Pharmacy Reports

https://doi.org/10.51511/pr.103

ORIGINAL ARTICLE

Open Access

How do French patients perceive the environmental impact of drugs?

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Abstract: Medications account for nearly one-third of healthcare-related greenhouse gas emissions in France, yet their environmental impact remains largely overlooked in public discourse. This study aimed to explore how patients with chronic illnesses perceive their medications' ecological footprint and identify opportunities for a more sustainable pharmaceutical model supported by patient engagement. An anonymous survey was conducted via an online survey among French adults with chronic illnesses (asthma, diabetes, multiple sclerosis, rheumatoid arthritis, and chronic myeloid leukaemia) to explore their awareness and attitudes regarding the environmental impact of medications. The 11-item questionnaire was distributed via patient associations and social media over two weeks (October 15–November 1, 2024). Data were analysed using descriptive and comparative statistics; open-ended responses were thematically explored. Nearly 90.0% (n=202) of respondents were willing to choose medications with a lower environmental impact, provided their efficacy and tolerability were equivalent. However, 47.0% (n=104) of patients were unsure if there is a link between environmental impact and medication effectiveness, highlighting a significant lack of clarity on the topic. This uncertainty reinforces the need for accessible and transparent information. Over 88.0% (n=199) of participants wished to be informed about the environmental footprint of their treatments, favouring labelling on medication packaging. While most patients were willing to act individually—by returning unused medications or choosing greener options—only 68.7% (n=155) reported using recycling programs, a rate below the national documented average of 81.0%. Patients also expressed a strong desire for systemic change: 87.0% (n=195) supported the inclusion of environmental criteria in national medication evaluation policies, and they also expected the pharmaceutical industry to invest in sustainability, while remaining cautious about potential economic trade-offs. In conclusion, patients are open to contributing to a more sustainable healthcare model, but a lack of clear, trustworthy information and accessible environmental options hinders their willingness. Public institutions, healthcare providers, and pharmaceutical companies must work together to support this shift by raising awareness and making sustainable choices visible, credible, and actionable within the patient care pathway.

Keywords: chronic disease, drug evaluation, health literacy, patient preference, sustainable development

Introduction

While dedicated to protecting human health, the healthcare sector also contributes to environmental harm. In France, it is responsible for approximately 8% of national greenhouse gas emissions [1]. This issue is particularly pressing given the country's high reliance on pharmaceuticals: France ranks among the highest per-capita consumers of medications in Western Europe, with an estimated 3.6% of the French population taking antibiotics daily, compared to just 2.4% across the EU/EEA (European Union/European Economic Area) [2, 3]. This highlights the urgent need to rethink how healthcare is delivered, ensuring it remains effective and environmentally responsible.

Beyond their role in patient care, medications also have a considerable environmental footprint. Their production, packaging, transport, and disposal generate greenhouse gas emissions, contributing to climate change [1,4]. Some compounds, such as inhaler propellants, are especially high emitters [5]. In addition, pharmaceutical residues are increasingly identified as pollutants of concern. Many active substances are excreted unmetabolized and enter wastewater systems, which are not equipped to eliminate them fully. A global study by Wilkinson et al. detected pharmaceutical contaminants in over 25% of rivers across 104 countries, including antibiotics, hormones, and psychotropic compounds [6]. These pollutants disrupt aquatic ecosystems, impair wildlife

reproduction, and fuel the spread of antimicrobial resistance, identified by the WHO as a major global health threat [7]. Supporting this, recent data show that up to 60% of bacterial isolates in pharmaceutical-contaminated environments produce extended-spectrum β-lactamases (ESBL), highlighting pharmaceutical waste as a key driver of resistance development [8].

French public health authorities have recognized the urgency of this topic. In 2023, the Ministry of Health made ecological transformation a national priority [9]. However, one key element is often overlooked in this transition: the role of patients.

Only a few international studies have explored patients' views on the environmental impact of medication: in the Netherlands, a 2024 national survey of over 9,000 patients found that 69% viewed environmental sustainability as an important aspect of healthcare, and 73% were willing to factor it into their healthcare decisions [10]. A 2023 Swedish study also highlighted patient openness to eco-conscious choices: 68% of respondents selected the most environmentally friendly option for minor conditions, but this figure decreased to 36% for chronic diseases and 23% for acute, life-threatening conditions [11].

In France, such data are still lacking, which makes it difficult to define how and when environmental factors should be introduced in clinical decision-making. This also raises questions about how healthcare professionals can approach the issue. Although there is growing awareness among prescribers, sustainability remains largely absent from prescribing habits. A study of French general practitioners in the Isère region found that 98% would consider prescribing a less polluting medication if its efficacy and tolerance were equivalent. Many reported concerns about potential resistance from patients when proposing alternative treatments based on environmental reasons [12]. These findings suggest that while patients and physicians may support more sustainable practices in principle, they often lack the information, tools, and confidence to act accordingly.

This paper seeks to explore this issue. It focuses on patients with chronic illnesses and investigates their awareness, preferences, and openness to integrating environmental impact into their treatment decisions.

Methods

Study design and participants

An anonymous, self-administered online survey was conducted via Google Forms among adults in France receiving treatment for chronic conditions: multiple sclerosis (MS), rheumatoid arthritis (RA), type 1 and type 2 diabetes (T1D & T2D), and chronic myeloid leukaemia (CML). These conditions were selected due to their high prevalence in France—diabetes affects approximately 8.6% of French adults, a rate among the highest in Europe [13] — and their substantial impact on quality of life due to factors such as chronic pain, disability, fatigue, or the burden of long-term treatment. Most also offer therapeutic alternatives with varying environmental impacts, such as different inhaler types for asthma and oral versus injectable treatments in RA or MS. This made them particularly suitable for exploring the integration of environmental considerations into treatment choices.

Survey development and distribution

The 11-item survey (10 multiple-choice and one open-ended; see Appendix 1) was developed based on existing questionnaires exploring patient perspectives on sustainability in healthcare, particularly those used in studies conducted in the Netherlands and Sweden [10, 11]. It was then pre-tested with 20 participants to ensure clarity and comprehension. During this phase, participants were invited to provide feedback on wording and structure. One item related to reduced efficacy for environmental benefit was removed as it led to confusion. Additionally, throughout the recruitment process, the researcher remained receptive to any respondent comments or questions, allowing for real-time clarification if needed. The final version was shared through seven patient groups, mainly via social media, over two weeks (October 15–November 1, 2024), with reminders sent during.

Ethical considerations

Participation was voluntary and anonymous. No personal data was collected. According to French law, written consent was not required, but each participant was informed of the academic objectives of the study.

Data analysis

The first author was responsible for all data collection and analysis.–Quantitative data were analysed using R

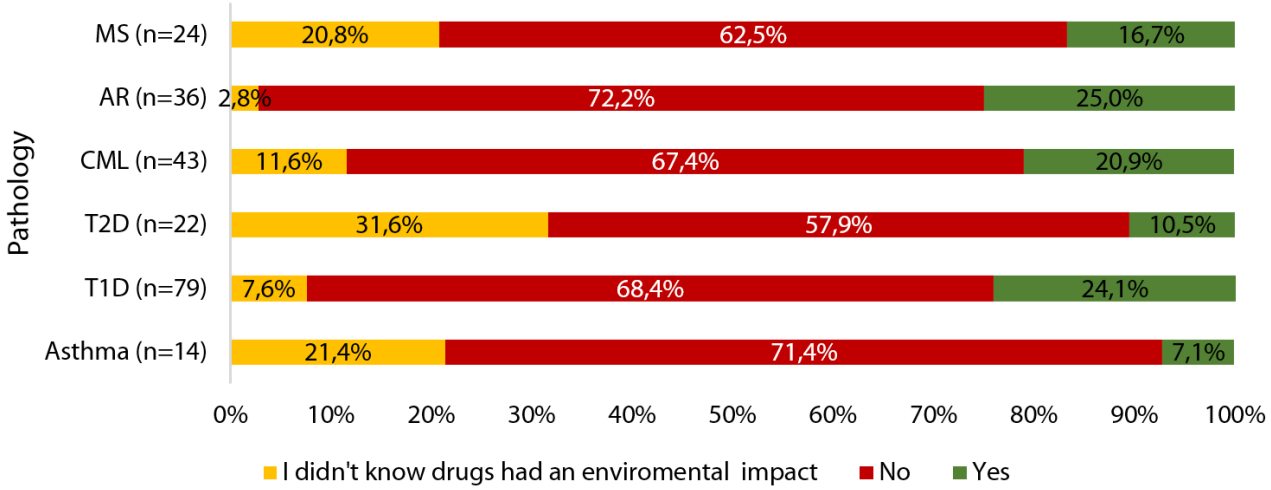

Figure 1. Awareness of environmental impact of medications by medical condition. Bar charts show the percentage of patients aware of their medications' environmental impact based on their condition. CML = Chronic Myeloid Leukemia, MS = Multiple Sclerosis, RA = Rheumatoid Arthritis, T1D = Type 1 Diabetes, T2D = Type 2 Diabetes

(version 4.3.1) and Microsoft Excel (Office 365 version 2306), applying descriptive statistics and comparative tests (chi-squared, z-tests, Fisher's exact) to examine associations between respondent characteristics (e.g., age group, pathology) and selected survey items (items 3, 4, 5, 6, and 7). Only results relevant to the study objectives are presented in the Results section. The first author thematically analysed open-ended responses using an inductive approach. Although no second coder was involved, internal checks ensured consistency, and qualitative findings were compared with quantitative results to support interpretation.

Results

Patient characteristics

A total of 225 patients completed the survey. The most represented conditions were T1D n=79 (35.1%), chronic myeloid leukaemia n=43 (19.1%), rheumatoid arthritis n=36 (16.0%), multiple sclerosis n=24 (10.7%), T2D n=22 (9.8%), and asthma n=14 (6.2%). Comorbidities (n = 25) were reassigned to the closest targeted condition for consistency. Participants were mostly aged "36–55" (106 - 47.3%), followed by "26–35" (46 - 20.4%), "18–25" (33 - 14.4%), "56–65" (26 - 12.4%), and "over 65" (14 - 5%).

Awareness of environmental impact

Awareness levels varied by medical condition; however, a chi-square test revealed no statistical significance (p = 0.067) (Figure 1). Awareness was highest among RA patients (n=9, 25.0%). At the same time, it was lower among those with asthma (n=1, 7.1%) and T2D (n=2, 10.0%). By age, the level of awareness was low across all groups. However, it peaked among those aged "26–35" (n=15, 32.6%) and was lowest among "56–65" (n=3, 11.5%). Targeted comparisons between these two age groups using z-tests for proportions showed a significant difference (p = 0.047).

The second question explored the perceived link between efficacy and carbon footprint. It revealed that nearly half of the participants (n=108, 48.0%) were unsure whether the carbon footprint could affect medication's efficacy, (n=100, 42.0%) perceived no link between the two, and (n=21, 10.0%) believed there was a link.

Patient willingness to choose environmentally friendly treatments

When asked if they would be willing to opt for a treatment with lower environmental impact, assuming equal efficacy and tolerance, most respondents (n=202, 89.8%) answered "Yes". Only 18 (8.0%) responded negatively, while a small proportion either preferred to follow the physician's advice (n=2, 1.0%) or were uncertain (n=3, 1.2%).

Desire for environmental information and preferred communication channels

Most respondents (n=199, 88.0%) expressed a desire to be informed about the carbon footprint of their medications. The vast majority (n=152, 71.4%) preferred that this information appear directly on the

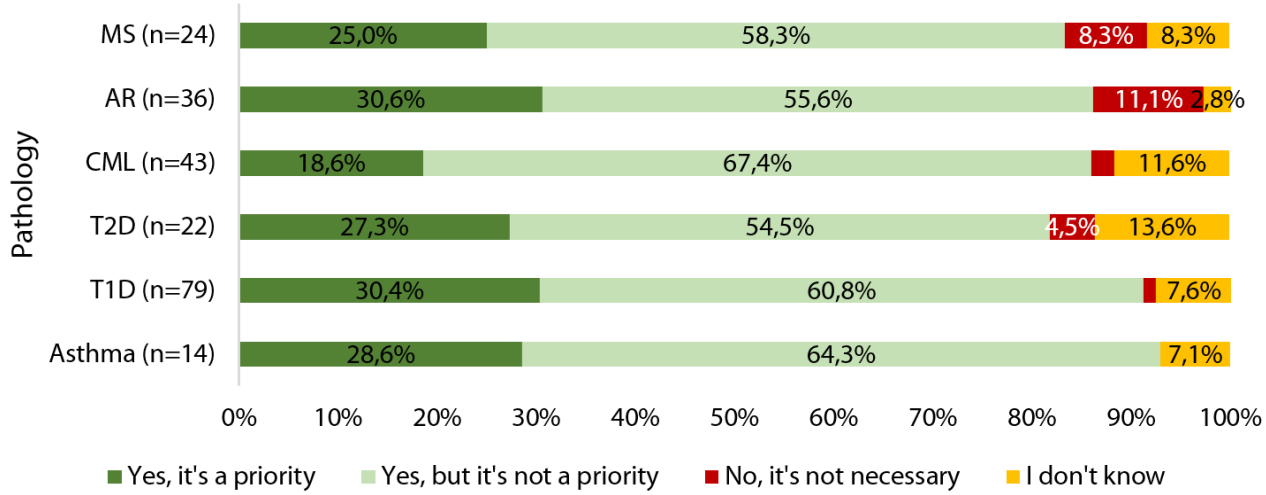

Figure 2. Patient support for including environmental impact in medication evaluation. A stacked bar chart shows responses to whether environmental impact should be considered in official drug evaluation. CML = Chronic Myeloid Leukaemia, MS = Multiple Sclerosis, RA = Rheumatoid Arthritis, T1D = Type 1 Diabetes, T2D = Type 2 Diabetes

packaging. Additional preferences included access via digital platforms (n=43, 20.3%), physicians (n=59, 27.7%), and pharmacists (n=4, 1.8%). A minority of participants (n=26, 12.3%) felt such information was unnecessary.

Patient involvement in environmental impact reduction

Most participants, n=193 (86.0%), believed patients can contribute to reducing the environmental footprint of medicines through actions like returning unused medications or recycling packaging. Additionally, 49 (22.0%) felt patients could be helped by choosing greener treatments. Only 17 (8.0%) rejected any patient responsibility in this area.

Most respondents were aware of recycling or medication take-back programs. Most n=144 (64.0%) patients reported participating systematically in these programs, while n=11 (5.0%) participated occasionally. A third of participants did not participate, among them (n=36, 16.0%) were aware of the programs but chose not to participate, while (n=29, 13.0%) had never heard of them.

Perceptions on the inclusion of environmental impact in medication evaluation

Most patients supported the inclusion of environmental criteria in the official evaluation of medicines (Figure 2), but not as a priority, most notably among those with CML (n=29, 67.4%) and asthma (n=9, 64.3%). Support for prioritizing environmental criteria outright was highest in T1D (n=24, 30.4%) and RA (n=11, 30.6%), but lower in CML (n=8, 18.6%). Rejection of this consideration was rare overall, though slightly more present in rheumatoid arthritis (n=4, 11.1%) and nearly absent in T1D and asthma.

Perceptions of pharmaceutical industry investment in environmental sustainability

A large majority supported industry investment in reducing the environmental footprint of medicines: 87 participants (38.7%) fully agreed, while 124 (55.1%) agreed with the condition that it should not raise medication prices (Figure 3). Only 14 (6.2%) opposed this priority. By age, full support was highest among those aged ≥65 (n=7, 50.0%) and 18–25 years old (n=15, 45.5%), and lowest among 26–35 years old (n=15, 32.6%). Conditional support peaked in the 26–35 group (n=27, 58.7%), while outright opposition remained marginal across all age groups (3.0–8.7%).

Patient perspectives on environmental responsibility in healthcare: insights from open-ended responses

The open-text section of the survey allowed patients to share additional reflections. These qualitative responses provide important context to enrich the quantitative results. Three key themes emerged in Table 1.

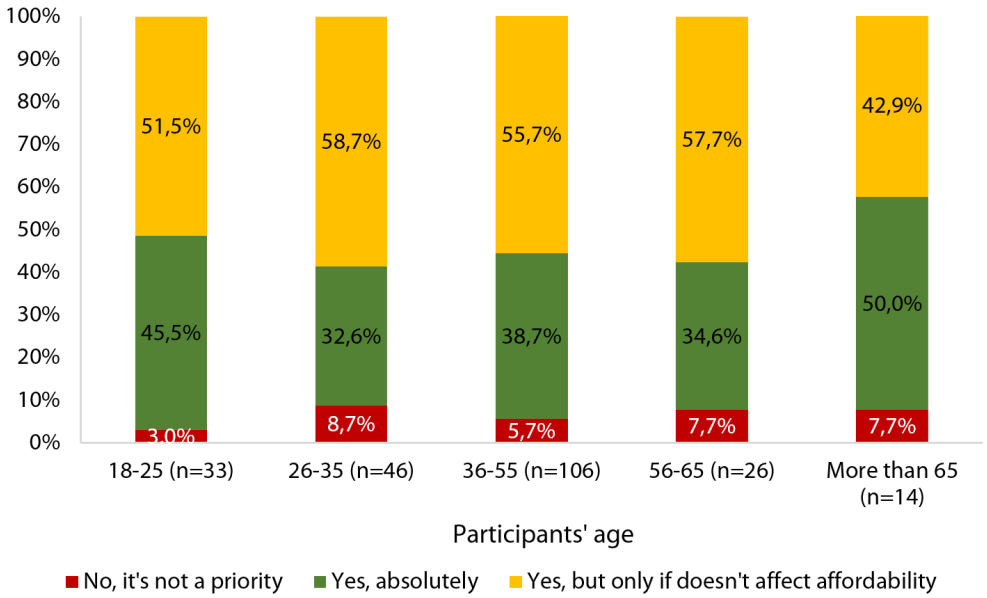

Figure 3. Patient attitudes toward pharmaceutical industry environmental investment by age group. A grouped bar chart showing levels of agreement with the pharmaceutical industry's involvement in sustainability was split by age group

Table 1. Key themes in patients' statements

Key theme	Patient's statement
Concerns about medication waste due to overprescription or packaging formats that exceed actual treatment needs	"The dispensing of treatment quantities should be adjusted to the treatment duration, to avoid wasting medication and leaving half-used boxes that often go unused."
Lack of transparency in recycling: Frustration over the absence of clear information on what happens to returned equipment	"… What shocks me most in diabetes is the equipment. Insulin pumps that last 3 days (Omnipod®) and are recycled at the pharmacy (but then what happens to them?) … I'd like to know at least what becomes of these devices after collection. Seeing these single-use devices (which I can't live without) frustrates me, while I try to reduce my impact on the planet."
Patients shared that adding environmental factors into treatment decisions could become mentally burdensome.	"I had never thought about it before, but it could be an additional mental load for the patient, having to choose between treatment effectiveness and a smaller environmental impact. And I worry a lot about the environment: I chose to be a vegetarian and make daily efforts. But I didn't choose to be sick, and I didn't choose to have to take a lifelong treatment."

Discussion

This study suggests that patients are increasingly receptive to integrating environmental considerations into healthcare. Most participants expressed a strong interest in receiving information about the ecological impact of their medications, acknowledging a shared responsibility between healthcare institutions and individuals.

Yet despite this receptiveness, awareness of the environmental impact of medications remained limited. Although younger adults (26–35) demonstrated higher knowledge, likely reflecting their higher interest in the environmental cause [14]. The overall understanding of pharmaceutical environmental impact was low. This trend, also noted by Scholz et al. (2024), underlines the need to strengthen environmental health literacy across all demographics [15].

This gap in awareness is reflected in many misconceptions: about half of the respondents were uncertain if there's a link between a medication's carbon footprint and its efficacy. As shown in Dohle et al. (2013), patients often misjudge a medication's environmental impact based on irrelevant criteria like perceived potency or prescription status—seeing OTC drugs as less polluting and treatments for severe diseases as more harmful, regardless of actual

ecotoxicity [16, 17]. Addressing these beliefs through targeted, accessible education is key to enabling informed choices.

Interestingly, this limited knowledge did not translate into disinterest. On the contrary, participants clearly expressed a demand for greater transparency. Many wanted to better understand the ecological footprint of their treatments, with a preference for simple, visible formats on packaging. This supports the use of eco-labels in line with findings from Håkonsen et al. (2020), where over 83% of respondents endorsed such tools [11]. However, few patients cited pharmacists as preferred information sources, diverging from practices in countries like Sweden. This points to an opportunity for better integration of environmental communication in French community pharmacies.

Patients were willing and eager to contribute to more sustainable healthcare. Nearly 90% (n=199) reported readiness to choose environmentally friendly treatments when therapeutic efficacy was equal, mirroring findings from Dutch surveys, where 73% of patients considered sustainability in medical decisions [10]. This openness also translated into action: most participants reported engaging in environmentally conscious behaviours, such as recycling or returning unused medications.

However, this willingness was not without limits: actual recycling behaviours remained below national estimates (81%) and international figures reported in Spain (86%) and Finland (90%) [18–20]. Some participants were unaware of available return programs, while others, despite being informed, chose not to engage. Frustration was also voiced regarding the lack of transparency on what happens to returned medications, a factor likely dampening motivation. Improving communication and public trust could help close this intention-action gap [21].

Beyond disposal, participants also identified upstream issues, such as overprescription and oversized packaging. They noted that even returned medications still carry environmental costs due to production and distribution. These insights support growing calls for more precise and efficient prescribing practices, which align with emerging local initiatives encouraging more rational prescribing in France [22].

At the systemic level, participants viewed environmental responsibility as a shared task, including patients, healthcare providers, authorities, and the pharmaceutical industry. However, support for green innovation was not unconditional. Over half of respondents stressed that environmental efforts must not come at the cost of higher medication prices. This sensitivity contrasts with greater price tolerance reported in Swedish populations [11] and reflects strong cultural expectations around equity and access in the French healthcare context.

Support for including environmental impact in medication evaluation conducted by authorities was broadly shared, even among patients with severe chronic illnesses such as CML. However, for these patients, clinical outcomes took precedence. They did not reject the idea but ranked it lower in their hierarchy of concerns, highlighting the need to balance sustainability with the realities of serious disease management.

This caution serves as a reminder that, in clinical settings, integrating environmental impact into shared decision-making must be approached with sensitivity. As highlighted in previous Cohen et al. (2024), these discussions should occur under appropriate conditions, outside of emergencies, when patients are stable, and framed without guilt or pressure [10]. Tailoring the conversation to individual needs and clinical realities is essential to preserve trust and therapeutic quality.

Ultimately, these findings support the ethical inclusion of environmental sustainability in healthcare delivery. Patients are not barriers to progress; they are potential drivers. Systems must evolve to support informed, equitable, and environmentally responsible care to meet individual and collective health goals.

This study has several limitations. First, while efforts were made to include a variety of age groups and chronic conditions, the sample was not fully representative. Some subgroups, such as patients with asthma, were underrepresented, and participation among young adults and older individuals was limited.

Second, the data were self-reported and may be influenced by recall bias or misunderstanding of the questions. In addition, limited familiarity with the topic may have led some respondents to express opinions that were not fully informed, especially on complex aspects such as the inclusion of environmental criteria.

Lastly, this study intentionally focused on patients with chronic conditions, who are regular users of medications and may be more engaged with treatment-related decisions. As a result, the findings may not reflect the views of individuals with acute illnesses or those not currently undergoing treatment.

Table 2. Strategic levers for promoting environmentally sustainable medicines

Pillar	Key Insights	Proposed Actions
Pharmaceutical industry	Over 84% of patients in the study expect pharmaceutical companies to invest in more environmentally friendly medicines. Industry must reduce carbon footprint and be more transparent in market authorization processes.	• Integrate ecodesign principles from R&D to packaging and waste management. • Improve energy efficiency in manufacturing sites and shift toward renewable energy sources. • Include environmental criteria in market authorization procedures, such as carbon footprint.
Patients	Most patients are willing to choose greener treatments when equivalent in efficacy and tolerance, but feel insufficiently informed.	• Provide clear, visual, and cognitively accessible materials explaining treatments' environmental impact and recycling's importance. • Communicate non-judgmentally, emphasizing health–environment co-benefits and allowing patients to engage comfortably. • Adapt discussions to clinical context, prioritizing these exchanges during stable or non-urgent consultations, where shared decision-making is possible.
Health institutions and professionals	Over 75% of patients support including environmental impact in official drug evaluations. Health institutions and prescribers play a central role but need training, tools, and systemic support to act.	• Strengthen healthcare professional training in environmental sustainability without compromising the quality of care. • Involve environmental health experts in HAS assessments, from guideline development to validation. • Reinvent prescribing through decision-support tools with environmental indicators, and by limiting low-value or unnecessary prescriptions. • Revise public procurement policies to include sustainability criteria, encouraging greener industrial practices.

This study supports three key implications. First, pharmaceutical production should embrace eco-design principles, reducing emissions throughout the supply chain, while remaining transparent about their medication's carbon footprint. Second, institutions and professionals must lead by example through sustainable procurement policies, improved training, and integration of environmental metrics into prescribing decisions and medication evaluations. Third, patients must be empowered without burden; effective information tools, neutral communication, and tailored discussions in appropriate clinical settings can help facilitate engagement. These three strategic levers (industry, healthcare institutions, and patients) are summarized in Table 2, along with corresponding insights and actionable recommendations to guide implementation.

Conclusion

Sustainability in healthcare cannot be driven by one group alone. A collective effort involving patients, professionals, institutions, and industry must balance therapeutic efficacy, environmental responsibility, and social equity. This study reveals that patients are not a barrier but a potential force for change that can be activated through trust, information, and shared commitment.

Acknowledgments

The authors would like to thank all patient associations, individuals who helped distribute the survey, and the participants who generously shared their time and insights. No funding was received for this study.

Funding

None.

Declaration of interests

The authors declare no conflicts of interest.

Author contributions:

SC: Conceptualization, Methodology, Survey Development, Data Collection, Data Curation, Formal Analysis, Writing, Original Draft, Visualization. BM: Supervision, Critical Revision of the Manuscript. All authors approved the final version of the manuscript.

Received: July 22, 2025
Revised: August 7, 2025
Accepted: August 12, 2025
Published: August 12, 2025

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