THE LEGAL IMPERATIVE – FRAMEWORKS AND CHALLENGES FOR IMPLEMENTING SUSTAINABLE PRACTICES IN THE HEALTHCARE SECTOR[1]

INTRODUCTION:

The well-known proverb "*Health is Wealth*" clearly means how important health is for any person. Healthy life doesn't depend on an individual but the contribution of many. WHO in its report says that "*for a society to be healthy the safe water and clean air, healthy workplaces, safe houses, communities and roads all contribute*". This means that apart from an individual's life style that contributes towards a healthy life there are lot more that contributes. In such manner health care sectors is one of the important contributors of a healthy society as it plays a crucial role in both Nourishing and Recuperating individuals.

From the time to time the world could clearly witness how healthcare sectors have played a vital role in promoting health and saving lives. And for the world that exist today health care sectors acts as a guardian and fighting warrior helping so many people from diseases that are discovered every now and then. Health care sectors contribution in saving lives and overcoming from continually occurring issues have always been great. But on the other hand, there are notable issues that are also created by health care sectors.

As the world witness lots of issues that affect the health of individuals, the contribution by health care sector is not little. Within having the role as a saviour, health care sector also as adverse effect on environmental degradation that almost causes 4.4% emissions of worldwide greenhouse gas[2]. The percentage quoted can be also said as healthcare sector across the globe almost contributes equally as a nation does. Apart from years of bio medical waste and non-biodegradable waste that is generally contributed by the healthcare sector, linear supply chains and excessive energy usage are also the harms given to the world.

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[2] OECD (2025), *Decarbonising Health Systems Across OECD Countries*, OECD Health Policy Studies, OECD Publishing, Paris, https://doi.org/10.1787/5ac2b24b-en

This shows that impact of healthcare sectors on climate change and issues associated with that cannot be ignored but should be taken as an alarm for begin all form of works towards sustainable practices.

SUSTAINABLE PRACTICES IN HEALTH CARE:

Sustainability:

It is well known that sustainable practices are opted at international level by all states in order to attain the continuous development without damaging the environment much. In the year 1987 for the first time in the history the term "sustainable development" was introduced to this world by United Nations in the Burtland report. So according to the said report, sustainable development means "development that meets the needs of the present without compromising the ability of future generations to meet their personal needs"[3]. But it is important to know that this interpretation is not exclusive meaning but there is various open interpretation for the term sustainable development. For understanding the term or its practical applicability of sustainable development in better manner the definition of Karl-Henrik Robert a Swedish Scientist can be adopted. The definition says, "an ideal society would strive to reduce the consumption of mineral and other natural resources" that means the ultimate purpose of sustainable development is to protect the resources that are available naturally even during the process of development. This definition gives a better clarity on what is the step to be taken.

Sustainability in Healthcare:

As the world have adopted the policy of Sustainable Development it is also necessary for the health care sectors also to have adopt the same. As we have discussed already a sector which as a primary goal of protecting and boosting the health of public is also having its adverse effect on environment that ultimate again affects the public health. So, there is a need for all the health care sectors, from multi-speciality hospitals to small clinics and labourites to construct a method that would be suitable without degrading the environment.

It is evident that there are lot of sustainable measures practiced in now, but is it sufficient is the question that arises. As nations together and as well as individually have adopted various policies or practices towards sustainability in health care, whether it is supporting or whether

[3] Biason KM, Dahl P. [Updated on Oct 2016];Strategic steps to sustainability in healthcare - Sustainable Operations. https://healthcarefacilitiestoday.com/posts/Strategic-steps-to-sustainability-in-healthcare--13629

the target is achieved is the question. Also, it is important to remember whatever actions are taken it shall not affect the primary role of healthcare centres.

As discussed in introduction the issues that contribute towards environmental degradation by the healthcare centres are bio-medical waste, bio-degradable waste, linear supply chains and excessive energy. Also, the pollution caused to the air level cannot be ignored. In the research work of Klangsin & Harding[4], it was evident that the major global pollutant that contributes towards the issues such as air pollution, soil degradation and contagion of disease are bio medical waste. For practically achieving the sustainable practice in healthcare centres setting up different teams to monitor different issues can be done[5].

While there is a need to bring a sustainable practice for addressing all the said issues, at the same time the healthcare centres should also concentrate on quality, accessibility and affordability of the services provided by them. The challenges for healthcare centres start at the point when they are adopting sustainable practices and at the same time has the duty to provide better services for all.

From the above it is important to highlight that sustainable development goals that always means practices of development without much affecting the environment. But it is drastically different in healthcare centre. In healthcare centres sustainability means protecting and maintaining the environment while saving lives. Though sustainability causes more it is the duty of the healthcare centres to concentrate equally on proving affordable healthcare as both goes hand in hand.

REGULATORY FRAMEWORK FOR PROMOTING SUSTAINABILITY:

The question whether law changes the society or society changes the law have been a debate from the days of Jurist defining Law. Though society have a great role in creating a law, it is the law that regulates the society. And in the sustainable practices in healthcare centre, it's the same. As the words of Herzlinger says "The sustainability of a health system depends on environmental, political, legal, and social factors that influence budget allocation and

[4] Klangsin P, Harding AK. Medical waste treatment and disposal methods used by hospitals in Oregon, Washington, and Idaho. J Air Waste Manag Assoc. 1998

[5] https://pmc.ncbi.nlm.nih.gov/articles/PMC7591295/#:~:text=Thus%2C%20it%20has%20become%20imperative%20for%20healthcare,addressing%20various%20aspects%20of%20sustainability%20in%20healthcare.

healthcare priorities[6]". Though nations adopt various steps towards sustainability, it can be achieved only through their legislative measures. And in a country like India, that hosts numerous healthcare centres only through laws and regulations all the issues caused by the sector can be addressed by simultaneously implementing sustainable practices.

The various legal framework implemented in India are as follows:

1. **The Environment (Protection) Act, 1986 (EPA)**

   The Union government enacted The Environmental (Protection) Act in the year 1986 making it the foundation and primary law to regulate the environmental issues in India. This act plays the role as a parent environmental statue for all the others laws governing environmental and issues associated with the same. Also this act empowers the central pollution control board to enact rules and regulation for better governance of the ecosystem. It serves as the foundation for many environmental regulations and penalty for noncompliance. Its importance stems from the fact that the EPA gives the BMW Rules and a number of CPCB guidelines their authority, allowing the Central Government to provide State Pollution Control Boards instructions for enforcement, monitoring compliance, and even closing plants that violate the rules.

2. **The Bio-Medical Waste Management Rules, 2016 (as amended):**

   Replacing the BMW rules 1998, the rules of 2016 become the primary legislation governing the waste management of healthcare centre. The said rules were introduced under the issued under the Environment (Protection) Act, 1986 that applies to all the healthcare institutions including hospitals, clinics, labs, blood banks, AYUSH centres, health camps, veterinary facilities, research labs, educational institutions, forensic labs, etc.

   The rules address various aspects such as waste categorization, treatment and disposal of each along with their storage, segregation and transportation. The rules also speak about liquid waste, effluent treatments and air emission standards. So according to the said rules the biomedical waste has to be categorised into four simplified system based on colour. Under yellow category waste such as Anatomical waste, soiled waste, expired medicines, chemical waste, lab waste will be segregated. Under red category

[6]https://www.sdmimd.ac.in/iec2023/papers/IEC23195.pdf#:~:text=The%20sustainability%20of%20the%20health%20system%20is,is%20determined%20by%20those%20factors%20(Herzlinger%2C%202006).

Contaminated recyclables like tubing, bottles, catheters, IV sets, gloves, etc. will be collected. Under White category sharp items such as needles, blades, scalpels, etc and under blue category Glassware and metallic implants will be classified. And each category has different treatment and disposal methods such as: Yellow category waste is treated through incineration, plasma pyrolysis, or deep burial, while cytotoxic drugs require high-temperature disposal above 1200°C. Red category waste undergoes autoclaving or microwaving followed by shredding and is then sent to authorized recyclers. White category (sharps) waste is managed through autoclaving or dry-heat sterilization, followed by mutilation and disposal in foundries or sanitary landfills. Blue category waste is disinfected—typically using sodium hypochlorite—and then processed for recycling.

Being the primary regulation, it also lays multiple responsibilities upon healthcare facility occupiers such as safe segregation, storage, treatment and transportation. The rules also mandate the occupiers to follow the WHO/NACO guideline for ventilated storage areas, pre-treat microbiological and library waste. The facility occupiers are also given an obligation of training their staff members during induction as well as annually for managing the waste in a better way. Also, the healthcare centres need to safeguard the health of the workers those who are directly engaged in waste management by maintain the proper registers and through immunizing them against Hepatitis B and Tetanus.

And it is important to note that the rules not do not stop at laying duties but also monitors whether the said rules are practiced properly by brining into picture the State pollution control Borad. The healthcare centres have another duty of preparing annual report which has to be submitted to the State pollution control Borad and also displaying their compliance status in online. And they sure ensure that the prescribed standard for BOD, COD, pH, and other parameters is met during the effluent treatment. In addition to this, the framework prescribes detailed operational responsibilities such as timely collection, safe handling, barcoding, GPS tracking, worker training, and logbook maintenance by Common Biomedical Waste Treatment Facility (CBWTF) operators, while ensuring that recyclables are given only to authorized recyclers. Strict norms also govern segregation at source using color-coded containers, limiting storage to 48 hours, proper labelling and barcoding of bags, and transporting waste in closed, dedicated trolleys to a locked and ventilated central storage area. Liquid waste must undergo pre-

treatment before being routed to an Effluent Treatment Plant (ETP), which must meet standards such as pH 6.5–9, BOD ≤ 30 mg/l, COD ≤ 250 mg/l, oil and grease ≤ 10 mg/l, and 90% fish survival in bio-assay tests, using processes like coagulation, filtration, and multi-level treatment. The rules further regulate incineration by prohibiting single-chamber units and mandating specific temperatures—800°C in the primary chamber and 1050°C in the secondary chamber with 2 seconds residence time—along with Air Pollution Control Devices to meet emission limits for particulate matter, NOx, HCl, dioxins, and furans. Other approved technologies include plasma pyrolysis, gasification with 99.99% efficiency, autoclaving or microwaving achieving Log-6 reduction, chemical disinfection using 10% sodium hypochlorite, and deep burial in remote areas with SPCB approval. All these processes are overseen by regulatory bodies such as SPCBs, PCCs for Union Territories, the DGAFMS for Armed Forces facilities, and the CPCB for nationwide monitoring, with authorizations to be granted within 90 days and appeals lying with the State/UT Secretary (Environment).

3. The Water (Prevention & Control of Pollution) Act, 1974

The 1974 act deals with water pollution, and in regards with healthcare centres it regulates the liquid effluents discharged into the ground water and land surface. For disposing the liquid effluents, the healthcare centres are required to obtain establishment consent and operational consent from the State Pollution Control Board. Also, the healthcare centres are required to comply with the said standards of effluent discharge. And it is the duty of the healthcare centres to neutralize and pretreat any chemical waste prior its disposal. The neutralization and disposal process as to be in compliance with the said act and the guidelines prescribed time to time by both the Central and State Pollution Control Board. The act also mandates the operators to get obtain consent from the State Pollution Control Board for operating the Common Biomedical Waste Treatment Facilities. Finally, under the act the State Pollution Control Board is empowered to enforce their power of imposing penalties and even issuing closures when institutes fail to follow the law.

4. The Air (Prevention & Control of Pollution) Act, 1981

Though the primary role of the act is to regulate the pollutants of the air, the law also concentrates how healthcare centres should operate the emission caused by them in air. Similar to water act, even in the air acts mandates the healthcare centres to acquire the Consent to establish and consent to operate from the State Pollution Control Board.

The said consent is applicable for all emission-generating treatment systems, especially incinerators, thermal treatment units, and combustion devices used for biomedical waste. All healthcare incinerators must adhere to the CPCB's mandated emission guidelines, which include limitations for particulate matter, NOx, HCl, dioxins, and furans. Incinerators must have Air Pollution Control Devices (APCDs), like scrubbers and filters, in order to comply with these regulations and stop the production of harmful emissions. Healthcare facilities cannot lawfully operate incinerators or other thermal treatment units without adhering to the Air Act's emission standards, and any infraction may result in suspension, closure, or fines from the State Pollution Control Board.

5. **Hazardous and Other Wastes (Management & Transboundary Movement) Rules, 2016 (and subsequent amendments)**

   The rules govern the storage, handling, transportation, treatment and disposal of hazardous waste. The said law is an addition to BMW rules, 2016 for healthcare centres to comply with. If the institutions deal with wastes from incineration or plasma pyrolysis it this their duty to follow the rules as these are classified to be hazardous.

6. **Solid Waste Management Rules, 2016**

   This rule discusses about non-biomedical, non-hazardous and non-infectious waste that is produced by the healthcare centres. These wastes include waste generated from office, canteens or even primary sanitary waste. The rules mandate the institutes to identify and segregate each of such wastes for surrendering it to the local authorities or even authorized recyclers.

7. **Plastic Waste Management Rules, 2016**

   Under the said rules the healthcare institutes are said to categorise the single use plastics waste separately for sending them for recycling. These wastes include PPE wrappers, packaging and even gloves. The rules also mandate to phase out chlorinated plastics within two years of the enforcement of the act and also to use plastic bags that meets BIS standards. It is important to note that the incineration is strictly prohibited as it releases toxic gas and pollutants.

8. **E-Waste (Management) Rules, 2016 (and amendments)**

   As there in evolution in every sector even healthcare sector has witnessed better changes. Utilizing better technology in health sector is important at the same time disposal of all the electronic waste is much more important and this rule talks about the discarded electronic equipment like monitors, machines, and batteries. The rules also recommend on proper handling and recycling of e waste.

9. Municipal Solid Waste and Construction & Demolition Waste Rules, 2016

Healthcare facilities are required to make sure that biomedical waste is never transported to municipal disposal sites or combined with ordinary municipal solid waste after treatment. Furthermore, the Construction & Demolition Waste Management Rules, 2016 must be followed while handling and disposing of any construction or demolition waste produced by these institutions.

INTERNATIONAL LEGAL FRAMEWORK GOVERNING HEALTHCARE SECTOR WASTE:

As healthcare institutions continue to play a vital role in preserving life and promoting public health, the waste generated by these institutions has gradually emerged as a serious concern at the international level. Healthcare waste, if not properly managed, does not remain confined within hospital premises; instead, it extends its impact to sanitation workers, nearby communities, water bodies, and the environment at large. Recognising these risks, the international community has attempted to regulate healthcare sector waste through a combination of environmental, health, labour, and human rights instruments, even though no single treaty exclusively governs this issue.

One of the most significant international legal instruments addressing healthcare waste is the Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and Their Disposal, 1989. The Convention aims to reduce the generation of hazardous waste and ensure that such waste is managed in an environmentally sound manner. It places strict controls on the transboundary movement of hazardous healthcare waste, particularly infectious and pharmaceutical waste, and expressly prohibits its export to countries that lack the capacity to safely dispose of it. Through these measures, the Basel Convention seeks to prevent the dumping of medical waste from developed countries into developing nations, where regulatory mechanisms and disposal infrastructure are often inadequate.[7]

In addition to the Basel Convention, the Stockholm Convention on Persistent Organic Pollutants, 2001 addresses the environmental hazards arising from improper healthcare waste treatment, especially incineration. Medical waste incineration often releases toxic substances such as dioxins and furans, which have long-term effects on human health and the environment.

[7] Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and Their Disposal, Mar. 22, 1989, 1673 U.N.T.S. 57.

The Stockholm Convention encourages States to adopt safer alternatives to incineration and promotes the use of best available techniques and best environmental practices in waste management.[8] Similarly, the Minamata Convention on Mercury, 2013 responds to the risks posed by mercury used in medical equipment such as thermometers, blood pressure measuring devices, and dental amalgam. By requiring the gradual phase-out of mercury-containing medical devices, the Convention aims to protect healthcare workers, patients, and the environment from mercury exposure.[9]

Apart from binding treaties, the World Health Organization (WHO) has played a crucial role in guiding States through its technical and policy guidelines on the safe management of healthcare waste. Although these guidelines are not legally binding, they provide detailed standards for segregation, collection, treatment, and disposal of healthcare waste and have significantly influenced national laws and hospital practices across the world.[10] The relevance of healthcare waste management also extends beyond environmental regulation into the realm of human rights. Improper disposal of medical waste directly affects the right to health under Article 12 of the International Covenant on Economic, Social and Cultural Rights and the right to life under Article 6 of the International Covenant on Civil and Political Rights. Further, the recognition of the right to a clean, healthy, and sustainable environment by the United Nations General Assembly in 2022 strengthens the obligation of States to address healthcare waste as a matter of human rights protection.[11]

The safety of workers handling healthcare waste has been addressed through international labour standards, particularly ILO Convention No. 155 on Occupational Safety and Health, which emphasises the duty of States to ensure safe working conditions and prevent occupational hazards. Healthcare waste management also aligns closely with the objectives of the Sustainable Development Goals, especially those relating to health, sanitation, responsible consumption, and climate action.[12] Despite these efforts, the international framework governing healthcare waste continues to face serious challenges, including the absence of a dedicated treaty, weak enforcement mechanisms, limited capacity in developing countries, and

[8] Stockholm Convention on Persistent Organic Pollutants, May 22, 2001, 2256 U.N.T.S. 119.
[9] Minamata Convention on Mercury, Oct. 10, 2013, 55 I.L.M. 582 (2016).
[10] World Health Organization, *Safe Management of Wastes from Health-Care Activities* (2d ed. 2014).
[11] G.A. Res. 76/300, *The Human Right to a Clean, Healthy and Sustainable Environment* (July 28, 2022); International Covenant on Economic, Social and Cultural Rights art. 12, Dec. 16, 1966, 993 U.N.T.S. 3; International Covenant on Civil and Political Rights art. 6, Dec. 16, 1966, 999 U.N.T.S. 171.
[12] ILO Convention No. 155, Occupational Safety and Health Convention, June 22, 1981, 1331 U.N.T.S. 222; United Nations, *Transforming Our World: The 2030 Agenda for Sustainable Development*, G.A. Res. 70/1 (Sept. 25, 2015).

the massive increase in medical waste during public health emergencies such as the COVID-19 pandemic. These challenges underline the need for stronger international cooperation and a more integrated, rights-based approach to healthcare waste governance.

WASH IN THE CONTEXT OF HEALTHCARE AND CLIMATE CHANGE

Access to safe water, adequate sanitation, and proper hygiene practices has increasingly emerged as a critical concern in the context of healthcare delivery, climate change, and public health protection. While healthcare systems are expected to promote health and prevent disease, these objectives cannot be meaningfully achieved in the absence of basic WASH services. The growing pressures of climate change, rising healthcare waste, and recurring infectious disease outbreaks have highlighted the need to examine WASH as a distinct and foundational component of healthcare systems rather than a subsidiary or supporting concern. WASH directly influences infection prevention, patient safety, environmental protection, and the resilience of healthcare facilities during public health emergencies and climate-related stresses.

Concept and Significance of WASH

The concept of Water, Sanitation and Hygiene (WASH), as propounded and promoted by the World Health Organization (WHO), forms the backbone of public health by ensuring access to safe drinking water, proper sanitation, and essential hygiene practices. These elements are indispensable for improving health outcomes, preventing disease transmission, and supporting overall human development. In healthcare settings, WASH assumes even greater importance as it directly contributes to quality of care, infection prevention, and patient dignity, while also supporting the achievement of health-related Sustainable Development Goals. The absence or inadequacy of WASH services not only compromises healthcare delivery but also increases the risk of healthcare-associated infections and preventable deaths.[13]

Role of the World Health Organization in Advancing WASH

The World Health Organization plays a central role in advancing WASH by developing global guidelines aimed at improving drinking water quality, wastewater management, and hygiene practices within healthcare systems. Its focus lies primarily on enhancing quality of

[13] World Health Organization & UNICEF, *WASH in Health Care Facilities: Global Baseline Report* (2019).

care and preventing healthcare-associated infections. WHO supports governments through technical guidance and capacity building and works in close coordination with international partners such as UNICEF and UN-Water. Further, WASH is integrated into broader health programmes addressing challenges such as climate change, cholera, and other infectious disease outbreaks. Importantly, WHO recognises access to WASH as a human right, acknowledging that it is fundamental to dignity, health, and sustainable development.[14]

Climate Change and the Vulnerability of WASH Systems

Water, sanitation, and hygiene services within healthcare facilities are among the most essential requirements for delivering quality care and preventing avoidable deaths. However, climate change has placed increasing pressure on WASH systems across the world. Floods, droughts, heatwaves, and water scarcity damage water sources, sanitation infrastructure, sewage systems, and hygiene facilities. When WASH systems are not designed to be climate-resilient, they are most likely to fail during extreme conditions, precisely when health services are needed the most. This exposes healthcare providers, patients, and surrounding communities to heightened health risks.[15]

WASH During Epidemics and Public Health Emergencies

Recent epidemics and pandemics have further demonstrated the indispensable role of WASH in healthcare settings. The COVID-19 pandemic clearly showed that diseases spread more rapidly in environments where access to clean water, sanitation, and hand hygiene is inadequate. Healthcare facilities require reliable WASH services to protect patients and health workers, prevent the spread of infections, and safely manage waste and sanitation during outbreaks. WASH systems must therefore be capable of responding to public health emergencies, accommodating sudden increases in demand, and continuing to function during crises.[16]

Inclusivity and Equity in WASH Services

An effective WASH framework must also be inclusive in nature. Populations using healthcare facilities are diverse and include children, older persons, persons with disabilities, pregnant women, menstruating individuals, patients, visitors, and healthcare workers. Inclusive

[14] World Health Organization, *Water, Sanitation and Hygiene in Health Care Facilities* (WHO 2019).
[15] World Health Organization, *Climate Change and Health* (WHO 2021).
[16] World Health Organization, *Infection Prevention and Control during Health Care when COVID-19 is Suspected* (WHO 2020).

WASH ensures that facilities are accessible, safe, private, and culturally appropriate for all users, rather than catering to only a limited section of the population. Such inclusivity is essential for achieving equity in healthcare access, dignity, and health outcomes.[17]

Sustainability and Systemic Challenges

Sustainability is a critical dimension of WASH. Sustainable WASH systems use water and resources efficiently, minimise environmental pollution, and are capable of functioning over long periods without degrading ecosystems. Poorly planned or short-term WASH interventions often fail under climate stress, leading to system breakdowns and service disruption. Despite its importance, the current status of WASH in healthcare facilities remains inadequate in many regions. Even where infrastructure exists, services often perform poorly due to unreliable water supply, broken or inaccessible sanitation facilities, lack of hygiene materials, and ineffective waste management systems. These challenges usually stem from weak governance, insufficient maintenance, lack of trained personnel, limited financing, and unclear institutional responsibilities rather than the mere absence of infrastructure.[18]

Climate Stress, System Failure, and Health Consequences

The sustainability of WASH systems is further threatened by climate change. Flooding damages water and sanitation infrastructure, droughts reduce water availability for hygiene, and extreme weather events disrupt electricity, supply chains, and staffing. These impacts severely affect healthcare delivery, making it difficult for facilities to continue essential services such as maternal care, immunisation, and surgical procedures. As a result, WASH systems become overwhelmed or unusable precisely when demand is at its peak. The consequences of WASH failure are far-reaching: infection prevention measures collapse, disease exposure increases, routine healthcare services are interrupted, and outbreak management becomes significantly more difficult. These realities reinforce the understanding that WASH is a foundational component of healthcare systems and not merely an auxiliary service.

Strengthening and Building Resilient WASH Systems

Strengthening WASH systems, rather than focusing solely on infrastructure creation, is therefore imperative. System strengthening includes the development of clear policies and

[17] United Nations, *The Human Rights to Water and Sanitation*, G.A. Res. 64/292 (July 28, 2010).
[18] World Health Organization, *Progress on WASH in Health Care Facilities 2000–2021* (WHO 2022).

standards, sustainable financing mechanisms, trained personnel responsible for WASH management, reliable supply chains, and robust monitoring and accountability frameworks. Strong systems enable healthcare facilities to withstand shocks, respond to emergencies, recover from disruptions, and adapt to future climate and health risks.[19]

During public health emergencies and periods of climate stress, reliable WASH services become even more critical. They ensure safe patient care, protect health workers, support infection prevention, and maintain continuity of essential health services. Without resilient WASH systems, healthcare facilities cannot function safely during crises. Learning reports based on real-world experiences across multiple countries play an important role in capturing lessons, sharing effective practices, identifying investment priorities, and guiding policy decisions. Sustained collaboration with Ministries of Health and long-term institutional engagement are essential for strengthening national systems and achieving durable, systemic change rather than short-term solutions.[20]

HEALTHCARE WASTE AS A CLIMATE CONCERN:

Climate change has increasingly emerged as a profound public health challenge, affecting not only the environment but also the physical, social, and mental well-being of human populations across the globe. Rising temperatures have led to a significant increase in air pollutants, which aggravate respiratory conditions and contribute to heat-related illnesses and deaths, particularly among vulnerable groups such as the elderly, children, and those with pre-existing health conditions. Alongside this, the growing frequency and intensity of extreme weather events—including floods, droughts, cyclones, and heatwaves—have disrupted ecological systems and altered patterns of disease transmission. These ecological changes, coupled with disruptions in water and food supply systems, have resulted in a rise in cardiovascular and allergic diseases, as well as the increased spread of malaria and other vector-borne and water-borne diseases. Rising sea levels further compound these challenges by degrading water quality, salinising freshwater resources, and threatening coastal livelihoods, which in turn leads to food insecurity, malnutrition, forced migration, and serious mental health impacts among displaced communities. These climate-driven health outcomes occur through

[19] WHO & UNICEF, *Strong Systems for WASH in Health Care Facilities* (2023).
[20] World Health Organization, *Learning from Country Experiences: WASH in Health Care Facilities* (WHO 2021).

various mechanisms such as air pollution, ecological imbalance, compromised water and food systems, and deteriorating coastal environments, demonstrating the close and inseparable link between climate change and human health.[21]

While climate change poses severe risks to public health, it is equally important to recognise the paradoxical role played by the healthcare sector itself in contributing to the climate crisis. The healthcare sector, whose primary mission is to protect and promote human health, has become a significant source of greenhouse gas emissions, thereby indirectly exacerbating the very health risks it seeks to address. The global healthcare sector is responsible for approximately 4.4 per cent of total net global greenhouse gas emissions, amounting to nearly 2 gigatons of carbon dioxide equivalent. This level of emissions is comparable to the annual output of 514 coal-fired power plants, and if the global healthcare sector were classified as a country, it would rank as the fifth-largest emitter worldwide.[22] Such figures highlight the substantial environmental footprint of healthcare systems, driven by energy-intensive infrastructure, pharmaceutical production, medical supply chains, waste generation, and transportation.

The distribution of healthcare-related emissions also reveals significant global inequalities. The United States, China, and the European Union together account for more than half of the global healthcare climate footprint, underscoring the disproportionate contribution of high-income regions. The United States health sector, in particular, stands out as the largest emitter in both absolute and per capita terms, producing emissions 57 times higher per person than India. In contrast, although India ranks as the seventh-largest healthcare emitter in absolute terms, it records the lowest healthcare-related emissions per capita among the countries studied. Similarly, China's health sector emits significantly more greenhouse gases per capita than India's, yet far less than that of the United States and several other developed regions. These disparities reflect differences in healthcare delivery models, resource consumption patterns, and technological dependence, and they raise important questions about equity, responsibility, and sustainability in global health governance.[23]

Taken together, these realities demonstrate that climate change and healthcare systems are deeply interconnected. Climate change intensifies health risks, while healthcare systems, if

[21] U.S. Centers for Disease Control and Prevention (CDC), *Climate Effects on Health* (CDC 2023).
[22] Health Care Without Harm & ARUP, *Health Care's Climate Footprint: How the Health Sector Contributes to the Global Climate Crisis and Opportunities for Action* (2019).
[23] World Health Organization, *Climate Change and Health* (WHO 2021).

left unregulated, contribute to environmental degradation and climate instability. Addressing this dual challenge requires a fundamental rethinking of healthcare delivery, with a focus on climate-resilient and low-carbon health systems. Sustainable healthcare practices are therefore not merely environmental choices but essential public health interventions, necessary to protect present and future generations and to ensure that the pursuit of health does not come at the cost of planetary well-being.

IMPORTANCE OF REDUCING THE ECOLOGICAL IMPACT OF HEALTHCARE

Achieving efficient healthcare delivery while minimizing environmental harm requires careful planning and strategic action. Today, environmental responsibility is no longer an optional enhancement or a mark of prestige; it has become a societal expectation and an integral component of healthcare services.[24]

Hospitals, healthcare practitioners, and the laboratory medicine community must take the lead in advancing carbon neutrality by reducing their environmental footprint. This involves adopting innovative and sustainable approaches to mitigate the effects of climate change and pollution without compromising the quality of patient care.[25]

Given that healthcare accounts for nearly half of government expenditure in the European Union, sustainable procurement and responsible management of healthcare materials present a significant opportunity for governments and healthcare stakeholders to achieve broader sustainability and growth objectives. With over 15,000 hospitals across the EU[26], the healthcare sector is uniquely positioned to influence the production and consumption of healthcare goods, and to champion the transition to safer, more sustainable, and innovative products and services.

Policy-makers and healthcare institutions should focus on the six domains of healthcare waste identified by the Institute of Medicine and further elaborated by Berwick and Hackbarth:

[24] Biason KM, Dahl P. [Updated on Oct 2016];Strategic steps to sustainability in healthcare - Sustainable Operations. https://healthcarefacilitiestoday.com/posts/Strategic-steps-to-sustainability-in-healthcare--13629
[25] Directorate-General for Environment (European Commission), author; Intrasoft International, author; University of the West of England (UWE), author; Science Communication Unit, author; Indicators for sustainable cities, author. [Updated on March 2018]; https://publications.europa.eu/en/publication-detail/-/publication/cbaa6e59-437c-11e8-a9f401aa75ed71a1
[26] Health Care Without Harm, EUKI Anaesthetic Gases Project, author. [Updated on 2018];Fostering low carbon healthcare in Europe. https://noharm-europe.org/issues/europe/fostering-low-carbon-healthcare-europe-euki-anaesthetic-gasesproject

failure of care delivery, failure of care coordination, overtreatment or low-value care, pricing inefficiencies, fraud and abuse, and administrative complexity. Recent estimates by Shrank et al.[27] indicate that waste-related costs in the U.S. healthcare system range between $760 billion and $935 billion, representing approximately 25% of total healthcare expenditure. These figures highlight the urgent need to implement sustainable practices in healthcare waste management to optimize both economic and environmental outcomes.

PURSUIT OF SUSTAINABILITY:

The pursuit of sustainability in laboratory medicine requires several focused actions. Policymakers need to recognise and promote the value of sustainable practices, while publishing clear guidelines, action plans, and policies to support them. New policies should be introduced to achieve sustainability goals, including environmentally responsible procurement and operational practices. Laboratory professionals must be encouraged to adopt these measures and share insights and outcomes.

Sustainable procurement systems should align suppliers and contractors with the overall sustainability plan. Financial support, whether through direct grants, loans, or indirect incentives like tax credits, is essential to back sustainable initiatives and research. Investors should be engaged to create sustainable financial markets, and innovation, emerging technologies, and experimentation should be promoted to tackle social, environmental, and economic challenges. Transparent, standardised, and interoperable data sharing is vital, along with adequate funding for data infrastructure to support evidence-based sustainability efforts.

EU AND DANISH APPROACHES TO SUSTAINABLE HEALTHCARE:

Comparison of EU Measures to Promote Healthcare Sustainability:

The European Green Deal (EGD), also known as the Sustainable Europe Investment Plan, aims to mobilize at least €1 trillion for sustainable investments over the next decade, with the ultimate goal of making Europe the world's first climate-neutral continent by 2050. Renewable energy is expected to become the primary source of power across the EU, but the

[27] Chevalier F, Lévitan J, Garel P. Hospitals in the 27 Member States of the European Union. 2009:5559. http://www.hope.be/wp-content/uploads/2015/11/79_2009_OTHER_Hospitals-in-27-Member-States-ofthe-European-Union-eng.pdf

success of the EGD depends on active participation from all stakeholders. The European Commission has already launched initiatives targeting hospitals and healthcare providers, such as *"Towards Zero Carbon Hospitals with Renewable Energy Systems"*, which supports the 15,000 hospitals in Europe in reducing their CO2 emissions. Hospitals, with their high energy demands, present both a challenge and an opportunity for implementing renewable energy systems and energy-efficiency measures. While new hospitals can be designed to be energy-efficient from the outset, existing hospitals must focus on reducing energy consumption and incorporating renewable sources to meet long-term CO2-reduction targets. A *Guide for European Hospitals on Renewable Energy* has also been developed and widely distributed, offering best practices and lessons learned, and encouraging a system-wide shift toward sustainability and environmentally conscious practices.

Denmark – Government Strategies for Sustainable Healthcare:

Denmark has long been a pioneer in sustainability and climate action. In 2022, it was named the world's most sustainable country for the second consecutive year[28] by the Environmental Performance Index. Denmark's sustainability efforts are backed by legally binding national climate targets, a strong focus on renewable energy, reduction of fossil fuel dependency, public-private partnerships, and investments in innovative green technologies. At the regional and local level, Danish municipalities and regions maintain climate action plans or sustainability strategies, and all five regions actively work to reduce hospitals' CO2 emissions.

In 2020, Danish Regions, the umbrella organization for all five regions, set ambitious goals to cut CO2 emissions from energy and transport in public hospitals by 75% by 2030 compared to 2018 levels. Key measures include climate-friendly buildings, conversion of heating systems, and hybrid ambulances. The regions also extended their focus to CO2 emissions from healthcare procurement, which accounts for the majority of hospitals' emissions, by setting stricter "green" criteria in supplier contracts and promoting reuse of medical equipment to minimize waste.

The Climate Alliance, a partnership of 98 municipalities, five regions, and the association Realdania, together with think tank CONCITO and C40 as knowledge partners,

[28] Environmental Performance Index, "https://epi.yale.edu," 2022. [Online]. Available: https://epi.yale.edu/epi results/2022/component/epi.

provides a framework for local and regional climate action and aims to raise climate solutions to international standards.

In 2022, Denmark passed the Climate Act (*Klimaloven*), legally committing the government to reduce greenhouse gas emissions by 70% by 2030 compared to 1990 levels.[29] Denmark is also dedicated to achieving the Paris Agreement goal of limiting global warming to 1.5°C, with the long-term objective of climate neutrality by 2050. The current government (2021–present) has set even more ambitious targets, aiming for climate neutrality by 2045 and a 110% reduction in emissions by 2050 compared to 1990.[30]

ACTIONS NEEDED FOR CLIMATE-SMART HEALTHCARE

Transitioning to climate-smart healthcare requires focused and deliberate action. Key steps include:

- **Reducing Healthcare's Climate Footprint:** Minimizing emissions and environmental impact across all healthcare operations.
- **Supporting the Shift to Clean Energy:** Promoting the adoption of renewable energy sources and facilitating a social transition away from fossil fuels.
- **Planning for Zero Emissions by 2050:** Establishing clear roadmaps and strategies to achieve carbon-neutral healthcare systems within the next decades.
- **Making Development Assistance Climate-Sensitive:** Ensuring that health-related development aid incorporates climate-smart principles.
- **Implementing Government Action Plans:** Governments must develop and execute comprehensive policies to support climate-smart healthcare.
- **Expanding Research on Health and Climate:** Investing in research to better understand the links between healthcare practices, climate change, and public health outcomes.

These actions collectively provide a roadmap for healthcare systems to reduce their environmental impact while maintaining high-quality care.

[29] The Danish Government, "Aftale om klimalov," 2019.
[30] The Danish Council on Climate Change, Statusrapport 2023, Copenhagen, 2023.

RECOMMENDATION:

Climate Change and Sustainable Healthcare Practices:

Hospitals and healthcare systems worldwide are increasingly recognizing the profound impact of climate change on public health. Alongside this, there is growing understanding that climate mitigation and climate resilience are closely linked. Many strategies that strengthen healthcare resilience against climate-related risks simultaneously contribute to reducing greenhouse gas emissions. Likewise, mitigation measures enhance the ability of healthcare systems to withstand climate stresses.

For example, situating healthcare facilities near public transportation hubs reduces carbon emissions while ensuring access during emergencies. Similarly, the adoption of on-site renewable energy sources, such as solar power or combined heat and power systems, reduces dependency on centralized energy grids. Building designs that incorporate natural ventilation, energy-efficient medical equipment, and sustainable operational practices support both environmental sustainability and system resilience. Telemedicine, remote consultations, and digital healthcare models further reduce travel, conserve resources, and strengthen the capacity of healthcare systems to respond during crises.

Experience shows that reducing dependence on centralized infrastructure allows hospitals to operate effectively even during extreme events like storms or floods, highlighting that climate mitigation and resilience in healthcare are mutually reinforcing, not separate objectives.

Fundamental Principles of Sustainable Healthcare

1. **Emphasis on Prevention:**

A cornerstone of sustainable healthcare is prevention. Encouraging healthy lifestyle practices—such as balanced nutrition, regular physical activity, maintaining a healthy weight, and avoiding harmful habits—reduces the demand for resource-intensive medical treatments. Early detection through timely screenings and diagnostics also ensures conditions are managed at an early stage, improving outcomes while conserving healthcare resources.

2. **Digital Solutions in Healthcare:**

Digital technologies are key to sustainable healthcare delivery. Virtual consultations, AI-assisted remote assessments, and advanced imaging systems improve diagnostic accuracy

and enable early intervention. These approaches reduce unnecessary hospital visits, limit repeated procedures, and decrease overall resource consumption, contributing to both operational efficiency and environmental sustainability.

3. **Reducing Environmental Impact in Care Delivery:**

Sustainable healthcare integrates high-quality patient care with environmentally responsible practices. This includes adopting renewable energy, improving waste segregation and management, and sourcing eco-friendly medical products. Minimizing hospital stays when clinically possible, avoiding redundant procedures, and assessing the environmental impact of treatment options alongside clinical effectiveness allow healthcare providers to deliver care that is both medically sound and environmentally responsible.

Infrastructure and Design Recommendations for Sustainable Healthcare

1. **Incorporating Rainwater Basins into Hospital Design and Infrastructure:**

With extreme weather events becoming more frequent, climate-resilient healthcare infrastructure is critical. Incorporating rainwater harvesting and stormwater management systems into hospital design helps prevent flooding, conserve water, and maintain operational continuity. Such infrastructure enhances resilience while supporting the long-term sustainability of healthcare services.

2. **Innovative Fire Protection Solutions:**

Fire safety remains a fundamental requirement in healthcare facilities. Implementing innovative and reliable fire protection systems ensures the safety of patients, staff, and essential medical equipment. It also safeguards hospital operations, reduces property damage, and strengthens public trust in healthcare institutions.

3. **Healing Architecture:**

Hospital design significantly affects patient recovery and staff well-being. Healing architecture emphasizes therapeutic environments through natural lighting, proper ventilation, calming spaces, and accessible design. Such features support faster patient recovery, reduce stress for both patients and staff, and enhance the overall quality of healthcare services.

Need for a Standardized Framework:

To effectively address climate change in healthcare, a standardized framework is essential for measuring the environmental footprint of health systems. This allows governments to consistently track progress toward decarbonization and climate resilience. It also supports health ministries in developing action plans aligned with local, regional, and national climate policies, as well as countries' commitments under the Paris Agreement. Standardized measurement and monitoring mechanisms are crucial for ensuring accountability, informed decision-making, and long-term sustainability in healthcare.

CONCLUSION

Sustainability today is no longer a choice—it is an urgent necessity for the survival and well-being of society. The healthcare sector holds a unique and critical role in this context. While it protects, restores, and improves human health, it also carries a substantial environmental footprint. Energy-intensive hospitals, pharmaceutical production units, excessive resource consumption, and high volumes of waste collectively contribute to environmental degradation and climate change. These impacts, in turn, worsen climate-related challenges that directly and indirectly affect human health and well-being.

In the 21st century, healthcare's responsibility extends beyond delivering quality medical services. Given its significant consumption of energy and resources, the sector must actively reduce environmental harm while continuing to improve public health and support economic development. Sustainability in healthcare is therefore not just an ecological requirement—it is an essential public health imperative.

By adopting sustainable practices, healthcare systems can significantly lower their carbon footprint, strengthen resilience to climate stresses, and improve health outcomes. Global commitments, such as the Declaration on Climate and Health endorsed by 124 countries at COP28, highlight the recognition that climate action and health protection are deeply interconnected.

Denmark provides a practical example of this transition. Known for its leadership in green energy and water technologies, the country is now applying this expertise to the healthcare and pharmaceutical sectors. Through innovative and sustainable solutions, Denmark demonstrates that healthcare can become environmentally responsible without compromising

patient safety or quality of care. Its experience offers valuable models for other nations to follow in aligning healthcare with sustainability and global climate goals.

Sustainability in healthcare goes beyond emissions reduction and resource conservation. It also involves social responsibility and equity. A truly sustainable system protects the environment while ensuring fair access to healthcare and supporting vulnerable communities. This holistic approach recognizes the interconnections between environmental protection, economic stability, and social well-being.

Looking forward, achieving a sustainable healthcare system requires strong global cooperation. Governments, healthcare institutions, and communities must work together to implement climate-smart policies, innovative practices, and inclusive strategies. Only through coordinated action can we build healthcare systems that are environmentally responsible, resilient, inclusive, and capable of securing a healthier, fairer, and more sustainable future for all.