

## Annexures

### Making India’s Healthcare Infrastructure Climate Resilient

A District-level Risk Assessment Framework

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#### Annexure - I

**Table A1 Criteria matrix for selection of critical infrastructure sectors**

Sector	Sub Sectors	Class
TRANSPORT (C11)	Roads and Access Ways	Highways
		Bridges
		Freight
		Arterial/Secondary
		Service Roads
	Railway	
	Waterways	
POWER (C12)	Generation	Nuclear
		Thermal
		Renewable
		Hydroelectricity
	Ownership	Private
		Central
	State	
FOOD AND AGRICULTURE (C13)	Manufacturing	
	Production	
	Processing	
	Packaging	
	Supply	
	Distribution	
HEALTH INFRASTRUCTURES (C14)	Care	Primary
		Secondary
		Tertiary
	Scale	Small
		Medium
		Large
	Ownership	Private
		Central
	State	
	PPP	
FINANCIAL INFRASTRUCTURE (C15)	Banks	
	Financial Services	
	Insurance asset	
	Taxation	
	Credit and financing organization	
INDUSTRIAL INFRASTRUCTURE (C16)	Primary Metals	
	Machinery	
	Chemical Manufacturing	

	Electrical Equipment, Appliance and Component	
	Transportation Equipment	
<b>DEFENCE Services (CI7)</b>	Defence Research	
	Defence Supply	
	Production	
<b>WATER Supply and Sanitation (CI8)</b>	Sources	Lakes(Natural)
		Streams and Rivers
		Reservoir
		Ponds
		Springs
	Resource	Surface
		Ground Water
<b>SOCIAL INFRASTRUCTURE (CI9)</b>	Socio-cultural facilities	
	Safety and Security Infrastructure	
	Cremation-Burial- Cemetery facilities	
	Education	
	Distributive facilities	
<b>EMERGENCY SERVICES (CI10)</b>	Fire and Rescue Services	
	Emergency Medical Services	
	Disaster Management	
	Police	
	Public Works	
<b>COMMERCIAL INFRASTRUCTURE (CI11)</b>	Shopping Center	
	Petrol Pumps	
	Guest House/Budget hotels	
	Lodging and Boarding	
	Service and Repair shops	
	Service and Repair shops	
<b>COMMUNICATIONS (CI12)</b>	Postal	
	Internet	
	Broadcast Media	
	ICT	
	Space	
		Telecommunication

## Annexure - II: Indicators for Climate Risk Assessment of Healthcare Facilities

### Table A1 Indicators for Hazard Component

SI No.	Indicator Name	Indicator Description/Data Point	Ind_Weightage	Data Source	Correlation
1	Flood Occurrence	No. of floods recorded in the last three decades by the respective District Disaster Management Plan	1.00	Respective DDMP	Positive
2	Cyclone Occurrence	No. of cyclones recorded in the last three decades by the respective District Disaster Management Plan	1.00	Respective DDMP	Positive

### Table A2 Indicators for Exposure Component

SI No.	Indicator Name	Sub-indicators	Data Source	Correlation
1	Total no. of healthcare facilities in the district	No. of primary healthcare centres	Multiple govt. datasets (refer Table 1 in the report)	Positive
		No. of secondary healthcare centres	Multiple govt. datasets (refer Table 1 in the report)	
		No. of tertiary healthcare centres	Multiple govt. datasets (refer Table 1 in the report)	
2	District Area	N.A.	Census 2011	Positive

**Table A3 Indicators for Sensitivity Component**

Category Name	Rank	Rationale behind category rank	Category Weight	SI No	Indicator Name	Indicator Description/Data Point	Indicator Weight	Final Weight	Data Source	Correlation	Rationale	Supporting Literature/Guideline	Method
Susceptibility based on Landscape parameters (sub-indicators detailed in Table A4)	1	Landscape -based parameters influence factors such as the level of flooding, which contribute to the sensitivity the most.	0.5	1	Susceptibility to Floods	% of hospitals present in flood susceptible areas	1.50	2.30	GIS Based Analysis	Positive	As per the <b>NDMA Guidelines for Hospital Safety, 2016</b> , a hospital should not be located in a flood or cyclone-prone area. The more hospitals present in highly susceptible areas, the more sensitive the district is or the degree to which the healthcare system will be affected.	As per the <a href="#">NDMA Guidelines on Hospital Safety, 2016</a> , "The following sites shall be prohibited for locating a hospital: ii. Hill slopes (unstable) iii. <b>Flood or tsunami-prone areas</b> ; v. <b>Poor accessibility in post-disaster situations. When existing hospitals are located in any of these vulnerable locations, no future expansions shall be permitted on the hospital campuses. Also, critical assessment shall be undertaken to study the risks involved and appropriate actions shall be taken either to mitigate the effects or relocate the hospital. When new towns or layouts are being planned, the master plan of the same shall take cognisance of the prevalent vulnerabilities before determining the location of new hospitals.</b> "	1. Weighted overlay of selected parameters of susceptibility to find areas highly and very highly susceptible to floods and cyclones (30m) > polygonize at 100m resolution 2. Intersection of susceptible areas with hospital locations (all are point data) 3. Tabulate intersections to find the percentage of hospitals in each district lying in susceptible areas
				2	Susceptibility to Cyclones	% of hospitals present in cyclone susceptible areas	0.50	0.65	GIS Based Analysis	Positive			
				3	Susceptibility to Floods and Cyclones	% of hospitals present in areas of compounded impact	1.00	1.30	GIS Based Analysis	Positive			
Compliance with Zoning Regulations	3	Cases of non-compliance are rarely observed, if at all, it is because of discrepancies between authorities, land ownership, or due to a lack of awareness of the development authority about the newest regulation.	0.17	4	Compliance with Flood Risk Zoning	% of hospitals within 100 Yr Flood Line	1.33	0.90	<a href="#">Link</a>	Positive	A nodal agency in every state - here, the <b>Water Resources Department</b> of Maharashtra, demarcates <b>25-year and 100-year flood lines</b> along every river based on historical flooding levels, which are declared <b>no development zones</b> . If a hospital is present within such a no-development zone, it is inferred that it would be more sensitive to floods.		1. A buffer is created along the rivers following the demarcated flood line in every district. 2. The buffer is intersected with the location of hospitals to find the no. of hospitals falling within the flood line.
				5	Compliance with latest CRZ Notification	% of hospitals present in CRZ-IB and CRZ II	0.67	0.45	<a href="#">Link</a>	Positive			

Category Name	Rank	Rationale behind category rank	Category Weight	SI No	Indicator Name	Indicator Description/Data Point	Indicator Weight	Final Weight	Data Source	Correlation	Rationale	Supporting Literature/Guideline	Method
<b>Dependence on Susceptible Assets</b>	<b>2</b>	Inter-dependencies within the system may lead to magnification of the inherent sensitivity. Hence, this is assigned a second priority.	0.33	6	Dependence of PHCs on susceptible SHCs	% of PHCs dependent on susceptible SHCs	1.24	1.00	GIS Based Analysis	Positive	During a disaster, secondary healthcare centres such as District Hospitals and sub-district hospitals serve as the nodal centres for trauma response. All PHCs transfer critical patients to their nearest SHC. If the SHC itself is susceptible and has many PHCs dependent on it, the sensitivity of the healthcare system increases.	Petit, Frederic & Verner, Duane & Brannegan, David & Buehring, W. & Dickinson, David & Guziel, Karen & Haffenden, Rebecca & Phillips, Julia & Peerenboom, James. (2015). <a href="#">Analysis of Critical Infrastructure Dependencies and Interdependencies</a> .  <a href="#">Critical Infrastructure Interdependencies Assessment</a>	1. The susceptible SHCs are identified by intersecting all SHCs with highly susceptible areas. 2. A buffer of 5 km is created. 3. PHCs falling in that buffer are listed by intersecting with the buffer. 4. District-wise dependent PHCs are tabulated using the tabulate intersection tool.
				7	PHCs/SHCs dependent on susceptible roads	% of hospitals connected at last-mile by susceptible road	1.26	1.00	GIS Based Analysis	Positive	Connectivity to a healthcare institution plays a crucial role in emergency response. If a hospital is connected by a susceptible road at the last mile, it increases the chances of systemic failure and, hence, the sensitivity.		1. The susceptible roads are identified by intersecting all roads with susceptible areas. 2. A 3-km buffer is created around the susceptible stretch of road. 3. The buffer is intersected with all hospitals to identify which are connected by a susceptible road at the last mile.
				8	PHCs dependent on susceptible substations	% of PHCs dependent on susceptible substations	0.50	0.40	GIS Based Analysis	Positive	PHCs, being the smallest healthcare units, often do not have a power backup. If a PHC is dependent on a susceptible substation, the chances of it facing a power outage are higher. Therefore, the system's sensitivity is increased.		1. The susceptible sub-stations are identified by intersecting all sub-stations with susceptible areas. 2. A buffer is created around the susceptible substation. The radius of the buffer is determined by the density of that power circle zone. 3. The buffer is intersected with all hospitals to identify which are dependent on a susceptible substation.

**Table A4 Sub-Indicators for Susceptibility to Floods and Cyclones (Under sensitivity component)**

Sub-Indicator	Layer No.	Name	Unit	Weight (%)	Rationale for Weights	Relation	Explanation	Link
Susceptibility to Floods	1	Elevation	Meters	13	AHP	Inverse	Less is the elevation; more is the susceptibility	<a href="#">Link</a>
	2	Slope	Percent Rise	12		Inverse	Less is the slope % rise (flatter), more is the susceptibility	<a href="#">Link</a>
	3	Proximity to Rivers	Meters	10		Inverse	Less is the distance; more is the susceptibility	<a href="#">Link</a>
	4	Profile Curvature	NA	5		Inverse	Less is the curvature; the more is the susceptibility	<a href="#">Link</a>
	5	Stream Power Index	NA	7		Direct	Less is the SPI; the Less is the susceptibility	<a href="#">Link</a>
	6	Topographic Wetness Index	NA	9		Direct	Less is the TWI; the Less is the susceptibility	<a href="#">Link</a>
	7	Land Use Land Cover	NA	11		Other	Built-Up Area > Agriculture > Forests > Water Bodies	
	8	Normalised Difference Vegetation Index	NA	6		Inverse	More is the NDVI, and less is the susceptibility.	<a href="#">Link</a>
	9	Soil Moisture Level	kg/kg or m <sup>3</sup> /m <sup>3</sup>	6		Direct	More is the soil moisture, more is the sus.	
	10	Groundwater Level	mbgl	3		Inverse	Less is the groundwater level, more is the sus.	
	11	Drainage Density	miles/sq mile	10		Inverse	More is the drainage density, more is the sus.	<a href="#">Link</a>
	12	Soil Type	% clay	8		Direct	More is the percentage of clay, more is the sus.	
Susceptibility to Cyclones	1	Elevation	Meters	33	Delphi - Proximity to coastline is assigned first priority as it is the most important factor in determining the level of impact from a cyclone. The flood susceptibility is assigned second priority as it determines the level of cyclone-induced flooding, followed by the wind risk zone as identified by BMTPC based on previous cyclone tracks.	Inverse	Less is the elevation, more is the susceptibility	
	2	Slope	Percent Rise			Inverse	Less is the slope % rise (flatter), more is the susceptibility	<a href="#">Link</a>
	3	Proximity to Rivers	Meters			Inverse	Less is the distance, more is the susceptibility	

Sub-Indicator	Layer No.	Name	Unit	Weight (%)	Rationale for Weights	Relation	Explanation	Link
Susceptibility to Cyclones	4	Profile Curvature	NA			Inverse	Less is the curvature, more is the susceptibility	<a href="#">Link</a>
	5	Stream Power Index	NA			Direct	Less is the SPI, Less is the susceptibility	<a href="#">Link</a>
	6	Topographic Wetness Index	NA			Direct	Less is the TWI, Less is the susceptibility	<a href="#">Link</a>
	7	Land Use Land Cover	NA			Other	Built-Up Area > Agriculture > Forests > Water Bodies	
	8	Normalised Difference Vegetation Index	NA			Inverse	More is the NDVI, less is the susceptibility	<a href="#">Link</a>
	9	Soil Moisture Level	kg/kg or m <sup>3</sup> /m <sup>3</sup>			Direct	More is the soil moisture, more is the susceptibility	
	10	Groundwater Level	mbgl			Inverse	Less is the groundwater level, more is the susceptibility	
	11	Drainage Density	miles/sq mile			Inverse	More is the drainage density, more is the susceptibility	<a href="#">Link</a>
	12	Soil Type	% clay			Direct	More is the percentage of clay, more is the susceptibility	
	13	<b>Proximity to Coastline</b>	Km	50		Direct	More is the proximity, more is the susceptibility	
14	<b>Wind Risk Zone</b>	m/s	17		Other	Zone 1>Zone2>Zone3		

**Table A5 Indicators to Measure Adaptive Capacity of Healthcare Facilities against floods and cyclones**

Indicator Category	SI No.	Indicator Name	Indicator Description/Data Point	Ind_Weightage	Data Source	Correlation	Rationale	Supporting Literature/Guideline	Estimation Method
DDMP Evaluation	1	Identification of the term 'climate proofing'	The DDMP of the district mentions the term 'climate proofing' or mentions a related term, such as 'disaster resilient infrastructure, hazard resilient infrastructure', etc. with respect to healthcare infrastructure	0.33	Respective DDMP	Positive	<p>The adaptive capacity of the healthcare infrastructure in the district would be greater if the district disaster management plan identifies the healthcare infrastructure that could be at risk and contains relevant strategies and interventions to increase their resilience. As per the <b>DM Act of 2005, Section 30. Clause (I) Para (2)(iv)</b>, the DDMA must ensure that the guidelines for the prevention of disasters as laid by the National Authority are followed by all departments of the Government at the district level and be reflected in the District Disaster Management Plan. Therefore, the DDMP is evaluated on the basis of:</p> <p>a. whether or not it <b>identifies the healthcare infrastructure system as 'critical'</b> and contains a catalogue of the assets within the district</p> <p>b. whether or not it <b>contains relevant structural as well as non-structural strategies</b> to improve the resilience of its healthcare infrastructure, with the intention to 'climate-proof' them</p>	<p><a href="#">National Disaster Management Guidelines: Hospital Safety, 2016</a> Promotion of the Disaster Risk Tool for Hospitals in India, NIDM, 2023</p>	Keyword based scoring
	2	Identification of the term "critical infrastructure"	Identifies the term 'critical infrastructure' or a related term such as hazard resilient or hazard proof infrastructure or lifeline facilities	0.11	Respective DDMP	Positive			Keyword based scoring
	3	Identification of healthcare as critical infrastructure	Identifies the healthcare sector as 'critical infrastructure' or recognises it as a lifeline facility during a disaster, or a related term	0.56	Respective DDMP	Positive			Keyword based scoring
	4	The presence of a data catalogue identifying the distribution of healthcare infrastructure assets in the district	Contains a catalogue of healthcare facility names and locations in the form of a map, list, etc.	0.89	Respective DDMP	Positive			Keyword based scoring
	5	Presence of structural strategies for climate proofing of healthcare	It mentions structural strategies for strengthening healthcare infrastructure, such as hazard-resistant construction of new infrastructure, retrofitting of existing infrastructure, greening of hospital buildings, etc.	0.78	Respective DDMP	Positive			Keyword based scoring
	6	Presence of non-structural strategies for climate proofing of healthcare	Non-structural strategies for strengthening of healthcare infrastructure, such as capacity building of hospital institutions and administration, risk assessment of hospital buildings, presence of 24/7 medical teams, etc.	0.67	Respective DDMP	Positive			Keyword based scoring



Indicator Category	SI No.	Indicator Name	Indicator Description/Data Point	Ind_Weightage	Data Source	Correlation	Rationale	Supporting Literature/Guideline	Estimation Method
	7	Year of Publication of Latest DDMP	The year of publication of the latest DDMP that is openly accessible and in the public domain	0.22	Respective DDMP	Positive	As per the <b>DM Act of 2005</b> and the <b>NDMA Framework for Preparation of Disaster Management Plans</b> , the DDMP must be <b>updated annually</b> . Therefore an updated DDMP increases the adaptive capacity of the district by allowing to take proper preparedness measures in advance	<a href="#">The National Disaster Management Act, 2005</a> <a href="#">Model Framework for District Disaster Management Plan, 2014</a>	Keyword based scoring
	8	Identification of the Chief Medical Officer in the District Disaster Management Authority	Identification of the Chief Medical Officer who is part of the DDMA or the District Health officer and is mentioned in the state emergency operations centre along with their contact details	0.44	Respective DDMP	Positive	As per the <b>National Disaster Management Act of 2005, Section 25 Sub-section (2) (e)</b> , the District Disaster Management Authority must consist of the district's Chief Medical Officer. As per the NDMA Model Framework for District Disaster Management Plans (2014), the CMO must be identified and listed, along with their contacts in the DDMP.	<a href="#">The National Disaster Management Act, 2005</a> <a href="#">Model Framework for District Disaster Management Plan, 2014</a>	Keyword based scoring
Network Capacity	9	Shortfall in No. of Rural PHCs	% shortfall in terms of difference b/w no. of PHCs required as per IPHS norms and no. of PHCs present - as per 2021 pop.	0.86	RHS Rural Statistics 2019	Negative	As per the <b>NDMA Guidelines for Hospital Safety</b> , the healthcare infrastructure must be adequate for the target population it serves to accommodate added stress during a disaster. The <b>Indian Public Health Standards Guidelines, 2022</b> by MoHFW has set population norms for each hospital category, based on which the shortfall in health facilities has been estimated by MoHFW (RHS, 2021-22) as per the estimated mid-year population 2022 in India. The extrapolation of this estimate at the district scale serves as an indicator of the adaptive capacity of the district healthcare system. More is the % shortfall; less is the adaptive capacity.	<a href="#">National Disaster Management Guidelines: Hospital Safety, 2016</a> <a href="#">IPHS 2022 Guidelines</a> <a href="#">Rural Health Statistics, 2021-22</a>	1. The projected mid-year population of the district is estimated as per the the district's rural and urban growth rates. 2. The % shortfall is calculated by comparing with the required number of healthcare facilities in each category, as per IPHS 2022 norms.
	10	Shortfall in No. of Urban PHCs	% shortfall in terms of difference b/w no. of UPHCs required as per IPHS norms and no. of UPHCs present - as per 2022 mid-year population	0.71	RHS Rural Statistics 2020	Negative			
	11	Shortfall in No. of SHCs	% shortfall in terms of difference b/w no. of SHCs required as per IPHS norms and no. of SHCs present - as per 2022 mid-year population	1.00	RHS Rural Statistics 2021	Negative			
	12	Shortfall in No. of SCs	% shortfall in terms of difference b/w no. of SCs required as per IPHS norms and no. of SCs present - as per 2022 mid-year population	0.29	RHS Rural Statistics 2022	Negative			

Indicator Category	SI No.	Indicator Name	Indicator Description/Data Point	Ind_Weightage	Data Source	Correlation	Rationale	Supporting Literature/Guideline	Estimation Method
	13	Road Network Density	Total length of roads per unit area of the district (km/sq km)	0.57	Maharashtra Infrastructure Statistics 2021-22	Positive	As per the <b>NDMA Guidelines for Hospital Safety, 2016</b> , the healthcare infrastructure must be adequate in terms of the accessibility of the hospital. The accessibility can be measured through three indicators:	<a href="#">National Disaster Management Guidelines: Hospital Safety, 2016</a> <a href="#">JPHS 2022 Guidelines</a>	GIS-based calculation using tabulated intersection
	14	Type of Link Road	% of PHCs connected to tertiary roads and above	0.43	Open Street Map Database	Positive	<b>a. Road Network Density</b> More is the road network density; more is the ease of access to healthcare institutions during a disaster.		GIS-based calculation using intersection tool
	15	Centeredness of District & Sub-district Hospitals	Avg Distance of SHC from the district centre	0.14	Open Street Map Database	Positive	<b>b. Last Mile Connectivity to the hospital (type of link road)</b> More is the Right of Way of the connected road, more is the ease of access to the healthcare institution.  <b>c. Centeredness of Secondary Healthcare Centres:</b> More is the centeredness (by road) of the district or sub-district hospital, and more is the ease of access from all parts of the district/sub-district, as advised by the NDMA Guidelines.		GIS-based calculation using centroid analysis

Indicator Category	SI No.	Indicator Name	Indicator Description/Data Point	Ind_Weightage	Data Source	Correlation	Rationale	Supporting Literature/Guideline	Estimation Method
Structural Capacity	16	Compliance with Building Codes for Structural Safety	<p>Compliance with relevant building codes as suggested by the NDMA Guidelines for Hospital Safety, as per:</p> <p>a. New Hospitals: NBC, IS:875, IS:1893(1), IS:1893(4)(for pipelines), IS:456, IS:800, IS:13920, GSDMA Guidelines, and IPHS, and</p> <p>b. Existing Hospitals: NBC 2007, IS:875, IS:1893(1), IS:456, IS:800, IS:1905, IS:13920, IS:13935, IS:15988, and GSDMA Guidelines.</p>	2.67	Respective DDMP	Positive	<p><b>Chapter 5 of NDMA Guidelines for Hospital Safety</b> outlines in detail the measures to ensure the safety of structural and non-structural elements of hospital buildings, both for planning, design and construction of new hospitals and re-planning, assessment and retrofitting of existing hospitals. It advises the compliance of relevant national standards and guidelines laid down by various statutory and non-statutory bodies and mentions the relevant standards. As per the <b>DM Act of 2005, Section 30. Clause (I) Para (2)(iv)</b>, the DDMA must ensure that the guidelines for the prevention of disasters as laid by the National Authority are followed by all departments of the Government at the district level and be reflected in the District Disaster Management Plan. Therefore, the DDMP has been quantitatively scored based on the mention of codes and standards outlined by the NDMA Guidelines as a measure of compliance by the district's hospitals, which would enhance their structural strength.</p>	<a href="#">National Disaster Management Guidelines: Hospital Safety 2016</a> <a href="#">IPHS 2022 Guidelines</a>	Keyword based scoring
	17	Expenditure on structural upgradation of hospitals	% of NHM Health System Strengthening budget spent on upgradation as per IPHS norms	1.33	National Rural Health Mission State PIP Budget 2018-2023	Positive	<p><b>Chapter 4 of NDMA Guidelines for Hospital Safety, 2016</b> advises that higher levels of engineering shall be adopted in the planning, design, construction and maintenance of critical units of existing hospital buildings. If a more significant amount is spent on upgrading or retrofitting hospitals in the district to meet IPHS norms, the structural strength of the hospitals is expected to be greater. Therefore, the relevant vertical under Healthcare System Strengthening of the NHM Budget has been evaluated.</p>		Excel based calculation

Indicator Category	SI No.	Indicator Name	Indicator Description/Data Point	Ind_Weightage	Data Source	Correlation	Rationale	Supporting Literature/Guideline	Estimation Method
Institutional Capacity	18	Presence of Healthcare Sector Preparedness Plan	Availability of Healthcare Sector Preparedness Plan/Hospital Disaster Management Plan or Committee	1.60	Respective DDMP	Positive	<b>The NDMA Guidelines on Hospital Safety, 2016</b> , as a part of Preparedness, Response and Recovery measures, advise that each hospital must have a detailed Hospital Disaster Management Plan and to ensure that the said plan is well practised and rehearsed so that it may be implemented when disaster strikes, without any lapses.		Keyword based scoring
	19	Conformity with IPHS Standards	% of IPHS Standard PHCs	0.40	NRHM - IPHS Monitoring Wing	Positive	<b>Indian Public Health Standards 2022</b> by MoHFW contain guidelines for the adequacy and efficiency of healthcare institutions. The Monitoring wing of IPHS under NHRM has identified and listed hospitals which comply with their standards within the state. More is the number of such hospitals within a district, and more is its adaptive capacity.		Excel based calculation
	20	Demarcation of Emergency Operation Centres or Trauma Centres	Demarcation of Emergency Operation Centres for floods and cyclones	0.80	NRHM - IPHS Monitoring Wing	Positive	As per <b>IPHS 2022</b> , some of the secondary healthcare facilities must be demarcated as Emergency Operation Centres that comply with <i>"Operational and Technical Guidelines on Emergency Services at District Hospitals."</i> for the efficiency of medical services during a disaster. The number of such centres is estimated for each district.		Excel based calculation
	21	Continuity of Essential Support Services	% of Hospitals with Utility Systems Management Plan or mention of mechanisms for backup for lifeline facilities in the DDMP	1.20	NRHM - IPHS Monitoring Wing	Positive	<b>Chapter 4 of the NDMA Guidelines for Hospital Safety, 2016</b> advises that <i>"every hospital shall ensure the continuity of essential services in all the circumstances by ensuring adequate resources and hospital supplies, developing and ensuring back up arrangement of utility services, having a deployable evacuation plan, coordinating and networking with neighbouring hospitals/health care institutions that can facilitate in continuing the essential services of the hospitals during the emergencies"</i> . The presence of relevant measures as components of a utility management plan, such as 24/7 power backup, water supply, etc, has been evaluated in the DDMPs.		Excel based calculation

Indicator Category	SI No.	Indicator Name	Indicator Description/Data Point	Ind_Weightage	Data Source	Correlation	Rationale	Supporting Literature/Guideline	Estimation Method
Functional Capacity	22	NQAS Accreditation	% of hospitals within the district that are NQA accredited	2.00	Maharashtra State Public Health Dept	Positive	<p><b>Chapter 8 of NDMA Guidelines for Hospital Safety</b> states that <i>"to ensure the continued functioning of the disaster preparedness and mitigation measures that are undertaken as per the standards mentioned in the preceding chapters of the guideline, hospitals shall be evaluated and thereby accredited by recognized and established accreditation organizations, regularly"</i>. Therefore, the more the number of accredited hospitals in the district, the more is the adaptive capacity. Two kinds of accreditations, as recommended by NDMA, have been evaluated:</p> <p>1. <b>NABH Accreditation Standards</b> address all the requirements related to hospital safety, risk management, disaster planning, monitoring and evaluation under various chapters. The Facility Management &amp; Safety (FMS) chapter provides the criteria for implementing emergency management plans. Emergency Response capacity and Preparedness of a hospital can be achieved by complying with NABH Accreditation Standards.</p> <p>2. <b>National Quality Assurance Standards (NQAS)</b> have been developed keeping in mind the specific requirements for public health facilities as integrated into the 'Operational Guidelines for Improving Quality in Public Healthcare Facilities, 2021'. NQAS are currently available for District Hospitals, CHCs, PHCs, and urban PHCs.</p>	<p><a href="#">National Disaster Management Guidelines: Hospital Safety, 2016</a>,  <a href="#">National Quality Assurance Standards for Hospitals</a>  <a href="#">National Accreditation Board for Hospitals and Healthcare Providers</a></p>	Excel based calculation
	23	NABH Accreditation	% of hospitals within the district that are NABH accredited	2.00	NABH Website, Maharashtra State Public Health Dept	Positive			Excel based calculation

Indicator Category	SI No.	Indicator Name	Indicator Description/Data Point	Ind_Weightage	Data Source	Correlation	Rationale	Supporting Literature/Guideline	Estimation Method
Expenditure on Maintenance	24	Expenditure on Healthcare System Strengthening	% of District-wise NHM Budget spent on Health System Strengthening	4.00	National Rural Health Mission State PIP Budget 2018-2023	Positive	As per <b>Chapter 7 of NDMA Guidelines for Hospital Safety, 2016</b> , "a hospital is expected to periodically carry out its maintenance to ensure that the safety and service quality to patients is not compromised, especially in a post-disaster scenario". The frequency and quality of maintenance measures can be quantitatively measured by the expenditure in each district on healthcare system strengthening, which is outlined under the NHM PIP Budget. The greater the share of NHM in strengthening of the healthcare system, the higher the adaptive capacity of the hospitals in the district	<a href="#">National Disaster Management Guidelines: Hospital Safety, 2016</a> ,	Excel based calculation

Table 6 Indicator Prioritisation Exercise through Delphi Technique

The devised indicators were discussed and prioritised through the Delphi technique. This was done by conducting an expert opinion survey comprising 15+ climate change and health sector experts who debated the nature and importance of each indicator in contributing to the risk posed to the healthcare institution. The order of priority thus obtained was converted into weights for each indicator by the rank sum method.

Category	Indicator Name	Criterion	Rank assigned	Rationale behind the order of priority	Rank Sum	Normalised	Ind_Weight - Eq. Category Scores	Ind_Weight - Wt Category Scores
Evaluation of Disaster Management Plan for Climate Proofing Measures	Presence of a data catalogue for healthcare infrastructure assets in the district	8	1	Assuming the respective DDMP has already identified the healthcare sector as a critical area, the measure with the highest priority would be to prepare a catalogue of healthcare infrastructure at risk to identify potential assets at risk. This would be followed by the presence of structural and non-structural strategies in order, as the quality of strategies are more relevant for climate proofing than identification of the sector as critical or containing the specific term "climate proofing".	8	0.22	0.89	
	The presence of structural strategies for climate-proofing	8	2		7	0.19	0.78	
	The presence of non-structural strategies for climate-proofing	8	3		6	0.17	0.67	
	Identification of healthcare as critical infrastructure	8	4		5	0.14	0.56	
	Identification of a Public Health Officer in the Emergency Response Chain	8	5		4	0.11	0.44	
	Identification of the term 'climate proofing'	8	6		3	0.08	0.33	
	Year of Publication of Latest DDMP	8	7		2	0.06	0.22	
	Identification of the term "critical infrastructure"	8	8		1	0.03	0.11	
Network Strength	Shortfall in No. of SHCs	7	1	The secondary healthcare centres act as first responders in case of a disaster. Therefore the shortfall in no of SHCs has been assigned highest priority., followed by Rural PHCs, followed by Urban PHCs, and then SCs. This is followed by the indicators addressing the accessibility to the healthcare facility.	7	0.25	1.00	
	Shortfall in No. of Rural PHCs	7	2		6	0.21	0.86	
	Shortfall in No. of Urban PHCs	7	3		5	0.18	0.71	
	Road Network Density	7	4		4	0.14	0.57	
	Type of Link Road	7	5		3	0.11	0.43	
	Shortfall in No. of SCs	7	6		2	0.07	0.29	
	Centeredness of District & Sub-district Hospitals	7	7		1	0.04	0.14	
Structural Strength	Compliance with Building Codes for Structural Safety	2	1	Expenditure on structural upgradation may not always be directly inferred from a disaster proofing point of view, however the reference of structural norms in a DDMP is	2	0.67	2.67	
	Expenditure on structural upgradation of hospitals	2	2		1	0.33	1.33	

Category	Indicator Name	Criterion	Rank assigned	Rationale behind the order of priority	Rank Sum	Normalised	Ind_Weight - Eq. Category Scores	Ind_Weight - Wt Category Scores
				direct.				
Institutional Preparedness	Presence of Healthcare Sector Preparedness Plan	4	1	Healthcare sector preparedness plans are the most basic necessity, however are not available in most states. Therefore it is assigned first priority, followed by utility plan to ensure continuity of essential support services, and demarcation of trauma centres.	4	0.40	1.60	
	Continuity of Essential Support Services	4	2		3	0.30	1.20	
	Demarcation of Emergency Operation Centres or Trauma Centres	4	3		2	0.20	0.80	
	Conformity with IPHS Standards	4	4		1	0.10	0.40	
Functional Preparedness	NQA Accreditation	2	1	NQA and NABH are both equally relevant tools in assessing the accreditation of hospitals. Therefore they have been assigned equal priority.	2	0.50	2.00	
	NABH Accreditation	2	1		2	0.50	2.00	
Expenditure on Maintenance	Expenditure on Healthcare System Strengthening	1	1		1	1.00	4.00	
							<b>24.00</b>	
Susceptibility based on Landscape parameters	Susceptibility to Floods	3	1	If the geographical location of the study area is not taken into consideration, the susceptibility to floods and cyclones would ideally be assigned equal priority, as one is not known to cause more harm to healthcare institutions than the other. However, given the history of past disasters in the State of Maharashtra, which shows that floods are more recurrent than cyclones, the susceptibility to floods has been assigned higher priority, followed by the susceptibility to compounding events, followed by susceptibility due to cyclones.	3	0.50	1.50	2.30
	Susceptibility to Cyclones	3	3		1	0.17	0.50	0.65
	Susceptibility to Floods and Cyclones	3	2		2	0.33	1.00	1.30
Compliance with Zoning Regulations	Compliance with Flood Risk Zoning	2	1		2	0.67	1.33	0.90
	Compliance with latest CRZ Notification	2	2		1	0.33	0.67	0.45
Dependence on Susceptible Assets	Dependence of PHCs on susceptible SHCs	3	1	Failure of a secondary healthcare centre, or inaccessibility to a hospital during a disaster would cause a higher degree of failure of the healthcare system than the failure of a substation, as a hospital may be possessing a 24/7 power backup.	3	0.41	1.24	1.00
	PHCs/SHCs dependent on susceptible roads	3	2		2	0.42	1.26	1.00
	PHCs dependent on susceptible substations	3	3		1	0.17	0.50	0.40