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REVIEW ARTICLE

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The United European Gastroenterology green paper—climate change and gastroenterology

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Abstract

Climate change, described by the World Health Organization (WHO) in 2021 as 'the single biggest health threat facing humanity', causes extreme weather, disrupts food supplies, and increases the prevalence of diseases, thereby affecting human health, medical practice, and healthcare stability. Greener Gastroenterology is an important movement that has the potential to make a real difference in reducing the impact of the delivery of healthcare, on the environment. The WHO defines an environmentally sustainable health system as one which would improve, maintain or restore health while minimizing negative environmental impacts. Gastroenterologists encounter the impacts of climate change in daily patient care. Alterations in the gut microbiome and dietary habits, air pollution, heat waves, and the distribution of infectious diseases result in changed disease patterns affecting gastrointestinal and hepatic health, with particularly severe impacts on vulnerable groups such as children, adolescents, and the elderly. Additionally, women are disproportionally affected, since climate change can exacerbate gender inequalities. Paradoxically, while healthcare aims to improve health, the sector is responsible for 4.4% of global carbon emissions. Endoscopy is a significant waste producer in healthcare, being the third highest generator with 3.09 kg of waste per day per bed, contributing to the carbon footprint of the GI sector. Solutions to the climate crisis can offer significant health co-benefits. Steps to reduce our carbon footprint include fostering a Planetary Health Diet and implementing measures for greener healthcare, such as telemedicine, digitalization, education, and research on sustainable healthcare practices. Adhering to the principles of 'reduce, reuse, recycle' is crucial. Reducing unnecessary procedures, which constitute a significant portion of endoscopies, can significantly decrease the carbon footprint and enhance sustainability. This position paper by the United European Gastroenterology aims to raise awareness and outline key principles that the GI workforce can adopt to tackle the climate crisis together.

KEYWORDS
climate change, climate-sensitive diseases, eco-gastroenterologist, eco-intensivist, eco-surgeon, greener gastroenterology, sustainable healthcare

INTRODUCTION – CLIMATE CHANGE AND HEALTH (CARE)

On 9 April 2024, the European Court of Human Rights issued a landmark decision declaring that governments must protect their citizens from the dangers and impacts of climate change, reinforcing the principle that inaction violates human rights.

Compared to pre-industrial levels, climate change has led to a rise of 1.1°C in mean global temperature, with projected increases of 2.5–2.9°C by the end of the century, in the absence of effective reductions in greenhouse gas (GHG) emissions. The Intergovernmental Panel on Climate Change Report 2023 states the insufficiency of former actions and current plans and emphasizes the need for accelerated action against climate change.

While healthcare is meant to help patients, there is one big paradox: the healthcare sector worldwide is responsible for 4.4% of total carbon emissions, with disproportionally high carbon footprints in rich countries.[1] If healthcare worldwide were a country, it would be the fifth largest emitter.[2] It is thus worsening climate change and, consequently, population health (Figure 1).

Greener Gastroenterology is an important movement that has the potential to make a real difference in reducing the environmental impact of healthcare. The World Health Organization (WHO) defines an environmentally sustainable health system as improving health while minimizing environmental harm. By reducing carbon footprints and adopting sustainable practices, gastroenterologists can help mitigate the effects of climate change on gastrointestinal health. The *Lancet* Countdown states 'Climate change is the greatest global health threat facing the world in the 21st century, but it is also the greatest opportunity to redefine the social and environmental determinants of health'.

EFFECTS OF CLIMATE CHANGE ON GASTROENTEROLOGY: GI HEALTH

Changes in disease patterns due to habitat and environmental changes

Overview

The WHO identified climate change as the foremost health threat to humanity.[3] It precipitates various detrimental outcomes, including a rise in extreme weather events such as heatwaves, storms or droughts, disruptions to food supply chains and water scarcity. These can lead to negative health outcomes including an increase in gastrointestinal, liver, vector-born and other infectious diseases and mental health burdens (Figure 2). Climate change undermines key health determinants such as livelihoods, equality, social support, and healthcare access, directly impacting human health, medical practice, and healthcare system stability.

In summary, planetary health is fundamental to public health. Specifically, planetary health implies that healthy and intact ecosystems are essential for the good health and well-being of the world's population.[4]

Gastrointestinal disease

Esophago-gastric diseases

Environmental factors, including climate change, have been implicated in the etiology of gastric cancer incidence.[5] A connection between the frequency of gastric cancer and long-term exposure to sulfur-containing particulate matter 2.5 (PM2.5) was revealed.[6] Furthermore, PM2.5 exposure was associated with increased esophageal food impactions in a crossover analysis of emergency department visits among patients with eosinophilic esophagitis.[7] Additionally, climate change can alter concentrations of aero-allergens which may be able to induce eosinophilic esophagitis.[8]

Gut microbiome

The gut microbiome is sensitive to climate change.[9] Environmental temperature elevations correlate with a shift in gut microbiome,[10–12] while climatic variability can modify external environmental microbes and the dietary habits of the host, subsequently impacting the gut microbiota.[9] Climate change also reduces soil microbiome diversity, potentially decreasing human gut microbiome diversity.[13,14] Reduced soil organic content limits essential micronutrients,[15] and increased use of chemicals and pesticides risks microbiome alterations.[16]

Inflammatory bowel disease

Climate change exacerbates air quality issues, mainly through wildfires and sandstorms. Apart from respiratory and cardiovascular mortality,[17] it impacts gastrointestinal disorders like IBD.[18] Climate change also affects pollen seasons, increasing allergenicity.[19] Asthma and allergic rhinitis can increase the risk of IBD, with aeroallergens as potential triggers.[20]

Functional GI diseases

Climate change-induced psychological conditions—such as distress and post-traumatic stress disorder, climate change-specific anxiety, depression, solastalgia, eco-anxiety, and ecological grief—are becoming more prevalent as climate crisis intensifies.[21,22] Given the established connection between mental health and functional GI disorders, an increase in the latter is projected.[18,23,24]

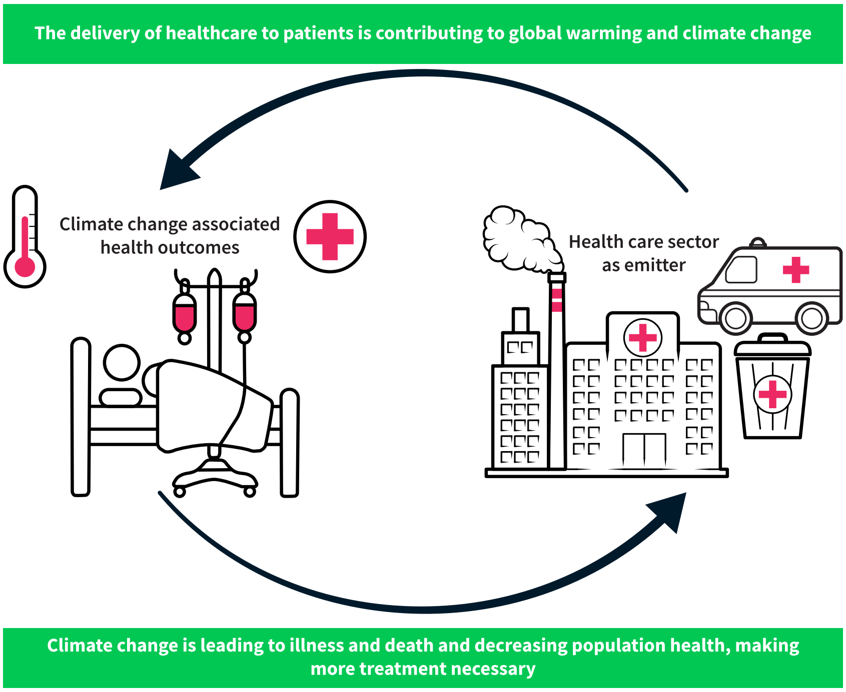

FIGURE 1 The bidirectional linkage between climate change and healthcare is evident as emissions, waste and resource consumption from the healthcare sector amplify climate change, which subsequently increases the incidence of health-related problems. This interaction forms a feedback loop that intensifies both healthcare demands and climate change impacts.

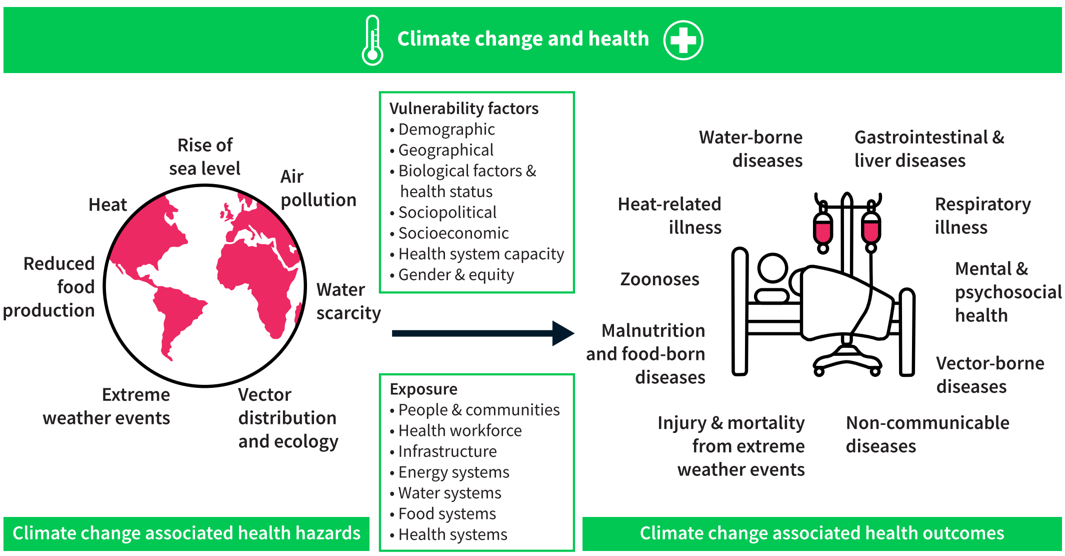

FIGURE 2 Adapted from WHO. Fact sheet climate change and health. Climate-induced environmental changes, such as heat, air pollution, water scarcity, and extreme weather events, subsequently lead to negative health outcomes such as mental, respiratory and heat-related illnesses, zoonoses, vector-borne diseases, and malnutrition.

Liver disease

Metabolic dysfunction-associated steatotic disease (MASLD)

The current epidemic of MASLD is escalating due to multifactorial influences, including climate change.[25–27]

Climate change contributes to undernutrition and obesity.[28] Increasing obesity rates and dietary shifts toward processed food products pose a risk of MASLD. Conditions of undernutrition, including Kwashiorkor, micronutrient deficiency, and subclinical undernutrition (Environmental Enteric Dysfunction), have been suggested to contribute to the pathophysiology of fatty liver disease.[29] Additionally, early-life undernutrition is associated with later obesity, highlighting the interconnected nature of these conditions.[30]

Gastrointestinal epithelial-barrier dysfunction is associated with the development of MASLD and liver cirrhosis. It can be caused by factors like altered diets, air and environmental pollutants or microparticles. Inflammation in epithelial tissue is associated with microbial dysbiosis, marked by the growth of opportunistic pathogens and reduced biodiversity of beneficial microbes.[31]

Long-term exposure to fine particulate matter air pollution (PM2.5) concentrations above 23.5 μg/m^3 correlates with a higher incidence of MASLD[32,33] due to oxidative stress and inflammatory responses that likely affect liver metabolism, including elevated hepatic triglycerides and cholesterol.[34]

Hepatocellular carcinoma

The incidence of hepatocellular carcinoma (HCC) is expected to rise with climate change, partly due to the increasing prevalence of MASLD, but climate change also exacerbates other HCC risk factors.

Higher global temperatures constitute a risk of food safety in the Mediterranean[35] and potentially Europe[36] through enhanced aflatoxin B1 levels, a potent liver carcinogen produced by Aspergillus spp.

Climate change is anticipated to enhance the atmospheric persistence of carcinogenic Polycyclic Aromatic Hydrocarbons (PAHs), raising the HCC risk by 15%.[37,38]

Alcohol consumption/substance misuse

Climate change impacts mental health, carrying the risk of increased alcohol and drug consumption, and affecting liver health.[22,25] Higher temperatures are associated with more hospital visits for alcohol- and substance-related disorders, a trend likely to intensify with climate change.[39]

Infectious diseases

Climate change is exacerbating over half of the infectious diseases known to humans by affecting pathogen and vector survival, reproduction, and transmission.[40–42]

Water-borne and fecal-oral diseases

Rising ambient temperatures impact the transmission of waterborne pathogens by directly affecting their growth, survival, and infectivity. Warm summer months can increase diarrheal infections.[43] Extreme precipitation and flooding heighten the risk of waterborne and enteric infections.[44] Key climate-sensitive waterborne pathogens of significant public health concern include Non–Vibrio cholerae *Vibrio* species, Vibrio cholerae, Crypotosporidium, and Leptospirae bacteriae.

Vector-borne diseases

Arthropods rely on the surrounding temperature for their physiological balance. Warmer global temperatures favor the proliferation and geographic expansion of these disease vectors, particularly ticks and mosquitoes, which are extending their habitats to higher latitudes and altitudes.[45] Diseases transmitted due to the expansion of vectors include Leishmaniosis, Dengue fever, West Nile virus, Zika virus and Lyme disease.

Parasites

Climate change and globalized food production are altering parasite habitats,[46–48] increasing parasite infections in Europe over the last decade.[49–51] Infections by parasites such as Echinococcus spp., liver flukes, Ascaris lumbricoides, and Entameba histolytica, can cause severe liver and bile duct diseases.

Zoonoses

Climate change facilitates the convergence of wildlife, livestock, and humans, raising zoonotic disease risks.[52–54] Viruses like Nipah and Ebola have spread due to wildlife movement caused by droughts and wildfires.[55]

Vulnerable groups – children and the elderly

Children younger than five years are expected to experience nearly 90% of the health impacts from climate change.[56] They are severely affected due to their vulnerability to environmental stressors and immature biological defenses for detoxification, DNA repair, and immune protection.[57] Children in economically disadvantaged regions, already burdened with diseases, are disproportionately affected.[58]

Rising temperatures increase heat-related illnesses in children, including nausea, vomiting, diarrhea and mortality, particularly in infants.[59]

Climate change-induced shifts in temperature and precipitation enhance the risks of food shortages, malnutrition, and micronutrient deficiencies. By 2050, climate change-related reduced calorie availability is expected to increase child malnutrition by 20%, affecting an additional 25 million children. This will significantly undermine progress in reducing child malnutrition.[60]

Diarrheal diseases, mainly waterborne and fecal-oral transmitted viral infections, constitute the second leading cause of death in children under five years and are exacerbated by climate change.[61] Children's behaviors, like higher water consumption, food, and soil relative to body weight, increase their risk of disease transmission.[62] Furthermore, infants and young children are prone to gastrointestinal infection: The occurrence of Escherichia coli, Cryptosporidium, rotaviruses, and parasites such as Giardia and Toxoplasma gondii increases with rising temperatures.[63]

Older adults are a vulnerable population facing excessive morbidity and mortality from extreme weather. They are more prone to heat-related issues due to compromised thermoregulation, health conditions, medication effects, and mobility challenges.[64] Heat-related deaths among people over 65 have risen by 85% compared to 1990–2000, exceeding the expected 38% increase without temperature changes. If temperatures rise by 2°C, these deaths are projected to increase by 370% by 2041–2060 and 683% by 2081–2100.[65]

Gender inequalities

The 2024 Lancet Countdown in Europe report has revealed that heat-related mortality can be twice as high in women as in men. Low-income households show a much higher probability of experiencing food insecurity and deaths,[66] disproportionately affecting women and girls due to their different nutritional needs and position in household food hierarchies, which makes them often eat last and skip meals in cases of food shortage. Climate change may further impact women by hindering access to reproductive and maternity health services and affecting pregnancy outcomes through changes in infectious diseases, temperature, and nutritional status.[67]

Nutrition

Food insecurity and prevention

Overall, the impact of climate change on agriculture, fisheries, and aquaculture is negative.[68] Climate change poses significant challenges to food security worldwide, threatening the availability, accessibility, and nutritional quality of food. In 2021, more frequent heatwaves and droughts led to 127 million additional cases of moderate or severe food insecurity compared with the 1981–2010 average. If global temperatures rise by 2°C, an estimated 524.9 million more people are projected to face food insecurity by 2041–2060, compared to the 1995–2014 baseline, increasing the risk of global malnutrition.[65]

Global food systems are at a critical juncture, necessitating a reorientation toward sustainable, healthy, and equitable diets to meet the nutritional needs of 9–10 billion people by 2050,[69] while preserving the environment for future generations. Climate change presents challenges such as extreme weather, altered growing seasons, and increased pest pressures. Biodiversity loss from habitat destruction and pesticides threatens food security.

Malnutrition

Despite global efforts to reduce undernutrition, millions of people, particularly in low- and middle-income countries, continue to suffer from undernutrition. Driven by climate change, rising prices, poverty, lack of access to nutritious food, inadequate healthcare and food insecurity are the underlying factors.

Malnutrition, however, is not limited to undernutrition; there is a growing global challenge of overnutrition, which includes rising rates of obesity and diet-related non-communicable diseases such as heart disease, diabetes, and cancer. Extreme temperatures and poor air quality can cause reduced physical activity and increase obesity rates.[16,25] In developing countries, a 1°C temperature rise has been shown to correlate with a 4% and 2% BMI increase in children and women, respectively.[70] Climate shifts affecting fruit and vegetable yields are projected to increase prices, pushing consumers toward more economically viable processed foods, typically high in fats, sugars, and sodium.[30,71] Combating overnutrition is vital for addressing global malnutrition.

Migration

Currently, over 1 billion people are on the move, including 281 million international migrants.[72]

The International Organization for Migration has proposed a definition for people forced to migrate because of climate-related changes and environmental consequences. "Environmental migrants" are people or groups of people who are forced to leave their homes due to adverse environmental changes, either temporarily or permanently, within their country or abroad.[73]

Climate-related events can influence the prevalence and distribution of GI disease among migrants. Extreme weather events and floods can lead to water contamination, increasing the risk of gastrointestinal infections such as cholera and hepatitis A. The migration of individuals infected with Hepatitis B Virus from endemic countries to the European Union/European Economic Area (EU/EEA) accounts for approximately 25% of all chronic Hepatitis B infections in the region.[74]

Effect OF GASTROENTEROLOGY ON CLIMATE CHANGE: GASTROENTEROLOGY AS AN EMITTER AND POSSIBLE SOLUTIONS

Overview

Gastrointestinal diseases are among the world's largest therapeutic areas, representing a significant global burden. Consequently, their diagnosis and advanced management greatly contribute to the generation of health-associated waste and the consumption of environmental resources[75] (Figure 3).

Greenhouse gas (GHG) emissions are categorized into three scopes: Scope 1 for direct emissions from owned sources, Scope 2 for indirect emissions from purchased energy, and Scope 3 for all other indirect emissions in the value chain[76] (Figure 4).

Figures 5 and 6 provide an overview of possible measures to reduce gastroenterology-related carbon emissions at any structural level.

Making a change at individual level

Daily choices

Individuals have the power to make daily choices that significantly contribute to lowering their CO_2 footprint while promoting personal health. Sustainable transportation, dietary preferences, financial decisions, and energy efficiency are pivotal areas where informed and conscientious choices can align personal behavior with the imperative of climate change mitigation. By embracing these changes, individuals

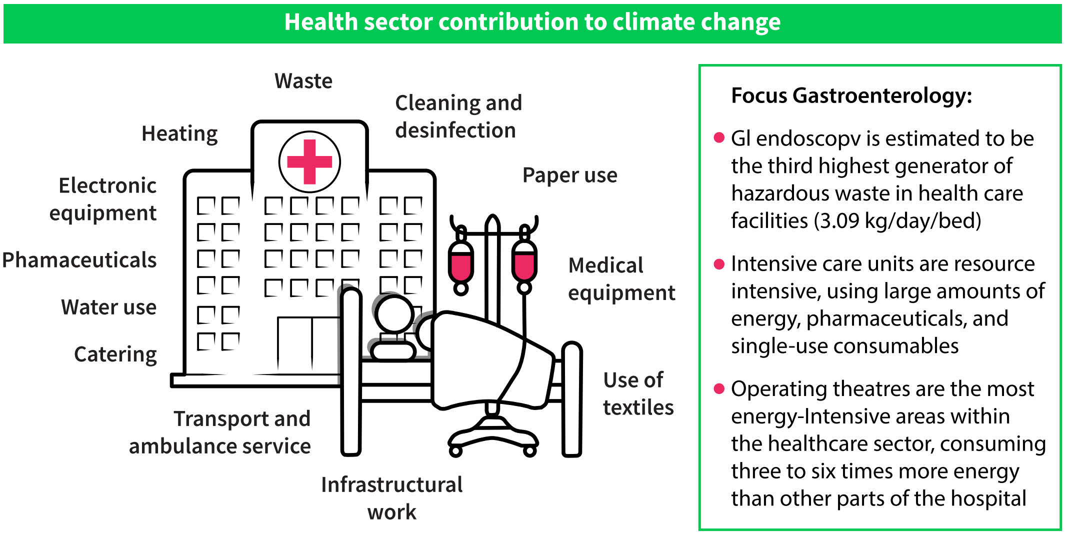

FIGURE 3 Healthcare operations significantly contribute to global carbon emission due to various elements including the usage of pharmaceuticals, electronic and medical equipment, water, paper, and textiles, as well as waste production and infrastructural work.

can be active participants in the global effort to combat climate change while enjoying the benefits of improved health.

Planetary health diet

A third of global GHG emissions come from the food system.[77] Food production emits 17,318 ± 1675 TgCO_2 eq per year, with 57% from animal-based foods and 29% from plant-based foods.[78]

Adopting a "Planetary Health Diet" that balances human health and environmental sustainability was advocated by the Eat-Lancet Commission. This report emphasizes the interplay between nutritional well-being and ecological concerns, emphasizing the urgency of action to mitigate the environmental impacts of food production, address food inequity, and promote multisectoral collaboration.[79,80]

From a nutritional perspective, the Planetary Health Diet aims to provide essential vitamins, minerals, and other nutrients while reducing the intake of foods associated with health problems. Necessary dietary changes include minimizing the consumption of red meat, sugar and highly processed items while doubling the consumption of nuts, fruits, and vegetables.[81] This diet aligns with current dietary recommendations for reducing the risk of chronic diseases like heart and respiratory disease, diabetes, and certain cancers and is associated with lower risk of total and cause-specific mortality and environment impacts.[82] Adopting a more plant-based diet can enhance human and planetary health.

Greener patient care: Gastroenterology

Greener endoscopy

While the healthcare sector is a high emitter of GHG, the endoscopy activity has to be outlined as a significant factor since it is the third highest producer of waste at 3.09 kg/day/bed, following anesthetics at 5.96 kg/day/bed and intensive care at 3.37 kg/day/bed.[83,84] (Figure 3) The average amount of waste within a typical endoscopy procedure is 2.1 kg.[85] For a high-volume endoscopic center (13,000 procedures/year), this leads to a total waste generated during a 5-day routine of 546 kg.[86] Considering also in-house energy consumption and emissions caused by the production and transportation of endoscopy-related consumables, the total amount of emitted CO_2equivalents (CO_2eq) for a middle-sized gastrointestinal endoscopy unit in Germany (8000 procedures per year) amounts to 62.72 tons.[87]

A recent article by Siau et al.[88] and the latest European Society of Gastrointestinal Endoscopy (ESGE)-European Society of Gastroenterology and Endoscopy Nurses and Associates (ESGENA) position statement[89] propose several easily implementable interventions to accomplish a more sustainable practice following the classic sustainability principle of "reduce, reuse, recycle" (Figure 4). First, reducing unnecessary procedures, which account for up to 56% of upper GI endoscopy and between 23% and 52% of colonoscopies, can significantly lower carbon footprints.[90] In Italy, inappropriate endoscopy emit 3500–4700 metric tons of CO_2 annually[91] and across Europe, they result in 30,804 metric tons of CO_2.[92] This underscores the urgent need to reduce unnecessary interventions for both environmental and medical sustainability. Since 36% of emissions in endoscopy are related to the histological processing of tissue samples, rationalizing the use of specimen pots is another important measure to reduce the carbon footprint of endoscopy.[93]

Second, the ESGE suggests against routine use of single-use devices and proposes using reusable alternatives instead of disposables. Finally, any waste should be recycled. Sustainable waste management is relatively easy to implement in daily practice and is immediately visible in the department. This may motivate other employees and increase awareness of sustainability.[94]

Combining various measures like reducing instruments per procedure, recycling packaging,[94] and using alternative

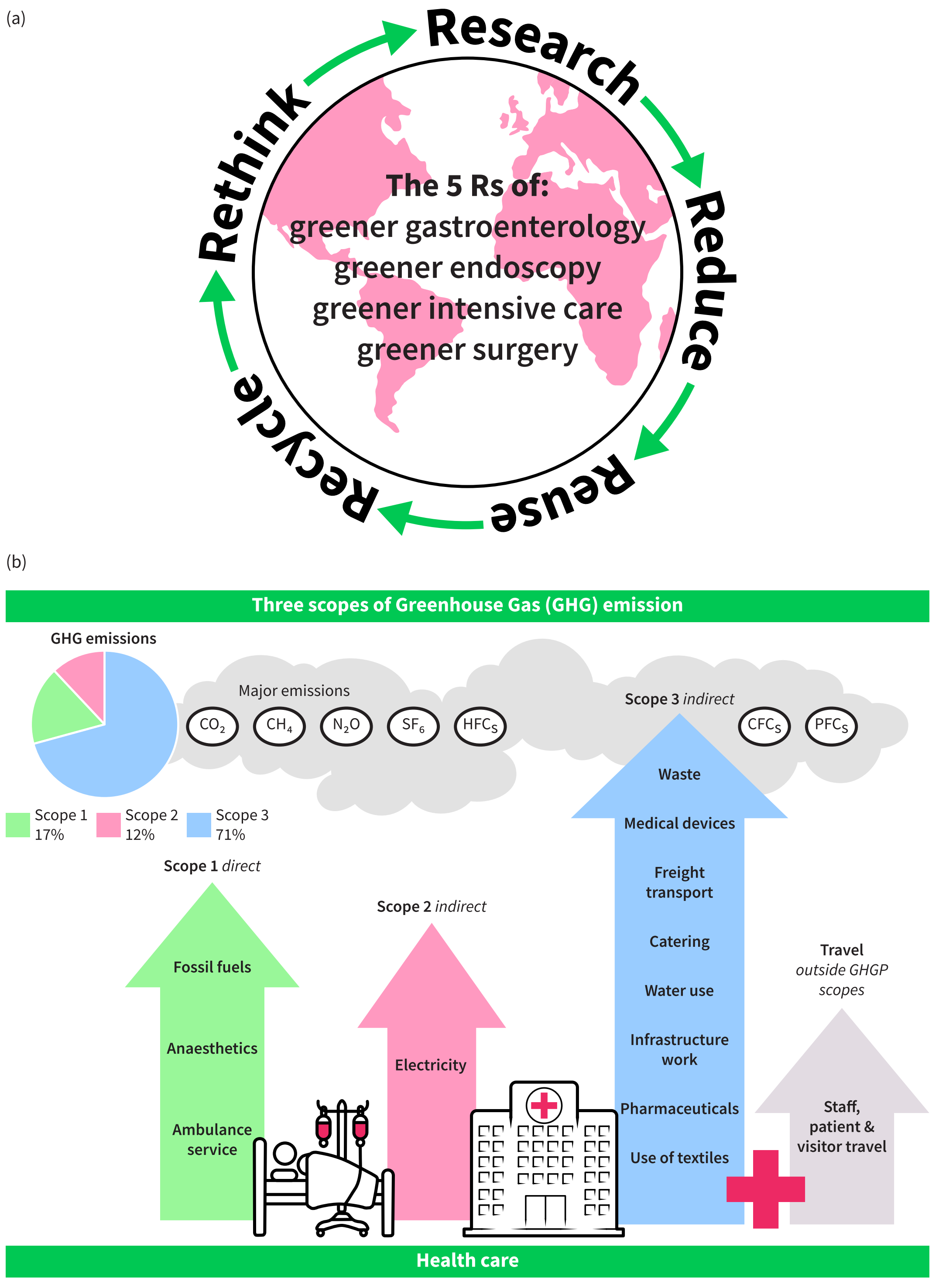

FIGURE 4 (a) Adapted from *Hutchins DC et al. 2009*[121]; *Kagoma YK et al. 2012.*[122] This diagram illustrates the five key stages in the sustainability cycle: Research, Reduce, Reuse, Recycle, and Rethink. Each stage is interconnected, contributing to the overall goal of sustainability. (b) Adapted from *NHS England 2022*[123]; *Sampath B et al. 2022*[124]; World Health Organization 2023.[125] GHG emissions are categorized into three scopes: Scope 1 for direct emissions from owned sources, Scope 2 for indirect emissions from purchased energy, and Scope 3 for all other indirect emissions in the value chain. Patient and visitor travel to receive health care services represents emissions outside scopes 1, 2 and 3 as defined in the Greenhouse Gas Protocol (GHGP).

products can lower carbon emissions without disrupting the endoscopic workflow. In the endoscopy unit of a university hospital, these measures could collectively reduce carbon emissions by 18.4%.[95]

Greener Gastroenterology beyond endoscopy

Greener Gastroenterology extends beyond endoscopy. Efforts include minimizing accessory use and promoting recycling projects.

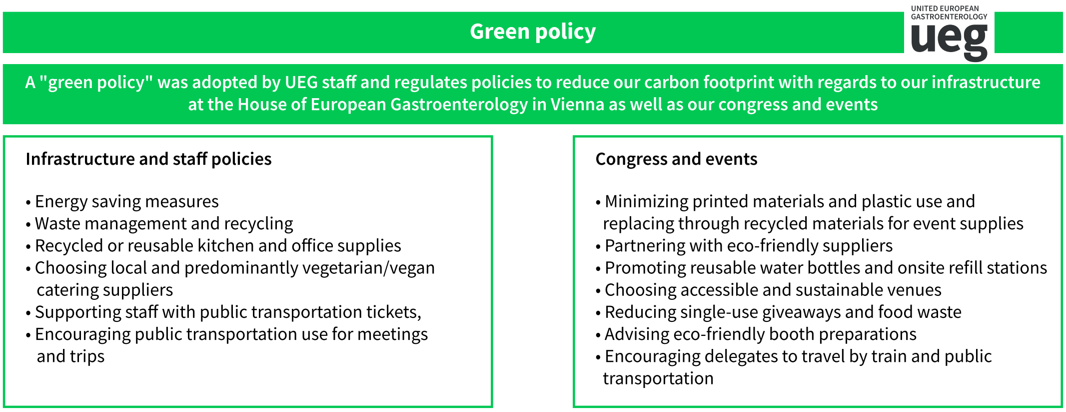

FIGURE 5 The “green policy” by UEG aims to reduce the carbon footprint of its infrastructure and staff policies at the House of European Gastroenterology in Vienna and provide eco-friendly congresses and events. Measures include energy saving, waste management, promoting public transportation among staff, board members and delegates, collaborating with environmentally conscious suppliers, promoting reusable items, and choosing venues that prioritize sustainability and accessibility via public transportation.

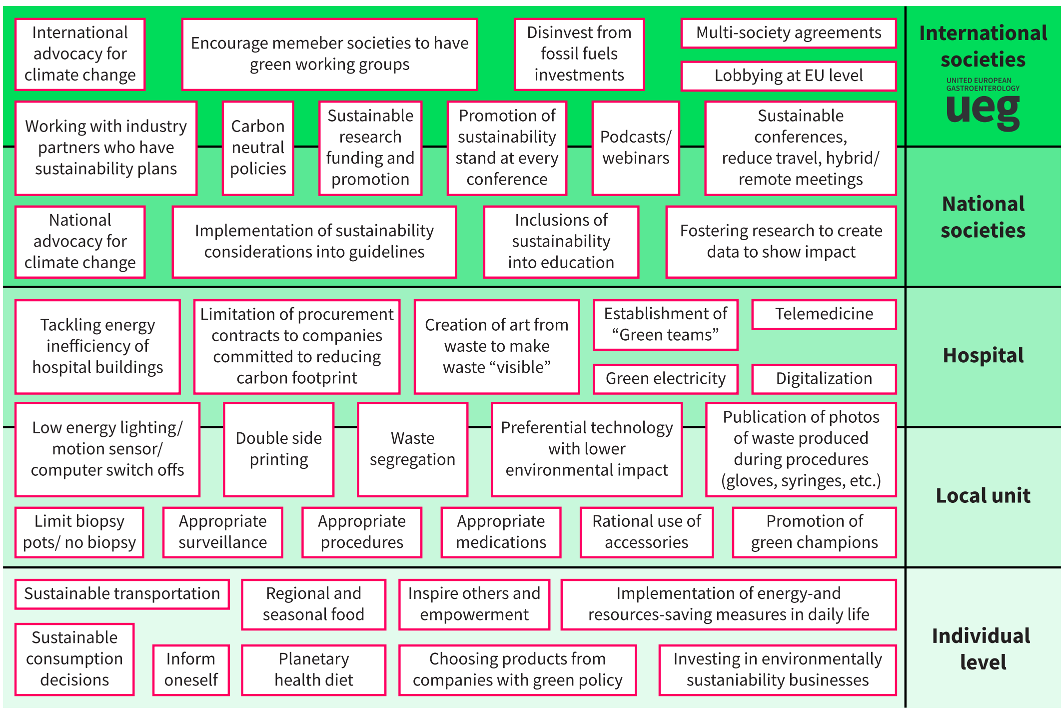

FIGURE 6 UEG toolkit for stakeholders to provide approaches to reduce environmental impact at any structural level of gastroenterology.

Using serology instead of biopsies in celiac disease aims to reduce environmental impact. Additionally, alternative diagnostic methods, such as intestinal ultrasound instead of colonoscopies,[96] are encouraged to align GI practice with sustainability goals. Fecal calprotectin may avoid unnecessary endoscopic procedures if there is a low likelihood of IBD. Using subcutaneous biologics instead of intravenous infusions reduces the logistical and financial burden of IBD and lowers patient traffic to infusion centers.[92] In hepatology, tools like FibroScan have a lower environmental impact than liver biopsies and repeated endoscopy for detecting cirrhosis and varices.[92] The Baveno VII consensus recommends using transient elastography and platelet counts to estimate variceal risk, thereby reducing unnecessary endoscopies.[97]

These measures help to make GI practices more sustainable while maintaining high-quality standards.

Greener intensive care

Intensive Care Units (ICUs) provide life-saving care to critically ill patients, but are resource-intensive with significant environmental impacts.[98] (Figure 3) The estimated carbon emissions from critical care range between 88 and 178 kg CO_2eq/patient/day.[99] Reducing these impacts is essential.

Firstly, energy consumption is a significant contributor to the environmental footprint of ICUs.[100] These units require constant electricity to power medical equipments, ventilation systems, lighting, and climate control. Reducing energy use in ICUs involves optimizing equipment efficiency, implementing energy-saving technologies, and encouraging staff to minimize unnecessary energy use. For instance, ventilators and patient monitors can consume almost as much electricity in standby mode as in active use (72% and 87%, respectively), so turning off these devices when not needed is recommended instead of using standby mode.[101]

Second, waste generation is a notable environmental challenge in ICUs,[102] making proper waste segregation, recycling programs, and waste minimization strategies necessary.

Thirdly, family travel and employee commutes are another hotspot in the environmental impact of ICU medicine.[103] Sustainable options for employees' commutes are essential.

Finally, also in intensive care, the reduction of unnecessary resource consumption is crucial. for example, less frequent red blood cell transfusions and shorter ventilator support durations can improve patient outcomes and sustainability.[104]

Greener surgery

Operating theaters are the most energy-intensive sites in the healthcare sector, generating 50%–70% of total hospital clinical waste.[105] Surgical environmental impacts that occur intraprocedurally include anesthetic gas emissions, energy and water usage, and waste output.[106] Each sector can be considered individually to identify potential approachable methods to reduce its environmental burden. For example, surgical hand disinfection with water in the first operating theater procedure, followed by alcohol gel in subsequent procedures, could reduce water usage per current guidelines.[107] During surgery, avoiding general anesthetic and using anesthetic gases if regional and local anesthetic options are available can have a remarkable effect.

Moreover, using single-use disposable drapes and instruments significantly contributes to surgical solid waste despite the availability of reusable options, which should be considered. Notably, a 2009 UK multi-theatre audit demonstrated that 40% of waste generated was potentially recyclable.[108] However, operating theater recycling processes are rarely available and must be implemented to reduce waste production (Figures 3 and 4).

Greener patient care: Hospital in general

Infrastructure

Healthcare organizations significantly contribute to climate change, necessitating a green agenda in national strategies. One such policy is the UK "net zero strategy" (delivering a Net Zero National Health Service, NHS England 2020) to achieve net zero in the emissions it controls directly, by 2040. The stand on climate change will positively impact on population health in the future, thereby reducing the burden on the healthcare system.[109] National initiatives should support regional healthcare delivery with appropriate funding.

Supply, procurement and recycling of materials

A judicious review of policies on procurement for clinical and non-clinical areas and recycling is imperative. Changes are needed in the supply and production chain and at every level.[110] All hospitals suppliers should be required to publicly report targets and emissions and publish their carbon emissions reduction plan aligned to national and local policies. Future procurement contracts should be limited to companies committed to sustainability.

Estates

Most older hospital buildings could be more energy efficient. Using roofs and adjacent spaces for renewable energy, implementing low-energy lighting, motion sensors, and intelligent energy monitoring can significantly reduce energy use. For heating, organizations should be encouraged to move to alternative sources, such as installing photovoltaics or heat air source pumps and solar panels.[111]

Digitalization

More digitalization is needed. Clinical letters and patient information must be sent digitally to reduce paper use.[112] User-friendly videos should be provided to assist those who are less digitally savvy.

Food and nutrition

Hospitals should review their food chain to reduce nutrition-associated carbon emissions.[113] The procurement of food supply should be in line with the national strategy of using local products with a lower carbon footprint and ensuring sustainable healthy diets with reduction of meat and processed foods.

Reducing food waste and losses along the supply chain can improve resource utilization and food access. Collaboration among governments, international organizations, scientific societies, civil society, and the private sector is crucial for developing and implementing effective policies and initiatives to ensure food security in the face of climate change.

Education

Climate change education must be integrated into daily practice for staff, patients, and visitors. Trainees should develop competencies and skills to recognize the impact of climate change and understand the bidirectional relationship between climate change and healthcare. The curricula, and onboarding for new doctors, should include climate change, local action, and policy.

Local policies should focus on reducing unnecessary procedures.[91,114–117] Clinicians should consider sustainability when choosing the appropriate medication.

Analytics, targets and development

Healthcare organizations should track carbon emissions by department and ensure progress with clear 1-year and 3-year plans. Success stories from departments that have significantly reduced their carbon footprints should be encouraged and publicized.

Telemedicine and virtual consultations

Telemedicine and virtual consultations offer an eco-friendly alternative to traditional medical visits and consultations. It has been proven that virtual healthcare significantly reduces environmental impact by reducing the number of patients and healthcare professionals commuting to healthcare facilities, cutting emissions by an average of 148 kg of CO_2eq per patient.[118,119] This illustrates the dual benefits of better care and a smaller carbon footprint. The main environmental benefit of telemedicine is the reduction in travel-related pollution. Telemedicine received positive feedback from patients and improved their treatment adherence.[120] Furthermore, advocating for e-health when in conversation with family members is essential.

UEG and sustainability

The United European Gastroenterology (UEG) believes that the GI workforce has a clear responsibility to raise awareness and call to action to address the challenges that a warming climate poses to humanity. National Gastroenterology societies and specialist member societies must advocate for change to reduce their carbon footprints. It is becoming more critical than ever to ensure that our society is doing its part to reduce its carbon footprint. Within our strategic plan for 2023–2026, the UEG Council clearly defines its core values (integrity, quality, diversity, independence, respect, accountability, transparency, and sustainability) as an inclusive concept for all strategic drivers.

Furthermore, we demonstrate our commitment to offset our ecological impact by various measures (Figure 5).

Education and the latest research on how climate change affects GI practice and healthcare are deliberately tackled in UEG's educational offers such as webinars, online courses and educational papers. A focus is given to key topics and research related to climate change. All future published guidelines are encouraged to consider sustainability as an important aspect of the guidelines.

The concept of the eco-gastroenterologist and eco-endoscopist,[89,92] as well as eco-intensivist and eco-surgeon, needs to be promoted! UEG is committed to empowering and advocating for these principles on a personal and global scale, alongside efforts to implement sustainable practices at the institutional level.

We provide a toolkit for stakeholders to promote such concepts and provide possible solutions at any structural level (Figure 6).

The literature search strategy and selection criteria for this article are depicted in Figure 7.

Systematic search and literature selection

We accomplished a systematic literature search in major databases, including Pubmed and Google scholar. Articles were included until a publication date of until July 14, 2024. Full-text articles published in English and articles providing an english abstract were reviewed. The terms "climate change", "global warming", "gut", "gastroenterology", "gastrointestinal", "gastric", "intestinal", "liver", "hepatic", "gastroenterology", "endoscopy", "environmental impact" and "sustainability", separately and differently combined, were used for a fully comprehensive research, further searches were conducted for specific questions. We also manually examined the reference lists to identify additional relevant studies.

FIGURE 7 Outline of the systematic search strategy and literature selection process of this article.

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CONFLICT OF INTEREST STATEMENT

The authors declare no conflicts of interest statement.

DATA AVAILABILITY STATEMENT

Data sharing not applicable to this article as no datasets were generated or analyzed during the current study.

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