# Treatment Strategy as a Determinant of Carbon Footprint in Inflammatory Bowel Disease Care

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**Abstract**

**Objective:** The environmental footprint of healthcare is increasingly recognized as a component of care quality; however, patient-level carbon emissions associated with inflammatory bowel disease (IBD) remain insufficiently quantified. This study aimed to prospectively quantify the carbon footprint of IBD care and compare it across maintenance treatment strategies.

**Methods:** This prospective observational cohort study was conducted at a tertiary IBD referral center between December 2025 and January 2026. Consecutive adults with ulcerative colitis or Crohn's disease were included. The annual carbon footprint (kg carbon dioxide equivalent [$CO_2e$] per patient-year) was estimated using activity-based accounting across patient travel, clinical care delivery, and pharmaceuticals. Patients were stratified by dominant maintenance therapy. Independent predictors were assessed using multivariable linear regression.

**Results:** Among 248 patients (169 with ulcerative colitis and 79 with Crohn's disease), the median annual carbon footprint was 52.6 kg $CO_2e$ (interquartile range, 31.8–74.2). Patient travel accounted for 46.2% of emissions, followed by pharmaceuticals (29.4%) and clinical care delivery (24.4%). The carbon footprint was highest with intravenous biologics (86.1 kg $CO_2e$), followed by subcutaneous biologics (48.9 kg $CO_2e$) and oral/systemic therapy (24.7 kg $CO_2e$) ($P < .001$). In adjusted analyses, intravenous and subcutaneous biologics were associated with increases of 31.4 kg $CO_2e$ (95% CI, 24.1–38.7) and 18.6 kg $CO_2e$ (95% CI, 12.2–25.1), respectively. Each 10-km increase in one-way travel distance was associated with an additional 3.2 kg $CO_2e$ (95% CI, 1.9–4.5).

**Conclusion:** Long-term IBD management is associated with a measurable carbon footprint, primarily driven by treatment modality and patient travel. A more sustainable organization of care may reduce the environmental impact while preserving care standards.

**Keywords:** Carbon footprint, Crohn's disease, health care delivery, inflammatory bowel diseases, ulcerative colitis.

## INTRODUCTION

Climate change is increasingly recognized as a determinant of population health, and the environmental performance of healthcare systems has become a measurable component of responsible clinical practice.[1] Healthcare delivery accounts for a substantial share of global greenhouse gas emissions, prompting renewed attention to sustainability within routine care. Chronic diseases that require long-term, resource-intensive management warrant particular scrutiny in this context.

Inflammatory bowel diseases (IBD), which primarily include ulcerative colitis (UC) and Crohn's disease (CD), are chronic conditions that exemplify the need for long-term, resource-intensive care. The global burden of IBD continues to rise, with increasing incidence in newly industrialized regions and sustained prevalence in established Western populations.[2,3] Because disease onset typically occurs in early adulthood and IBD follows a relapsing-remitting course, patients often require decades of structured monitoring, repeated objective assessments of inflammation, and prolonged pharmacologic therapy. Over time, even modest differences in care intensity may result in significant cumulative environmental impact.

Recent discussions have introduced the concept of sustainable or "green" IBD management, suggesting that environmental considerations should complement clinical effectiveness and safety in the design of care pathways.[4] Contemporary treat-to-target strategies, formalized in STRIDE-II, prioritize objective disease control and tight monitoring to prevent structural damage and long-term complications.[5] Although these approaches have improved clinical outcomes, they may also increase healthcare utilization through more frequent outpatient visits, laboratory testing, imaging, endoscopy, and administration of advanced therapies. The environmental implications of these intensified care models remain insufficiently quantified.

While the environmental determinants of IBD risk and activity have been extensively characterized,[6,7] the environmental impact of delivering IBD care has received far less attention. In particular, prospective patient-level comparisons of carbon footprints across maintenance treatment

## MAIN POINTS

- The median annual carbon footprint of inflammatory bowel disease (IBD) care was 52.6 kg $CO_2$e per patient-year in this prospective cohort.
- Patient travel was the largest contributor to total emissions (46.2%), followed by pharmaceuticals (29.4%) and clinical care delivery (24.4%).
- Treatment modality was the strongest independent predictor of carbon footprint, with intravenous biologics associated with the highest emissions.
- Disease activity was not independently associated with the carbon footprint after multivariable adjustment.
- Longer travel distances and a higher number of in-person healthcare encounters were independently associated with increased emissions.

modalities—oral therapies, self-administered subcutaneous biologics, and hospital-based intravenous biologics—using standardized carbon accounting methods are limited.

We hypothesized that treatment modality independently influences the annual per-patient carbon footprint of IBD care, with hospital-based intravenous therapies generating higher emissions than oral or subcutaneous regimens.

To address this gap, we conducted a prospective observational study at a tertiary IBD referral center. Using a standardized activity-based carbon accounting methodology, we aimed to: (i) quantify annual per-patient carbon dioxide equivalent ($CO_2$e) emissions, (ii) identify dominant emission sources within the care pathway, and (iii) compare carbon footprints across major maintenance treatment strategies in a real-world tertiary-care setting.

## METHODS

### Study Design and Setting

This prospective observational cohort study was conducted at a high-volume tertiary inflammatory bowel disease (IBD) referral center. The protocol was developed in accordance with the Declaration of Helsinki, and the study was designed and reported following the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) guidelines.[8]

Patients were enrolled between December 2025 and January 2026. For each participant, the carbon footprint was calculated for the preceding 12-month observation period.

### Participants and Eligibility Criteria

Adults aged ≥18 years with an established diagnosis of ulcerative colitis (UC) or Crohn's disease (CD), confirmed by standard clinical, endoscopic, histopathological, and/or radiological criteria, and under active follow-up at the study center were eligible.

Exclusion criteria included inability or unwillingness to provide written informed consent, incomplete medical records that prevented accurate extraction of data for the preceding 12-month period, receipt of primary IBD care at another institution, or concomitant primary immunodeficiency or chronic infectious colitis.

No exclusions were made based on disease activity, phenotype, disease duration, or treatment type, in order to reflect routine clinical practice.

### Data Collection

Data were collected using a structured and piloted case report form. Clinical and healthcare utilization data were extracted from the hospital's electronic medical record system. Travel-related variables, including mode of transportation and caregiver accompaniment, were verified through brief structured interviews at enrollment when not available in the electronic records.

Recorded variables included demographic and clinical characteristics (age, sex, disease subtype, disease duration, prior surgery, and disease activity indices [partial Mayo score for UC; Harvey–Bradshaw Index for CD]), treatment details (all IBD-related medications, specific agents, dose, route of administration, and dosing frequency), healthcare utilization (number and type of outpatient visits, infusion sessions, endoscopic procedures, and imaging studies during the 12-month period), and travel patterns (round-trip distance, primary mode of transportation, and visit frequency).

### Carbon Footprint: Definition and System Boundaries

The primary outcome was the annual patient-level carbon footprint of IBD care, expressed as kilograms of carbon dioxide equivalent per patient-year (kg $CO_2$e per patient-year).

A healthcare-delivery–focused system boundary was adopted, consistent with the Greenhouse Gas Protocol and established healthcare carbon accounting frameworks.[9] The analysis included direct and upstream emissions (Scope 1, Scope 2, and selected patient-attributable Scope 3 emissions, including pharmaceutical production and medical consumable manufacturing) associated with discrete care activities.

Emissions related to hospital infrastructure, capital equipment, staff commuting, and non-allocable waste streams were excluded because reliable patient-level attribution was not feasible.

Three emission domains were evaluated: patient travel, clinical care delivery, and pharmaceuticals.

### Carbon Footprint Calculation

Carbon footprint estimation followed an activity-based accounting approach aligned with ISO 14040/44 life cycle assessment principles.[10]

### Travel Emissions

Travel emissions were calculated by multiplying round-trip travel distance (km) by transport-specific emission factors (kg $CO_2$e/km). Standard emission factors for private car travel were applied when no alternative mode was reported.

For patients aged ≥65 years or those reporting functional limitations requiring assistance, emissions for one accompanying caregiver were included. A sensitivity analysis excluding caregiver travel was also performed.

### Clinical Care Delivery Emissions

Per-event emission factors were assigned to outpatient visits, infusion sessions, and endoscopic procedures based on published life cycle assessment literature evaluating comparable healthcare services.[11] Reported estimates for in-person outpatient visits vary depending on system boundaries and service intensity; emission factors were selected from tertiary-care settings with comparable structures and applied uniformly across patients. Only activity-specific emissions were included

to avoid overlap with pharmaceutical or travel emissions.

**Pharmaceutical Emissions**

Pharmaceutical emissions were calculated using medication-specific cradle-to-gate emission factors (kg $CO_2$e per dose or per milligram) identified from peer-reviewed life cycle assessment literature where available.[12]

For medications without published emission data, proxy emission factors were estimated using therapeutically comparable agents with available cradle-to-gate data. Emissions were adjusted proportionally based on the annual cumulative dose and relative molecular weight between the index medication and the reference agent. Annual pharmaceutical emissions were calculated by multiplying the cumulative annual dose by the emission factor per unit.

To prevent double counting, pharmaceutical emission factors were restricted to production-related emissions and excluded transport or facility components already accounted for in other domains. All emission factors and formulas were prespecified prior to analysis and applied consistently.

**Exposure Groups**

Patients were classified into three mutually exclusive groups based on the dominant maintenance therapy during the 12-month period: oral/systemic agents, subcutaneous biologics, and intravenous biologics. A predefined hierarchical approach was applied, with intravenous biologics taking precedence over subcutaneous biologics, and subcutaneous biologics over oral/systemic agents.

**Outcome Measures**

The primary outcome was the total annual IBD-related carbon footprint (kg $CO_2$e per patient-year).

Secondary outcomes included the absolute and proportional contributions of each emission domain and the comparison of total carbon footprints across treatment groups.

**Statistical Analysis**

Continuous variables are presented as mean ± standard deviation or median (interquartile range), as appropriate. Categorical variables are presented as number (percentage).

Between-group comparisons were performed using analysis of variance (ANOVA) or the Kruskal–Wallis test for continuous variables, and the chi-square or Fisher's exact test for categorical variables.

Independent predictors of carbon footprint were assessed using multivariable linear regression, including prespecified covariates: treatment group (oral/systemic agents as the reference), age, disease subtype, disease activity index, and one-way travel distance.

Multicollinearity was evaluated using variance inflation factors (VIF), with values <5 considered acceptable. Model assumptions were assessed by inspection of residual plots and evaluation of normality diagnostics.

Regression results are reported as β coefficients with 95% confidence intervals (CI). A two-sided $P < .05$ was considered statistically significant. P values are reported according to AMA guidelines.

All analyses were performed using R statistical software (version 4.3.0; R Foundation for Statistical Computing, Vienna, Austria).

Because prior prospective data on patient-level carbon footprint in IBD care were unavailable, a formal sample size calculation was not feasible. Therefore, all consecutive eligible patients during the predefined study period were enrolled.

**Ethical Considerations**

The study protocol was approved by the Kayseri City Hospital Non-Interventional Clinical Research Ethics Committee (Approval Number: 677, Date: 02.12.2025) and was conducted in accordance with the Declaration of Helsinki. Written informed consent was obtained from all participants prior to enrollment.

## RESULTS

**Patient Characteristics**

A total of 248 consecutive patients with inflammatory bowel disease (IBD) were included: 169 (68.1%) with ulcerative colitis (UC) and 79 (31.9%) with Crohn's disease (CD). Baseline characteristics are presented in Table 1.

The median age was 42 years (interquartile range [IQR], 34–51), and 136 patients (54.8%) were male. The median disease duration was 6.4 years (IQR, 3.1–11.2), which was significantly longer among patients

**Table 1.** Baseline characteristics of the study cohort (N = 248)

| Characteristic | Total Cohort (n = 248) | Ulcerative Colitis (n = 169) | Crohn's Disease (n = 79) | P |
|---|---|---|---|---|
| Age, years, median (IQR) | 42 (34–51) | 43 (35–52) | 40 (32–49) | .15 |
| Male sex, n (%) | 136 (54.8) | 89 (52.7) | 47 (59.5) | .38 |
| Disease duration, years, median (IQR) | 6.4 (3.1–11.2) | 5.8 (2.8–10.1) | 7.1 (4.2–12.9) | .041 |
| IBD-related surgery, n (%) | 37 (14.9) | 14 (8.3) | 23 (29.1) | < .001 |
| Primary treatment strategy, n (%) | | | | < .001 |
| Oral/systemic | 152 (61.3) | 121 (71.6) | 31 (39.2) | |
| Subcutaneous biologic | 58 (23.4) | 35 (20.7) | 23 (29.1) | |
| Intravenous biologic | 38 (15.3) | 13 (7.7) | 25 (31.6) | |
| Biologic therapy (any), n (%) | 96 (38.7) | 48 (28.4) | 48 (60.8) | < .001 |

IBD indicates inflammatory bowel disease; UC, ulcerative colitis; CD, Crohn's disease; IQR, interquartile range. Continuous variables were compared using the Mann–Whitney U test. Categorical variables were compared using the chi-square test. P values for primary treatment strategy reflect overall group comparison.

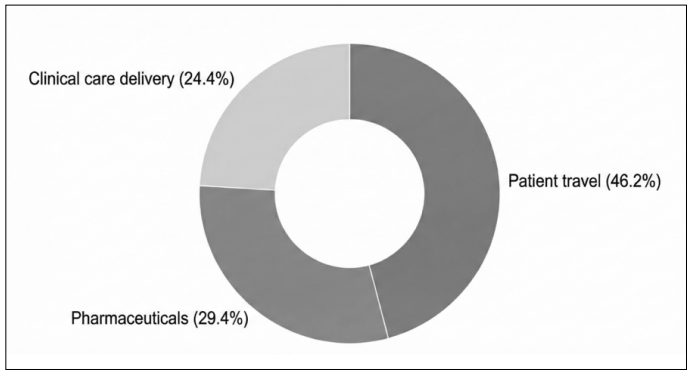


**Figure 1.** Proportional contribution of emission domains to the annual carbon footprint of IBD care (N = 248).
Patient travel accounted for 46.2% of total emissions, followed by pharmaceuticals (29.4%) and clinical care delivery (24.4%). The proportions represent the relative contribution of each emission domain to the cohort's median annual carbon footprint (kg $CO_2$e per patient-year). IBD indicates inflammatory bowel disease; $CO_2$e, carbon dioxide equivalent.

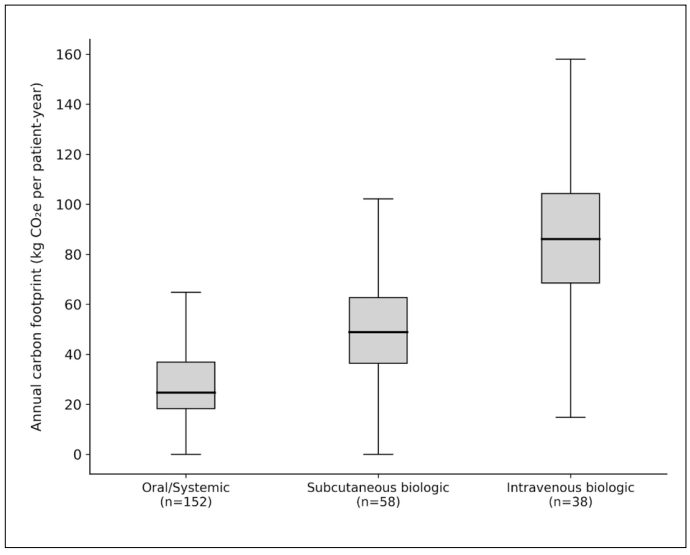


**Figure 2.** Annual carbon footprint according to maintenance treatment strategy. Boxplots show the distribution of annual carbon footprint (kg $CO_2$e per patient-year) across oral/systemic agents, subcutaneous biologics, and intravenous biologics. The central line represents the median; boxes indicate the interquartile range (IQR); whiskers extend to 1.5 × IQR. Overall differences were assessed using the Kruskal–Wallis test (P < .001). Post hoc Dunn's test demonstrated significant differences for all pairwise comparisons (all P < .001).

with CD than among those with UC (7.1 vs 5.8 years; P = .041). A history of IBD-related surgery was more prevalent in the CD group (29.1% vs 8.3%; P < .001).

Overall, 96 patients (38.7%) received biologic therapy, including 58 (23.4%) receiving subcutaneous agents and 38 (15.3%) receiving intravenous agents. Biologic therapy was more common among patients with CD than among those with UC (60.8% vs 28.4%; P < .001).

**Overall Carbon Footprint of IBD Care**

The median annual carbon footprint of IBD care was 52.6 kg carbon dioxide equivalent ($CO_2$e) per patient-year (IQR, 31.8–74.2).
Patient travel was the dominant emission source, accounting for 46.2% of total emissions, followed by pharmaceuticals (29.4%) and clinical care delivery (24.4%) (Figure 1).

**Carbon Footprint by Treatment Strategy**

Annual carbon footprint differed significantly across the three maintenance treatment strategies (Kruskal–Wallis test; P < .001) (Figure 2).
Patients receiving oral/systemic therapy had the lowest median footprint (24.7 kg $CO_2$e per patient-year; IQR, 18.3–36.9). Those receiving subcutaneous biologics had a higher median footprint (48.9 kg $CO_2$e; IQR, 36.4–62.7; P < .001 vs oral/systemic therapy). The highest emissions were observed in the intravenous biologics group (86.1 kg $CO_2$e; IQR, 68.5–104.3), which was significantly higher than those in both other groups (both P < .001).

**Contribution of Emission Domains by Treatment**

The proportional contribution of each emission domain varied according to treatment modality (Table 2).

In the intravenous biologics group, patient travel accounted for the largest share (52.8%), followed by pharmaceuticals (27.6%) and clinical care delivery (19.6%).

Among patients receiving subcutaneous biologics, pharmaceuticals were the dominant contributor (41.3%), with travel and clinical care delivery accounting for 34.7% and 24.0%, respectively.
In the oral/systemic group, emissions were more evenly distributed, with clinical care delivery representing 38.9%, travel 36.5%, and pharmaceuticals 24.6%.

**Disease Subtype Analysis**

At the cohort level, patients with CD had a higher median carbon foot-

**Table 2.** Annual carbon footprint by emission domain and treatment strategy

| Treatment Strategy | n | Total Footprint, kg $CO_2$ e per Patient-Year, Median (IQR) | Patient Travel, Median kg (% of total) | Pharmaceuticals, Median kg (% of total) | Clinical Care Delivery, Median kg (% of total) |
|---|---|---|---|---|---|
| Oral/systemic agents | 152 | 24.7 (18.3–36.9) | 9.0 (36.5) | 6.1 (24.6) | 9.6 (38.9) |
| Subcutaneous biologics | 58 | 48.9 (36.4–62.7) | 17.0 (34.7) | 20.2 (41.3) | 11.7 (24.0) |
| Intravenous biologics | 38 | 86.1 (68.5–104.3) | 45.5 (52.8) | 23.8 (27.6) | 16.9 (19.6) |
| Total | 248 | 52.6 (31.8–74.2) | 24.3 (46.2) | 15.5 (29.4) | 12.8 (24.4) |

$CO_2$e indicates carbon dioxide equivalent; IQR, interquartile range. Values are presented as the median (IQR) for total annual carbon footprint and the median absolute contribution of each emission domain. Percentages represent the proportional contribution to total emissions. Percentages may not sum to 100 due to rounding.

**Table 3.** Multivariable linear regression of annual carbon footprint

| Predictor | Adjusted β (kg $CO_2$e per Patient-Year) | 95% CI | P |
|---|---|---|---|
| Treatment strategy | | | |
| Subcutaneous biologic | 18.6 | 12.2–25.1 | < .001 |
| Intravenous biologic | 31.4 | 24.1–38.7 | < .001 |
| Travel distance (per 10-km increase) | 3.2 | 1.9–4.5 | < .001 |
| Healthcare encounters (per additional encounter per year) | 1.1 | 0.3–1.9 | .008 |
| Disease subtype (CD vs UC) | 2.8 | −3.1–8.7 | .35 |
| Age (per 10-year increase) | −0.5 | −2.1–1.1 | .54 |
| Disease activity index | 0.7 | −0.5–1.9 | .24 |

Reference category for treatment strategy: oral/systemic agents. β indicates regression coefficient; CI, confidence interval; $CO_2$e, carbon dioxide equivalent; UC, ulcerative colitis; CD, Crohn's disease. Model $R^2 = 0.62$. β coefficients represent adjusted changes in annual carbon footprint (kg $CO_2$e per patient-year).

print than those with UC (61.9 vs 46.8 kg $CO_2$e; P = .002). However, this association was no longer significant after multivariable adjustment for treatment strategy, suggesting that the unadjusted difference was largely explained by differences in treatment strategy rather than disease subtype alone.

**Predictors of Carbon Footprint**

Multivariable linear regression identified treatment modality as the strongest independent predictor of the annual carbon footprint (Table 3). The final model explained 62% of the variance ($R^2 = 0.62$).

Compared with oral/systemic therapy, intravenous biologics were associated with an adjusted increase of 31.4 kg $CO_2$e per patient-year (95% CI, 24.1–38.7; P < .001), and subcutaneous biologics with an increase of 18.6 kg $CO_2$e per patient-year (95% CI, 12.2–25.1; P < .001).

Each 10-km increase in one-way travel distance was independently associated with an additional 3.2 kg $CO_2$e annually (95% CI, 1.9–4.5; P < .001).

The total number of in-person healthcare encounters was also independently associated with higher emissions (β = 1.1 kg $CO_2$e per additional encounter per year; 95% CI, 0.3–1.9; P = .008).

Disease subtype, age, and disease activity indices were not independently associated with carbon footprint after multivariable adjustment.

## DISCUSSION

In this prospective cohort study, we quantified the patient-level carbon footprint associated with long-term inflammatory bowel disease (IBD) management. Our findings demonstrate substantial variability in emissions. This variability appears to be driven primarily by treatment modality and patterns of healthcare utilization, rather than by the intrinsic clinical characteristics of the disease.

The median annual carbon footprint of 52.6 kg $CO_2$e per patient indicates that chronic IBD care is associated with a measurable environmental burden. Consistent with broader healthcare analyses,[1,9] patient travel was the largest contributor, accounting for nearly half of total emissions. Treatment modality was the strongest predictor in the adjusted model, with intravenous biologics associated with the highest carbon footprint, followed by subcutaneous biologics and oral/systemic therapies.

After multivariable adjustment, disease activity indices were not independently associated with emissions. This finding suggests that the environmental impact reflects structural and organizational features of care delivery more than clinical disease severity. In addition to structural determinants, patient-level lifestyle and psychosocial factors may also influence healthcare utilization patterns in IBD.[13] These data indicate that sustainability considerations can be incorporated into care models without compromising established monitoring and treatment standards.

The higher footprint observed with intravenous biologics appears to be attributable to recurrent hospital-based infusion visits and upstream emissions related to pharmaceutical manufacturing.[12] While biologic therapies remain essential for moderate-to-severe IBD, the use of subcutaneous formulations, when clinically appropriate, may reduce travel-related and facility-associated emissions. Integrating environmental considerations into health technology assessment frameworks may further contextualize the carbon impact of therapeutic strategies.[14]

Across treatment groups, travel-related emissions represented the largest potentially modifiable component of the overall footprint. Telemedicine has been shown to reduce healthcare-associated emissions without adversely affecting patient satisfaction or quality of care.[15] Practical approaches may include structured telehealth follow-up for stable patients, consolidation of laboratory testing with clinic visits, and optimization of follow-up intervals.

Diagnostic and monitoring procedures also contribute to the environmental burden of IBD care. Endoscopic and radiologic interventions are inherently resource-intensive. Adoption of evidence-based surveillance intervals and sustainability initiatives in endoscopy may help mitigate this impact.[16] Within treat-to-target frameworks, careful alignment of monitoring intensity with clinical necessity may limit avoidable healthcare utilization and associated emissions.[5]

IBD should also be viewed within a broader environmental context. Environmental exposures, dietary patterns, and pollution have been linked to IBD risk and outcomes.[6,7,17] Diets high in ultra-processed foods have been associated with both increased IBD risk and higher greenhouse gas emissions.[18,19] Emerging microbiota-targeted strategies[20] may therefore warrant evaluation not only for clinical effectiveness but also for environmental implications across the continuum of care.

**Strengths and Limitations**

Strengths of this study include its prospective design, detailed patient-level activity data, and use of a standardized activity-based carbon accounting framework aligned with ISO life cycle assessment principles.[10,11] These features enabled the comparison of real-world IBD care pathways at the patient level.

Several limitations merit consideration. Emission factors were derived from published life cycle assessment sources, which may introduce estimation uncertainty. Infrastructure-related emissions and staff commuting were excluded due to allocation constraints, likely resulting in conservative overall estimates. Additionally, the single-center design may limit generalizability; however, relative differences between treatment modalities are likely applicable to similar tertiary care settings.

**Implications and Future Directions**

These findings support the incorporation of environmental sustainability considerations into routine IBD management through incremental, evidence-based modifications in care delivery. Future research should include multicenter validation studies. In addition, comprehensive life cycle assessments of IBD therapies should be conducted, and environmental metrics should be integrated into value-based care models. As the global burden of IBD continues to increase,[3,21] aligning effective disease control with environmental responsibility may become increasingly relevant.

## CONCLUSION

Long-term management of inflammatory bowel disease is associated with a measurable carbon footprint, largely driven by treatment modality and healthcare utilization patterns. In this cohort, patient travel and biologic therapies—particularly intravenous administration—were the principal contributors to emissions.

Optimization of treatment strategies and reduction of avoidable in-person encounters, when clinically appropriate, may reduce environmental impact while maintaining standards of care. Integrating sustainability principles into IBD practice represents a practical step toward environmentally responsible healthcare delivery.

**Ethics Committee Approval:** The study's protocol received approval from the Ethical Committee for Clinical Investigations of the Kayseri City Hospital Non-Interventional Clinical Research Ethics Committee (Approval Number: 677, Date: 02.12.2025).

**Informed Consent:** Written informed consent was obtained from the patients participating in this study.

**Peer-review:** Externally peer-reviewed.

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**Author Contribution**: Concept – Y.Ö.; Design – Y.Ö.; Supervision – Y.Ö.; Materials – Y.Ö.; Data Collection and/or Processing – Y.Ö., D.T.; Analysis and/or Interpretation – Y.Ö.; Literature Review – Y.Ö., D.T.; Writing – Y.Ö.; Critical Review – Y.Ö., D.T.

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## REFERENCES

1. Lenzen M, Malik A, Li M, et al. The environmental footprint of health care: a global assessment. Lancet Planet Health. 2020;4(7):e271-e279. [CrossRef]
2. Wang R, Li Z, Liu S, Zhang D. Global, regional and national burden of inflammatory bowel disease in 204 countries and territories from 1990 to 2019: a systematic analysis based on the Global Burden of Disease Study 2019. BMJ Open. 2023;13(3):e065186. [CrossRef]
3. Caron B, Honap S, Peyrin-Biroulet L. Epidemiology of Inflammatory Bowel Disease across the Ages in the Era of Advanced Therapies. J Crohns Colitis. 2024;18(Supplement_2):ii3-ii15. [CrossRef]
4. Cammarota G, Laterza L, Bibbò S, et al. Review Article: Green Management of IBD-New Paradigms for an Eco-Friendly Approach. Aliment Pharmacol Ther. 2025;61(1):65-74. [CrossRef]
5. Turner D, Ricciuto A, Lewis A, et al.; International Organization for the Study of IBD. STRIDE-II: An Update on the Selecting Therapeutic Targets in Inflammatory Bowel Disease (STRIDE) Initiative of the International Organization for the Study of IBD (IOIBD): Determining Therapeutic Goals for Treat-to-Target strategies in IBD. Gastroenterology. 2021;160(5):1570-1583. [CrossRef]
6. Piovani D, Danese S, Peyrin-Biroulet L, Nikolopoulos GK, Lytras T, Bonovas S. Environmental Risk Factors for Inflammatory Bowel Diseases: An Umbrella Review of Meta-analyses. Gastroenterology. 2019;157(3):647-659.e4. [CrossRef]
7. Chhibba T, Gros B, King JA, et al. Environmental risk factors of inflammatory bowel disease: toward a strategy of preventative health. J Crohns Colitis. 2025;19(4):jjaf042. [CrossRef]
8. von Elm E, Altman DG, Egger M, Pocock SJ, Gøtzsche PC, Vandenbroucke JP; STROBE Initiative. The Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) statement: guidelines for reporting observational studies. Lancet. 2007;370(9596):1453-1457. [CrossRef]
9. Health Case Without Harm. Health care's climate footprint: how the health sector contributes to the global climate crisis and opportunities for action. Health Care Without Harm; 2019. Accessed March 27, 2026. https://noharm-global.org/sites/default/files/documents-files/5961/HealthCaresClimateFootprint_092319.pdf
10. European Committee For Standardization. Environmental management—life cycle assessment—principles and framework. Accessed March 27, 2026. https://www.cscses.com/uploads/2016328/20160328110518251825.pdf
11. Drew J, Christie SD, Tyedmers P, Smith-Forrester J, Rainham D. Operating in a Climate Crisis: A State-of-the-Science Review of Life Cycle Assessment within Surgical and Anesthetic Care. Environ Health Perspect. 2021;129(7):76001. [CrossRef]
12. Belkhir L, Elmeligi A. Carbon footprint of the global pharmaceutical industry and relative impact of its major players. J Clean Prod. 2019;214:185-194. [CrossRef]
13. Demers K, Hendrix EMB, Ardabili AR, et al. Lifestyle and psychosocial factors in inflammatory bowel disease: Prevalence, impact, motivation, and support needs. PLoS One. 2025;20(8):e0331092. [CrossRef]
14. McAlister S, Morton RL, Barratt A. Incorporating carbon into health care: adding carbon emissions to health technology assessments. Lancet Planet Health. 2022;6(12):e993-e999. [CrossRef]
15. Marković S, Kralj D, Knežević Ivanovski T, Svorcan P. Telehealth-An Environmentally Friendly Way to Take Care of Patients with Inflammatory Bowel Disease. Medicina (Kaunas). 2025;61(2):332. [CrossRef]
16. Rodríguez de Santiago E, Dinis-Ribeiro M, et al. Reducing the environmental footprint of gastrointestinal endoscopy: European Society of Gastrointestinal Endoscopy (ESGE) and European Society of Gastroenterology and Endoscopy Nurses and Associates (ESGENA) Position Statement. Endoscopy. 2022;54(8):797-826. [CrossRef]
17. Estevinho MM, Midya V, Cohen-Mekelburg S, et al. Emerging role of environmental pollutants in inflammatory bowel disease risk, outcomes and underlying mechanisms. Gut. 2025;74(3):477-486. [CrossRef]
18. Spiller AL, Costa BGD, Yoshihara RNY, et al. Ultra-Processed Foods, Gut Microbiota, and Inflammatory Bowel Disease: A Critical Review of Emerging Evidence. Nutrients. 2025;17(16):2677. [CrossRef]
19. Adolph TE, Zhang J. Diet fuelling inflammatory bowel diseases: preclinical and clinical concepts. Gut. 2022;71(12):2574-2586. [CrossRef]
20. Nagayama M, Gogokhia L, Longman RS. Precision microbiota therapy for IBD: premise and promise. Gut Microbes. 2025;17(1):2489067. [CrossRef]
21. Jairath V, Feagan BG. Global burden of inflammatory bowel disease. Lancet Gastroenterol Hepatol. 2020;5(1):2-3. [CrossRef]