

# Applying an Environmental Lens to Value-Based Care: A Resident-Driven Pilot Project to Limit Laboratory Testing on an Internal Medical Ward Service

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## Abstract

The cumulative impact of climate change on human health is undeniable, and the role of the healthcare system in exacerbating climate change is well-documented. The healthcare industry is responsible for nearly 5% of Global Greenhouse Gas (GHG) emissions and toxic air pollutants, with this percentage rising to 10% in the United States. More than 80% of the GHG emissions produced by the healthcare sector originate from the manufacturing and transportation of supplies used by clinicians, rather than from the medical facilities themselves. This indicates that a significant portion of the environmental impact is embedded in the supply chain and logistics associated with medical care.

Among the various proposals to reduce the healthcare system's carbon footprint, one particularly effective strategy is minimizing low-value care by reducing overtreatment and overprescribing. It is estimated that up to one-third of laboratory tests may be unnecessary, and by limiting these wasteful tests, the healthcare sector can make substantial progress towards reducing its carbon emissions. The carbon footprint of each laboratory test varies significantly, from 0.5 grams of CO<sub>2</sub> equivalent per test for C-reactive protein to 116 grams of CO<sub>2</sub> equivalent per test for a full blood examination. Most of the carbon footprint associated with laboratory tests comes from the blood sample collection process, including the plastics used for test tubes, rather than from reagents or power usage. With over 14 billion lab tests ordered annually in the United States alone, reducing the number of unnecessary laboratory tests could lead to a significant decrease in the healthcare sector's carbon footprint on a large scale. This approach not only

addresses the environmental impact but also has the potential to improve the efficiency and cost-effectiveness of healthcare delivery. By focusing on reducing low-value care and unnecessary testing, the healthcare industry can take meaningful steps towards sustainability and climate responsibility, ultimately contributing to the broader effort to combat climate change and protect public health.

**Keywords:** Climate change • Healthcare system • Global emissions • Laboratory tests

## Introduction

The cumulative effects of climate change on human health are undeniable, and the healthcare system's role in exacerbating climate change is well documented. The healthcare industry contributes nearly 5% of Global Greenhouse Gas Emissions (GHGs) and toxic air pollutants, with the percentage rising to 10% in the United States [1, 2]. More than 80% of GHGs produced by healthcare originate from the manufacturing and transportation of supplies used by clinicians, rather than from the medical facilities themselves [1].

Among the various proposals to reduce the healthcare system's carbon footprint, one effective strategy is minimizing low-value care by reducing overtreatment and overprescribing [3]. It is estimated that up to one-third of laboratory tests may be unnecessary, and limiting these wasteful tests can help achieve this goal [4]. The carbon footprint of each lab test varies, from 0.5 g CO<sub>2</sub>e/test for C-reactive protein to 116 g CO<sub>2</sub>e/test for a full blood examination (Table 1) [5]. Most of the carbon footprint of laboratory tests comes from blood sample collection, including the test tube plastics, rather than from reagents or power use. With over 14 billion lab tests ordered annually in the US alone, reducing wasteful laboratory testing could significantly decrease healthcare's carbon footprint on a large scale [6]. While the overuse of medical services, including diagnostic tests like laboratory tests, is mainly observed in higher-income countries, evidence suggests that the overuse of low-value testing is a global issue. Therefore, efforts to reduce inappropriate testing could have a worldwide impact.

However, the environmental benefits of reducing unnecessary laboratory tests are rarely discussed, often overshadowed by the more immediately observable benefits. Studies have shown that reducing blood draws can minimize patient harm and decrease rates of hospital-acquired anemia, which is associated with increased blood transfusions, extended hospital stays, higher charges, and increased mortality. Additionally, it can prevent cascades of wasteful care, as laboratory testing guides 70% of

medical decisions, and false-positive results can lead to more unnecessary tests and procedures [6-13]. Reducing the number of lab tests can also significantly decrease costs. For example, an academic medical center saved over \$2 million by reducing laboratory orders by 8% over three years [14].

While these benefits are critically important, the environmental arguments for reducing waste in healthcare are equally significant. There is a substantial opportunity to bring these environmental considerations into mainstream conversations.

The American Board of Internal Medicine's Choosing Wisely campaign, along with multiple professional societies such as the Society of Hospital Medicine, has identified routine and repetitive inpatient laboratory testing of clinically stable patients as low-value care. Despite these strong recommendations, numerous barriers to reducing unnecessary laboratory testing remain. These include entrenched practice habits, a lack of awareness of the benefits of fewer unnecessary tests, discomfort with diagnostic uncertainty, and perceived expectations for daily laboratory ordering.

Numerous reports from the US and around the world detail interventions aimed at overcoming barriers to reducing unnecessary laboratory testing. For example, at Vanderbilt University Medical Center, a combination of didactic sessions and sharing data on ordering practices among peers resulted in decreases in complete blood count and basic metabolic panel tests, as well as increases in lab-free days, without affecting length of stay, ICU transfers, mortality, or readmissions. Another study among hospitalists demonstrated that a variety of interventions, including provider education, rounding checklists, feedback on costs, and financial incentives, led to significant reductions in costs per day and the number of unnecessary tests ordered.

**Table 1.** The carbon footprint of laboratory tests.

<b>Laboratory Test</b>	0.5 g CO <sub>2</sub> e/test
<b>Arterial Blood Gas</b>	49 g CO <sub>2</sub> e/test
<b>Coagulation Profile</b>	82 g CO <sub>2</sub> e/test
<b>Urea and Electrolytes</b>	99 g CO <sub>2</sub> e/test
<b>Full Blood Examination</b>	116 g CO <sub>2</sub> e/test
<i>Adapted from McAlister et al. (2020). *The estimated carbon footprint for C-reactive protein testing excludes the impact of sample collection (e.g. needle holder, collection tube, nitrile gloves) and thus is an underestimate</i>	

Ultimately, best practices involve a combination of approaches:

Educational initiatives outlining guidelines for ordering tests and highlighting the potential harms of unnecessary testing audit and feedback on ordering practices compared to peers.

Restricting the ability to order repetitive daily laboratory tests within electronic medical records [11]. While evidence suggests that multimodal approaches yield the best results, implementing educational interventions alone has also been shown to significantly reduce common lab orders and costs.

However, previous efforts to reduce unnecessary laboratory test ordering often overlook the impact of educating healthcare providers about the environmental consequences of unnecessary testing. In our study, we present a resident-directed proof-of-concept educational pilot aimed at reducing unnecessary laboratory tests ordered by Internal Medicine

residents at a tertiary academic medical center. Unlike previous studies that focused on analyzing the clinical impact or financial costs of wasteful care, our study examines how educating residents about the environmental costs of low-value, unnecessary care, along with other associated benefits, may influence their behavior.

## Pilot methods

We've developed a comprehensive educational intervention aimed at educating both residents and faculty members on an inpatient medical ward service about the appropriate indications for ordering laboratory tests and the adverse environmental impacts of excessive testing. At the beginning of their general medicine rotation, attending physicians and residents will receive informative videos and handouts on this topic, designed to be reviewed in just 5 minutes-10 minutes. During morning and/or daily sign-out rounds, attending physicians or residents will be prompted to encourage interns to discuss which labs they plan to trend and which ones they intend to discontinue for each patient. Residents will be encouraged to continue these discussions beyond rounds as they finalize their daily patient care plans.

We plan to evaluate the effectiveness of this pilot using a mixed-methods approach, including qualitative interviews, surveys, and quantitative analyses of the frequency of various lab tests ordered per patient. We will compare data from before and after the intervention and also compare the intervention group with a control group consisting of other residents. At the end of each clinical rotation, we will distribute a brief five-question paper survey, which will be collected by one of the study investigators. All interviews will be conducted by a study investigator experienced in qualitative methods (KKA).

Additionally, we will estimate the number of plastic blood tubes avoided as a result of the intervention. This information will then be used to generate a rough assessment of the greenhouse gas emissions avoided, as well as any cost savings. We will communicate this information back to the clinical care teams involved in the study.

Currently, this program has been initiated on one of the five general medicine teaching services, and we have begun collecting initial data. However, as a pilot study, there are several limitations to consider.

Firstly, the size of the study is limited, preventing us from capturing all meaningful outcomes, such as the impact of laboratory ordering on hospital length of stay, ICU transfers, readmissions or mortality. To address potential patient safety concerns arising from this limitation, residents are encouraged to report both positive and negative experiences, including any safety issues encountered during the pilot. Additionally, residents will be provided with guidelines on appropriate indications for ordering and discontinuing labs, and attending physicians will be encouraged to review labs with residents during rounds.

Furthermore, our ability to estimate carbon savings is constrained by relying on a surrogate measure of blood tubes saved. In the future, we aim to leverage the data generated by this pilot to garner support for larger studies that can directly measure carbon savings. Lastly, we acknowledge that we will not be assessing the impact of the intervention on patient satisfaction or cost at this stage.

Despite these limitations, residents have reported that the intervention has been beneficial without adding significant burdens, and it has helped them develop a heightened appreciation of the potential negative impacts of repetitive testing. As one resident expressed, "I do think the increased awareness and thoughtfulness that goes into considering whether the labs being ordered are necessary for each patient every day is a positive thing... this forced me to reconsider each day what the patient truly needs and doesn't need."

## Conclusion

Despite these limitations, residents have reported that the intervention has been beneficial without adding significant burdens, and it has helped them develop a heightened appreciation of the potential negative impacts of repetitive testing. As one resident expressed, "I do think the increased awareness and thoughtfulness that goes into considering whether the labs being ordered are necessary for each patient every day is a positive thing... this forced me to reconsider each day what the patient truly needs and doesn't need." Achieving substantial reductions in carbon utilization in healthcare delivery will necessitate a multifaceted approach. This approach includes:

Quantifying the environmental impacts of medical procedures and treatments.

Implementing policies that prioritize sustainability efforts in hospitals, such as recycling and green procurement.

Creating incentives to encourage drug and device manufacturers, as well as other suppliers, to adopt energy-efficient production processes and minimize packaging waste.

While these efforts will take time to implement, one effective starting point, which requires no additional cost but yields high benefits, is focusing on judicious ordering of diagnostic studies, particularly laboratory tests. Every plastic tube ordered for a stable patient represents plastic waste, additional fossil fuel consumption, another unnecessary venipuncture, and potentially adds little or no useful clinical information. There is a significant opportunity to view resource utilization through an environmental lens, creating a win-win situation for both patients and the environment.

As we seek solutions to decarbonize the healthcare system, it is crucial to act with a sense of urgency. The health of our planet and our patients cannot afford further delay.

## Declaration of competing interest

The authors affirm that they have no known competing financial interests or personal relationships that could have influenced the work reported in this paper.

## Reference

1. Eckelman, M. J., & Jodi D.S. "Estimated global disease burden from US health care sector greenhouse gas emissions." *Am J Public Health* 108.(2018): S120-S122.
2. Salas R. N. et al. "A pathway to net zero emissions for healthcare." *BMJ*371 (2020).
3. Zhi Ming. et al "The landscape of inappropriate laboratory testing: a 15-year meta-analysis." *PloS One* 8.11 (2013): e78962.
4. McAlister, Scott. "The carbon footprint of pathology testing." *Med J Aust*212.8 (2020): 377-382.
5. Brownlee Shannon et al. "Evidence for overuse of medical services around the world." *Lancet* 390.10090 (2017)156-168.
6. Müskens Joris L.J.M. et al. "Overuse of diagnostic testing in healthcare: a systematic review." *BMJ Qual Saf*31.1 (2022): 54-63.
7. Vrijssen B E L et al. "Inappropriate laboratory testing in internal medicine inpatients: prevalence, causes and interventions." *Ann Med Surg*51 (2020): 48-53.
8. Bindraban Renuka S. et al. "Association of a multifaceted intervention with ordering of unnecessary laboratory tests among caregivers in internal medicine departments." *JAMA Netw Open* 2.7 (2019): e197577-e197577.
9. Eaton Kevin P. et al. "Evidence-based guidelines to eliminate repetitive laboratory testing." *JAMA Intern Med*177.12 (2017): 1833-1839.
10. Salisbury Adam C. et al. "Hospital-acquired anemia and in-hospital mortality in patients with acute myocardial infarction." *Am Heart J*162.2 (2011): 300-309.
11. Koch Colleen G. et al. "Hospital-acquired anemia: prevalence, outcomes, and healthcare implications." *J Hosp Med*8.9 (2013): 506-512.
12. Vidyarthi Arpana R. et al. "Changing resident test ordering behavior: a multilevel intervention to decrease laboratory utilization at an academic medical center." *Am J Med Qual*30.1 (2015): 81-87.
13. Bulger John. et al. "Choosing wisely in adult hospital medicine: five opportunities for improved healthcare value." *J Hosp Med*8.9 (2013): 486-492.
14. Sedrak Mina S. et al. "Residents' self-report on why they order perceived unnecessary inpatient laboratory tests." *J Hosp Med*11.12 (2016): 869-872.

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