Carbon footprint of gastroenterology practice

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The healthcare sector is a major contributor to greenhouse gas (GHG) emissions,[1] contributing to global warming and thereby to the harm of current and future generations. It is therefore a moral obligation for us as physicians to reduce the environmental impact of our practice.

The GHG Protocol classifies emissions into three 'scopes' (figure 1). Scope 1 includes all direct emissions, for instance the burning of fuel, or release of anaesthetic gases within a hospital. Scope 2 (indirect) emissions are generated from producing electricity. Scope 3 emissions are mostly generated in the supply chain and represent the majority of emissions in healthcare, accounting for 70%–80% of the total.[1] Specialties that require high-volume consumable equipment, supplies and frequent deliveries are therefore a major contributor to the carbon footprint of healthcare.

CARBON FOOTPRINT OF NON-PROCEDURAL GASTROENTEROLOGY

As in any field of medicine, gastroenterology (including endoscopy and hepatology) contributes to GHG emissions during each component of care: performing diagnostic tests, outpatient visits, use of medication and performing procedures, all of which include patient and staff travel. Administrative services are required to organise and reimburse care. Clinical care requires infrastructure, electricity, heating, ventilation and air conditioning. Finally, we pursue educational and research activities including national and international professional conferences or smaller group meetings.

Laboratory tests

Several studies have examined the carbon footprint of performing laboratory tests. The carbon footprint of pathology biopsies is 0.29 kg CO_2 equivalent (CO_2e) per container.[2] Notably, one grown tree absorbs approximately 20 kg CO_2e per year[3]; therefore, 1 tree would need to absorb CO_2 for 1 year to offset the carbon footprint of 70 biopsies! In practical terms, considering how we might reduce this footprint, a relative comparison is valuable. For instance, putting three biopsies into one jar would reduce emissions by 67% compared with three biopsies into three jars (incurred by supplies, chemicals and reagents required for processing). An average blood test generates a third of a biopsy, approximately 0.1 kg CO_2e. Therefore, it becomes easy to visualise the multiplier effect.

Imaging

Among imaging modalities, 1 MRI generates approximately 20 kg CO_2e, 3 times more than a CT scan (7 kg CO_2e), and 20 times more than an ultrasound (1 kg CO_2e).[4 5] These considerable differences highlight the potential for environmental savings by choosing the appropriate test for the patient (eg, for hepatocellular carcinoma (HCC) screening, evaluating pancreas pathology, or assessment of disease activity in inflammatory bowel disease).

Medications

It has been estimated that 1 g of a medication has a 3-fold to 300-fold greater carbon emission than 1 g of petroleum oil.[6] However, estimating the carbon footprint of medications is challenging because of varying environmental impact during their development. Cost is therefore typically used as a surrogate and converted to an emission value; yet cost also varies by country and changes over time.[7] The carbon footprint can range from 0.1 kg CO_2e for one tablet of omeprazole (comparable to a blood test) to 240 kg CO_2e (comparable to a major surgery) for one dose of adalimumab (calculated based on price in the UK and USA).[8]

Telemedicine

The COVID-19 pandemic led to the adoption of telemedicine as a major part of daily gastrointestinal (GI) practice. Several studies have shown that virtual visits typically reduce carbon emissions by 40%–70%, while maintaining high quality of care.[9–11] Telemedicine reduces the carbon footprint due to reduced travel, but perhaps also because of reduced unnecessary testing. In addition, it may improve access to care for patients who live remotely or are less able to afford a visit in person. However, environmental impact analyses have not always accounted for the broader infrastructure required to support digitisation, the energy requirements of servers and the impact of remote consultation on downstream resource use.[12]

CARBON FOOTPRINT OF GI ENDOSCOPY

Published audits have focused attention on the significant waste generation in endoscopy, and demonstrated the potential for waste mass to increase by 40% were a single-use endoscope model adopted.[13 14] More comprehensive and sophisticated methodologies, using carbon footprinting and life cycle assessment (LCA), are beginning to quantify emissions more accurately.

One LCA estimated that the production, transport, use and reprocessing of a reusable duodenoscope generates 1.53 kg CO_2e.[15] In this model, a single-use duodenoscope would generate up to 47-fold more GHG emissions, with >90% of these emissions generated during the manufacturing process of the single-use endoscope. The study used approximated data to estimate emissions related to production of the endoscope, and the assessment also accounted for the electricity and detergents required during high-level disinfection. However, these headline figures do not reflect other important sources of emissions such as patient and staff travel, hospital building energy, and the production, shipping and disposal of consumables.

Inclusion of the procedural pathway in analysis gives a different insight. A French ambulatory endoscopy unit estimated GHG emissions of 28 kg CO_2e per endoscopic procedure, with travel (patients and staff) being the biggest contributor, responsible for 45% of the unit's footprint (74% of patients travelled to the centre by car).[16] The production of equipment such as wash disinfectors and endoscopes was responsible for a third of the emissions, although cost was used as a surrogate for the production of the equipment, given the absence of specific emission factors. By contrast, a group reporting a process-based analysis found emissions from the

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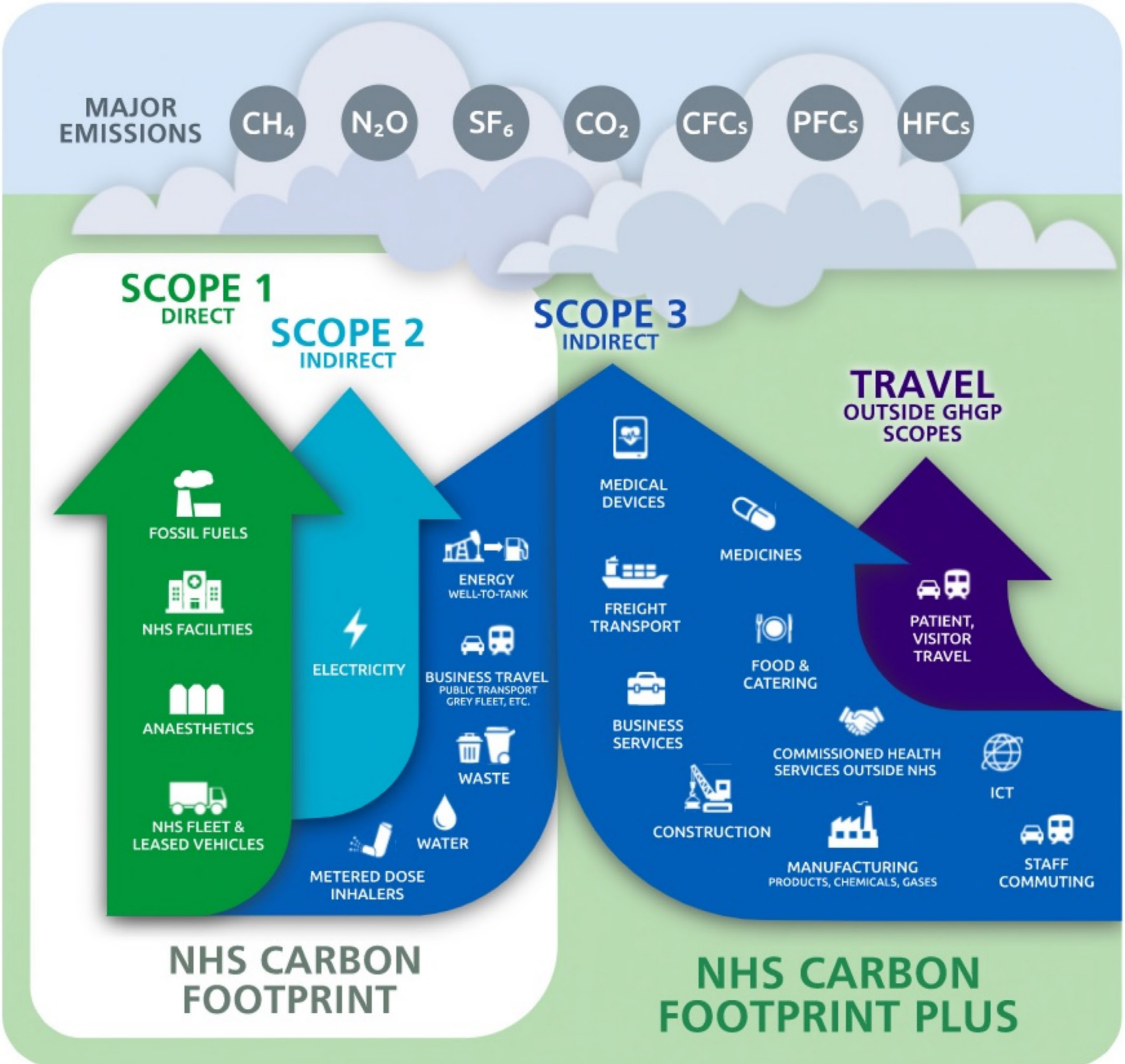

Figure 1 Greenhouse gas protocol scopes, in the context of the United Kingdom's National Health Service's carbon footprint. 'NHS Carbon Footprint Plus' includes scopes 1, 2 and 3, as well as the emissions from patient and visitor travel to and from NHS services, and medicines used within the home. CH_4, methane; N_2O, nitrous oxide; SF_6, sulphur hexafluoride; CO_2, carbon dioxide; CFCs, chloroflurocarbons; PFCs, perflurocarbons; HFCs, hydroflurocarbons; GHGP, Greenhouse Gas Protocol. *Figure as displayed in 'Delivering a Net Zero National Health Service', published October 2020 (reprinted with permission)*.

production of a reusable endoscope to be very small when averaged over its lifetime.[17] Energy represented only 12% of the French centre's emissions (in part, a reflection of France's high nuclear fraction in their energy mix and the relative efficiency of a dedicated ambulatory unit).

A study from a medium-sized endoscopy unit in Germany reported a procedural carbon footprint of only 8 kg CO_2e per endoscopy at their centre.[18] However, this assessment did not include emissions originating from patient and staff travel or the production of capital equipment, such as endoscopes. Had the German unit not used 100% renewable energy, GHG emissions from endoscopy would have increased by >30%. An Italian study reports an even smaller procedural footprint (5.43 kg CO_2e for an OGD and 6.41 kg CO_2e for a colonoscopy), but the authors sought to highlight the carbon burden generated by unnecessary endoscopic procedures.[19]

A Spanish group have used thermochemical analysis to determine the material composition of endoscopic forceps, snares and haemoclips.[20] This material composition data enabled the study team to conduct a process-based LCA, reporting GHG emissions of 0.31–0.57 kg CO_2e per accessory. The authors proposed a 'Green Mark' technique which aims to safely reduce the mass of product requiring high temperature incineration after use. However, while the prioritisation of environmentally considerate waste disposal practices features frequently in clinicians' sustainability initiatives, unit-level studies in endoscopy and other healthcare settings often find waste handling to be a minor (< 5%) contributor to the overall carbon footprint.[1 21]

In an attempt to assist endoscopy units to consider their environmental impact, both the British Society of Gastroenterology and the European Society for Gastrointestinal Endoscopy have produced consensus statements on the subject, covering most aspects of clinical practice in and outside the procedure room, including decontamination and water usage.[22 23] These documents provide those working in endoscopy with practical steps to reduce a department's environmental footprint.

LOWERING THE CARBON FOOTPRINT IN GASTROENTEROLOGY CARE

At the centre of clinical practice, it is us as healthcare professionals who order tests, recommend treatment and decide how we engage with patients (virtual or in person) (figure 2). With each decision, we have an opportunity to lessen the environmental impact of our practice, all the while striving for high quality and accessible care. We suggest a few key principles:

1. Avoid the test, procedure or medication that is not needed or is of low value. Overdiagnosis and overtreatment has been well documented, with 20%–50% of tests not being indicated.[24] Examples include premature surveillance colonoscopy, repeat gastroscopy for non-specific symptoms (eg, dyspepsia), frequent repeat imaging of small pancreatic cysts, oesophageal pH measurement for typical reflux symptoms responsive to acid suppression, and unnecessary escalation or prolongation of acid suppressive medications.
2. Consider an alternative test or treatment of comparable quality, yet less environmentally impactful. Examples include: ultrasound instead of an MRI for HCC screening, assessing disease activity in inflammatory bowel disease with ultrasound and calprotectin instead of a colonoscopy, or use of a non-invasive H. pylori test instead of an upper endoscopy.
3. Green planning. Think ahead and optimise use of supplies. Avoid instruments

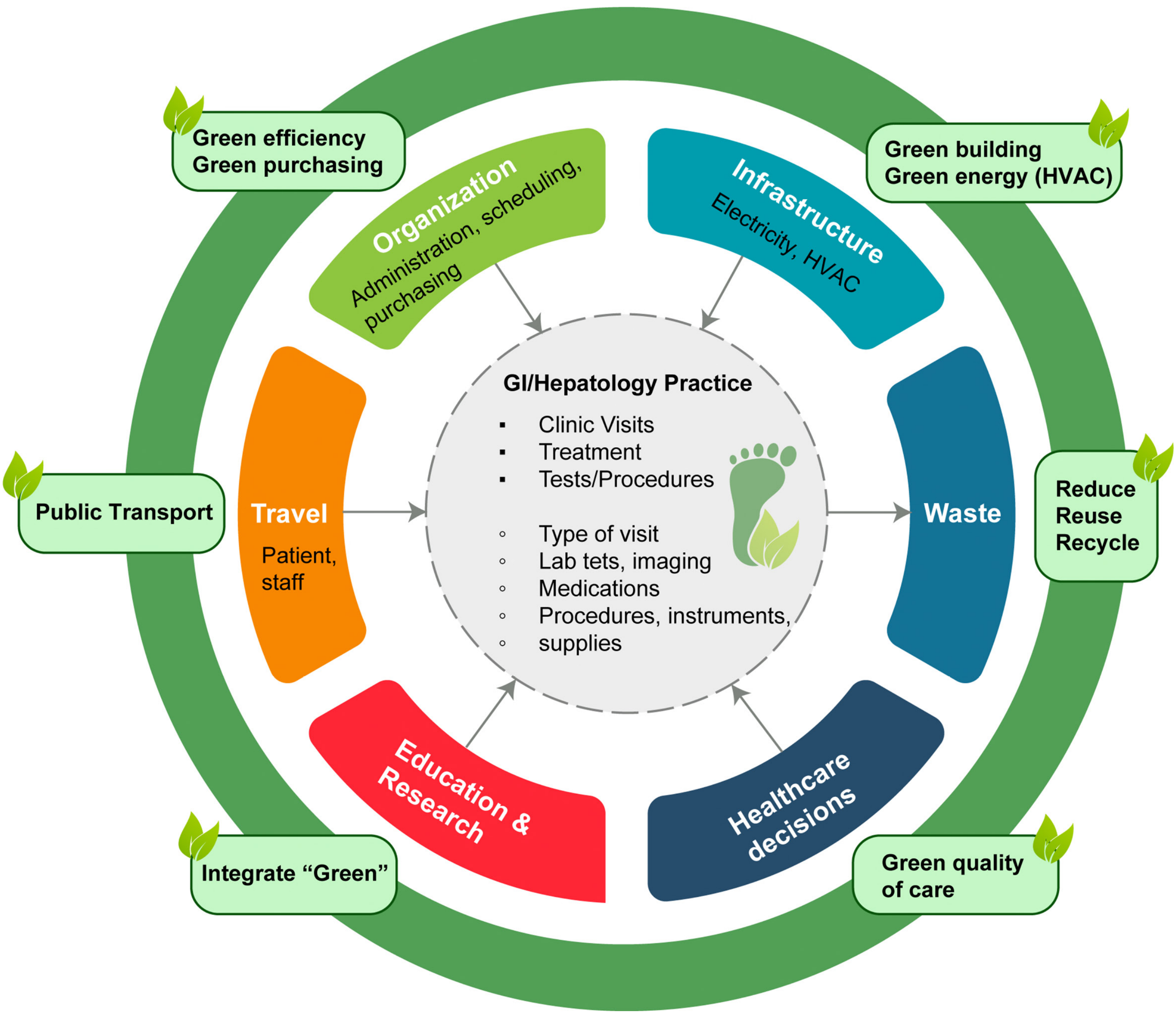

Figure 2 Sources of emissions generated in the provision of gastroenterology care, and opportunities to embed sustainable solutions. HVAC, heating, ventilation and air conditioning.

that may not be needed (eg, snare for all polyp resections, rather than a biopsy forceps). Reuse instruments and recycle per local guidance. Consider virtual visits for patients that require a follow-up check.

A growing number of structured efforts seek to objectively quantify the environmental impact of healthcare interventions. But we are in the foothills of understanding the nature and scale of these impacts. Findings from published studies vary, and the data on which estimates are based are dynamic. Notwithstanding robust data to support complex change, we can advocate for the use of renewable energy sources, support strategies to optimise departmental energy consumption and favour the procurement of sustainably produced supplies.

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