Climate Resilient Hospitals

Guidance Document

Context

Climate change will increase the frequency and magnitude of extreme weather events and create risks that will impact healthcare facilities due to more frequent and severe extreme weather events and increased health risks from a range of other climate hazards including food, water and vectorborne as well as zoonotic diseases alongwith poor air quality. It threatens the quality and continuity of care provided at the healthcare facilities, which will become increasingly vulnerable to impacts from climate change. Without adaptation, these facilities are highly dependent on critical community services (e.g., electricity, clean drinking water, food service delivery, waste disposal and treatment) that are vulnerable to power disruptions as evidentin the literature. Challenges include damage to infrastructures, limited access to essential services, increased patient loads, and issues with maintaining supply chains, such as essential drugs. Current system does not provide adequate support to the facilities in case of emergencies, which may not be the case with changing weather patterns due to climate change. Risks of critical infrastructure loss from flooding events are expected to rise with climate change, hence healthcare facilities will need to adapt systems accordingly.

In order to cope up with changing scenario, healthcare facilities will need to assess climate change risks and adopt adaptive management strategies to be resilient. At present, guidance for healthcare officials is simply lacking.

Taking into account the above context, WHO, India in partnership with the National Centre for Disease Control (NCDC)has supported a study “Action Plan to Enhance Climate-Resilient Health Facilities at the Hospitals in Madhya Pradesh” . In this study, a guidance document was prepared for the public healthcare facilities at the district and block levels to reduce the risks of climate change impacts and help them to deal with the challenges of climate change in an effective manner. This document provides guidance on critical infrastructure, electricity, clean drinking water, food service delivery, waste disposal and treatment.

Low-carbon healthcare provides an approach for designing, building, operating, and investing in health systems and facilities that generate minimal amounts of greenhouse gases. It puts health systems on a climate-smart development path, aligning health development and delivery with global climate goals. This approach saves money by reducing energy and resource costs. It can improve the quality of care in a diversity of settings. Low-carbon healthcare strengthens health systems by increasing facilities’ resilience to extreme weather events and other disasters, while also promoting approaches to adaptation.

Design of Healthcare Facility

Infrastructure

The condition of structural infrastructure elements (e.g., roofs, doors, windows) are to be reviewed taking into account increasing temperature, heavy rains and extreme events. Assessment to be made whether these will withstand these extreme events and accommodate the additional pressure emerging due to climate change. Considering the likely adverse impact of climate change, existing infrastructure (Hospital buildings, approach roads, electricity, water and communication systems) are to be maintained regularly and wherever needed may be retrofitted to make them more resilient to climate change.

For example, healthcare facilities in drought prone regions that may be vulnerable to future water shortages can install storm water collection systems, design landscapes with drought resistant native plants, and conserve water by using appropriate low flow taps, nozzles and toilets. Healthcare facilities can increase their resilience to extreme heat events by installing devices and equipment for monitoring indoor temperatures, cooling existing buildings and outdoor spaces, blocking direct sun, and increasing air flow and reducing humidity. In addition, encouraging sustainability practices, such as turning off equipment when not in use, has shown to be a cost-effective measure. Back-up generators should be tested and protected to ensure that they are functional in an extreme weather event.

Some of the options to make existing buildings compatible with Greening initiatives are:

- Adopting energy-efficient solutions by using low energy lighting, boilers and electrical systems, increasing reliance on natural ventilation, promoting active transportation and the use of energy efficient vehicles, providing distant counselling services and using green procurement (e.g., purchasing locally can help mitigate greenhouse gas emissions, and reduce healthcare facility costs and vulnerability to power disruptions).
- Greening healthcare facility properties (e.g., planting trees, grass and gardens) offers multiple health co-benefits such as the provision of natural shade for patients, staff and visitors during extreme heat events, reduced risk of facility flooding through the creation of natural flood water infiltration and the improvement of air quality by filtering pollutants.nstallation of high performance windows and exceeding minimum insulation requirements can also improve energy efficiency and enhance the comfort and safety of patients during extreme temperature events..
- Besides non-structural components (e.g., computers, diagnostic equipment, HVAC systems, back-up generators), the infrastructure should be also able to withstand extreme weather events that may cause acute or gradual damage due to extreme heat and flood waters. Regular maintenance, prioritizing replacement of old equipment and using new and emerging technologies to mitigate the effects of such events can reduce vulnerability.
  Retrofitting of existing buildings include Smart Landscaping, insulation for roof rafters, lofts, and suspended floors,Reflective Paint/Tiles for Roof and External Walls,energy-efficient retrofit

measures, efficient water and electricity supply systems,reducing concretization of open spaces etc.

All relevant officials need to look after their respective areas, in consultation with appropriate experts and adopt suitable cost-effective technologies to make it resilient and prepare a plan of action (for at least 5 years).

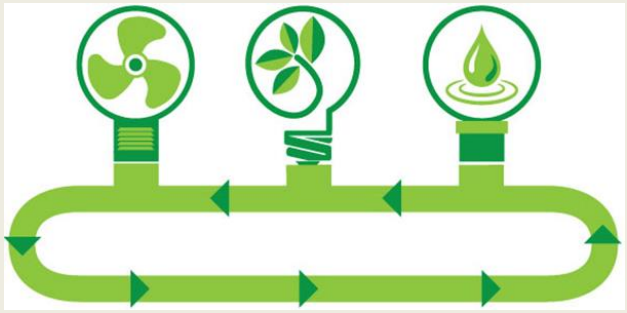
In addition, all New Hospitals planning healthcare facilities shold incorporate the following Climate/Disaster Resilient Aspects:

New building /infrastructures require to follow appropriate site selection,measures of earthquake, fire, flood & cyclone safety and resilience (multi-hazard) as per the National Building Codes 2005, Bureau of Indian Standards(BIS) codes,Indian Public Health Standards (IPHS) and National Disaster Management Authority (NDMA), 2018 guidelines, and Heat wave Action Plan Guidelines, 2019, in order to adopt all Green Building Aspects.

Location of hospitals

The location of the hospitals should not be at the edge of a slope, near the foot of a mountain vulnerable to landslides, near creeks, rivers or bodies of water that could erode its foundation, on top of or in proximity to active fault lines. In addition, facilities should avoid locations which have exposure to air pollution, or in the neighbourhood of hazardous industries etc.

Building, system design and construction



- The design and architecture of buildings should incorporate all existing building laws and enviromental guidelines, together with possible additional components considering the projected vulnerabilities to climate change, earthquake,disasters etc. In addition, low-carbon approaches considering the sitting and orientation of buildings to optimize solar shading and natural ventilation, which will keep the buildings comfortable.

- The design of buildings should maximize the building envelope performance to avoid overheating in hot weather and heat loss in cold weather. Incorporating high efficiency heating ventilation and air conditioning (HVAC) equipment, high-efficiency electric lighting, and energy-efficient equipment will further reduce energy consumption. Therefore, the hospital designs as per IPHS Guidelines, State Civil Engineering Divisions need to incorporate mandatory maximum levels for U-values (coefficients of thermal transmittance) for the entire building envelope, including walls, foundations, roof and windows.

- Energy-efficient design should be incorporated at the design stage of a building, considering present and future energy needs so that energy consumption could be reduced. For example, a well-ventilated hospital will have a lower cooling requirement.

- Reduced Window Wall Ratio (WWR) and Openable windows will enable heat flow out through a glazed window ten times faster than through a well-insulated wall. In addition, windows should be openable to allow passage of sunlight and air ventilation.

Emergency Preparedness Measures for Existing facilities

- **Safety audits**: Healthcare facilities need to go for mandatory safety audits with respect to their strength of the existing structure and the extent of retrofit or repair needed..
- **Plumbing, Electric cables should be protected from the floods, fire:** Incorporate necessary protection measures for electric cablesand plumbing works so that essential utilities function during emergencies.
- **Critical building Inventory:** Water, Energy, Fire protection and Communication installation, Utility systems(Electrical, mechanical and air-conditioning to be located at an elevated level) to withstand emergencies situations.
- **Rooftop to be retrofitted to withstand high wind and cyclonic conditions**,and non-structural infrastructure should also be installed properly to withstand impacts of high winds/rains/cyclones.
- **Access to Health facilities:** Health facilities should have atleast two all-weather roads operational for the catchment area population.

Energy security and Efficiency

The healthcare sector is a major energy consumer. Many of its components operate continuously and require a good quantum of energy to function.

Standard care delivery processes for most large hospitals require significant energy use (for heating water, temperature and humidity controls for indoor air, lighting, ventilation and numerous clinical processes) along with significant financial cost and greenhouse gas emissions. As such, fostering more efficient and sustainable energy use is essential in climate resilient healthcare.

Some of the measures that the existing and new facilities need to implement are as follows:

Conduct Comprehensive Energy Auditing

Comprehensive energy management program and strategy should be developed to optimize energy use, perform maximum energy efficiency and energy conservation at the hospitals. An assessment of the electricity requirement in different seasons and availability of power, including existing loads, on-site generation alternatives such as Solar Rooftop, electrical system upgrades to remove inefficient equipment, peak saving opportunities etc. Energy demand and supply assessment, taking into account the projected temperature rise in the region, need to be undertaken by the concern officials.

Use of Renewable Energy Sources

Healthcare facilities can significantly cut greenhouse gas emissions and energy costs over time by using alternative forms of clean and renewable energy – such as solar since these facilities have large spaces like the rooftop, parking lots etc.

On-site renewable energy can also serve those areas without access and enable health facilities to operate out of daylight hours and provide a wider range of services. Renewable energy sources such as solar photovoltaics/ thermal solar energy for heating water provides a low-carbon and reliable form of energy for facilities for lighting, heat generation, pumping and water-heating, which account for a large portion of the energy consumption.

The alternative sources of energy provide health facilities an advantage in terms of disaster preparedness, since alternative energy sources are less vulnerable to disruption than traditional energy infrastructure. Indicative Solar systems for the public healthcare facilities which could be installed at various types of Hospitals used in the study are presented in the following table.

Healthcare facility type	Nmber of Beds	Energy Consumption (KWH)	Assumed Electricity Price	Suggestive Capacity(KW)	Total Cost (INR)/ Energy Savings
District Hospital	200-400	50000-100000	7	100 – 200 KW	7,00,000
CHC	30-60	5000-20000	7	50 -100 KW	1,40,000
PHC	5-10	1000 -5000	7	5-10 KW	10,000

Energy Efficiency (retrofitting of old equipment)

- Hospitals are using a significant amount of energy by use of HVAC, Medical Equipments, Lighting and other non-medical equipment. Therefore, the existing equipment may be refurbished to make them energy-efficient or be replaced. These actions should be cost- effective.
- The procurement of equipments should consider energy-efficiency. The improvements will reduce energy costs, benefitting economic and environmental management. Following measures could be implemented to achieve efficient energy management in public healthcare facilities:

    - Conduct detailed energy-audit and prepare an energy conservation plan
    - Switch to LED lighting and use 5 star rated appliances
    - Install solar water heaters to replace electric geysers
    - Controlling the opening of windows and doors between spaces with different temperatures.
    - Periodic revision and maintenance of the boilers
    - Periodic revision and maintenance of the air-conditioning system, including the restoration of leaks of cooling liquid.
    - Pause hot water circulation in periods where there is no demand.
    - Installation of low consumption light bulbs/tubes wherever possible.
    - Use of electronic energy-saving equipment
    - Solar cold chains

- **Emergency Back-up Systems**

In order to meet emergency needs, it is important to have adequate power back-up, such as DG sets and Solar Battery back-up for atleast 12-24 hours, depending upon the electricity supply situation. In addition, electric wiring works, location of emergency back-up location etc. need to be properly placed to withstand external impacts.

Water Security and Efficiency

Water is an important resource for hospitals. Healthcare facilities consume vast amounts of water for hand-washing, drinking, food preparation and hygiene, flushing toilets and bathing patients, laundry and other services provided by central services (e.g. cleaning and sterilization of surgical instruments), reprocessing of medical equipment (e.g., endoscopes, surgical instruments and accessories), patient care (e.g., haemodialysis, hemofiltration, extracorporeal membrane oxygenation, hydrotherapy), fire suppression sprinkler systems, water-cooled medical gas and suction compressors (a safety issue for patients on ventilation), HVAC and decontamination. According to the Bureau of Indian Standards for hospitals exceeding 100 beds, the average consumption of water is 450 L/head/day (equating to 164,250 L of water/head/year).

Every healthcare establishment must have a "Water Use Audit plan" which should include (a) water usage under normal operating conditions, (b) identification of essential functions and minimum water needs, (c) identification of emergency water conservation measures and (d) identification of emergency water supply options, and (e) development of emergency water restriction plan.

Climate change, with its accompanying impacts of precipitation pattern and aquifer depletion, will exacerbate water scarcity. In order to have the required amount of water from different sources to meet the demand under various constraints scenario, the health facilities need to conserve water, enhance water use efficiency and adopt demand-side management of water.

- **Secured Water Supply**

Healthcare facilities should have diverse water supply sources like dedicated municipal water supply, borewells etc. In addition, it is also important to monitor the quality of water available for different purposes.

- **Storage Facilities**

Sufficient provision of water storage can help mitigate short-term intermittency, bridge seasonal shortages, specifically during hot days.Therefore, as suggested in the IIPS guidelines, 500 liters per patient/ day requirement should be maintained for at least 3-5 days, depending on the location of municipal supplies and borewells.

- **Drinking Water Provision**

Safe drinking water provision such as Industrial RO set-up needs to be established for providing reliable drinking water. In addition, sufficient portable safe drinking water needs to be provided for staff, patients, and caretakers at all times.

- **Provision of Sanitation Facilities**

Health facilities need to have adequate water for proper sanitation. In addition, reliable water points, with soap or a suitable alternative, should be available at all critical points within the healthcare setting (operating theatres, wards, consulting rooms, dressing stations, etc.) and in service areas (sterilization rooms, laboratory, kitchen, laundry, showers, toilets, waste zone, and mortuary). Furthermore, Faecal sludge management in health care is also particularly important to ensure faecal pathogens do not contaminate the healthcare facility environment or surrounding areas during extreme events. Therefore, advanced sanitation facilities should be designed. In addition, facilities need to improve accessibility in terms of hand-washing stations for not only healthcare workers but also patients and visitors to reduce the spread of infectious diseases.

- **Sewage Treatment Plants**

The waste-water discharge needs to be treated. Care should be taken to avoid any leakage from on-site sanitation systems at healthcare facilities. Further,to improve the resilience of the hospital, waste-water can be reused for non-essential purposes like gardening, cooling requirements etc. In addition, STP can be used for the recovery of methane from waste-water treatment plants. If possible, Effluent Treatment Plants (ETP) could be installed in existing hospitals. For new ones, it is a must as per the IPHS guidelines.

- **Improve Water Use Efficiency**

The facilities need to improve water-use efficiency through regular water audits and implement water conservation and efficiency measures. For Example:

- Install watersense labeled showerheads, toilets, bathroom faucets, and flushing urinals where appropriate watersense labelled products have been independently certified to be at least 20 percent more water-efficient and perform as well or better than the standard models.
- Check automatic sensors on faucets, toilets, and urinals to ensure they are operating properly and avoid unnecessary water use.
- Design water-smart landscapes that provide beautiful surroundings while reducing the amount of water needed for irrigation.
- Cut down on water loss from evaporation, wind, and runoff by replacing existing clock timers with watersense labelled irrigation controllers.
- Implement energy-efficiency measures to reduce the need for building and equipment cooling and heating, which will reduce the amount of water required by these systems.

- Keep indoor temperatures at a comfortable setting while increasing the efficiency of cooling towers, evaporative coolers, and boilers by using alternative sources of water, such as air-handler condensate and captured rainwater.
- Monitor cooling tower and boiler water chemistry to minimize the mineral build-up in the system and maximize the number of times water can be recycled through the system.
- Conduct awareness generation activities on water-saving for the hospital staff and patients.

Waste Management Infrastructure

Health-care activities protect and restore health and save lives. But, the waste and by-products generated will create a health hazard if they are not managed or disposed properly. WHO, in its report in 2018, provided the information that of the total amount of waste generated by health-care activities, about 85% is general, non-hazardous waste comparable to domestic waste. The remaining 15% is considered hazardous material that may be infectious, chemical or radioactive.Different types of wastes are: Infectious, Pathological ,Sharps, Chemical, Pharmaceutical, Cyctotoxic, Radioactive and Non-hazardous. The quantity of waste generated depends on the consumption of materias and pressure of patients.

The major sources of healthcare waste are: hospitals and other health facilities,laboratories and research centres,mortuary and autopsy centres,animal research and testing laboratories,blood banks and collection services,nursing homes for the elderly. Treatment and disposal of healthcare waste may pose health risks indirectly is vital for our life and health, but it also generates significant volumes of waste that must be safely disposed of, including infectious waste such as sharps and bandages, human tissues, and other hazardous waste including heavy metals, pharmaceuticals, and other chemicals. The biomedical waste generated from medical activities includes infectious, chemical, expired pharmaceutical, radioactive items and sharps. Other waste items generated through healthcare but not hazardous include medication boxes, packaging of medical items, waste from offices etc. In addition, facilities also generate substantial amount of organic waste, which includes food waste from kitchen, remains of food etc. For appropriate Waste Management, folloing sps should be taken:

- Comprehensive Waste Management Plan
- The management of health-care waste requires increased attention and diligence to avoid adverse health outcomes associated with poor practice, including exposure to infectious agents and toxic substances.

Elements in improving healthcare waste management are:

- promoting practices that reduce the volume of wastes generated and ensure propoer waste segregation;
- developing strategies and systems along with strong oversight and regulation to incrementally improve waste segregation, destruction and disposal practices with the ultimate aim of meeting national and international standards;
- where feasible, favouring the safe and environmentally sound treatment of hazardous health care wastes (e,g, by autoclaving, microwaving, steam treatment integrated with internal mixing, and chemical treatment) over medical waste incineration;
- building a comprehensive system, addressing responsibilities, resource allocation, handling and disposal. This is a long-term process, sustained by gradual improvements;
- raising awareness of the risks related to healthcare waste, and of safe practices; and

- selecting safe and environment-friendly management options, to protect people from hazards when collecting, handling, storing, transporting, treating or disposing of waste.

The healthcare facilities need to develop a comprehensive plan for hospital waste management, in line with the above points.Different kinds of waste generated in hospitals is given in the table below:

Waste Generation per day	Biomedical Waste (Yellow, Red, Blue, White Kgs)	Other Waste(Kgs)	Organic Waste(Kgs)
District Hospital	10-20	200-300	100-200
CHC	10-15	50-100	30-80
PHC	1-5	2-3	3-5

Biomedical Waste

- Facilities need to ensure safe disposal of Bio-medical waste as per The Bio-Medical Waste (Management & Handling Rules, 1998 notified under the Environment Protection Act, 1986 (29 of 1986) by the Ministry of Environment and Forests, Govt. of India. In addition, a strict monitoring mechanism needs to be established. In addition, Hospitals need to also follow necessary environmental regulations/clearances for discharging waste water and waste management rules.

Other wastes

- Waste management service of municipal authorities could be utilized for disposing plastic, paper and other waste. Depending on the quantity and availability of the space, health facilities can also establish incineration facilities as well.

Waste to Energy

- Most waste produced in health care facilities– about 85% – is not hazardous and can be disposed of along with general solid waste. Recycling and composting not only reduce emissions from waste facilities, but significantly reduce the demand for primary materials, thus reducing associated greenhouse gas emissions. So far, facilities are under-utilizing the waste to energy potential of the large organic waste generated from the hospital kitchens. In other words, bio methonization and composting not only reduce emissions from waste facilities, but also replaces fossil fuels use in the hospital kitchens.

Emergency Waste Storage

Facilities need to make necessary provision for emergency storage of waste during the natural disaster to avoid contamination of infectious waste.

Enhance Climate Preparedness

Capacity Building

- Hospital authority need to have climate and weather informationfrom the Nodal Agency for climate change
- Constitute a Taskforce on climate change taking all sections of the Hospitals.

Obtain standard training and awareness materials on climate change, impact and risk identification, preparedness, waste management etc. and provide in-house training to all officials/staff members. Have an additional budget for climate action at the hospital level. Climate change considerations should be included in proposals related to climate-sensitive diseases submitted to and funded by health funding mechanisms. It is also important to promote linkages with research organization and universities to exchange information on climate change and human health.

Climate-sensitive Diseases

Surveillance of climate change related health risks must be conducted. Enhanced Health Management Information System (HMIS) to improve data collection will facilitate monitoring and receiving early warnings and provide the opportunity to prepare and respond to potential health risks.

- Meteorological and surveillance data – Improve and correlate meteorological and surveillance data for climate-sensitive health outcomes
- Mainstreaming of climate change in existing Vector Controlling, Water and Sanitation programs
- Coordination – Form climate change core groups at the district level to coordinate and implement the climate and health initiatives.

Preparatory Measures for Vector-borne Diseases

Vector-borne diseases continue to contribute significantly to the burden of diseases and cause epidemics that disrupt health security and cause wider socio-economic impacts and also threaten to undermine recent global progress against these diseases. These diseases are sensitive in different ways to weather and climate conditions, such as increasing temperature and more variable weather supports ideal ecological conditions for sustaining the parasites and their vectors. Healthcare facilities need to strengthen grassroot human resource capacity, infrastructure and public health reporting to control vector diseases, which will, in turn, increase resilience to long-term climate change.

Health Decision Support Systems for Early Warning & Forecasting

Develop an integrated health data dashboard that will help the department of health to analyze data and make better decisions for climate-sensitive disease information, such as disease

prevalence, hot spots, healthcare indicators related to service delivery, health financing, procurement of drugs and other usables, mortality, morbidity and scenario generation for the policy formulation.

Staff Availability

The provision of enough appropriately trained professionals for health and other relevant disciplines to respond to changes in climate-sensitive health risks.

Preparation of Facility Level Action Plan

Health services address a wide array of life-sustaining and critical human needs such as medical care, mental and behavioural health care, health surveillance, and other basic support services. Climate change impacts these health services, directly or indirectly. Therefore, facilities need to prepare an action plan and earmark dedicated funds for its implementation as well.

- Communities should prepare for Climate Change.
- Hospitals should have adequate system flexibility to direct resources, information, knowledge and health interventions to communities which need them most.
- Communities are empowered to effectively prevent and respond to the health risks posed by extreme weather events.
- Strong, culturally diverse communities, in which people know, respect, and care for each other, will fare better during times of stress or disturbance. Social aspects of resilience can be as important as physical responses.

Emergency Planning & Response

Emergency Preparedness

Last few decades have witnessed an increased frequency of extreme weather/climate events and disasters causing tremendous human casualties, in terms of loss of life and disability in addition to huge economic losses. Although, these may not be totally preventable but their impact could be minimized by effective adaptation measures and planning. At least, as per NDMA guidelines for hospitals, 2018, basic emergency preparedness measures such as provision for imprest money, emergency storage of foods and drugs, power back-up facilities, ambulance, mock drills, trainings, water storage etc. need to be a part of the Standard Operating Procedures(SOP) for the facilities depending upon its bed strength, staff and other resources. All disaster response teams and their position holders (including their Second and Third line back-ups) shall learn the SOPs and Job Action Sheets (JASs) etc.

Critical Building Inventory

Hospitals must continue to function at full capacity when an emergency event occurs. Facilitea also need to have proper management of equipment and other essential items like transport, first-aidtreatment facility, water, food, life-saving supplies (e.g. Oxygen).

Determine Clinical Care Needs and Personnel Availability

The healthcare system has to respond to a surge , the inflow of patients, , and the need for specialized services. Therefore, resource allocation must take into account both supply and demand. Facilities need to maintain information about early dischargeable beds, expanded treatment areas, alternate care sites and necessary infrastructure. In addition, they also need to have dedicated and trained medical and non-medical teams, space management, logistics management for evacuation and handling surge capacity to meet the increased demand for clinical care. Further, hospitals need to have a mechanism to engage volunteers/other facilities services in the pre-disaster phase.

Conclusion

Resilience is not absolute. Recognizing that incremental steps could be taken and that total resilience in the face of all situations is not possible, implement what is feasible in the short term and work to achieve greater resilience in stages.