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Best Practices in Environmental Advocacy and Research in Endoscopy

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Abstract

Gastroenterology is a known to be a resource intensive specialty mainly due to endoscopy. The contribution of endoscopic activities to the overall carbon footprint is quite substantial akin to that of operating theatres. However, there remains significant knowledge gaps in quantifying this and identifying measures to mitigate the impact. Up until now the endoscopy sustainability in the context of climate change was not particularly in the limelight with some discussions at the fringes but it now needs to come into the mainstream of discussions. Awareness about this problem along with individuals and institutions tackling this issue head on is the need of the hour. There are several challenges, most of them are broad and global but some specific to local endoscopy units and their practices. We must address these issues with utmost sincerity and find ways and avenues to advocate at all levels. Here we discuss the above issues and lay out an initial roadmap to direct our future efforts to gather more data and come up with innovative environmentally friendly actions in sustainable endoscopy. We attempt to address the challenges, opportunities where we can drive forwards on this and provide a roadmap for research in environmental sustainable endoscopy.

Keywords: Green endoscopy; Climate emergency; Sustainable practice; Research.

Introduction

Gastroenterology and in particular Endoscopy is a very resource heavy health care setting. The numbers of endoscopies done in every unit is rising steadily year on year.[1,2] With better technology to diagnose early neoplastic lesions, there is an increase in more therapeutic procedures that are being done endoscopically increasing its scope and nudging itself into the realms of surgery sometimes directly competing with it and other times complementing it. Like operating theatres,[3] endoscopy units consume a lot of energy and use a lot of consumables, most of it being single use based on infection control principles. A lot of clean mineral free water is used to clean and reprocess the scopes.[4] Most centres are now using nitrous oxide for pain relief[5,6] and carbon dioxide for insufflation. All these contribute to the emissions of green house gases (GHGs) and hence the carbon footprint. The carbon footprint of every endoscopy activity has thus far been difficult to enumerate.

In this article, we try to outline some of these problems and then attempt to understand some of the challenges to the implementation of sustainable endoscopy practices. While a few of the challenges are unique to endoscopy, most are general obstacles, which we all as healthcare professionals must face to bring about such large-scale changes. We then discuss some of the opportunities where such changes can be advocated. We conclude this article by providing a roadmap for further research and innovation.

Challenges to Uptake of Sustainable Practices in Endoscopy

There are numerous challenges to achieving a environmentally sustainable net zero carbon endoscopy unit (**Figure 1**)

Provider Challenges

There is a large gap in our knowledge and understanding of how endoscopy contributes to climate change. There is no robust data on how delivery of each procedure causes emission of greenhouse gases. We undertake many practices trying to adhere to guidelines and quality standards some of which may appear to be wasteful. Carbon footprint of these practices is not quantified to any degree of certainty and hence when considering procedures, environment and sustainability are not in the forefront of providers.

While there is increasing awareness among health care providers about climate change and its health implication, many health care professionals are uncertain of their role in addressing this topic[6] at organizational level and individual procedural level.

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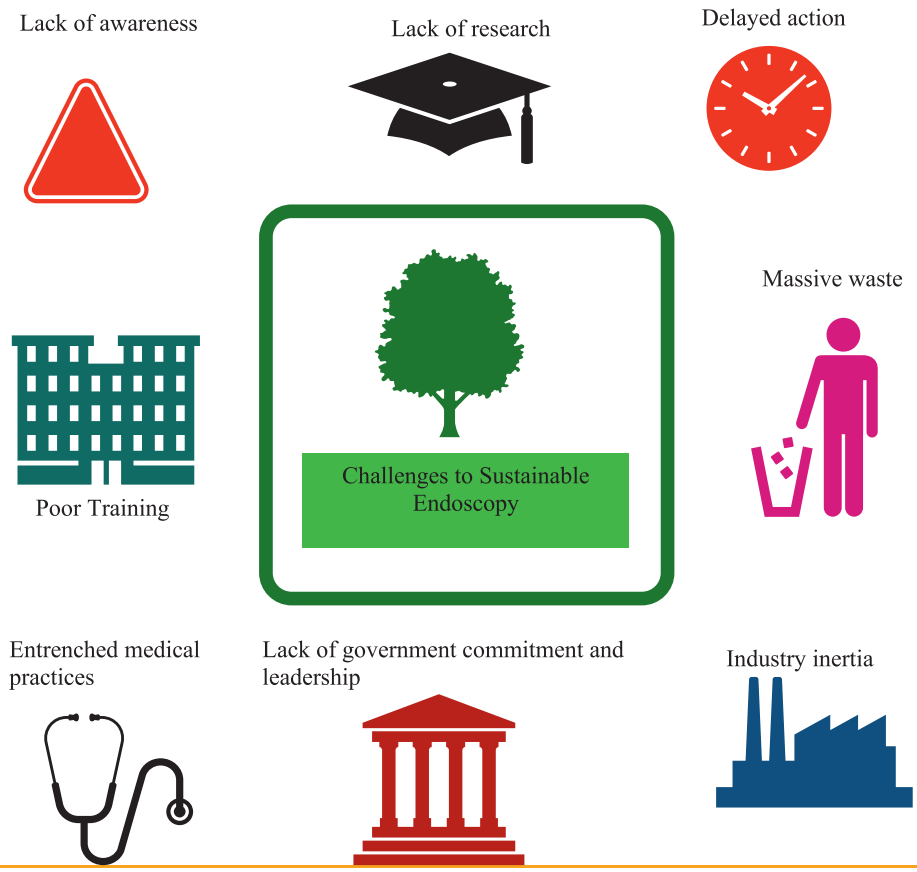

Figure 1. Challenges to environmentally sustainable endoscopy.

There are financial barriers to incorporating organizational changes to environmentally sustainable endoscopy practices.[7] Endoscopy currently comprises a large portion of the daily practice of gastroenterologists in many care settings including publicly funded institutions, in private practice and at academic centres.[8,9] More recently gastroenterologists with subspecialization in advanced endoscopy techniques have emerged and practice essentially as full time endoscopists. Their incomes are dependent largely on the volume of endoscopic procedures and hence attempts at reducing the carbon footprint by reducing endoscopic volumes may need to be balanced against the financial impact on the providers. Additionally, revenue from endoscopic procedures, especially screening colonoscopy, accounts for a large portion of the total revenue of many GI practices. Hence economics and organization of GI practice may not be conducive to promotion of non -endoscopy based screening and diagnostic modalities.[10]

The provider institutions may be reluctant to invest in capital spending schemes to make the infrastructure and equipment more sustainable. Organizations such as the National Health Service (NHS) in UK need to grapple with, amongst others three fundamental challenges: a multi-million pound funding gap; the requirement to reduce our carbon footprint (environmental impact) by 34% by 2020 and; a workforce of 1.3million, whose well-being and productivity is closely linked to environmental health.[11] Often the priority is given to bridging the funding gap rather than investing in long term environmentally friendly buildings, equipment and staff resources.

Industry Challenges

The endoscopes though are reusable, need a lot of energy, water and resources for reprocessing. We use a lot of consumables not just for the procedure but also peri-procedural practices. Almost all the consumables are single use. These accessories are manufactured to the highest standards and are products of innovative engineering. They are expensive. They have limited shelf life and cannot be recycled or reused. Strict regulations govern their use and disposal.

In the last decade the focus of device manufacturers has been more on improving quality of endoscopic images and efficiency of the procedures. There is ever increasing number of accessories to assist the endoscopists, particularly in therapeutic endoscopy rather than investment into manufacture of more sustainable endoscopes prolonging their life span or multiuse devices.

For endoscopy device companies adhering to industry guidelines whilst trying to be environmentally friendly is a challenge, especially in the healthcare sector. Strict regulatory requirements for device certifications means investment in manufacturing reusable accessories are no longer attractive to the industry. Indeed, on the contrary the move from the industry have been to develop single

use endoscopes and endoscopic accessories to enable them to navigate the regulatory hurdles particularly in relation to infection control.

There are also financial factors to consider for the industry. The Gastrointestinal (GI) Endoscopy Devices market in the U.S. is estimated at US$8.2 Billion in the year 2020. The country currently accounts for a 27.11% share in the global market. China, the world second largest economy, is forecast to reach an estimated market size of US$8.3 Billion in the year 2027 through 2027. Within Europe, Germany is forecast to grow at approximately 2.8% CAGR(compound annual growth rate) while Rest of European market will reach US$8.3 Billion by the year 2027 [12]

Within this huge market where demand and volumes are the key drivers for growth, there is limited incentive for industry partners to reduce the demand for endoscopic devices and accessories.

Governmental Challenges

The Covid pandemic has left us all in an exceedingly difficult situation. The healthcare sector both public and private will need a long time to recover from this global crisis which is far from over. It has sent the global economy in to a free fall like never before. The worldwide effort in controlling, dealing, and recovering from the pandemic will no doubt place the government's priorities elsewhere. It is extremely easy to put the climate crisis problem on the backburner or lower down in the list of priorities. There will be a lot of inertia from the government and funding bodies to commit so heavily for this cause. Although this may appear justified, what is needed is overarching leadership with long term vision. Leadership that can look beyond the current and mundane issues is the need of the hour. Support from the Government and funding agencies is the next big challenge. Commitment is needed not just financially but also other prime resources like manpower and timePolitical will and awareness of the urgency of this problem is variable across the globe even in the developed countries. It is not surprising to find some people in high offices denying the climate emergency. This will probably be one of the biggest challenges. In order to meet the ambitious plans and objectives of the Paris agreement, a concerted and coordinated effort is needed cutting across political boundaries and political affiliations.

For example, Scottish government declared climate emergency in April 2019. In response to this, amendments were introduced to the Climate Change Bill to introduce net zero target for all green house gases by 2045. This includes from all healthcare activities.[13]

NHS England has set up a NHS Net zero expert panel,[11] which looks at its own activities including supply chain working with wider partnerships to achieve Governmental targets.

Legislations from governing bodies should not just dictate the aims of meeting the climate change objectives but also create a supportive atmosphere where all stake holders can work together to achieve carbon neutrality.

Along with legislations imposed by the Government, Gastroenterology as a professional body acting through various national and international associations and societies must also take it upon themselves to self-regulate and drive this agenda forwards focussing on action on climate change on equal footing with other academic activities.

Public Health /Population Health Challenges

Climate change is a major health emergency. According to Inter-governmental Panel on Climate Change report, Climate change is a direct consequence of human activities. It is already causing significant impact in perpetuating ill health and suffering. Not unexpectedly climate change will also accelerate health inequalities by affecting poorer nations disproportionately. Increasing human population and the aspirations of the developing world to improve standards of healthcare, to levels as established in the more developed countries further add to this vicious circle. Healthcare services on the contrary contribute to these human activities responsible for GHG. The report from King's fund[14] estimates that NHS England is responsible for £20million tonnes of CO2 emissions annually and spends £50 million to buy carbon permits This challenge is acknowledged in the new NHS report on the future plans for environmental sustainability.[13] .(https://www.england.nhs.uk/wp-content/uploads/2018/05/nhse-sustainable-development-management-plan-2018-2020.pdf). A study from Australia estimated that healthcare activities contributed to 7% of total Carbon emissions annually.[15]

As Endoscopy has developed over the years it has occupied a central role in various health promotion and disease prevention strategies. One of the major influences on the provision of top quality, effective endoscopy services is the widely acknowledged shift in patient demographics with cancer prevalence at its peak in the 85-89 years age group, increasing age is widely accepted as the main risk factor for cancer. This has led to an increase in diagnostic requirements to identify and treat precancerous polyps as part of the bowel cancer screening programme, offered to patients in England aged 55 and in the US from age 45. There are multiple cancer screening and surveillance programmes that use diagnostic endoscopy as a main tool.[16,17] The carbon footprint of these programmes is not known. If we can find better ways of detecting cancers or disease by non-invasive, non-endoscopic methods with better yield, it will most certainly be more carbon efficient.[18–21]

Opportunities for Environmental Advocacy in Endoscopy Practice

Due to increasing demands on endoscopy services, more and more healthcare providers are needing to invest in facilities, equipment and staff for delivering this demand. The pandemic has provided a challenge to the

endoscopic community not only to meet the inevitable increase in demand due to back log but also an opportunity to reconfigure all aspects of the endoscopy service. The idea of transparency in sustainable delivery of endoscopy services will only become more important and hospitals around the world will be held accountable for impacts throughout the lifecycle of delivery of services including information about practices and products.

The interventions we propose should be evaluated on the following dimensions (**Figure 2**)

1. Calculating the carbon footprint for different models of endoscopic devices and services
2. Evaluating the cost effectiveness and carbon cost effectiveness of interventions to specific aspects of endoscopic pathways and devices
3. Global impact of changes in endoscopy devices and practices on carbon cost effectiveness

Endoscopy units have can use a number of bite size interventions and we provide a narrative of these with potential for incorporating audit and research into these interventions to gather quantifiable evidence of their impact on endoscopy carbon footprint. A number of priorities can become the framework for action (**Table 1**)

Healthcare Professional and Endoscopy Units Role

The current endoscopic training does not emphasise at any stage about the environmental impact of our care delivery . From a very early stage endoscopists and endoscopy staff must be trained to think about how their practices, actions and procedures affect environmental health. This added dimension to training and curriculum will then generate a workforce which is sensitised to this critical emergency and motivated to play their part not only in their own personal but also contributing to system changes to reduce endoscopic carbon footprint. This will be the most potent vehicle of bringing large scale changes.

Another vital link is responsibility for each, and every endoscopy practitioner and other staff involved in delivering endoscopy.[22] Every health care worker should take responsibility and act. 23. Having sustainability champions in every team to raise the awareness of climate change and carbon footprint among staff, motivate and encourage members of the team to embrace the recycling ethos, actively seek out new opportunities for recycling, and develop new ideas to replace single-use plastics by critical review and assessment of sustainability principles in all aspects of the service. These champions can use the platform to influence all the members of the wider healthcare team and bring to the table sustainable products and practices from collaborative networks such as the Health Alliance of Climate Change (http://www.ukhealthalliance.org/) . The sustainability champions can propose assessment of the appropriateness of the overuse of endoscopic pathways when non-invasive tests [24] are available to answer the clinical question prompting the request for endoscopy.

We also need to practice what we preach in environmental principles as individual endoscopists.[23] This will involve utilizing the most carbon efficient transport to our work environment and using sustainably produced products for our personal use thereby leading by example. One can use a number of online carbon footprint

Figure 2. Challenges to sustainable endoscopy.

Table 1. Table of priorities

Easy wins – low cost and easy to implement	Intermediate targets – higher cost and more difficult to implement	Long term targets – expensive and global, strategic
1 Recycling waste – waste segregation, raising awareness amongst endoscopy staff	Reducing the need for plastic bottled water by implementing a RO Water plant for filtered clean water to be used for endoscopy	Use of new technologies to reduce the demand for endoscope based diagnostic procedures in Gastroenterology (e.g. colon capsule endoscopy, cytosponge, artificial intelligence enabled radiology, ultrasound)
2 Reducing paper use – electronic reporting and dissemination by email	Reducing plastic containers for water and cleaning agents and moving over to recyclable cardboard containers	Reducing single use consumables in endoscopy, especially high volume low end items like biopsy forceps by re-usable items where feasible
3 Reduce cost of lighting, heating by installing motion Sensor lights, timers on heating controls	Minimise the workforce and travel needs for endoscopy – more community endoscopy where appropriate rather than hospital based diagnostic endoscopy	A global perspective on the most cost effective landscape for diagnostic and therapeutic endoscopy

calculators such as the one produced by the Cool Climate Network (www.coolclimate.berkeley.edu/calculator) and other free carbon footprint calculator resources (https://www.carbonfootprint.com/calculator.aspx)

More importantly, the pandemic has provided us an opportunity to review current endoscopic practices. Due to severely restricted resources, it forced us to concentrate on providing endoscopy to patients who need it the most. We soon realized that some specific settings doing less was actually achieving more. For example, simple change in triaging procedures with senior clinicians responsible for final vetting of procedures resulted in more efficient service by simply requesting alternative non-invasive tests instead of endoscopy in low risk group of patients.[25]

We also need to determine the clinical and environmental value of a given endoscopic procedure and also consider whether combining procedures such as endoscopy and colonoscopy and also “one stop” clinic and endoscopy procedures are feasible. While there may be financial billing pressures in such pathways, combining clinical procedures can significantly reduce the carbon footprint of a single patients care pathway.

We can also interrogate the feasibility of reducing the carbon footprint interprocedurally such as use of single accessory for biopsies, resect and discard policy for low risk polyps[26] and limiting where possible the size or number of biopsy containers used.

One of the `low hanging fruits` but still not achieved in all endoscopy units is incorporation of a `paperless endoscopy unit` principle. Eventually all of the documentation (nursing, administrative, and endoscopic) should be incorporated into a comprehensive electronic management system. Such a system will substantially reduce the paperwork burden, and increase both efficiency and quality control.[27] We need to study the barriers to adoption of paperless endoscopy units by provider surveys and come up with solutions to overcome those barriers. Paperless pathology requests from endoscopy units reduces pathology specimen labelling errors.[28] It will be useful to study and quantify the impact of conversion to a paperless system on the carbon footprint.

Endoscope pre-cleaning is a vital step in reprocessing that should always be implemented at the bedside. Eco-friendly cleaning kit made from bagass a waste product made from sugar cane which is non-toxic, exceptionally light and thereby reducing transport carbon footprint and 100% compostable has been muted as an option.

Institutional Role

Every institution must step up efforts to create green action plans. Endoscopy departments generate huge amounts of waste per year and whilst some processes are necessary there are some that are crying out for change. Using sustainably sourced products is a small step that all departments should be making now and in the future. Challenging green credentials of all products purchased for endoscopy need to be a priority for endoscopy units. Increasing demand from endoscopy services to get transparency about a product from where it is produced and how it is used in the delivery of care, to how it is treated at end of use will be required. Procurement and supply chain professionals are typically not sustainability experts and hence engaging and educating them about the importance of sustainability in purchasing of endoscopy products is key. Research into procurement practices including products purchased with a mandate for green credentials as a criterion is urgently needed. This will enable procurement managers to choose more sustainable options and for the industry partners to invest in developing environmentally friendly products.

At a local level of a health care organization, endoscopy provision is complex and involves many different partners. As such our work on sustainable endoscopy must take a ‘whole systems’ approach. This includes; planning and buying, provision in endoscopy units, staff and patient behaviors relating to environment – all working efficiently and fluidly together. Endoscopy units need to think about ways they can provide “care without

carbon." For this embedding a culture of sustainable behaviors into the workplace should be a priority for healthcare organizations.

Staff and patient numbers and the size of endoscopy estates had increased, and they continue to do so due to increasing demand from areas such as bowel cancer screening. How we occupy buildings, travel between them and share spaces will become increasingly important in the future. We must work even harder to ensure our carbon reduction activity will meet targets despite a larger physical footprint.

Many of the quick wins – such as switching to low energy lighting within endoscopy units, running recycling campaigns and promoting digital documentation need to be implemented at institutional level.

Role of Industry Partners

The involvement from the industry partners is paramount in the effort on action against climate change. Industry must take onus of their manufacturing, distribution and recycling process. But for industry to actively participate, the governmental legislations on medical equipment must be reviewed. Companies must be encouraged to adopt green energy practices and legislations must be appropriately revised to incentivise these practices. Hence the fight against climate action needs support from the industry. Manufacturers of accessories, endoscopy equipment and companies which are responsible for cleaning and re-processing of endoscopes must work together to reduce waste, review processes to make it more efficient and environmentally friendly.

Role of Gastrointestinal Societies

Gastrointestinal societies need to be involved in the drive towards reducing carbon footprint of activities from the specialty. They should join the debate at governmental, organizational and membership level and provide support development of environmentally sustainable practices by their membership. In addition, they should encourage and lobby the industry to come up with environmentally friendly endoscopy devices.

Gastroenterology must continue to advocate for greater endoscopic research funding from government and other major research funding bodies. In this regard consideration of climate change as one of the key themes for research funding from for example, The Welcome trust is a major step forward and the gastroenterology societies and researchers should tap into these. Non-profit organizations and industry funding for research in this field also need to be sought.

Research Roadmap Into Environmentally Sustainable Endoscopy

Research in this field of sustainable endoscopy is limited and only occurring in small patches by some enthusiasts. The recently formed Green Endoscopy network of gastroenterologists has highlighted the need for research as their key objectives.[23] We need large scale cohesive, collaborative research to meet the ambitious timelines that have been drawn. Academic agencies and universities must put this at the top of the agenda and must work on a scale equivalent or more rigorously than development of a vaccine for the Covid pandemic.

Research in this complex area of environmental impact and sustainability related to endoscopy is fraught with several issues: (1) there is limited existing data on the environmental impact of each area of endoscopic practice in terms of CO2 equivalents and greenhouse emissions, (2) endoscope and endoscopic accessories manufacturers have traditionally not taken sustainability into account when designing their products, and it would be useful to liaise with them to develop a project looking at the environmental costs of their products (3) the costs and benefits of single use products compared to re-usable products needs to be researched carefully (4) gastroenterologists and endoscopists are not trained to understand sustainability research and so need to work closely with environmentalists, engineers and economists to design these studies in a scientific manner. How do we overcome these issues?

Quantifying the Carbon Footprint of Endoscopy

Accepting the existence of the crisis and the acknowledgement of the big contribution of healthcare activities to the climate crisis is one of the first challenges to overcome. Every specialty of healthcare sector should understand their own carbon footprint and such accounting must be done robustly to know where the biggest gains can be made. In endoscopy, it is paramount to quantify this problem and hence we can start by defining the scale of the problem. Actual research into the environmental impact of the vast numbers of endoscopic procedures being carried out at institutional or national level is lacking. This is a huge fertile area for good research to be done and will undoubtedly have a great impact on handling the climate crisis head on. The pace and zeal needed for this research cannot be understated.

Quantifying the waste generated by a single diagnostic endoscopic procedure will be useful. As an example this includes: a plastic box containing 4 × 4 gauze, a plastic 1000 mL sterile water bottle, a disposable single use plastic bite block, plastic suction catheter and yankauer, plastic suction tubing connecting the endoscope to suction bottles, plastic packaging of all accessories like biopsy forceps, valves, scope buttons, gloves, rinse sponge etc.1 It has been estimated that one endoscopic procedure generates 1.5kg of plastic waste, of which only 0.3kg is recyclable, and the rest goes to landfill sites.[29]

The carbon footprint of diagnostic endoscopy is huge, but it is also the area where new technology has the potential to reduce the carbon footprint most easily. Some examples of effective diagnostic endoscopy without using traditional re-usable transoral gastroscopes and colonoscopies include screening diagnostic gastroscopy by capsule endoscopes[19,21] or Cytosponge[20] and screening

colonoscopy by using FIT stratified Colon Capsule Endoscopy.[27,30] All of these technologies allow a screening examination to be performed in the community, without the need to travel and also avoids the use of a conventional endoscope together with all its consumables, in a healthcare setting.

Incorporation of advanced imaging for mucosal assessment and decision making is expected to reduce the need for routine biopsies and polypectomy. The COVID adaptation of the British Society of Gastroenterology guidelines for diagnosis of Coeliac disease eliminates the need for duodenal biopsies in patients with a IgA-tissue transglutaminase level >10x upper limit of normal and a positive anti endomysial antibody test.[31]

Similarly, polyps found in the colon can now be characterized using advanced imaging such as narrow band imaging (NBI) or blue light imaging (BLI) and more recently by artificial intelligence (GI Genius or similar technologies) as hyperplastic (NICE Classification Type 1) or neoplastic (NICE Classification Type 2 or 3), thereby allowing decision making for leaving them in situ or resect and discard. This strategy has been shown to be accurate and safe in the DISCARD Study and several other publications.[32] These strategies will be expected to reduce the volume of endoscopic accessories currently used in management of small colonic polyps.

Devices

The risk of transmissible infections through gastrointestinal secretions during endoscopic retrograde cholangiopancreatography (ERCP) in the United States of America in 2018 prompted endoscopy companies to develop detachable end-tips for duodenoscopes and single use duodenoscopes. The first single use duodenoscope was manufactured by Boston Scientific Corporation Inc. followed by Ambu. During this innovative development, the companies have recognized the environmental impact of disposing single use endoscopes. The increasing availability of single use plastic disposable endoscopes in Europe and USA may further add to the plastic waste being generated from endoscopic procedures. It has been reported that the disposal of a single use bronchoscope is equivalent to 349g of household waste. This drive towards using single use or disposable endoscopes was generated by the incidence of duodenoscope related infections in the United States,[33] prompting the Federal Drug Administration (FDA) in 2019 to recommend that healthcare providers and manufacturers transition to disposable components in duodenoscopes to reduce transmissible infections.[34] If all ERCP procedures in the United States were to be done using single use duodenoscopes, this would amount to approximately 400,000 to 500,000 procedures with disposable scopes.[29] It is important to note, however, that although the actual rate of duodenoscope related infection is quite low, and most instances of duodenoscope infection were actually related to human factors errors during reprocessing and could be rectified by proper training.[35-37] A comparative study of the environmental impact of re-usable and single use bronchoscopes has reported on need to compare the costs of disposing a single use plastic bronchoscope to the cost of sterilizing a re-usable bronchoscope with the labour costs, disinfecting equipment and consumables costs.[38] It is also important to consider the life cycle assessment approach of single use and reusable scopes. This paper looks at a comparative analysis of the costs of disinfecting a re-usable endoscope regularly during its life cycle together with the disposal costs of the endoscope at the end of its life, with a single use disposable endoscope; it also included the costs of miscellaneous consumables (gowns, face shields, gloves, shoe covers, masks, wipes, brushes, Sekusept) and personal protection. The CO2 equivalents for disposal of a single use scope were lower than that of the cleaning operation of a single cycle of a re-usable scope. The study was funded by the manufacturer of the single use scope and so there is an element of potential bias.

We need to develop devises which are more eco-friendly in their manufacturing. Research investment and promotion to the new concept of Endoneering [39] will provide us to evaluate and discover the technology and equipment developed with environmental sustainability at all stages of manufacturing.

Changing Existing Care Models

The current care model of Endoscopy is based around the performance of a diagnostic and therapeutic procedures in a purpose-built endoscopy unit either in the community or in a hospital setting. This not only requires a patient to travel from home to the facility (generating greenhouse gases), but also requires staff to similarly travel to work and a conventional endoscope to be used for the procedure, with attendant energy consumption and generation of waste. New and innovative approaches to carry out diagnostic evaluation of the gastrointestinal tract may be able to significantly reduce the carbon footprint of the hundreds of diagnostic endoscopies that are carried out in every country of the world. The approaches may, for example, include (1) Cytopsonge (Medtronic Inc.) examination for screening for upper gastrointestinal cancer in patients with reflux disease or Barrett's oesophagus, (2) capsule endoscopy for screening for suspected cancer in the digestive tract, or oesophageal varices in patients with liver disease, and (3) a Colon Capsule colonoscopic examination in patients who are positive on Faecal Immunochemical test (FIT). While we do not have enough data to endorse these new techniques from a comparative environmental sustainability point of view, their clinical efficacy is validated and promising as potentially disruptive strategies in our current paradigm of diagnostic endoscopy. At the same time, we need to evaluate the carbon efficiency of these technologies compared to conventional diagnostic endoscopic examinations, with the test being non-inferior and equivalent in accuracy, in a large scale well powered RCT.

Finally, the development of Artificial Intelligence in Endoscopy has opened up new disruptive models of AI enabled diagnosis of gastrointestinal pathology using

capsule endoscopy (such as Navicam), and the use of such a technology to make diagnostic endoscopy sustainable as well as effective as a first line investigation needs to be studied. In one study aimed at detecting protruding lesions and classify them into polyps, nodules, epithelial tumors, submucosal tumors, and venous structures, Saito et al. developed a convoluted neural network (CNN) analysis model using 30,584 Capsule Endoscopy images from 292 patients.[40] When this CNN model analyzed 17,507 test images (including 7,507 images of protruding lesions from 73 patients), the AUROC was 0.91 and the sensitivity and specificity were 90.7% and 79.8%, respectively. In the analysis of the classification of protruding lesions, the sensitivity for the detection of polyps, nodules, epithelial tumors, submucosal tumors, and venous structures were 86.5%, 92.0%, 95.8%, 77.0%, and 94.4%, respectively. AI can help reduce traditional biopsy and histopathological assessment.

Endoscopy service demand has grown all over the globe. A lot of times we do these procedures just because we can for minor indications. A more critical review has to take place whereby we limit the use of this service to who need it the most so that the value is optimised. We need to conduct not just a cost-effective evaluation from the financial point of view but also from the environmental perspective.

Recycling Principles

All endoscopy units must be sensitized to the principles of reducing waste and recycling. A large majority of units still do not provide dedicated recycling bins in each room. Almost all the packaging material could very easily be recycled. This responsibility must be reinforced at all levels and units must be held accountable. New designs and innovations must be encouraged whereby recycling becomes easier to achieve. The legislations around medical devices and their reuse and recycle practices must be updated to reflect eco-friendly principles. Best way to reduce waste is to actually use less in the first place. Wasteful practices like opening multiple accessories for a single procedure should be avoided. Endoscopists should plan each procedure and anticipate the accessories they might use for each procedure so that waste can be minimized. We have to learn to make ourselves thrifty for the sake of greener environment.

Recycling industry is expected to grow and develop new technologies to make this process more affordable and efficient. We should adopt these as and when they do become available.

Summary

The endoscopy community needs to join the debate on climate change by advocating, educating, amplifying, promoting, and organizing sustainable endoscopy practices as we and the next generation face the enormous challenges posed by global warming. This needs to be underpinned by research quantifying the carbon cost effectiveness of endoscopic equipment and procedures. Only through the much-needed investment into research and development by major funding bodies that we can solve the problem posed by the impact of endoscopy on greenhouse gas emissions.

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Author Contributions
All authors were equally involved in preparing the manuscript.

Ethical Statement
The study did not require the approval of an institutional review board.

Conflicts of Interest
Siddhi S - None
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