EDUCATION AND TRAINING FOR SUSTAINABLE MEDICINE

Abstract

In healthcare systems, sustainable medicine is a comprehensive strategy that incorporates social justice, economic viability, and environmental responsibility. Medical practices that prioritise high levels of care while minimising environmental impact are desperately needed in light of climate change, resource depletion, and growing healthcare expenses. Sustainable practices are crucial since the healthcare industry contributes significantly to waste production, resource consumption, and carbon emissions worldwide. Using these ideas to integrate sustainable medicine into medical curricula, this chapter examines the vital role that education and training play in this regard. Environmental literacy, resource efficiency, and leadership in green healthcare practices are among the specialised qualities that medical professionals need to address sustainability. A multidisciplinary strategy combining public health, environmental science, and clinical practice is needed to integrate sustainability into medical education. Redesigning the curriculum, utilising problem-based learning, and exposing clinical staff to sustainable practices are examples of practical tactics. Technological innovations that support sustainability can also improve training effectiveness, such as telemedicine, digital learning environments, and simulation-based instruction. The goal of this chapter is to develop a new generation of medical professionals that prioritise environmental, social, and economic sustainability in their practice by examining how sustainability can successfully be integrated into medical education and training programs.

Keywords: Sustainable Medicine, Instructional strategies and pedagogical approaches, Advantages, Obstacles & Difficulties, Guidelines, Educational framework.

Authors

Saniya Zehra

M.Sc. RIT Department of Radiological Imaging Techniques, College of Paramedical Sciences, Teerthanker Mahaveer University, Moradabad. saniyazehra1341@gmail.com

Mamta Verma

Assistant Professor Department of Radiological Imaging Techniques,College of Paramedical Sciences, Teerthanker Mahaveer University, Moradabad. mv926431@gmail.com

Raushan Kumar

Assistant Professor Department of Radiological Imaging Techniques College of Paramedical Sciences. raushank.paramedical@tmu.ac.in

I. INTRODUCTION

Healthcare sustainability is about providing for current needs without sacrificing the capacity of future generations to provide for themselves. Regarding healthcare, this entails providing excellent treatment while reducing environmental impact and guaranteeing that care is equal and available to all populations. But hospitals, clinics, and pharmaceutical businesses are the main sources of trash, carbon emissions, and energy consumption in the healthcare sector, which contributes significantly to environmental deterioration. The environmental impact of healthcare delivery is especially important in nations like India, where healthcare systems are growing quickly to meet rising demand. Healthcare is a major cause of pollution and resource depletion due to medical waste and resource-intensive therapies.¹ As such, including sustainability into medical education is not only appropriate but also essential. Future medical professionals need to be prepared with the information and techniques necessary to lessen these effects while upholding or raising patient care standards.² In order to promote sustainable healthcare education, this chapter clearly highlights how crucial institutional and policy assistance is. Enacting laws that encourage eco-friendly behaviour and helping educational institutions integrate sustainability into their curricula are proactive steps that governments and healthcare organisations should take. Resources, overburdening curricula, and low knowledge are just a few of the issues the chapter discusses when attempting to include sustainability into medical education. At the end, it provides ideas for developing a sustainable healthcare workforce and case studies of best practices, all the while promoting a healthcare system that can fulfil present and future requirements without endangering the health of the world.^(1,3)

II. SUSTAINABLE MEDICINE

A method of providing healthcare that balances environmental sustainability with the demands of the present population is known as "sustainable medicine."



Three foundations support for sustainable medicine:³

Figure 1: Sustainable medicine

- 1. Environmental Sustainability: Minimising the environmental impact of medical procedures by employing renewable resources, cutting down on energy use, and decreasing waste.
- **2. Economic Sustainability**: Ensuring long-term financial viability of healthcare systems by process simplification, cost reduction, and avoidance of resource overuse.
- **3.** Social Sustainability: Sustaining excellent standards of care while guaranteeing fair access to healthcare services for all populations, especially underprivileged and marginalised communities.

The usage of non-recyclable medical goods and hospitals' reliance on fossil fuels for energy have contributed to the healthcare sector's almost 5% global carbon emissions. In countries like India, this number is probably greater. In light of this, sustainable medicine aims to provide better care that is more easily accessible and efficient while also reducing its negative environmental effects.^(2,3)

III.AIM OF SUSTAINABLE MEDICINE





IV. BASIC KNOWLEDGE IN SUSTAINABLE MEDICINE

In order to tackle sustainability within the healthcare industry, physicians must cultivate a core competency set. Their ability to incorporate sustainable methods into administrative and clinical work is ensured by these competencies. Key areas of concentration are as follows:

1. Ecology Knowledge: The environmental effects of medical procedures must be understood by healthcare professionals. This covers information on pharmaceutical

manufacturing, medical waste disposal, and hospital carbon footprints. Education in this field ought to include subjects such as:

- The medical product life cycle.
- Sustainable substitutes for the ways things are done now.
- The part played by healthcare in the world's pollution and climate change.²
- 2. **Resource Utilisation:** Resource efficiency, or employing the fewest resources required to provide equivalent or superior health results, is another essential competence. This is attainable by:
 - Hospitals using lean management practices.
 - Minimising waste in medical procedures and testing.
 - Installing energy-saving equipment in healthcare facilities.^(1,2)
- **3.** Social and Ethical Accountability: Equity in access to care is a component of sustainability, which extends beyond the environment. Health disparities must be identified by medical practitioners, who must then be trained to address them with socially equitable and sustainable policies and practices.
- **4. Leading the Way in Sustainable Medical Practices:** It is important to teach healthcare professionals to spearhead the shift to sustainable healthcare. This entails cultivating lobbying abilities, shaping legislation, and leading programs that advance sustainability within their organisations.^(3,4)
- **5. Including Sustainability in Medical Education:** Sustainability is starting to be included into medical education programs and schools across the globe. But more work needs to be done to guarantee that aspiring medical professionals receive the necessary training his is still in its early phases. The following are some methods for teaching sustainability in medical education:
 - **Developing and Designing Curriculum:** The curriculum needs to be revised with sustainability as a key component as the first step. This includes:
 - Multidisciplinary Education: Sustainability is by its very nature multidisciplinary, incorporating aspects of economics, environmental science, and public health. To provide students with a thorough understanding of sustainable healthcare, a well-rounded medical curriculum should include lectures from all disciplines. ^(4,5)
 - PBL, or Problem-Based Learning: PBL is an instructional approach that involves students solving challenging, real-world issues to learn. Case studies on hospital waste management, energy conservation in healthcare facilities, or sustainable pharmaceutical practices should be included in PBLs pertaining to sustainability.⁵
 - Clinical Green Practice Exposure: In clinical settings, medical students ought to be able to witness and participate in sustainable healthcare practices. As learning hubs, hospitals that have adopted sustainable practices like waste minimisation, energy efficiency, and the utilisation of renewable energy sources should be involved.⁶

V. APPLICATION IN TRAINING PROGRAMS

Integrating sustainability into medical practice requires practical training. Healthcare training facilities and hospitals ought to:

- Employees should be trained on sustainable practices, such as reducing the usage of single-use items and switching to reusable or biodegradable materials.
- By reducing needless patient travel, telemedicine can help cut down on healthcare expenses and carbon emissions.
- To cut down on paper use and boost operational effectiveness, promote digital alternatives for patient records and diagnostics. ^(7,8)

VI. TECHNOLOGY'S PLACE IN SUSTAINABLE MEDICINE TRAINING

Technology is essential to improving healthcare sustainability. Both the instructional and hands-on implementation of sustainable practices can benefit from the use of digital tools and platforms. Technology may improve sustainability education in a number of important areas, including:

- 1. Training in Telemedicine: The use of telemedicine in healthcare can significantly lessen its environmental impact. Telemedicine can lower carbon emissions associated with travel by enabling physicians to consult with patients from a distance. Patient safety, data security, and clinical efficacy should be the main topics of modules in medical education that cover the proper implementation and use of telemedicine systems.⁹
- 2. Platforms for Online Learning: Because less physical infrastructure is required for online learning, medical institutions may be able to reduce their carbon footprint. E-learning platforms facilitate online access to course materials, student participation in discussions, and assessment completion, all of which enhance the overall sustainability of educational establishments.
- **3. Learning Via Simulation:** Through the use of simulation technologies, such as virtual and augmented reality, medical students can rehearse procedures in a safe setting. As a result, less tangible resources and supplies than in conventional clinical training are required, increasing the process' sustainability. ^(9,10)

VII. INSTRUCTIONAL STRATEGIES AND PEDAGOGICAL APPROACHES

Just as crucial as the subject matter is the manner in which sustainable medicine is taught. Here are a few creative ways to guarantee that kids completely understand sustainability principles:

- **1. Hands-on Education:** Practical experience is the best way to learn about sustainability. Placements in medical facilities that are using sustainable practices can be advantageous for aspiring physicians. Examples of this kind of experiential learning are:
 - Green Hospital Work Experiences: Permitting student employment in medical facilities with extensive sustainability initiatives in place. Students can take part in

and observe waste-reduction strategies, patient centered sustainability efforts, and energy-efficient operations.

- Environmental Initiatives: Providing students with the responsibility of creating and carrying out small-scale sustainability projects in their organisations. Student projects could include planning recycling campaigns, assessing departmental energy usage, or creating ideas for more environmentally friendly hospital purchasing practices.¹¹
- 2. Multidisciplinary Workshops and Collaborations: Collaboration between several disciplines is necessary for sustainability in medicine. In order to address sustainability concerns in healthcare, students from a variety of disciplines, including engineering, environmental science, economics, and public health, should collaborate during workshops. Medical students are exposed to a wide range of viewpoints on how healthcare might be made more sustainable through this kind of interdisciplinary collaboration that stimulates creativity.¹²
- **3. Virtual Education and Simulators:** When it comes to teaching sustainable medicine, technology can be quite helpful. Without requiring tangible materials, students can test various sustainability methods in hospital simulations. With these role-plays, students could:
 - Control the amount of waste and energy a hospital produces.
 - Practice making decisions in clinical circumstances where they must strike a balance between resource efficiency and patient care.

By simulating surgical rooms, hospital wards, or even major health emergencies, virtual reality (VR) and augmented reality (AR) can help students learn how sustainability can be used in stressful situations and real-world clinical contexts. ^(12,13)

- **4. Educational Framework for Sustainable Medicine:** A detailed analysis of the current inadequacies in medical education and the development of strategies to close them are necessary before developing an educational framework that tackles sustainable medicine. In order to create an efficient educational framework, the following elements are crucial:
 - **Basic Information about Sustainability:** Students must have a solid foundation in sustainability principles before delving into the details of sustainable medical practices. This entails becoming aware of global issues such as resource scarcity, climate change, and the effects that industrial sectors including the healthcare industry have on the environment. Courses might be created to address:
 - ✤ Worldwide Environmental Health: Establishing a connection between environmental and human health. The relationship between environmental health and patient care would be emphasised in this course.
 - Sustainability of the Healthcare System: Pay attention to how sustainable approaches can be implemented by entire healthcare systems, ranging from neighbourhood clinics to federal healthcare programs. Global healthcare systems would be compared in this course in order to determine which are setting the standard for sustainable practices.¹⁴

- **5. Long-Term Clinical Management Strategies:** Continuing education and training that demonstrates the application of sustainability in routine clinical settings should be required of medical students as they advance. Possible subjects might be:
 - **Resilient Surgery:** Teaching sterile environments how to utilise less energy, reprocess surgical instruments, and reduce waste in the operating room.
 - **Drug Stewardship:** Educating medical professionals about the environmental effects of pharmaceuticals, including the manufacture of antibiotics, the disposal of leftover drugs, and the duration of drug development. highlighting "green pharmacy" ideas such as using environmentally friendly medicine formulations and cutting down on over prescription.
 - **Resilient Imaging and Diagnosis:** Decreasing the excessive use of energy-intensive imaging tests (such as CT and MRI scans) and encouraging effective scheduling to cut down on pointless repeat examinations. ^(13,14,15)
- 6. Leadership in Sustainable Healthcare and Advocacy: In addition to practicing sustainable medicine, the upcoming generation of medical professionals will spearhead the shift towards more environmentally friendly healthcare practices. Courses ought to cover:
 - Healthcare and Sustainability Leadership: Students studying medicine will learn how to promote sustainability in their healthcare organisations by taking this course. Health executives, nurses, and aspiring doctors must learn how to lobby for national policy changes, implement greener procurement practices, and influence hospital regulations.
 - **Policy and Public Health for Sustainability:** The nexus of sustainability and public health will be the main topic of this course, which will give students the tools they need to support legislation that promotes sustainable healthcare practices at the local, national, or global policy levels. ^(15,16)

VIII. ADVANTAGES OF SUSTAINABLE MEDICAL EDUCATION

There are numerous advantages to integrating sustainability into medical education, including better patient outcomes, healthcare systems, and the environment. Among the long-term advantages are:

Towards a Greener Future: Sustainable Practices in Clinical Medicine E-ISBN: 978-93-7020-783-7 IIP Series, Chapter 11 EDUCATION AND TRAINING FOR SUSTAINABLE MEDICINE



Figure 3: Advantages of sustainable medical education

- **1. Better Outcomes for Patients:** Preventative measures are frequently the focus of sustainable healthcare practices. Healthcare providers can provide patients with more effective and efficient care by concentrating on cutting down on unnecessary procedures and medicine prescriptions. Proactive healthcare also alleviates the burden on medical resources and improves patient outcomes over time, which is another focus of sustainable medicine. ^(12, 15)
- 2. Lower Health Care Expenses: In the medical field, sustainability might result in large cost savings. Buildings with lower energy use, less trash, and the use of telemedicine can all save expenses and increase the financial sustainability of healthcare systems. These savings can be used to fund more sustainability projects, research, and patient care. ¹⁷
- **3.** Input to the Global Health Objectives: Goals for global health, including the Sustainable Development Goals (SDGs) of the United Nations, are directly impacted by physician education in sustainability. Good health and well-being, ethical consumption and production, and climate action are just a few of the SDGs that sustainable healthcare practices support. ^(17,18)

IX. OBSTACLES & DIFFICULTIES

Implementing sustainable medical education globally presents a number of problems despite its benefits: ¹⁷



Figure 4: Obstacles & difficulties

- 1. **Opposition to Change:** Because they see sustainability as a diversion from the primary goal of providing treatment, certain organisations and professionals may be resistant to the modifications required to integrate it into medical practice and education. It will take convincing proof of sustainability's advantages as well as strong institutional leadership to overcome this reluctance.
- 2. Overload in Curriculum: An already challenging curriculum awaits medical students. If sustainability is not carefully incorporated into current courses, adding new information could overburden teachers and students. It is imperative to strike an appropriate balance between sustainability training and the current educational standards.
- **3. Limitations on Resources:** Resource limitations prevent healthcare systems in many low- and middle-income nations from implementing sustainable methods. These areas may have trouble providing medical education programs with the technological and financial support necessary to adopt curriculum that emphasise sustainability. ^(18, 19)

X. SUPPORT FOR SUSTAINABLE MEDICINE IN POLICY AND INSTITUTIONS

The adoption of sustainability as a cornerstone of medical education requires institutional and policy-level support. The initiative to integrate sustainability into the healthcare system must come from governments, academic institutions, and healthcare organisations.

- **1. Rules and Policies of the Government:** Governments can encourage sustainability in healthcare by implementing laws like these:
 - Providing healthcare facilities that implement sustainable techniques with tax advantages or subsidies.
 - Putting hospital emissions, energy use, and waste management rules into effect.²⁰
- 2. Institutional Sustainability Commitment: Medical facilities need to set an example for others by implementing sustainable practices into their daily operations. This entails cutting back on energy use, enhancing waste control, and switching to renewable energy sources. By doing this, they can support the practical application of sustainability by giving healthcare professionals and students examples from real-world situations.²⁰
- **3.** Guidelines and Case Studies: Globally, a number of healthcare organisations have effectively incorporated sustainability into their operations and educational initiatives. As an illustration:
 - The National Health Service (NHS) of the United Kingdom has instituted an extensive array of sustainability endeavours, such as mitigating carbon emissions through the adoption of renewable energy sources and encouraging the utilisation of telemedicine to curtail patient travel.
 - In the United States, the Cleveland Clinic has made sustainability a central component of its purpose. By implementing green building standards and decreasing medical waste, the clinic has reduced its energy consumption and emissions.

Other healthcare facilities looking to make the switch to sustainable care can use these case studies as a model. ^(22,23)

XI. PROSPECTS AND SUGGESTIONS FOR THE FUTURE

Several steps need to be performed in order to completely incorporate sustainability into medical education and practice: 20



Figure 5: Prospects and suggestions for the future

- **1. International Cooperation:** International cooperation amongst medical schools is necessary to exchange best practices, establish international standards, and produce resources for sustainability education that are available to all academic institutions.
- 2. Exploration and Originality: Research on environmentally friendly medical therapies and sustainable healthcare practices is desperately needed. Clinical guidelines and instructional materials should be developed with this research in mind.
- **3. Policy Assistance:** To guarantee that all healthcare workers are prepared to handle the environmental issues raised by the provision of healthcare, governments and certifying organisations should encourage and require sustainability education as a component of medical school. ^(20,21)

XII. CONCLUSION

Incorporating sustainability into medical education is essential to equipping future medical professionals to tackle today's urgent environmental and social issues. The global healthcare systems' substantial contribution to environmental degradation makes it necessary for aspiring physicians, nurses, and health administrators to possess the knowledge and abilities necessary to practise sustainable medicine. In medical curricula, this entails promoting systems thinking, resource efficiency, climate impact awareness, and leadership abilities. Innovative teaching strategies including multidisciplinary cooperation, experiential learning, and technology integration can help teachers better prepare their students to strike a balance between environmental responsibility and patient care. Global cooperation and institutional support will also be key factors in the effective adoption of sustainability in healthcare. By incorporating these ideas into teaching, we may ultimately make sure that healthcare

contributes to a healthier, more sustainable future for everybody by healing people as well as communities and ecosystems.

REFRENCES

- [1] Eckelman, M. J., & Sherman, J. (2016). Environmental impacts of the U.s. health care system and effects on public health. *PloS One*, *11*(6), e0157014. https://doi.org/10.1371/journal.pone.0157014
- [2] Thiel, C. L., Eckelman, M., Guido, R., Huddleston, M., Landis, A. E., Sherman, J., Shrake, S. O., Copley-Woods, N., & Bilec, M. M. (2015). Environmental impacts of surgical procedures: life cycle assessment of hysterectomy in the United States. *Environmental Science & Technology*, 49(3), 1779–1786. https://doi.org/10.1021/es504719g
- [3] Pencheon, D. (2015). Making health care more sustainable: the case of the English NHS. *Public Health*, *129*(10), 1335–1343. https://doi.org/10.1016/j.puhe.2015.08.010
- [4] Fitzpatrick, J. (2010). The impact of healthcare on the environment: improving sustainability in the health service. *Nursing Times*, *106*(9), 18–20.
- [5] *Sustainability practices at WHO*. (n.d.). Who.int. Retrieved October 10, 2024, from https://www.who.int/about/policies/sustainability
- [6] Eckelman, M. J., & Sherman, J. (2016). Environmental impacts of the U.s. health care system and effects on public health. *PloS One*, *11*(6), e0157014. https://doi.org/10.1371/journal.pone.0157014
- [7] Chung, J. W., & Meltzer, D. O. (2009). Estimate of the carbon footprint of the US health care sector. JAMA: The Journal of the American Medical Association, 302(18), 1970–1972. https://doi.org/10.1001/jama.2009.1610
- [8] *Home*. (2021, October 6). SDU Health. https://www.sduhealth.org.uk
- [9] Connor, A., Lillywhite, R., & Cooke, M. W. (2011). The carbon footprints of home and in-center maintenance hemodialysis in the United Kingdom. *Hemodialysis International. International Symposium on Home Hemodialysis*, *15*(1), 39–51. https://doi.org/10.1111/j.1542-4758.2010.00523.x
- [10] *Google Scholar*. (n.d.). Google.com. Retrieved November 21, 2024, from https://scholar.google.com/scholar?q=Climate+change+and+human+health%3A+present+and+future+risk s+McMichael+2006
- [11] *Google Scholar*. (n.d.). Google.com. Retrieved November 21, 2024, from https://scholar.google.com/scholar?q=Ambient+Air+Pollution+Exposure+Estimation+for+the+Global+Bu rden+of+Disease+2013+Brauer+2016
- [12] *Google Scholar.* (n.d.). Google.com. Retrieved November 21, 2024, from https://scholar.google.com/scholar?q=TRACI+2.0%3A+the+tool+for+the+reduction+and+assessment+of +chemical+and+other+environmental+impacts+2.0+Bare+2011
- [13] *Google Scholar*. (n.d.). Google.com. Retrieved November 21, 2024, from https://scholar.google.com/scholar?q=Emerging+approaches%2C+challenges+and+opportunities+in+life+ cycle+assessment+Hellweg+2014
- [14] Bare, J., Gloria, T., & Norris, G. (2006). Development of the method and U.S. normalization database for Life Cycle Impact Assessment and sustainability metrics. *Environmental Science & Technology*, 40(16), 5108–5115. https://doi.org/10.1021/es052494b
- [15] Lautier, A., Rosenbaum, R. K., Margni, M., Bare, J., Roy, P.-O., & Deschênes, L. (2010). Development of normalization factors for Canada and the United States and comparison with European factors. *The Science of the Total Environment*, 409(1), 33–42. https://doi.org/10.1016/j.scitotenv.2010.09.016
- [16] *Google Scholar*. (n.d.). Google.com. Retrieved November 21, 2024, from https://scholar.google.com/scholar?q=Updated+US+and+Canadian+normalization+factors+for+TRACI+2. 1+Ryberg+2013
- [17] *Google Scholar*. (n.d.). Google.com. Retrieved November 21, 2024, from https://scholar.google.com/scholar?q=TRACI+Bare+2002
- [18] *Google Scholar*. (n.d.). Google.com. Retrieved November 21, 2024, from https://scholar.google.com/scholar?q=IMPACT+2002%2B%3A+a+new+life+cycle+impact+assessment+ methodology+Jolliet+2003
- [19] Fann, N., Fulcher, C. M., & Baker, K. (2013). The recent and future health burden of air pollution apportioned across U.S. sectors. *Environmental Science & Technology*, 47(8), 3580–3589. https://doi.org/10.1021/es304831q

EDUCATION AND TRAINING FOR SUSTAINABLE MEDICINE

- [20] *Google Scholar.* (n.d.). Google.com. Retrieved November 21, 2024, from https://scholar.google.com/scholar?q=Air+pollution+and+early+deaths+in+the+United+States.+Part+I%3 A+Quantifying+the+impact+of+major+sectors+in+2005+Caiazzo+2013
- [21] Berwick, D. M., & Hackbarth, A. D. (2012). Eliminating waste in US health care. JAMA: The Journal of the American Medical Association, 307(14), 1513–1516. https://doi.org/10.1001/jama.2012.362
- [22] https://scholar.google.com/scholar?q=The+triple+aim%3A+care%2C+health%2C+and+cost+Berwick+20 08
- [23] *Google Scholar*. (n.d.). Google.com. Retrieved November 21, 2024, from https://scholar.google.com/scholar?q=Public+health+benefits+of+strategies+to+reduce+greenhouse-gas+emissions%3A+food+and+agriculture+Friel+2009