CLIMATE CHANGE & HEALTH

Role of Health Sector

NHC 2019

Climate Change and Health

A White Paper based on National Health Conclave 2019

ASSOCIATION OF HEALTHCARE PROVIDERS INDIA

CENTRE FOR ENVIRONMENTAL HEALTH

PUBLIC HEALTH FOUNDATION OF INDIA

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KNOWLEDGE TO ACTION phfi PUBLIC HEALTH FOUNDATION OF INDIA

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ACKNOWLEDGEMENT

This White Paper and report culminated from the proceedings of the 'National Health Conclave 2019: Climate Change and Health – Role of the Health Sector', held on 23rd of March, 2019 at Manekshaw Centre, New Delhi. Dedicated to the health impacts of climate change in India and appropriate risk mitigation and adaptation strategies, with specific focus on the health sector, the one-day conclave was organised in collaboration with the Association of Healthcare Providers India (AHPI) and CEH, a Centre of Excellence within PHFI.

This report was developed by the Centre for Environmental Health under the supervision of Dr. Poornima Prabhakaran, Additional Professor & Deputy Director, Centre for Environmental Health (CEH), Public Health Foundation of India (PHFI) and Dr. Alexander Thomas, President and Dr. V.C. Shanmuganandan, Advisor, Association of Healthcare Providers India (AHPI).

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We are grateful for the valuable insights from external reviewers including Mr. Josh Karliner (International Director of Program and Strategy-Health Care Without Harm) and Dr. Aakash Shrivastava (Joint Director and Head, Centre for Environmental & Occupational Health, Climate Change & Health, National Centre for Disease Control, Ministry of Health & Family Welfare, Government of India), which were instrumental in shaping the discussions presented in this report. Guidance and support from Prof. K.Srinath Reddy (President, PHFI) and Prof. D. Prabhakaran (Vice-President, Research and Policy, PHFI) was pivotal throughout the report-writing process. We gratefully acknowledge the World Bank report produced in collaboration with Health Care Without Harm that served as a valuable resource for guiding principles and recommendations contextualised for India in this White Paper.

We are deeply indebted to all the external evaluators including Dr. G L Sivakumar Babu, Centre for Continuing Education (CCE), Indian Institute of Science (IISc); Dr. Girdhar Gyani, AHPI; Mr. Ricky Kej, UN Ambassador and Environmentalist; Prof. Srikanth, National Institute of Advanced Studies; Prof Satheesh, IISc; Lt Gen RS Grewal, Directorate General Armed Force Medical Services; Dr. H S Chhabra, Association of National Board Accredited Institutions (ANBAI); Dr. Paramesh – IISc; Dr. Prashant Mathur – National Centre for Disease Informatics and Research; Ms. Suruchi Bhadwal - Earth Science and Climate Change Division, The Energy and Resources Institute; Dr. Nihal Thomas – Christian Medical College Vellore (CMC Vellore); Dr. D J Christopher – CMC Vellore, Ms. Divya Alexander, Independent Consultant; for their valuable comments on the draft.

A special note of thanks to Ms. Surabhi Dogra, Manager, Communications at CEH, PHFI for the final editing and cover designs for the White Paper. Last, but not the least, we appreciate all the administrative support from the secretariats at CEH, PHFI and AHPI throughout the process of drafting and publication of this White Paper.

ABOUT US

THE PUBLIC HEALTH FOUNDATION OF INDIA (PHFI)

The Public Health Foundation of India (PHFI) is a public private initiative that has collaboratively evolved through consultations with multiple constituencies including Indian and international academia, state and central governments, multi & bi-lateral agencies and civil society groups. Launched in 2006 by Prime Minister Manmohan Singh, PHFI is a response to redress the limited institutional capacity in India for strengthening training, research and policy development in the area of Public Health. PHFI recognizes the fact that meeting the shortfall of health professionals is imperative to a sustained and holistic response to public health concerns in the country, which in turn requires health care to be addressed not only from the scientific perspective of what works, but also from the social perspective of who needs it the most.

Website: https://phfi.org/

CENTRE FOR ENVIRONMENTAL HEALTH (CEH)

The Centre for Environmental Health was launched in May 2016 as a joint initiative of the Public Health Foundation of India and the Tata Institute of Social Sciences. The aim of the Centre is to build capacity in India in environmental health research and training, and to provide evidence-informed policy guidance based on research in several thematic areas including air pollution; water; sanitation and hygiene; chemical exposures; climate change, and other environmental issues of concern.

Website: https://www.ceh.org.in/

ASSOCIATION OF HEALTHCARE PROVIDERS- INDIA

(AHPI) Association of Healthcare Providers (India) represents the vast majority of healthcare providers in India. It was registered under Society Registration ACT- 1860 as "not for profit" organization in December 2012. It educates its members and at the same time, advocates with the government, regulatory bodies and other stake holders on issues, which have a bearing on enabling its member organizations in delivering Universal Health Coverage to the community at large. This includes national policy on health, regulations, taxation, tariffs, costing, reimbursement etc. AHPI has been working on building capacity in Indian health systems with focus on patient safety and affordability of healthcare services. Capacity building activities are provided through, AHPI Institute of Healthcare Quality which supports members through innovative and value added education & training programs on quality, patient safety, risk assessment & management, patient centric management, improving operational/ financial efficiency etc. AHPI believes that Safe & Affordable 'Health for All' is possible only through collaborative efforts between Government and private providers including Hospitals, Pharmaceuticals, IT and Medical Equipment companies. AHPI accordingly has organization structure in place to deal with multidisciplinary and complex issues related to delivery of universal health coverage in the country. AHPI is governed through an apex level Executive Committee, which is supported by similar committees at various state chapters. Presently there are 14-regional chapters, covering entire country. AHPI has enrolled about 3000-members with 100+ bed strength. In addition, we have about 7000-members with below 100-bed capacity on role of our regional chapters. AHPI has played key role in some of the major healthcare initiatives in the country. It interacts with government and NITI AYOG on matters related to medical education reforms through MCI/NMC, NBE and CPS. AHPI has been constantly working with government on restructuring of CGHS and more recently the Ayushman Bharat scheme. AHPI was first to raise issue related to electricity tariff and successfully got this lowered in state of Karnataka. AHPI played pivotal role in setting up of India's first THINK TANK in health at the National Law School of India University. In academics, AHPI has contributed through number of publications and papers. It has developed standards on patient safety, green & clean hospitals, ICUs, patient friendly hospitals etc. It has contributed through publication of two books on 'Healthcare Quality & Patient Safety' and 'Healthcare Communication', which are used as reference material for PG courses in NBE. All in all, AHPI is working as umbrella organization in supporting entire family of healthcare providers with motto: 'Educating & Advocating for Well Being of Common Man'.

Website: http://ahpi.in/

CLIMATE CHANGE AND HEALTH – ROLE OF HEALTH SECTOR

Executive Summary with Recommendations

Climate change is one of the greatest existential threats of this century. It will result in an increase in the incidence of illnesses due to vector and water-borne infections such as malaria, dengue, filarial and Japanese encephalitis, injuries and diseases due to extreme weather events, malnutrition, social & mental health stress. This warrants an increased role of the health sector in protecting public health through climate preparedness, resilience, adaptation and mitigation in the years to come.

India which is ranked as the 14th most vulnerable country to climate change is facing the threat of endangering the public health gains of previous decades. Overall, Climate Change could cost India 2.8% of GDP and depress living Standard of nearly half its population by 2050. The Indian Healthcare sector must recognise its own contribution to climate change and adopt appropriate measures. The Bureau of Energy Efficiency (BEE), India, has estimated the energy needs of government hospitals in the urban and rural areas as per consumption which is 750-1500 kWh and 150-300 kWh per bed per year respectively. In comparison, the private hospitals consumed 1000-2000 kWh per bed every year [23]. Converting this to a GHG emission equivalent, on an average, hospitals generate 1.3 to 2.7 MtCO2e per bed per year (as per USEPA GHG emission calculator). This is equivalent to one hospital-bed generating GHG emission equivalent to consuming 132 to 264 gallons of diesel per year [24]. Other sources of health sector GHG emissions include transport, building and infrastructural design, supply chain for the manufacture and procurement of all healthcare supplies, solid waste management, energy and water requirements etc. Also, Air pollution reduction through climate change mitigation (limiting global mean temperature increase to 2°C or less) is reported to reduce premature deaths in Asia by 0.79 million and India could be the biggest beneficiary with a net potential benefit of 1.4 trillion USD [16].

This White paper summarises the available evidence on these inter linkages between climate change, air pollution and its associated Health impacts and the critical role played by the health sector as a contributor as well as a first responder to climate change. As part of the NHC 2019 organised by the PHFI & the AHPI, experts from academia, healthcare providers, research groups, policy makers and civil society deliberated on climate concerns and its impact on human health and the Nation's economy. The recommendations are to ensure that the health care sector moves towards being climate smart & resilient in their operations leading to reduced GHG emissions and a concomitant reduction in health sector carbon foot print along with being in a state of preparedness to combat eventualities. The health sector including health professionals and hospitals play a crucial role in raising awareness among communities about climate change and its effect on health. After all, it is the responsibility of every individual in arresting this ominous trend to safeguard life on this planet.

Based on the interactive discussions among various stakeholder and experts during the National Health Conclave 2019, a list of recommendations has been formulated as detailed below;

1. Establishment of a dedicated tool – ***center for environmental health metrics*** – that will aid in collection of data from health systems for carbon foot-printing assessments, with parallel quality checks that can then be channelized for policy development and educational purposes.
2. Establishing a ***centralized repository*** to consolidate existing research in climate and health. In addition, a platform could be set-up where existing information systems on environment and health could be handled together to understand the impacts of one on another, and to ensure continuous monitoring of the situation.

3. Emphasis on ***requisite changes in the medical curriculum*** to bring in the missing component of environmental health discipline and associated health impacts through appropriate dialogue with the Medical Council of India. Building capacity for climate-resilience in the health system should be a substantial component of capacity building of all cadres of health care professionals.
4. Establish a ***network of networks of healthcare fraternity*** in India through all allied institutions and associations of healthcare professionals, including medical, nursing and pharmacy, colleges, accreditation bodies and health insurance companies to coalesce the health sector voice for influencing policy-making for climate-smart operations.
5. Establish ***validated procurement criteria that incorporate the principles of sustainability*** for all goods and services in the healthcare delivery sector, across the life cycle from manufacture, supply, use and disposal.
6. ***Assessment of cost-benefit of adoption of sustainable practices*** through commissioning of life-cycle costing analysis of sustainable products with appropriate incentivizing mechanisms to promote climate-friendly practices.
7. ***Promoting climate-smart health infrastructure*** at the planning stage of hospitals while providing strategies for retro-fitting existing operations through cost-effective options for mitigation.
8. Facilitating ***enhanced dialogue and effective communication between health and climate communities*** through the provision of appropriate platforms
9. Establish ***suitable channels of communication with media*** to promote effective communication of health impacts and discourage the spread of fake news.
10. ***Capacity building across all cadres of health care delivery*** from administration, healthcare services, management, operations, allied services including laboratories and waste management to promote awareness of climate-smart and climate friendly practices.
11. ***Development and adoption of mandated "Hospital Climate Action Plans"*** for all levels of health care that promote climate-preparedness, climate resilient and climate-smart operations.
12. Development of ***user-friendly action plans and road-maps for all stake-holders in healthcare delivery*** for effective adoption of climate-friendly practices
13. Implement government policies through institutions such as medical colleges, quality council (NABH) and insurance companies i.e. including the entire healthcare fraternity spanning across hierarchy to ensure that ***climate smart health care standards*** are adopted across the country.
14. Affordable healthcare incorporating climate friendly measures at the planning stage of hospitals should be promoted. This could be achieved through ***sustainable procurement*** practices through government regulations as well as providing incentives.

1. Introduction

Climate change is one of the greatest existential threats of this century. Changes in climate variables like temperature, precipitation and wind patterns are adversely affecting the basic elements that influence human health including air, water, food and shelter. Consequently, increases in illnesses due to heat stress, vector and water-borne infections, injuries and diseases due to extreme weather events, and malnutrition are becoming more frequent. The growing threats of climate change necessitate an increasing role of the health sector in protecting public health through climate preparedness, resilience, adaptation and mitigation in the coming years.

The primary objective of this white paper is to summarize the evidence available on interlinkages between climate change, air pollution and the associated health impacts. The document also examines the critical role played by the health sector as a contributor as well as a first responder to climate change. The potential mitigation and adaptation strategies applicable to Indian health sector are also discussed with implementable actions and policy focus in mind.

Along with a structured review of national and international literature on all related topics, the other primary source of information for this document is the input from the expert consultation conducted as part of the National Health Conclave 2019 organised by the Public Health Foundation of India (PHFI) and the Association of Healthcare Providers India (AHPI). Experts from academia, healthcare providers, research groups, policy makers and civil society convened and deliberated on climate concerns and its impacts on human health and economy. All assembled stakeholders agreed to the development of an agenda and roadmap for action across the health sector for adopting climate-friendly practices even whilst promoting advocacy and accountability from all key actors across government, industry, health care sector and civil society. This White Paper is a composite compilation of all the deliberations and strategies discussed and will serve as a Strategy Document for Action.

2. Climate Change in India

2.1. Impacts on Health and Economy

India, ranked as the 14th most vulnerable country to climate change, is facing threats of endangering its public health gains of previous decades [1]. With temperature extremes becoming more frequent and intense due to climate change, the related mortality and morbidity from heat and cold extremes is expected to rise along with an increase in cardiovascular illnesses [2]. India experienced 40 million additional heatwave exposure events in 2016 as compared to 2012. Moreover, the average duration of a heatwave in India has increased almost 150%, from 2 days in 2012 to nearly 5 days in 2016 [3]. Changes in temperature, precipitation and humidity affect vector habitats, lifecycles and transmission windows resulting in changing epidemiology of vector-borne diseases such as malaria, dengue, filaria and, Japanese encephalitis across geographies [4]. The climate change induced desertification of land, increasing temperatures, threatened water availability due to shifting precipitation patterns, loss of glaciers and earlier seasonal snow melt, and intrusion of saltwater into coastal aquifers are also expected to endanger future food production and supply threatening the food and nutrition security [5, 6]. Severe droughts affecting agricultural productivity have been shown to be a major cause of farmer suicides in India [7].

Climate change is also characterised by weather related disasters such as extreme and unprecedented precipitation events such as floods that are predicted to increase the illnesses due to waterborne diseases,

damage to the public health infrastructure, increase in physical injuries, and social and mental health stress. The impacts on health will vary with the local environmental factors and with different population groups affected.

Climatic impacts can promote increased population movements, namely forcible displacement resulting in resettlement schemes, and migration as an adaptive response. Such climate related migration can result in adverse health outcomes, for the displaced as well as the host populations. Such migrations will increase the burden on the health services in the areas where the migrant populations arrive. Along with this, morbidity and mortality due to infectious diseases and the diseases related to crowding are expected to increase [8].

Climate change is also affecting the country's economy. Two-third of the Indian population depends directly on the climate sensitive sectors like agriculture, fisheries and forests for livelihood. Indeed, climate change and related health impacts have huge direct and indirect economic implications by affecting the workforces across agriculture, industry and service sectors. Rising temperatures negatively affect workers' output and make sustained work increasingly difficult. In recent years, this has caused a spike in labour hours lost, with biggest losses being experienced by the agricultural sector.

As per the Economic Survey of 2017-18, climate change could reduce overall annual incomes in agricultural sector by 15-18% on average in India. The decreased incomes in turn reduce the adaptive capacity of the individuals making them more vulnerable to climate change impacts [9]. Labour laws, unless revised to improve work environments, timings, etc., to suit changing climatic conditions can cause serious impacts on health and productivity of the workforce across agricultural, industry and service sectors.

Overall, climate change could cost India 2.8% of Gross Domestic Product (GDP), and depress living standards of nearly half of its population by 2050 as average annual temperatures are expected to rise by 1-2% over three decades [10]. As per a "social cost of carbon" study, each additional tonne of carbon dioxide (CO_2) emitted is costing India $86. [11].

2.2. Air Pollution and Climate Change

Air pollution, both indoor and outdoor is a topical issue considering the wide spectrum of health effects it can result in- cardiovascular diseases, respiratory diseases, hypertension, diabetes and obesity. The global burden of disease assessments estimated over a million global premature deaths attributed to outdoor air pollution identifying $PM_{2.5}$ and ozone (O_3) as major pollutants [12]. The problem of air pollution is more in Asian countries due to the rapid economic growth and fossil energy consumption which is also contributing to climate change. The recently launched National Clean Air Program (NCAP) aims at 20-30% reduction in deadly particle air pollution ($PM_{2.5}$ and PM_{10}) in at least 102 non-attainment cities in India by 2024 [13].

Air pollution and climate change are intricately linked with immense opportunities of co-benefits from strategies for prevention and mitigation of their shared sources. For instance, elevated temperature results in the increased use of air conditioners requiring more electricity that when produced with fossil fuel combustion contributes to greater local air pollution and emits more Green House Gases (GHGs) to the atmosphere [14]. Climate change can also have synergistic effect on regional air quality as it affects the factors that govern pollutant transport like changes in chemical reaction rates and boundary layer mixing. Carbon-dioxide (CO_2), one of the major drivers of climate change can slow down the dispersal of air pollutants and increase the frequency of stagnation episodes which results in the degradation of air quality [15] . It also enhances the production rate of pollutants such as O_3 and $PM_{2.5}$, especially in the urban areas.

The mitigation of climate change results in the improvement of air quality (e.g. reducing air pollutants such as $PM_{2.5}$) since air pollution and GHGs are often released from the same sources. The use of cleaner fuels and/or the deployment of renewable energy in the transportation and power sector can cut down the GHG emissions as

well as air pollutants. The national level initiatives such as improved biomass cook stove (e.g. National Biomass Cook Stove Initiative) and distribution of subsidized Liquefied Petroleum Gas (LPG) (Pratyaksh Hanstantrit Labh (PAHAL- DBTL, Direct Benefit Transfer of LPG) and Pradhan Mantri Ujjwala Yojana (PMUY)) also aim towards climate change mitigation through a reduction in emissions. A major reduction in air pollution is also expected through effective actions in the transport sector such as promoting electro-mobility and implementation of Bharat stage VI as per recent NCAP. The NCAP also indicated the need for interventions in power sector and industrial emissions which is expected to have significant climate change co-benefits.

Air pollution reduction through climate change mitigation (limiting global mean temperature increase to 2°C or less) is reported to reduce premature deaths in Asia by 0.79 million and India could be the biggest beneficiary with a net potential benefit of 1.4 trillion USD [16]. Awareness about the serious ill effects of air pollution is however low, even amongst physicians. There is therefore much scope for addressing this gap in awareness through enhanced training and awareness building of physicians, who can in turn become advocates of the issue and promote advocacy for policy changes.

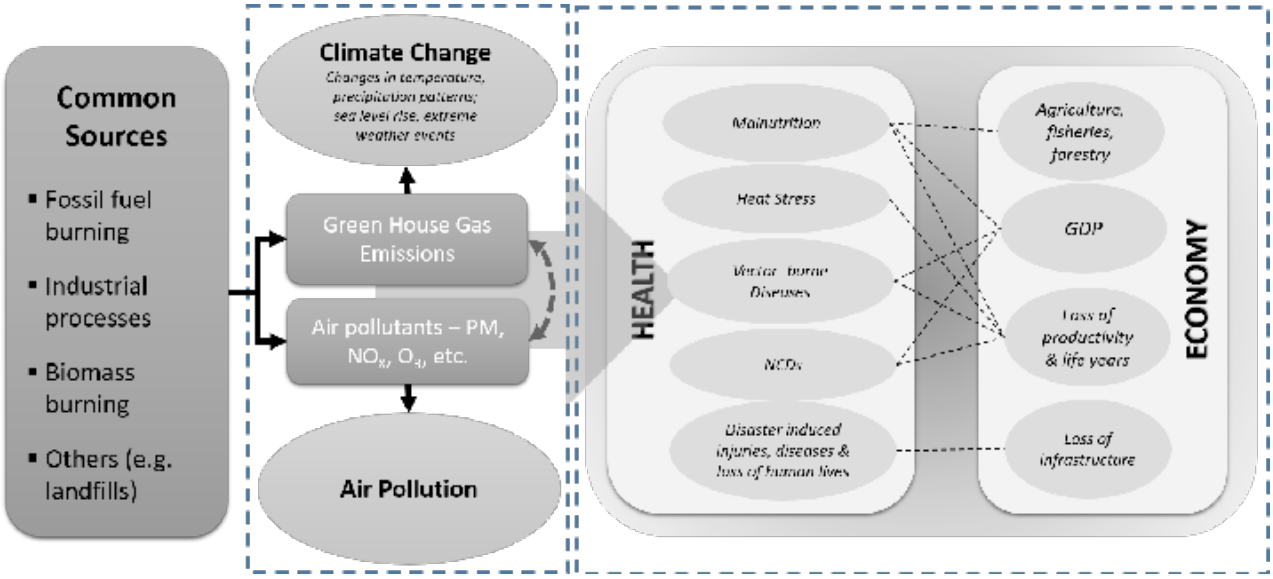

Figure 1: Climate Change and Air Pollution: Interlinkages

3. Role of the Health Sector in Climate Change

The health sector has a central role under changing climatic conditions to become climate-smart in their operations.

3.1. Green House Gas (GHG) Contributions

The health sector, paradoxically, contributes a significant amount of GHG emissions globally [17]. Energy and water use, transport, buildings, manufacture, supply and disposal of medical and pharmaceutical products, and waste (biomedical and solid waste) generation and disposal can all contribute to health sector emissions. Any efforts to address this will first require an appropriate assessment of the health sector's carbon footprint. However, this has been a challenge in developing countries as data is currently limited. Most often the figures for developing countries are derived from the GHG emissions of the developed nations [18]. Among developed

economies, the health and social care carbon footprint of England was 27.1 Mega tonnes (Mt) CO_2e representing about 6.3% of the nation's total carbon footprint [19]. In the US, the health sector contributed an estimated total of 546 million MtCO_2e of which 46% could be traceable to direct activities. The U.S. hospitals alone contributed to 39% of the total U.S. health sector GHG emissions of which 80% of total global warming potential was due to CO_2 emissions [20]. If we consider the U.S. healthcare sector as a country, its GHG emission would rank thirteenth in the world ahead of the U.K. [21, 18]. Similarly, Canada's health sector generated 33 million tonnes of GHG emissions and over 200,000 tonnes of other pollutants directly through the healthcare facilities and from other supply-chains resulting in an estimated 23,000 disability-adjusted life years (DALYs) lost annually [22]. Compared to North America and U.K., the healthcare services in the European region are responsible for 5-15% of the carbon emissions. In the absence of sufficient data, the GHG emissions from health sector in low- and middle-income countries (LMICs) can be extrapolated from the U.S. and European figures and is currently estimated to be between 3-5% of the country's total GHG contribution. Overall, there is a need to derive the accurate healthcare global contribution to climate change [18].

The Bureau of Energy Efficiency (BEE), India, has estimated the energy needs of government hospitals in the urban and rural areas as per consumption which is 750-1500 kWh and 150-300 kWh per bed per year respectively. In comparison, the private hospitals consumed 1000-2000 kWh per bed every year [23]. Converting this to a GHG emission equivalent, on an average, hospitals generate 1.3 to 2.7 MtCO2e per bed per year (as per USEPA GHG emission calculator). This is equivalent to one hospital-bed generating GHG emission equivalent to consuming 132 to 264 gallons of diesel per year [24].

Hospitals also produce municipal, hazardous, and bio-medical solid waste and electronic waste, all of which have ecological impacts through GHG emissions. On an average the quantum of waste generated in district hospitals in India is 1.5 to 2.2 kg per bed per day [25]. Most of this hospital-generated waste ends up in municipal landfills increasing the environmental burden [26]. The remaining waste generated from the hospitals, that gets incinerated, also contributes to the GHG emissions. Preventing food waste and finding ways to divert food waste from reaching landfill should also be focussed upon. Reducing the food waste by half could result in huge emission reduction [27]. Recent studies reveal that only one-third of the actual waste generated was treated while the rest gets disposed as municipal waste. In 2016, India produced 519.7 tonnes of bio-medical waste per day which is estimated to reach 775.5 tonnes per day by 2022 [25]. When compared to global estimates, the quantity of bio-medical waste generated in India is much lower. One of the reasons could be insufficiency of the data on quantification of biomedical waste generated. [28].

Water plays an important role in the daily functioning of a healthcare facility from its use in healthcare procedures to activities involving cleaning, heating, disposal etc., apart from also creating a soothing environment for patients and healthcare workers [29, 30]. An average Indian hospital consumes 450 litres of water per person per day [29]. The main source is often groundwater drawn through deep bore wells which is not only energy intensive [31], but also the water consumption pattern increases the water stress on already diminishing groundwater levels in India [32]. The availability of potable water is still unmet in many communities of LMICs including India [33]. Efficient water use and disposal in the health sector is therefore critical.

Other sources of health sector GHG emissions include transport, building and infrastructural design, and supply chain for the manufacture and procurement of all healthcare supplies. Procurement of all healthcare related goods comprising pharmaceuticals, medical devices and equipment, cleaning agents and housekeeping supplies, hospital clothing and linen should necessarily follow the principles of sustainable procurement through the entire lifecycle, from manufacturing, supply chains, use and disposal to ensure a move towards reducing the health sector's environmental footprint.

The unprecedented growth in the Indian healthcare sector should be strategically designed through climate-smart infrastructural planning and efficient resource management so as to curb future emissions from the health sector.

Key mitigation strategies applicable to health care sector (Climate Smart Healthcare, 2017)

Energy efficiency

Improve energy supply and distribution efficiency: This can be achieved by fuel switching, energy recovery options, using distributed energy generation (decentralized or on-site generation) and installation of combined heat and power system.

On-site renewable energy sources: Deployment of different forms of renewable energy for power generation can reduce GHG impacts. These may include installation of on-site solar photovoltaics, utilizing systems that utilize thermal energy, wind or any other form of renewable energy.

Reduced-energy devices: In order to achieve energy and operational savings healthcare sector may also adopt using non- electric medical devices, direct current devices and energy efficient appliances.

Passive cooling, heating and ventilation strategies: Such strategies include the use of natural ventilation, evaporative cooling, desiccant dehumidification and underground earth-pipe cooling systems for healthcare settings.

Facility for wastewater and solid waste management: Healthcare sector should keep working towards improving the on-site wastewater pre-treatment and sanitation systems that are prescribed as per the Indian policy guidelines. With respect to solid waste management, it is mandatory to segregate general municipal waste and bio-medical waste as per the regulations, however there is scope to improve the on ground implementation of these regulations.

Reduced GHG emissions from anaesthesia gas use and disposal: This can be achieved by recapturing and scavenging waste anaesthetic gas. Apart from cost savings and reduction in emissions, this measure can also reduce health risks for health workers and improve their productivity.

Reduced procurement carbon footprint: Procurement of pharmaceuticals, medical devices, business products, services, food and catering should be managed better, in order to reduce the energy footprint during production and transport. Healthcare sector should also come up with measures that aim to reduce the risks from the use of outdated/expired products. There should also be mechanisms to save resources on unused and wasted products making the overall healthcare more sustainable to consumption and production perspectives as well.

Telehealth/ Telemedicine: Health sector should explore alternatives for tele-monitoring at home via mobile phones. This would reduce the emissions from healthcare related travel.

Easy access to health facilities: Public transport connectivity should be mapped with the location of health facilities during the planning stages. To further promote the active use of public transport, healthcare employees should be incentivized for using the same. This can reduce risks of traffic related injury, hypertension, cardiac disease and diabetes for the healthcare workers.

Conserve and maintain water resources: Healthcare facilities should take measures to manage water leakages, install water efficient fixtures, install onsite water treatment systems, undertake water recycling, storage and harvesting methods, within the institute premises. These would better ensure water security, save water fees, reduce energy use for water extraction from surface/ aquifer sources and associated truck transit.

3.2. Climate Resilience

Health infrastructure in developing countries like India is already strained beyond capacity even to render basic health protection services. Often during climate change related disaster situations, the health care facilities, themselves get impacted. Hence resilience measures become imperative to be incorporated within healthcare sector to manage and respond to the additional demand for health services expected from the impacts of climate change. This will also help them to better cater to the increasing burden of diseases.

In order to build resilience towards extreme weather events associated with climate change, health care sector first needs to assess their climate risks, thresholds, vulnerabilities and infrastructural gaps. After these assessments healthcare sector should develop a plan to prepare themselves for climate associated disasters and adequately respond to the health impacts. Examples of health sector responses are available from Jammu &and Kashmir, Assam, Chennai and Surat, besides most recent incidences that took place in Kerala and Orissa [34, 35, 36, 37, 38].

Working in coordination with other agencies, such as the urban planners, can greatly catalyse health sector preparedness. Health community inputs to the New Urban Agenda could make urban planning more inclusive from human health perspectives. Partnership with meteorological department, especially for early warning systems for extreme events and for epidemic forecasting is a must [37]. Such partnerships will also help in generating data and evidence to convince decision makers and other stakeholders involved and would help in development of data driven evidence based policies. With respect to statistics, hospitals and public health researchers need to converge while dissolving their differences for further strengthening the evidences.

In addition, structural (building roofs, doors, windows etc.), non-structural (computers, diagnostic equipment) and functional components of health facilities need to be robust to withstand the unexpected extreme weather events and the facilities should have easy access even during disaster situations. Some of this could be achieved starting with simple changes, as demonstrated through the Ahmedabad Heat Action plan; where lower floor location of the maternity ward resulted in decreased neonatal morbidity [39] or installation of solar powered baby/infant radiant warmer in neonatal intensive care unit in a Tertiary Care Hospital in Delhi [40]. While new healthcare facilities can incorporate climate- friendly measures, existing facilities could consider retrofitting their establishments to become resource-efficient in energy and water use even as they adopt improvised waste management techniques.

Greening health care facilities could be another simple measure that offers additional health co-benefits to staff, patients and visitors during heat waves along with improving the air quality, or porous pavements that could help reduce the risk of facility flooding [41]. At the policy level, there is a need to ensure that the health effects of climate change are mainstreamed into various organisational structures and integrated with other sectors. With this issue in focus, the Health Ministry, Government of India is preparing a National Action Plan for Climate Change and Human Health (NAPCCHH) [42]. In order to build resilience, along with adaptation to climate change, efforts to reduce GHG emissions also need to be ensured.

Healthcare facilities are dependent on electricity and water supply to provide quality services to people which primarily accounts for the sector's GHG contribution. Considering the rapid growth of healthcare sector in India, its mobilization is necessary to reduce the growing contribution of healthcare related GHG emission. According to the Department of Industrial Policy and Promotion (DIPP), hospital and diagnostic centers attracted Foreign Direct Investment of worth US$ 6 billion between April 2000 to December 2018. Climate-smart practices can strengthen the health sector as well as communities by ensuring access to clean and independent energy, safe water, clean transport and clean waste disposal mechanisms [18]. Such practices can also promote the development and supply of sustainable products while preparing the health sector for future health-related climate hazards [18]. Indian healthcare sector already has some examples of best practices adopted by individual

healthcare organizations across the nation. These examples showcase the leadership from individual facilities on the aspects of waste management, adoption of solar energy applications, installation of on-site waste water recycling systems and green building design [43]. Using a common platform, these experiences should be shared widely across the Indian healthcare sector, to encourage and scale up the adoption of more of such practices among them. While doing so impact evaluation of such experiences should also be factored in.

There have been some early initiatives in India to establish standards for greening health facilities. The Standard for Green and Clean hospitals was established by the AHPI in 2014 and included the concepts of mitigation through resource efficiency and efficient waste management (GREEN) besides measures for infection control (CLEAN). The Indian Green Building Council (IGBC) subsequently provided the IGBC Green Healthcare Facilities Rating system in 2016 which covered additional features of site selection, building material, resources and innovative design. A more recent endeavour to evolve more comprehensive standards that cover all the above areas, in addition to procurement (including sustainable production and consumption), housekeeping and leadership has been completed by the Health and Environment Leadership Platform (HELP) under the Centre for Chronic Disease Control (CCDC) and PHFI. This will be evaluated as a complete accreditation standard for green healthcare facilities through various accreditation bodies including the National Accreditation Board for Hospitals and Healthcare Providers (NABH) and Quality Accreditation Institute (QAI). This will be further updated to include parameters for resilient healthcare and incorporated in all national guidelines for climate-smart and climate-resilient healthcare.

Globally, several coalitions have been formed that bring together medical fraternities, health professionals and organizations to promote leadership and advocacy in climate change impact on health. **Global and Green and Healthy Hospitals (GGHH)** is a network of over 1200 members from 60 countries representing over 36,000 hospitals and healthcare facilities focussing on promoting sustainable healthcare by reducing environmental footprint. Many of these members are participating in the health care climate challenge, making commitments to reduce their carbon footprint, build climate resilience and are engaging in leadership activities to address the health impacts of climate change. Some leading hospitals around the world—in developed and developing countries are also committing to implement 100% renewable electricity at their facilities. In India, **Health and Environment Leadership Platform (HELP)** which currently has over 7300 healthcare institutions and 27,000 physicians was established in 2017 to carry out activities aligned with the GGHH agenda in India. Such networks of hospitals (including government and private hospitals) could serve a crucial role in providing a platform to share best practices and showcase leadership with regards to adopting climate-smart strategies.

3.3. Creating community awareness as societal leaders

As trusted leaders in society, health sector professionals have the responsibility of sensitising the community and bringing about awareness regarding public response and responsibilities at times of calamities. Doctors are the first point of contact for the community at large during illness episodes but are increasingly lending their knowledge and communicative capabilities to advocate for environmental issues of concern. In a world where health-centric policies are increasingly relevant, the responsibility of clear and precise health messaging coming from healthcare professionals has added value. Recent examples of health sector voices joining the larger community in advocacy and mass sensitisation for environmental issues like air pollution and climate change will hopefully play a huge role in bringing about policy changes. This must be continued and amplified in the coming years through continued capacity-building of healthcare professionals as well.

4. Inter-Sectoral Approach – Role of Policymakers, Academics, Civil Society & Media

The Paris Climate Agreement signed at COP21 emphasized on taking action to address climate change while respecting, promoting and considering the obligations on the 'right to health'. Since challenges of climate change are multi-sectoral, the approaches for mitigation also must come from actions and policy measures taken by different sectors [44]. Thus, most countries are adopting measures as a cross-government priority requiring the health sector to work in a coordinated manner with other actors under a single climate change strategy [45].

The UN's 2030 Agenda for Sustainable Development Goals (SDGs) provides the basis for the health community to work together within the formal health sector as well as in partnership with others. Most of the SDGs are interlinked in a way that achievement of one affects the others and vice-a-versa. While the SDG 3 on 'Good Health and Well-being' has the central focus on health, achievement of the same depends on progress of all factors that relate to key environmental and social determinants of health (SDG 1-6, 7, 11-13). Above all, however, progress on all of the above aspects of sustainable development will be undermined if the world is not successful in achieving SDG 13 i.e. 'Climate Action'.

To curtail the sources and causative factors responsible for climate change, and to prevent further negative effects, concerted and co-ordinated actions are required by stakeholders across all sectors. Health, a key sector, in the frontline facing the burden of battle against morbidities due to climate change, could provide exemplified leadership by reducing its footprint, creating awareness and adapting climate-smart strategies.

4.1. Perspectives for Policymakers

The LMICs hold a key to global leadership on developing sustainable, climate resilient health systems as these nations invest more into their healthcare in the coming years [46] According to the Global Report of New Perspective on Global Health Spending for Universal Health Coverage for 2017, health expenditures on an average account for 7% of GDP in middle and low-income countries. In India, the GDP allocation for health continues to be under 2% in India while the National Health Programme (NHP) prescribes increasing health spending to more than 8 per cent of the States' Budget by the year 2020. In turn, the policymakers and healthcare providers play a key role in allocation of resources and priorities for developing a sustainable healthcare system in LMCIs including India (Fig 2). There are numerous examples within the health sector, nationally and internationally, of delivering efficient healthcare and improving health outcomes while reducing carbon footprint. An inter sectoral approach needs to be initiated by policymakers to encourage relevant ministries to develop a carbon baseline for their respective sector. Identifying carbon reduction targets and setting immediate and long-term goals on the emissions should be a priority.

Globally, the positive impacts of renewable energy on public healthcare centres, as observed in pilot projects are promising [47, 48]. However, evidences from renewable energy interventions should also be authenticated by conducting impact evaluations both in terms of energy access as well as health outcomes. The results of such exercises should be disseminated extensively to stakeholders. Implementation of decentralized, renewable energy sources can have co-benefits in reducing air pollution from diesel generators that are currently being used in community centers and PHCs. Further demonstration projects must be commissioned and funded so that the learnings can then be incorporated in the current efforts to develop National and State Climate Action Plans, with specific focus on a roadmap for the health sector. The low-carbon healthcare system can also help build climate resilient, low-cost, sustainable facilities in areas prone to be impacted readily by climate change and natural disasters [49].

Figure 2: Building blocks of health systems (Source– WHO, 2015)

4.2. Role of Academia & Civil Society

Although there are data available nationally and internationally on several aspects of climate change, the focus on health and health system is still lacking.

One of the challenges is unavailability and accessibility of regularly updated database with health information. Moreover, interdisciplinary research involving air pollution, climate change, social and public health professionals is required to generate evidence for effective policy making. Some of the private hospitals/hospital-chains and a few states in India collect and maintain digitized health information systems from hospital registration to clinical data. This form of Electronic Health Record (EHR) system needs to be centralized. The existing EHR data is rarely shared either with other hospitals or with policymakers. There is very little information available on how climate change events are already impacting us, and a need for such a system is an immediate requirement. Additionally, information on clinical data related to climatic events and even air pollution by private clinics and hospitals is sparse; thus a data system to help policymakers and academicians, needs to be brought in place. The National Health Policy released in 2017 has a component on health management information. This includes developing electronic databases and registries by 2025. As the nation is moving toward digitalization to empower and strengthen the economy, the digitalization of health records could also help in strengthening the understanding we have on climate change and health [30, 33].

The research in climate change and health needs to not only focus on understanding the linkages between the various factors at play but also on finding the solutions particularly from policy output perspectives. In addition, research aimed at measuring the impacts of various interventions being taken, should also be encouraged to facilitate filling up the gap between science and policy.

On the other hand, development institutions can engage on climate change and health policy at the national level. Focused inclusion of climate perspectives in health dialogue between development sector and government counterparts is needed. Participation of all stakeholders including those working in the health sector in climate policies should be encouraged [18].

4.3. Media as a Stakeholder

Media has a critical role in bringing climate and health issues into mainstream discussions. For this, they require climate and health data to be simplified for effective communication to general masses. Along with this, capacity building of journalists and reporters working in climate and health sectors is also required. Common platforms for interaction of media and climate and health communities should be established. Most of the information on climate and related health impacts is communicated through national media, while there is a need to strengthen and encourage participation from regional as well as local vernacular media. This will also help promote awareness building amongst all sections of society besides encouraging appropriate allocation of resources, where most required, for adaptation and mitigation.

5. Recommendations

Climate-smart solutions are the way forward to tackle climate change. Climate-smart strategies have already been initiated in agriculture and food systems. Low-carbon, resilient, climate-smart adaptive programs and policies need to be embraced for the health sector as well. Health sector is amongst the "first responders" and continues to cater to societies during natural and man-made disasters. A resilient health system therefore entails preparedness both with infrastructural changes and manpower deployment. Since energy, water use and waste disposal are three important factors driving and impacting development of climate-smart health systems, the health sector needs to address these domains in order to adapt to climate change and to mitigate its impact. Moreover, health sector leadership is also crucial in spreading awareness on health impacts of climate change. In addition to focussing on healthcare sector from climate change mitigation perspectives, all the health related policies and programmes should integrate the current and future climate risks as well.

> "Climate mitigation, adaptation, and low-carbon and resilient health development strategies reduce emissions, build healthcare climate resilience, and yield significant health and economic co-benefits"
>
> *– World Bank's Climate Smart Healthcare Report of 2017*

Based on the interactive discussions among various stakeholder and experts during the National Health Conclave 2019, a list of recommendations has been formulated as detailed below;

1. Establishment of a dedicated tool – ***center for environmental health metrics*** – that will aid in collection of data from health systems for carbon foot-printing assessments, with parallel quality checks that can then be channelized for policy development and educational purposes.
2. Establishing a ***centralized repository*** to consolidate existing research in climate and health. In addition, a platform could be set-up where existing information systems on environment and health could be handled together to understand the impacts of one on another, and to ensure continuous monitoring of the situation.
3. Emphasis on ***requisite changes in the medical curriculum*** to bring in the missing component of environmental health discipline and associated health impacts through appropriate dialogue with the Medical Council of India. Building capacity for climate-resilience in the health system should be a substantial component of capacity building of all cadres of health care professionals.

4. Establish a network of ***networks of healthcare fraternity*** in India through all allied institutions and associations of healthcare professionals, including medical, nursing and pharmacy, colleges, accreditation bodies and health insurance companies to coalesce the health sector voice for influencing policy-making for climate-smart operations.
5. Establish ***validated procurement criteria that incorporate the principles of sustainability*** for all goods and services in the healthcare delivery sector, across the life cycle from manufacture, supply, use and disposal.
6. ***Assessment of cost-benefit of adoption of sustainable practices*** through commissioning of life-cycle costing analysis of sustainable products with appropriate incentivizing mechanisms to promote climate-friendly practices.
7. ***Promoting climate-smart and health infrastructure*** at the planning stage of hospitals while providing strategies for retro-fitting existing operations through cost-effective options for mitigation.
8. Facilitating ***enhanced dialogue and effective communication between health and climate communities*** through the provision of appropriate platforms
9. Establish ***suitable channels of communication with media*** to promote effective communication of health impacts and discourage the spread of fake news.
10. ***Capacity building across all cadres of health care delivery*** from administration, healthcare services, management, operations, allied services including laboratories and waste management to promote awareness of climate—smart and climate friendly practices.
11. ***Development and adoption of mandated "Hospital Climate Action Plans"*** for all levels of health care that promote climate-preparedness, climate resilient and climate-smart operations.
12. Development of ***user-friendly action plans and road-maps for all stake-holders in healthcare delivery*** for effective adoption of climate-friendly practices
13. Implement government policies through institutions such as medical colleges, quality council (NABH) and insurance companies i.e. including the entire healthcare fraternity spanning across hierarchy to ensure that ***climate smart health care standards*** are adopted across the country.
14. Affordable healthcare incorporating climate friendly measures at the planning stage of hospitals should be promoted. This could be achieved through ***sustainable procurement*** practices through government regulations as well as providing incentives.

ACTION POINTS

Building Climate Resilience

Figure 3: Building climate resilience in healthcare

REFERENCES

[1] D. Eckstein, M.-L. Hutfils and M. Winges, *Global Climate Risk Index 2019 - Who Suffers Most From Extreme Weather Events? Weather-related Loss Events in 2017 and 1998 to 2017*, Germanwatch e.V., 2018.

[2] S. H. Fu, A. Gasparrini, P. S. Rodriguez and P. Jha, "Mortality attributable to hot and cold ambient temperatures in India: a nationally representative case-crossover study," *PLoS medicine*, vol. 15, no. 7, p. e1002619, 2018.

[3] N. Watts, M. Amann, S. Ayeb-Karlsson, K. Belesova, T. Bouley, M. Boykoff, P. Byass, W. Cai, D. Campbell-Lendrum and J. Chambers, "The Lancet Countdown on health and climate change: from 25 years of inaction to a global transformation for public health," *The Lancet*, vol. 391, no. 10120, pp. 581-630, 2018.

[4] R. C. Dhiman, S. Pahwa, G. P. S. Dhillon and A. P. Dash, "Climate change and threat of vector-borne diseases in India: are we prepared?," *Parasitology research*, vol. 106, no. 4, pp. 763-773, 2010.

[5] M. R. Smith and S. S. Myers, "Impact of anthropogenic CO2 emissions on global human nutrition," *Nature Climate Change*, vol. 8, no. 9, p. 834, 2018.

[6] S. S. Myers, M. R. Smith, S. Guth, C. D. Golden, B. Vaitla, N. D. Mueller, A. D. Dangour and P. Huybers, "Climate change and global food systems: potential impacts on food security and undernutrition," *Annual review of public health*, vol. 38, pp. 259-277, 2017.

[7] T. A. Carleton, "Crop-damaging temperatures increase suicide rates in India," *Proceedings of the National Academy of Sciences*, vol. 114, no. 33, pp. 8746-8751, 15 8 2017.

[8] C. McMichael, J. Barnett and A. J. McMichael, "An ill wind? Climate change, migration, and health," *Environmental health perspectives*, vol. 120, no. 5, pp. 646-654, 2012.

[9] Ministry of Finance, "Economic Survey 2017-18 (Volme I)," Government of India, New Delhi, 2018.

[10] M. Mani, S. Bandyopadhyay, S. Chonabayashi, A. Markandya and T. Mosier, South Asia's Hotspots: The Impact of Temperature and Precipitation Changes on Living Standards, The World Bank, 2018.

[11] K. Ricke, L. Drouet, K. Caldeira and M. Tavoni, "Country-level social cost of carbon," *Nature Climate Change*, vol. 8, no. 10, p. 895, 2018.

[12] P. J. Landrigan, R. Fuller, N. J. R. Acosta, O. Adeyi, R. Arnold, A. B. Baldé, R. Bertollini, S. Bose-O'Reilly, J. I. Boufford and P. N. Breysse, "The Lancet Commission on pollution and health," *The Lancet*, vol. 391, no. 10119, pp. 462-512, 2018.

[13] MoEFCC, "NCAP National Clean Air Program," 2019.

[14] Grimmond, "Urbanization and global environmental change: Local effects of urban warming.," *Geographical Journal*, pp. 173(1), 83–88, 2007.

[15] M. Jacobson, "Enhancement of Local Air Pollution by Urban CO2 Domes," *Environ. Sci. Technol*, pp. 44, 2497–2502, 2010.

[16] Y. Xie, H. Dai, X. Xu, S. Fujimori, T. Hasegawa, K. Yi, T. Masui and G. Kurata, "Co-benefits of climate mitigation on air quality and human health in Asian countries," *Environment international*, vol. 119, pp. 309-318, 2018.

[17] WHO, *Health, environment and sustainable development - Climate impacts*, 2019.

[18] B. Timothy , S. Roschnik and J. Karliner, "Climate-Smart Healthcare: Low-Carbon and Resilience Strategies for the Health Sector," World Bank Group, Washington DC, 2017.

[19] Sustainable Development Unit, "Reducing the use of natural resources in health and social care," Cambridge, 2018.

[20] J. W. Chung and D. O. Meltzer, "Estimate of the carbon footprint of the US health care sector," *Jama, vol.* 302, no. 18, pp. 1970-1972, 2009.

[21] M. J. Eckelman and J. Sherman, "Environmental impacts of the US health care system and effects on public health," PloS one, vol. 11, no. 6, p. e0157014, 2016.

[22] M. J. Eckelman, J. D. Sherman and A. J. MacNeill, "Life cycle environmental emissions and health damages from the Canadian healthcare system: An economic-environmental-epidemiological analysis," *PLOS Medicine*, vol. 15, no. 7, p. e1002623, 31 7 2018.

[23] R. Kappor and S. Kumar, "Energy Efficiency in Hospitals - Best Practice Guide," 2009.

[24] US EPA, "Greenhouse Gas Equivalencies Calculator," 2018. [Online]. Available: https://www.epa.gov/energy/greenhouse-gas-equivalencies-calculator.

[25] ASSOCHAM, "Unearthing the Growth Curve and Necessities of Bio-Medical Waste Management in India," in *Conference on Bio-Medical Waste Management: Issues, Challenges, Awareness and Opportunities*, New Delhi, 2018.

[26] S. Narain and S. S. Sambyal, Not in My Backyard: Solid Waste Management in Indian Cities, Centre for Science and Environment, 2016.

[27] M. Heller, "Waste Not, Want Not: Reducing Food Loss and Waste in North America through Life Cycle-Based Approaches," United Nations Environment Programme, Washington DC, 2019.

[28] A. Cebe, S. Dursun and H. Mankolli, "Hospital Solid Wastes and Its Effect on Environment," *Journal of International Environmental Application & Science*, vol. 8, no. 5, pp. 733-737, 2013.

[29] Centers for Disease Control & Prevention, "Medical Water | Other Uses of Water | Healthy Water | CDC," 2016. [Online]. Available: https://www.cdc.gov/healthywater/other/medical/index.html.

[30] B. Dziegielewski, J. C. Kiefer, E. M. Opitz, G. A. Porter, G. L. Lantz, W. B. DeOreo, P. W. Mayer and J. O. Nelson, "Commercial and Institutional End Uses of Water," AWWA Research Foundation and the American Water Works Association, Denver, USA, 2000.

[31] S. Collett, I. Samarin, R. Bhalchandra, J. R. Soundaranayagam, S. Garai, M. Chandy and S. Bhattacharya, "Water usage in a multi-speciality hospital and its effective management," *Journal of The Academy of Clinical Microbiologists*, vol. 18, no. 2, p. 135, 2016.

[32] S. N. Bhanja, A. Mukherjee, M. Rodell, Y. Wada, S. Chattopadhyay, I. Velicogna, K. Pangaluru and J. S. Famiglietti, "Groundwater rejuvenation in parts of India influenced by water-policy change implementation," Scientific reports, vol. 7, no. 1, p. 7453, 2017.

[33] S. Mehtar and G. Bearman, "Hospital Water," in *GUIDE TO INFECTION CONTROL IN THE HOSPITAL*, International Society for Infectous Diseases, 2018.

[34] S. Yadavar, "What Surat can teach other cities about public health | Business Standard News," 2017. [Online]. Available: https://www.business-standard.com/article/economy-policy/what-surat-can-teach-other-cities-about-public-health-117121600927_1.html.

[35] D. C. Sharma, "Flood waters cripple health facilities in Kashmir," *The Lancet*, vol. 384, no. 9950, p. 1251, 2014.

[36] J. Jesurun, "Incorporating disaster response-measures and climate change mitigation strategies in healthcare - Case of Kerala floods," in *National Health Conclave 2019*, Delhi, 2019.

[37] M. E. Keim, "Building Human Resilience: The Role of Public Health Preparedness and Response As an Adaptation to Climate Change," *American Journal of Preventive Medicine*, vol. 35, no. 5, pp. 508-516, 2008.

[38] V. Sambath, "Building Climate Resilient Health Systems - Assessment of Response of Health System to Kerala Floods of August 2018," Healthy Energy Initiative, Chennai, 2019.

[39] K. Kakkad, M. L. Barzaga, S. Wallenstein, G. S. Azhar and P. E. Sheffield, "Neonates in Ahmedabad, India, during the 2010 Heat Wave: A Climate Change Adaptation Study," *Journal of Environmental and Public Health*, vol. 2014, p. 8, 2014.

[40] V. Thavaraj, S. Ramji, O. Sastry and N. Sharma, "Solar powered baby/infant radiant warmer installed in neonatal intensive care unit in a Tertiary Care Hospital," *Journal of Clinical Neonatology*, vol. 6, no. 1, p. 15, 2017.

[41] J. Paterson, P. Berry, K. Ebi and L. Varangu, "Health Care Facilities Resilient to Climate Change Impacts," *International Journal of Environmental Research and Public Health*, vol. 11, no. 12, pp. 13097-13116, 2014.

[42] Ministry of Health & Family Welfare, "Draft - NATIONAL ACTION PLAN FOR CLIMATE CHANGE & HUMAN HEALTH (NAPCCHH)," New Delhi, 2016.

[43] Centre for Environmental Health, "H.E.L.P. Case Studies," 2019. [Online]. Available: https://www.ceh.org.in/resources/case-studies/.

[44] WHO, "COP24 Special Report: Health and Climate Change," World Health Organization, Geneva, 2018.

[45] WHO, "Strengthening health resilience to climate change," in *Conference on Health and Climate, Technical Briefing for the World Health Organization*, 2015.

[46] S. Mounier-Jack, S. Mayhew and N. Mays, "Integrated care: learning between high-income, and low- and middle-income country health systems," *Health Policy Plan*, vol. 32, no. iv, pp. 6-12, 2017.

[47] H. H. Dholakia, "Solar powered healthcare in developing countries," *Nature Energy*, vol. 3, no. 9, p. 705, 2018.

[48] A. Ramji, S. Patnaik, S. Mani and H. Dholakia, "Powering primary healthcare through solar in India: lessons from Chhattisgarh," *CEEW Report, 2017*.

[49] S. Hales, S. Kovats, S. Lloyd and D. Campbell-Lendrum, Quantitative risk assessment of the effects of climate change on selected causes of death, 2030s and 2050s, Geneva: World Health Organization, 2014.

GLOSSARY

[1] Adaptation

The process of adjustment to actual or expected climate and its effects. In human systems, adaptation seeks to moderate harm or exploit beneficial opportunities. In natural systems, human intervention may facilitate adjustment to expected climate change and its effects.

[2] Adaptation Capacity

The ability of systems, institutions, humans, and other organisms to adjust to potential damage, to take advantage of opportunities, or to respond to consequences.

[3] Air pollution

The contamination of air by a range of substances, at levels that pose a health risk. The key air pollutants include Particulate matter (PM), ozone (O_3), carbon monoxide (CO), sulfur dioxide (SO_2) and nitrogen oxides (NOX).

[4] Climate Change

Climate change refers to a change in the state of the climate that can be identified (e.g., by using statistical tests) by changes in the mean and/or the variability of its properties, and that persists for an extended period, typically decades or longer. Climate change may be due to natural internal processes or external forcings such as modulations of the solar cycles, volcanic eruptions and persistent anthropogenic changes in the composition of the atmosphere or in land use.

[5] Climate Resilience

The ability of a social or ecological system to absorb disturbances while retaining the same basic structure and ways of functioning, the capacity of self-organization, and the capacity to adapt to stress and change

[6] Climate Smart Healthcare

Climate-smart healthcare is an approach that helps to guide actions needed to transform and reorient healthcare systems to effectively aligning health development and delivery with global climate goals.

[7] Extreme Weather Event

An extreme weather event is an event that is rare at a particular place and time of year. Definitions of rare vary, but an extreme weather event would normally be as rare as or rarer than the 10th or 90th percentile of a probability density function estimated from observations. By definition, the characteristics of what is called extreme weather may vary from place to place in an absolute sense. When a pattern of extreme weather persists for some time, such as a season, it may be classed as an extreme climate event, especially if it yields an average or total that is itself extreme (e.g., drought or heavy rainfall over a season).

[8] Greenhouse Gas (GHG)

Greenhouse gases are those gaseous constituents of the atmosphere, both natural and anthropogenic, that absorb and emit radiation at specific wavelengths within the spectrum of thermal infrared radiation emitted by the Earth's surface, the atmosphere itself, and by clouds. This property causes the greenhouse effect. Water vapour (H_2O), carbon dioxide (CO_2), nitrous oxide (N_2O), methane (CH_4) and ozone (O_3) are the primary greenhouse gases in the Earth's atmosphere. Moreover, there are a number of entirely human-made greenhouse gases in the atmosphere, such as the halocarbons and other chlorine- and bromine-containing substances, dealt with under the Montreal Protocol. Beside CO_2, N_2O and CH_4, the Kyoto Protocol deals with the greenhouse gases sulphur hexafluoride (SF_6), hydrofluorocarbons (HFCs) and perfluorocarbons (PFCs).

[9] IPCC

The Intergovernmental Panel on Climate Change (IPCC) is the United Nations body for assessing the science related to climate change.

[10] Low-carbon healthcare

An approach for designing, building, operating, and investing in health systems and facilities that generate minimal amounts of greenhouse gases.

[11] Mitigation (of climate change)

A human intervention to reduce the sources or enhance the sinks of greenhouse gases (GHGs). The AR5 WGIII report also assesses human interventions to reduce the sources of other substances which may contribute directly or indirectly to limiting climate change, including, for example, the reduction of particulate matter (PM) emissions that can directly alter the radiation balance (e.g., black carbon) or measures that control emissions of carbon monoxide, nitrogen oxides (NOx), Volatile Organic Compounds (VOCs) and other pollutants that can alter the concentration of tropospheric ozone (O_3) which has an indirect effect on the climate.

[12] Particulate matter (PM)

The term Particulate matter(PM) refers to solid or liquid particles (except pure water) dispersed through the air by processes at the earth's surface. PM_{10} and $PM_{2.5}$ are the subset of PM, classified based on its size.

PM_{10-} particles with aerodynamic diameter 10 micrometers and smaller, also called as inhalable particles

$PM_{2.5-}$ particles with aerodynamic diameter 2.5 micrometers and smaller, also called as fine inhalable particles

[13] Sustainability

Meeting the needs of the present without compromising the ability of future generations to meet their own needs

[14] Vulnerability

The propensity or predisposition to be adversely affected. Vulnerability encompasses a variety of concepts including sensitivity or susceptibility to harm and lack of capacity to cope and adapt.

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