.44

At baseline, 34% of colonoscopies required no intervention, 32% required one tool (either biopsy forceps or a snare), and 33% required multiple tools. After the intervention, we observed a significant increase in the use of just one tool (17 percentage point increase; $P = 0.003$) and a decrease in the use of multiple tools (16 percentage point decrease; $P = 0.002$) (▶ **Table 2**; ▶ **Fig. 1**). Endoscopists were more likely to use only a single tool for polypectomy during the entire case compared with multiple tools after the intervention (OR 3.0, 95%CI 1.6–5.5; $P = 0.005$).

Discussion

In this quality improvement study performed at a single tertiary care center, a notable shift in practice occurred favoring the use of a single tool over multiple tools in colonoscopies following an environmentally conscious intervention. We observed threefold higher odds of choosing a single tool over multiple tools during colonoscopies after an open-ended environmentally conscious initiative, thereby reducing the waste generated by endoscopy. While direct waste generation after colonoscopy was not measured in this study, Rex et al. recently examined the impact of one-device colonoscopy among 379 screening and surveillance patients [6]. The authors showed that universal cold snaring of lesions ≤10 mm saved 35 and 47 cold forceps per 100 screening and surveillance patients, respectively.

Lopez-Munoz et al. [7] performed a thermochemical analysis to understand the composition of common endoscopic instruments, such as biopsy forceps, snares, and clips, along with the carbon emissions from their production, transportation, and incineration. Snares produced 0.41 kgCO_2 equivalents (range 0.38–0.44), which was similar to forceps at 0.41 kg CO_2 equivalents (range 0.31–0.47). Carbon emissions varied significantly based on the manufacturer and incineration, highlighting the emission burden of these single-use accessories.

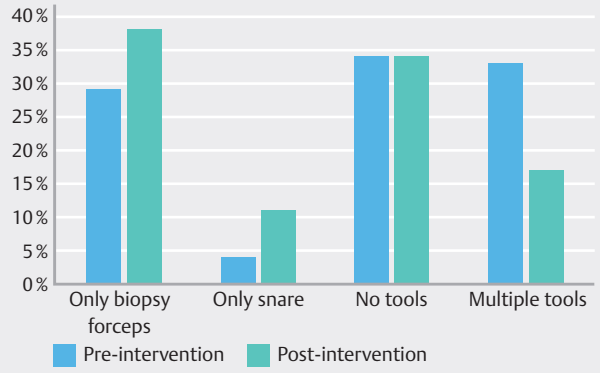
There are multiple factors involved in the carbon footprint of GI endoscopy, which include, but are not limited to, landfill and plastic waste from performance of the procedure, electrical power use, the treatment of waste generated during the endoscopy (both disposable and nondisposable), the manufacturing, processing, and delivery of the endoscopes and instruments, and travel for the procedures [8, 9]. Many of these factors are not however immediately modifiable, like greenhouse gas emissions related to the manufacturing of the endoscopes.

Modifiable factors include changes of practice for procedures such as screening/surveillance colonoscopy and single-tool/device use, strong adherence to guidelines for the performance of endoscopy when best needed, and on-site waste segregation. To prevent the excessive use of single-use disposable instruments, pre-procedure planning, effective communication, and "team briefs" and "huddles" have been proposed [5, 10, 11]. Concerted efforts should be made to reduce unnecessary polypectomies of benign polyps by the use of optical diagnostic imaging, such as narrow-band imaging, during polypectomies [12]. Through our quality improvement project and in line with the ESGE guidelines, the use of snares should be encouraged over forceps, even for diminutive polyps, for complete resection and to conserve tool usage [13].

In addition to these methods, our study demonstrated that quality improvement initiatives centered around improving awareness regarding waste generation and the practice of sustainable endoscopy can significantly reduce waste in endoscopy. Additionally, leadership at institutional, national, and international levels is critical in mitigating the effects of climate change, including the establishment of practical guidelines, strategic plans, and consensus statements by GI societies, which can be helpful to hospital leadership at an institutional level, as well as to individual practitioners, in making their practice more environmentally sustainable [5]. This is especially critical given the results of the recent LEAFGREEN survey [14], where gastroenterologists were surveyed about climate change and sustainability. Over 400 gastroenterologists responded to the survey. The most important factors in reducing the environmental impact of GI endoscopy identified in the survey included a reduction in single-use instruments and appropriate patient selection; however, a lack of knowledge was identified

▶ **Table 2** Comparison of pre- and post-intervention findings.

	Pre-intervention colonoscopies, n (%) (n = 210)	Post-intervention colonoscopies, n (%) (n = 112)	Difference, percentage points (95%CI)	*P* value
No tools	72 (34%)	38 (34%)	0	>0.99
Single tool (biopsy forceps or snare)	68 (32%)	55 (49%)	17 (5.79 to 27.89)	0.003
• Biopsy forceps only	60 (29%)	43 (38%)	9 (−1.64 to 19.87)	0.10
• Snare only	8 (4%)	12 (11%)	7 (1.21 to 14.39)	0.01
Multiple tools	70 (33%)	19 (17%)	16 (5.98 to 24.8)	0.002



▶ **Fig. 1** The use of tools for screening/surveillance colonoscopies before and after the intervention. A statistically significant post-intervention reduction was found for the use of multiple tools.

as a barrier to achieving sustainable endoscopy practice, highlighting the need for education-based interventions for gastroenterologists in this area. The ESGE and European Society of Gastroenterology and Endoscopy Nurses and Associates (ESGENA), in a joint position statement in 2022, also highlighted the need to add education and training about the environmental sustainability of endoscopy into GI curricula [15].

The strengths of our study include its relative ease of reproducibility among community gastroenterologists, tangible results, low cost of the intervention, and possible positive impact of a Hawthorne effect. Limitations noted were that it was a single-center study with a small sample size, and its short-term goal assessment. We also did not assess the impact on total waste generation. Further long-term studies are needed to ensure that the reduction in instrument use does not lead to detrimental outcomes, such as incomplete resections and the development of interval cancers.

In conclusion, this prospective study found a significant change in practice patterns favoring the use of a single tool over multiple instruments for polypectomies during screening colonoscopies after an environmentally conscious intervention. This low cost environmentally sustainable intervention can be applied to reduce endoscopy waste.

Green Stamp Explained

Reduce is one of the major elements to lower the environmental impact of GI endoscopy. Through a simple intervention (discussion of green practice change during a journal club and a business meeting) the need for multiple instruments during a colonoscopy could be lowered by approximately half. This was mostly achieved by continuing with the same instrument that was used for the resection of the first encountered polyp. This study encourages endoscopy teams to test this approach in their own unit.

Conflict of Interest

The authors declare that they have no conflict of interest.

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