

Opinion Paper

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Green transformation in the health sector and medical laboratories, adaptation to climate change in Türkiye

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Abstract: Societal habits' continuation is expected to result in severe consequences for climate change, causing significant environmental damage and humanitarian crises. Sustainability, defined as meeting present needs without compromising future generations, balances environment, equity, and economy. Türkiye, a middle-income developing country, has committed to achieving net-zero emissions by 2053 under the United Nations' framework. The construction sector is increasingly adopting eco-friendly practices, emphasizing green buildings and structures. Several green hospital certification systems, including BREEAM, LEED, and Australian Green Star, are now in use, with around 20 certified "green hospitals" in Türkiye. The "Zero Waste Project" initiated in Türkiye aims to reduce waste generation and resource usage efficiently. Recent efforts have focused on sustainability in high-carbon footprint medical laboratories, however, an international standard has not been established yet. Clinical chemistry and laboratory medicine federations have established working groups on the subject. Universities and nonprofits worldwide offer green laboratory certificate programs covering energy conservation, green chemistry, waste management, and water conservation. Laboratories' sustainability efforts encompass inventory management, green purchasing, test request reduction, greenhouse gas management, efficient building design, transportation choices, carbon footprint calculations, and education. The guides published in Türkiye are "Health Institutions Wastewater/Liquid Waste Management Handbook" and "Guide for Laboratory and Dialysis

Wastes". Türkiye's Ministry of Health introduced the "Rational Test Request Procedure" to enhance diagnostic accuracy and cost-effectiveness by reducing unnecessary tests. Collective efforts are essential to raise awareness and implement precautions, particularly in high-carbon footprint medical laboratories, addressing climate change and sustainability challenges in the healthcare sector.

Keywords: carbon footprint; climate change; developing country; green laboratory; sustainability

Climate change

The increasing use of fossil fuels, which began with the industrial revolution, has led to a proportional rise in the emissions of harmful gases associated with these fuels up to the present day. According to the Intergovernmental Panel on Climate Change's (IPCC) Physical Science Basis Report on Climate Change (2013), global warming is unequivocal. Many of the observed changes in the climate since the 1950s have been unprecedented in at least the last thousand years. Each of the three preceding decades has exhibited progressively higher surface temperatures on earth compared to any decade before 1850. Due to industrial activities, especially fossil fuel consumption, carbon dioxide emissions from human activities in oceans and forested areas are increasing much faster than oceans and forested areas can absorb. It is anticipated that the continuation of societies' existing habits will lead to severe consequences in terms of climate change, resulting in significant environmental devastation, potential mass casualties, and associated humanitarian disasters [1, 2].

Sustainability

Sustainability is the balance between the environment, equality, and the economy. The Brundtland Commission, established by the United Nations, described sustainability as "meeting the needs of the present without compromising the ability of future generations to meet their own needs" [3].

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Adaptation of the Republic of Türkiye to climate change

Türkiye's overarching national ambition in the context of climate change is to transform into a nation that seamlessly incorporates climate change objectives into its developmental strategies, promotes energy efficiency, amplifies the adoption of clean and sustainable energy sources, actively engages in global initiatives to combat climate change, all while ensuring a high standard of living and well-being for its citizens with minimal carbon emissions [4].

Taking into account its socioeconomic indicators, greenhouse gas emission profile, historical accountability, per capita emission rates, Gross Domestic Product (GDP) per capita, per capita energy consumption metrics, as well as its placement in the Human Development Index, Türkiye falls within the classification of “middle-income developing countries” [4].

Türkiye became a party to the United Nations Framework Convention on Climate Change on 24 May 2004 and joined the Kyoto Protocol on 17 February 2009 [4].

In 2009, Türkiye established the “Climate Change Department” within the General Directorate of Environmental Management, operating under the Ministry of Environment, Urbanization, and Climate Change. This department was formed to address matters concerning climate change. Considering its unique circumstances and capabilities, Türkiye unveiled a ‘National Climate Change Strategy’ in May 2010, aimed at contributing to global endeavors in mitigating the consequences of climate change. This strategy encompasses a set of objectives related to various sectors, such as transportation, industry, construction, waste management, and agriculture. These objectives are designed for short-term (within one year), medium-term (within 1–3 years), and long-term (over the next 10 years) implementation [2, 4].

On April 22, 2016, Türkiye signed the Paris Agreement, ratified through a Presidential decision in October 2021, completing the domestic approval process. In line with this, Türkiye announced its target of achieving net-zero emissions by 2053 [4].

The primary objective of the Paris Agreement is to enhance worldwide socio-economic resilience in the aftermath of the year 2020 in response to the challenges posed by climate change. The long-term goal of the Paris Agreement is to limit global temperature rise as much as possible below 2 °C, preferably to 1.5°, compared to the pre-industrial era. Achieving this goal necessitates gradually reducing fossil fuels (such as oil and coal) and transitioning towards renewable energy sources [4].

Green transformation in the healthcare sector

Due to the growing recognition of the importance of eco-friendly practices worldwide, green buildings and eco-friendly structures have started gaining prominence in the construction sector. With the increasing awareness of the benefits of going green, green building rating systems have been developed. Several green hospital certification systems have been developed, encompassing sustainable design and construction criteria for green buildings in the healthcare sector, which evaluate hospitals across various domains. Among these, the most widely used ones are the Building Research Establishment Environmental Assessment Methodology (BREEAM) for Healthcare, Leadership in Energy and Environmental Design (LEED) for Healthcare, and the Australian Green Star certification systems. In addition to those, there are also less commonly used green hospital certification systems such as Practice Greenhealth (PG), Green Guide for Health Care (GGHC) for Health Services, the American Society for Healthcare Engineering (ASHE) for Health Engineering, and Health Care Without Harm (HCWH) [5].

The era of green hospitals in Türkiye can be said to have begun when the Ministry of Health mandated adherence to the international green building certification system, LEED, for all hospitals with a capacity of 200 beds and above that is about to commence construction. This requirement was established through the General Communique on Minimum Technical Standards to be Followed in Existing and New Health Facilities dated 2012 [5].

To the best of our knowledge, around 20 hospitals in Türkiye have received “green hospital” certifications. These certifications are typically awarded through systems such as LEED, Technischer Überwachungsverein (TUV) Hessen, and Excellence in Design for Greater Efficiencies (EDGE) [5].

In 2017, the “Zero Waste Project” was initiated by the Republic of Türkiye the Ministry of Environment, Urbanization, and Climate Change to prevent waste generation, reduce waste, recycle waste at its source, prevent wastage, and utilize natural resources more efficiently [6].

In 2018, amendments were made to the environmental laws, and in 2019, the Zero Waste Regulation was published. With the Eleventh Development Plan, it became the Zero Waste Country Policy [6].

The General Directorate of Environmental Management of the Ministry of Environment and Urbanization of the Republic of Türkiye has published the Healthcare Facilities Zero Waste Management System Implementation Guide. The guide covers zero waste management under the following

headings: team establishment, planning, training/awareness activities, monitoring, record-keeping, and improvement. The guide defines various types of waste generated in healthcare facilities, such as paper, metal, plastic, glass, food, plant waste, oil, batteries, toner, cartridges, e-waste, and medical waste. It also emphasizes the need for quantifying the amounts of these waste types. Furthermore, the guide provides information on waste prevention/reduction practices and relevant examples. It highlights the importance of specifying waste collection points, the necessary equipment (e.g., bins and containers), and establishing temporary storage areas [6].

Green practices in medical laboratories

The European Federation of Clinical Chemistry and Laboratory Medicine (EFLM) established a Task Force, “Green and Sustainable Laboratories,” to assist medical laboratories in adopting sustainable methodologies and enhancing their sustainability standards, not only within Europe but also on a global scale. It strives to collect and disseminate best practices to direct laboratories toward creating more sustainable environments. This involves reducing their adverse ecological footprint, adopting effective measures within laboratory settings, and undertaking initiatives to minimize energy and water consumption, reduce hazardous chemicals, and limit waste generation – all while upholding the high standards of healthcare quality [3].

EFLM started to issue Green and Sustainable Laboratories certificates. For this purpose, a questionnaire set has been prepared, and they have begun accepting applications through their website. Laboratories that have received certification are published on the EFLM website [3].

In May 2023, the International Federation of Clinical Chemistry and Laboratory Medicine (IFCC) established the Taskforce on Environmental Impact of Laboratory Medicine (TF-EILM). For the latest updates, visit the website at <https://ifcc.org/executive-board-and-council/eb-task-forces/task-force-environmental-impact-of-laboratory-medicine-tf-eilm/>.

In Türkiye, the Turkish Biochemical Society translated the EFLM booklet into Turkish and shared it on their website.

An international standard that encourages sustainable practices within labs has not yet been published. However, implementing more sustainable practices within labs will align with and supplement organization-

level efforts to maintain ISO 50001 (Energy Management Systems) and ISO 14001 (Environmental Management) standards.

Although there is no standardization for green and sustainable laboratory certification, various institutions and organizations worldwide provide this certification. Medical laboratories that apply to relevant institutions and meet the requirements can obtain this certification.

Laboratory Efficiency Assessment Framework (LEAF) is a standard set by University College London (UCL) to improve the sustainability and efficiency of laboratories. Participating in the LEAF program reduces laboratory carbon emissions and creates an environment that supports research quality. Laboratories are awarded either a Bronze, Silver, or Gold level, depending on how many sustainability actions they take. For further information on the topic, one can acquire additional details from the LEAF: <https://www.ucl.ac.uk/sustainable/leaf-laboratory-efficiency-assessment-framework>.

Washington University also has a Green Lab certification program available. Labs that earn a score equal to or greater than 55 % will receive a certification: Bronze for a score of 55–69 %, Silver for 70–84 %, and Gold for 85 %+ . For the latest updates, visit the website at <https://sustainability.uw.edu/green-laboratory>.

In addition, Yale University and the University of California, San Diego, also offer Green Lab certification programs in the United States. For more information, please visit the official website at <https://ehs.yale.edu/green-lab-certification>. More details can also be found on the San Diego University website: <https://sustain.ucsd.edu/involve/green-labs.html#Green-Lab-Certification>.

Furthermore, My Green Lab, a nonprofit organization based in the United States with a 501(c)(3) status, offers Green Lab certification globally. Five different certification levels are available: bronze, silver, gold, platinum, and green. The certification level is determined based on the certification assessment score. Since the program began in 2014, My Green Lab has enrolled over 1,500 labs worldwide. For further information related to the topic, one can acquire additional details from My Green Lab: <https://www.mygreenlab.org/about.html>.

The International Institute for Sustainable Laboratories (I²SL), a 501(c)(3) nonprofit organization based in the United States but with a global reach, is devoted to the principles of sustainable laboratories and related high-technology facilities, from design to engineering to operation. For the latest updates, visit the website at <https://www.i2sl.org/about/index.html>.

In general, there are some fundamental topics under the umbrella of green laboratories

The initial stride toward implementing good environmental practices is for a laboratory to commit to reducing its environmental footprint. The transformation toward a sustainable laboratory begins with simple and easily implementable reductions carried out by laboratory staff, where senior management can effectively take a leading role and set an example.

Energy conservation

Clinical laboratories use 3–6 times more energy per m² than a typical office building. One of the simplest methods to reduce energy consumption is to turn off lights, computers, analyzers, and equipment at the end of the day or when they are not in use. High energy-consuming equipment such as ultra low-temperature freezers, biosafety cabinets, fume hoods, incubators, and autoclaves/dishwashers should be reviewed, and shared use should be suggested if possible. Sustainable energy sources such as solar, sustainable bio-fuels, wind, and energy-efficient lighting should be preferred to meet electricity and heat requirements. Energy-efficient certified products should be selected when purchasing equipment for the laboratory [3].

Green chemistry

The chemical strategy aimed at achieving sustainability and a toxic-free environment will enhance the safeguarding of human health and the environment against harmful chemicals. This strategy will also promote innovation in developing safe and sustainable chemicals, facilitating the transition to chemistries that are inherently safe and sustainable. In pursuing environmental responsibility, clinical laboratories must adopt eco-friendly practices, embrace sustainable alternatives to hazardous substances, and rigorously follow official directives to curb carbon emissions [3].

Green chemistry is “the design of chemical products and processes that reduce and eliminate the use or generation of hazardous substances.” Green chemistry and its guiding principles offer a strategic approach to minimizing pollution, mitigating the risk of hazardous synthesis, and

preventing accidents, all while comprehensively assessing a given chemical’s overall life cycle impact [3].

Waste management

In the United States, the healthcare system’s carbon footprint accounts for approximately 10 % of the nation’s overall carbon footprint. However, it should be noted that around 62 % of hospital waste is directed to landfills, and this waste comprises recyclable or combustible materials [7].

The management of clinical laboratory waste should be based on the three fundamental principles of good environmental practices: reduction, reuse, and recycling. The best strategy for managing laboratory waste should be considered from purchase. The most crucial principle in overseeing the proper management of laboratory waste is that no activity should commence without the creation of a plan for the disposal of both hazardous and non-hazardous waste. Implementing this simple principle ensures that local and national regulatory requirements are met regarding waste management and prevents unexpected challenges arising from the generation of waste types (e.g., biological, chemical, radioactive) that the institution may not be able to handle [3].

Water conservation

Clinical laboratories consume a significantly higher amount of water (four to five times more than similarly sized commercial buildings) to meet their requirements for analysis, cooling, and other needs. Water conservation is any action that reduces the amount of water drawn from sources, minimizes consumption for various purposes, decreases losses or waste, enhances efficient use, recycling, and reuse, or prevents water pollution. While laboratory water consumption may never reach office-level usage, effective conservation strategies and efforts to minimize water use are still valuable [3].

Furthermore, in the laboratory’s journey towards sustainability, other important topics include inventory management, green purchasing, reducing test requests, greenhouse gas management, building design and efficiency, transportation choices, sustainable food practices, calculating the carbon footprint, and education [8].

As far as we know, no institution in Türkiye currently provides green laboratory certification.

However, within the scope of the “Treatment and Disposal of Wastewaters from Healthcare Facilities Project”

carried out between 2015 and 2017 under the coordination of the Ministry of Environment and Urbanization by TÜBİTAK MAM Institute of Environmental and Clean Production, the “Healthcare Facilities Wastewater/Liquid Waste Management Handbook” was prepared. This handbook aims to provide information and guidance to healthcare facilities on matters to be considered and precautions to be taken in wastewater disposal and liquid waste management [9].

In the handbook, (i) hazardous liquid wastes that may arise from the sector and need to be collected separately, (ii) liquid wastes that may pose an ecological risk, and (iii) wastewater sources that can be discharged to sewerage in the current situation are presented. This handbook describes the aspects to be considered and the measures to be taken in wastewater disposal and liquid waste management to reduce pollution at the source, which may originate from healthcare facilities or potentially originate from them [9].

The Guide for Laboratory and Dialysis Wastes, published by the Turkish Biochemical Society, serves as a valuable resource for classifying and disposing of laboratory waste [9].

The “Rational Test Request Procedure” has been developed by the Ministry of Health of the Republic of Türkiye as part of the “Rational Laboratory Implementation Project” to ensure accurate diagnosis for patients, enhance the clinical utility of test results, and promote cost-effective test ordering by reducing the number of unnecessary tests requested from medical laboratories by healthcare service providers. The Ministry has defined specific intervals for test requests for certain tests and requires that tests not be asked more frequently than these specified intervals. Nevertheless, if a physician makes a test request, this request is statistically recorded and evaluated by the health service providers based on physicians. A significant savings will be achieved if this procedure is followed [10].

There is a need for collective efforts to raise awareness and implement necessary precautions in the healthcare sector, particularly in high-carbon footprint medical laboratories, to address climate change and sustainability issues. The younger generations should be educated and included in

the processes related to this issue. Shortly, there should be a global standardization effort for these initiatives and regulations should be made according to the needs in developed and developing countries.

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