

Climate Change and Cardiovascular Imaging: Challenges and Opportunities

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Climate change directly and indirectly affects human health. The increasing incidence and intensity of extreme weather events are directly associated with adverse health outcomes, including cardiovascular events, as well as increased demand and expenditure on health systems globally.¹ Vulnerable populations, such as the elderly and people with pre-existing cardiovascular and respiratory conditions, face increased risks due to temperature variations and poor air quality. Moreover, high temperatures also limit outdoor exercise, with potential long-term detrimental effects on cardiovascular health.² In a country like Brazil, where economic disparities often expose low-income populations to higher levels of pollution and less access to health care, the impacts of climate change on cardiovascular health are a matter of growing concern among medical and scientific communities.

On the other hand, the healthcare sector is responsible for almost 5% of the planet's greenhouse gas (GHG) emissions,³ with a significant contribution coming from general imaging and cardiovascular diagnostic tests.⁴ We thus face a double challenge: to improve cardiovascular health outcomes for the population while reducing the environmental footprint of our tests. Although advances in cardiovascular imaging technologies have undoubtedly improved our diagnostic accuracy and patient outcomes, these benefits have come at considerable financial and environmental costs.

Manufacturing and disposing of imaging equipment and supplies substantially contribute to GHG emissions, which vary significantly depending on the modality. Cardiac magnetic resonance imaging (MRI), tomography, echocardiography, and nuclear imaging have a significant environmental footprint, especially due to their high energy demands and waste generation.⁵ The energy required to operate, cool, and maintain imaging equipment, especially MRI devices and tomography scanners, is substantial. In this context, MRI and tomography produce higher emissions compared with echocardiography, which is more energy efficient and has a lower environmental impact.⁶ These modalities are responsible for high energy demands, and they produce significant emissions, including when not in use and in “standby” states. In addition, the environmental effects of the radiopharmaceuticals and contrast agents used are also a matter of increasing concern, given that gadolinium-based

contrast agents and iodinated contrast media can accumulate in water sources, resulting in potential ecological risks.

With the goal of integrating sustainability strategies into our healthcare practices, it is necessary to promote a new triple bottom line model — considering economic, social, and environmental factors.⁷ In the context of cardiovascular imaging, this means not only balancing cost and clinical effectiveness, but also prioritizing low-emission modalities whenever possible.

In practice, various strategies can help reduce the environmental impact of cardiovascular imaging without compromising patient care. For MRI, implementing abbreviated protocols and using artificial intelligence tools to speed up image acquisition can significantly reduce energy consumption. Minimizing standby power consumption by turning off or using low-power modes when equipment is not in use can reduce energy waste by up to one third.⁵

Nuclear imaging modalities, such as SPECT and PET, involve additional environmental considerations related to the supply chain and disposal of radiopharmaceuticals. Optimizing protocols and reducing the amount of radiopharmaceuticals administered can reduce the environmental impact. Invasive cardiovascular procedures, such as catheterization and ablation, also generate significant waste from disposable supplies, packaging, and sterilization materials. The largest sources of GHG emissions in these settings are room cooling systems and disposable supplies.⁵ Transitioning to reusable supplies, reducing redundant items in procedure kits, and encouraging recycling in intervention rooms are effective approaches to reducing waste and emissions.

In the near future, further studies are needed to identify opportunities for more sustainable practices in cardiovascular imaging. For example, the environmental impact of imaging devices throughout their life cycle should be investigated to understand the best time to replace old equipment with newer, more efficient equipment. New artificial intelligence applications, synthetic imaging, and low-field MRI protocols are promising areas to mitigate environmental impact while maintaining diagnostic quality.⁸ Finally, awareness on the part of the cardiology community should also lead professionals to consider the environmental footprint of imaging in the context of healthcare utilization, recognizing that reducing unnecessary exams can benefit both patients and the environment.

As Brazil and the global medical community face the challenges posed by climate change, the field of cardiovascular imaging has an opportunity to lead by example. By optimizing energy use, reducing waste, and adopting innovative low-emission technologies, we can align our practices with broader environmental goals, working toward a healthier, more equitable future.

Keywords

Climate Change; Echocardiography; Cardiovascular Diseases.

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