A.2 STORM CHECKLISTS

Storm include tropical storms, local storms and strong winds. IPCC notes that there are statistically significant trends in the number of heavy precipitation events in some regions. It is likely that more of these regions have experienced increasing storm events, although there are strong regional and subregional variations in these trends *(7)*. Storms threaten health care facilities in many ways. Strong winds can destroy windows, roofs, or cause trees to fall damaging the facility, access roads and electricity poles. Rain can cause flooding leading to damage of medical equipment, affect water and sanitation services, and overall damage to the infrastructure. In dry areas or in periods of drought, strong winds can create sand or dust storms.

CHECKLIST FOR ASSESSING VULNERABILITY TO STORMS

STORMS	Vulnerability level		
High: unprepared; unable to respond (Higher risk) **Medium:** basic or incomplete preparation; low level of response (Medium risk) **Low:** prepared; able to respond (Lower risk)	High	Medium	Low
HEALTH WORKFORCE — **Is the health workforce,**			
(Human resources)			
provided with programmes for supporting staff with regards to mental health, injuries, medical treatment and related support measures?*	☐	☐	☐
equipped with an emergency plan for shift relay or replacement of health professionals to ensure that staff get adequate rest after their high-demand duties from a severe storm event?*	☐	☐	☐
prepared with a contingency plan for accessing additional health workforce to strengthen performance capacity?*	☐	☐	☐
provided with an information system to manage occupational safety and health in the facility during a storm?	☐	☐	☐
equipped with an emergency plan to protect health workers from multiple biological and chemical hazards?	☐	☐	☐
provided with a poststorm employee recovery assistance programme according to staff needs?	☐	☐	☐
equipped with a coordinated plan, including volunteers on stand-by, to assist during an emergency or to support health professionals?*	☐	☐	☐
provided with full personal protective equipment, especially for clean-up crews (including waterproof safety boots, goggles, work gloves and masks)?*	☐	☐	☐
provided with safe water and food during an event?	☐	☐	☐
(Capacity development)			
trained on public health and climate change hazards, including health impacts related to different kinds of storms?	☐	☐	☐
equipped with knowledge, experience, training and resources to manage storm risk reduction at the facility and in the local communities?*	☐	☐	☐
engaged in the development of plans and responses to storm risks?	☐	☐	☐
prepared and able to implement risk reduction actions for protecting themselves?	☐	☐	☐
equipped with a contingency plan for continuing to provide services at other facilities or in the local communities (health primary care), if necessary?*	☐	☐	☐

STORMS		Vulnerability level		
High: unprepared; unable to respond (Higher risk) **Medium:** basic or incomplete preparation; low level of response (Medium risk) **Low:** prepared; able to respond (Lower risk)		High	Medium	Low
HEALTH WORKFORCE	**Is the health workforce,**			
	trained to manage hazardous chemicals in emergency situations?	☐	☐	☐
	trained in multihazard assessments?	☐	☐	☐
	trained to maintain correct level of water quality controls in an emergency or disaster situations?*	☐	☐	☐
	trained to an appropriate standard to maintain the correct level of safety of electrical power supply, in both routine and emergency/disaster situations?*	☐	☐	☐
	trained to detect posttraumatic stress disorder among staff to take prompt action?*	☐	☐	☐
	(Communication and awareness raising)			
	provided with a safe internal communication system, specially in emergency situations?	☐	☐	☐
	aware of contingency plans for accessing and leaving the facility during flood and strong wind emergencies, and health workforce transportation?	☐	☐	☐
	regularly participating in community disaster planning committees to: improve knowledge on how to reduce risks, be prepared and respond to storm hazards, and recover better than before through adaptation measures?*	☐	☐	☐
	prepared with clear messaging about water and food safety during and after a storm?	☐	☐	☐
	prepared with clear messaging, and staff trained on exit and evacuation routes that are clearly marked and free of obstacles to enable emergency evacuation?*	☐	☐	☐
	equipped with a community health educational programme to assist the community in reducing vulnerability to storm impacts?	☐	☐	☐
	equipped with a community health educational programme to improve community health in the face of storm risks?	☐	☐	☐
WATER, SANITATION AND HEALTH CARE WASTE	**Does the health care facility,**			
	(Monitoring and assessment)			
	assess the capacity of the existing stormwater management system, to ensure adequacy for anticipated 50- or 100-year storm events today?	☐	☐	☐
	verify water safety conditions, including updated risk assessments to map water resources and water supplies for the facility?*	☐	☐	☐
	regularly assess its sanitation systems for any possible damage in the event of storms and severe winds?	☐	☐	☐
	have information on water system installation that ensures lower risk of contamination?	☐	☐	☐
	have a water quality monitoring plan for drinking water during and after the event?*	☐	☐	☐
	monitor sewer overflows to fix pumps in advance of a storm and after the event?	☐	☐	☐
	(Risk management)			
	have a stormwater management system able to cope with storm-caused floods?	☐	☐	☐
	have a stormwater management system to avoid standing water near the facility?	☐	☐	☐
	store hazardous chemicals, radioactive and biological wastes in a safe place and on a level above the ground floor?*	☐	☐	☐
	have a schedule for emptying latrines in advance of storms to avoid overflows?	☐	☐	☐
	have water storage tanks supported and anchored to resist strong winds and rainfall?	☐	☐	☐

STORMS	Vulnerability level		
High: unprepared; unable to respond (Higher risk) **Medium:** basic or incomplete preparation; low level of response (Medium risk) **Low:** prepared; able to respond (Lower risk)	High	Medium	Low
WATER, SANITATION AND HEALTH CARE WASTE			
Does the health care facility,			
have a safe system for waste disposal after a storm?	☐	☐	☐
have an established safe management approach to health care waste transport (including hazardous waste) during and after a storm?	☐	☐	☐
provide appropriate covers for water storage tanks to prevent damage and water contamination?*	☐	☐	☐
have onsite water purification equipment to provide safe drinking water?	☐	☐	☐
have nonreturn valves installed on water supply pipes to prevent backflows, in case of flooding?*	☐	☐	☐
have a surveillance system for diseases related to water quality and sanitation?*	☐	☐	☐
(Health and safety regulation)			
have an assessment plan that maps risks to water and sanitation infrastructures to identify where services could be disrupted during storms, floods and landslides?	☐	☐	☐
have an emergency water supply plan?*	☐	☐	☐
have a plan to verify safety conditions and proper functioning of all elements of the water distribution system, including storage tanks, cisterns, valves, pipes and connections, as well as water disinfection to avoid or reduce impacts from a storm?*	☐	☐	☐
have a contingency plan to ensure effective and timely delivery of safe water during extreme temperatures and emergencies over the short- and long-term?*	☐	☐	☐
have an emergency plan for maintenance and restoration of waste management systems?*	☐	☐	☐
ENERGY			
Does the health care facility,			
(Monitoring and assessment)			
regularly assess its energy system to ensure that it can cope with storm events and minimize their impacts (e.g. solar photovoltaic panels, either rooftop or ground mounted)?	☐	☐	☐
have an emergency backup generator (including fuel, where relevant) that is able to cover at least all critical service areas and equipment during and after the event?*	☐	☐	☐
periodically check emergency backup generators (including fuel, where relevant)?*	☐	☐	☐
identify priority areas within the facility which would require emergency power when needed?	☐	☐	☐
assess whether renewable energy (if available, such as solar) is sufficient to power critical equipment?	☐	☐	☐
(Risk management)			
have a secure place to protect the backup generator (e.g. elevated and anchored in areas prone to floods and strong winds; including fuel or battery storage, where relevant) from damage?*	☐	☐	☐
have appliance thermometers in the refrigerator and freezer to determine if food, vaccines and other essential refrigeration-dependent medical supplies are safe?	☐	☐	☐
have adequate daylight to ensure proper visibility during a power outage?	☐	☐	☐
have power-operated doors that can be opened manually to permit exit during power failure?	☐	☐	☐
have a clear guidance to alert staff on safety measures (e.g. never restore power when the power is off, until a professional inspects and ensures the integrity of the electrical system; do not use electrical equipment that has been exposed to flood waters until checked by an electrician; unless power is off, never enter flooded areas or touch electrical equipment if the ground is wet)?	☐	☐	☐

STORMS	Vulnerability level		
High: unprepared; unable to respond (Higher risk) **Medium:** basic or incomplete preparation; low level of response (Medium risk) **Low:** prepared; able to respond (Lower risk)	High	Medium	Low
ENERGY			
Does the health care facility,			
(Health and safety regulation)			
have an emergency plan for power outages in the short- and long-term (before, during and after a storm)?	☐	☐	☐
work with energy utility agencies to prevent suspension of electricity services?	☐	☐	☐
have a management plan for intermittent energy supplies or system failure?	☐	☐	☐
have a plan or regulation to determine ways to reduce overall energy use?	☐	☐	☐
have an emergency plan to ensure availability of adequate lighting, communication and information systems, as well as refrigeration and sterilization equipment during a storm?*	☐	☐	☐
INFRASTRUCTURE, TECHNOLOGIES, PRODUCTS AND PROCESSES			
Does the health care facility,			
(Adaptation of current systems and infrastructures)			
have knowledge, experience (considering previous damages) and resources (including human, material, financial, supplies chain and logistics) to reduce disaster risk related to storms?*	☐	☐	☐
work with the local government to support vulnerable local populations to actively participate in risk reduction management, policy making, planning and implementation?	☐	☐	☐
conduct climate risk and vulnerability assessments for all facility sectors to identify risk scenarios, vulnerabilities and the facility's response capacity?	☐	☐	☐
have a monitoring and early warning system to manage and reduce the risks of storm-related health effects?	☐	☐	☐
utilize the assessed information as a basis to plan and prioritize measures to reduce risk impact?	☐	☐	☐
in their annual planning consider how climate risks may change in the future?	☐	☐	☐
have resources available to adopt risk reduction measures on the building and its infrastructure, technologies, products and processes?	☐	☐	☐
regularly update these assessments, considering emerging scientific information?	☐	☐	☐
have a schedule to inspect the facility regularly, both internally and externally, for signs of deterioration (e.g. broken plaster, cracks or sinking structural elements) to avoid or reduce storm impacts (including flood impacts)?	☐	☐	☐
evaluate the condition and safety of structural and nonstructural elements of the facility, impacted by previous exposures to storms or similar hazards?*	☐	☐	☐
have an effective emergency risk communication plan to reduce risks and impacts for health workers and patients?*	☐	☐	☐
have a contingency plan in place for safe and efficient personnel evacuation (including health staff and patients) before, during and following a storm?*	☐	☐	☐
have a plan to transfer critical equipment and medical supplies to another health care facility or to a secure storage?*	☐	☐	☐

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INFRASTRUCTURE, TECHNOLOGIES, PRODUCTS AND PROCESSES			
Does the health care facility,			
have a plan for relocating medical devices, medicines, mobile equipment and other supplies and services in case of operational disruption or outbreaks and epidemics that overwhelm the facility?	☐	☐	☐
have evaluation tools (e.g. forms) to identify damages and minimum needs in terms of health workers and medical supplies to ensure continuous functioning of services?*	☐	☐	☐
have a mechanism for providing prompt maintenance and repair of equipments required for essential services?	☐	☐	☐
have procedures to store food and bottled water on shelves that will be safely out of the way of contaminated water in case of flooding?	☐	☐	☐
have established procedures or plans for procuring, transporting and storing bottled water and food supplies during an emergency?	☐	☐	☐
have established procedures for procuring, and safely transporting and storing medical devices, vaccines, pharmaceuticals, parenteral nutrition and blood supplies, laboratorial supplies, and other essential medical supplies?	☐	☐	☐
assess the performance and vulnerabilities of each critical part of the facility (structural and nonstructural elements) that can be affected by storm hazards?	☐	☐	☐
calculate possible losses and implement measures to reduce impacts?	☐	☐	☐
have a plan to house staff at the health care facility if shelter in place is required (sleeping rooms, food, water)?	☐	☐	☐
have roof drainage systems and adequate capacity in the event of excessive rainfall?*	☐	☐	☐
have roofs that are leak-proof and insulated?*	☐	☐	☐
have safe roofing designed to withstand wind velocity of 175–250 kph (e.g. in a high intensity tropical storm)?*	☐	☐	☐
have rooftop structures and equipment which have been reviewed for anticipated storm and high wind speeds?*	☐	☐	☐
have machine rooms that are resistant to flooding or high wind/rooftop damage?	☐	☐	☐
have stairwell construction fortified against high-wind events?	☐	☐	☐
have measures in place to remove mosquito breeding sites?	☐	☐	☐
have glass walls, doors and windows able to resist basic wind speeds up to 200–250 kph?*	☐	☐	☐
have laminated or protected glass windows to prevent risk of shattering during a storm?*	☐	☐	☐
have leak proof windows and doors with wind protection devices?	☐	☐	☐
have walls that are protected and insulated against moisture and mold?	☐	☐	☐
ensure removal of equipment and power supplies from basements and ground floor level to avoid damage from flooding?	☐	☐	☐
have health care agreements with other health care providers for additional health services and clinical resources?	☐	☐	☐
have a coordinated mechanism across the health sector in different levels of government, to manage the response and risks of public health emergencies and disasters (including sharing of resources and supplies, transferring of patients, and health workforce support)?*	☐	☐	☐
have a plan on continuity of operational processes during a storm and for building back better through training and workshops?	☐	☐	☐

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INFRASTRUCTURE, TECHNOLOGIES, PRODUCTS AND PROCESSES			
Does the health care facility,			
conduct site and building maintenance procedures that include specifications on how the weather may affect the safety and continued functioning of the facility?	☐	☐	☐
have a space within or external to the facility for the storage and stockpiling of additional supplies, considering ease of access, security, temperature, ventilation, light exposure and humidity?	☐	☐	☐
have an established poststorm recovery plan for all infrastructure (structural and nonstructural elements) of the facility?*	☐	☐	☐
(Promotion of new systems and technologies)			
have an information system between the health sector and meteorological services to communicate about climate hazards?	☐	☐	☐
have an established plan to review, evaluate and catalogue climate risks related to storms for the health care facility location?*	☐	☐	☐
have an established plan to review, evaluate and catalogue risks related to storms for the health care facility supply chain?*	☐	☐	☐
have an established, clear and consistent knowledge transfer procedure in case of a public health emergency?*	☐	☐	☐
have electronic patient health records to make available to other receiving facilities in case of evacuation?	☐	☐	☐
ensure information and communication flow between the health workforce and policy makers, particularly during high-stress situations and demands created by emergencies?	☐	☐	☐
have information and communication systems safely secured with backup arrangement (via cloud, satellite) to satisfy the facility's demand?*	☐	☐	☐
have an information system for tracking and monitoring diseases following storm events?	☐	☐	☐
have more than one access route, especially if the facility is critical to higher demand following a storm event?*	☐	☐	☐
(Sustainability of health care facility operations)			
review building code design baselines against storm, wind speeds, rainfall volumes, and map each risk?*	☐	☐	☐
have a defined and sustained budget as part of core budgeting for emergency preparedness and response, including for storm hazards?*	☐	☐	☐
improve adaptive governance capacity regarding evaluation and measures for risk identification, risk reduction and response?	☐	☐	☐
have trees planted in a secure place that will not block access to the facility or fall on the building during an event?	☐	☐	☐
have established partnerships between the facility, community and local authorities to identify and reduce vulnerabilities in the surrounding areas?	☐	☐	☐
have an access route for public transportation which is likely to remain operational during or immediately following a storm event?	☐	☐	☐
have a secure storage for critical chemicals and materials to avoid their damage or release during or following a storm event?*	☐	☐	☐
have estimates of the consumption of essential medical, pharmaceutical, nutritional and laboratorial supplies, personal protective equipment, food, etc. (such as amount used per week), using the most likely storm scenario (including flood impact)?*	☐	☐	☐

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Does the health care facility,			
undertake risk assessments of the supply chain for essential medical and nonmedical products?	☐	☐	☐
have a secure plan to ensure continuity of the facility's supply and delivery chain?	☐	☐	☐
have secure access to essential backup services such as sterilization, laundry and cleaning services, via multiple agreements with different facilities to maintain functioning of critical services during or immediately following a storm event?	☐	☐	☐
have secure access to essential backup food sources via multiple agreements with different vendors and through cooperative agreements with other health care facilities to maintain functioning of critical services?*	☐	☐	☐

Note: For WASH and health care waste details see WASH FIT (3).

**For further details see Hospital Safety Index (2).*

IMPACTS CHECKLIST FOR STORMS

HEALTH WORKFORCE		
LEVEL OF IMPACT		
MAJOR	**MODERATE**	**MINOR**
☐ Deaths, life-threatening injuries or illness among health workers	☐ Serious harm, injury or illness causing hospitalization and medical treatment	☐ Minor injuries to health workers requiring minimal or short-term medical treatment
☐ Loss of work capacity	☐ Health professionals not able to arrive at or depart from the health care facility	☐ Difficulty in providing medications and home primary services to the communities
☐ Cessation of critical programmes or service availability with possible overflow to other locations	☐ Reduction of health workforce functions	☐ Reduced functioning of health workers if the facility lacks a plan to respond to overcrowding of patients and visitors
☐ Significantly reduced performance capacity of health workforce; needing additional support (local, regional or national)	☐ Restrictions to the provision of some health care services and programmes	☐ Service delivery and programme delays
☐ Increased risks of occupational hazards, including water-, food- and vector-borne diseases, animal bites, electrical shocks and hazardous chemicals exposure	☐ Effects on mental health due to disaster trauma resulting in diminishing ability to provide adequate care to patients	
☐ Increased health care demand for infectious diseases (water-, food- and vector-borne diseases), animal bites (including poisonous animals), noncommunicable diseases, and toxic chemicals exposure, increasing health workforce overload and availability	☐ Increased respiratory diseases from dust storms	
☐ Increased work overload with stress		

WASH AND HEALTH CARE WASTE		
LEVEL OF IMPACT		
MAJOR	**MODERATE**	**MINOR**
☐ Overflow of storm water and wastewater containment systems leading to surpassing the capacity of water treatment and distribution systems ☐ Severe damage to water supply system and infrastructure ☐ Severe disruption of wastewater and sewage systems ☐ Heavy rainfall risks the flushing of pathogens into water sources ☐ Large-scale water contamination ☐ Shortage of safe water ☐ No access to drinking water ☐ Unable to provide sanitation and hygiene services ☐ Damage to waste storage causing environmental contamination from biological and chemical hazards ☐ Sharps containers and specific biological and medical bins damaged, potentially releasing hazardous materials ☐ Increased risk of contamination of medical devices, instruments and equipment, and other medical supplies	☐ Increased health workforce infections from water and health care waste contamination ☐ Reduced capacity to provide efficient clean services (floor, toilets, patient rooms, emergency room and other rooms in the facility) ☐ Reduced capacity to provide water for drinking and cooking ☐ Reduced functioning of sanitation systems and hygiene practices (flush toilets, showers, sewerage, treatment, hand washing, medical procedures, etc.) ☐ Damaged sewage systems causing cross-contamination ☐ Possible damage to emergency water sources ☐ Increased nutrient loads ☐ Possible overflow of effluents into streams and rivers if surface water enters septic tanks ☐ Increased possibility of contamination of groundwater due to infiltration of pollutants (including during dust or sand storms)	☐ Reduced access to water for health care practices ☐ Reduced hygiene capacity (flush toilets, showers, etc.) ☐ Reduced capacity for using laundry and dishwashing machines ☐ Heavy sediment and pollution loads that make treatment ineffective ☐ Increased risk of breakdown of final waste collection and transportation systems within/outside the health care facilities

ENERGY		
LEVEL OF IMPACT		
MAJOR	**MODERATE**	**MINOR**
☐ Power outage (wind- and lightning-related) ☐ Interruption of acute medical care or other health services that rely on electricity (such as dialysis, intensive treatment rooms, oxygen therapy, radiotherapy, laboratory room, imaging and diagnostic equipment, and other areas) ☐ Loss of vaccines, laboratorial supplies, pharmaceuticals, drugs, milk, parenteral nutrition and blood supplies, and other essential refrigeration-dependent medical supplies ☐ Disruption of the fuel supply chain ☐ Damage to solar photovoltaic panels or other energy sources ☐ Disruption of energy-dependent water pumping and treatment systems	☐ Difficulty in providing health care services (such as dialysis, intensive care rooms, oxygen therapy, radiotherapy, imaging and diagnostic equipments), resulting in patients being transported to other facilities ☐ Reduced capacity to provide cleaning services that need electricity (laundry, dishwashing machines) ☐ Reduced capacity to provide disinfection services that need electricity (autoclave, microwave) ☐ Reduced electricity capacity resulting in loss of medical supplies and decrease in health care services ☐ Possible damage to the emergency generator or other sources of energy	☐ No ambient cooling, thereby increasing staff and patient discomfort ☐ Loss of food or difficulty in keeping food refrigerated ☐ Reduced capacity to follow boil water advisories

INFRASTRUCTURE, TECHNOLOGIES, PRODUCTS AND PROCESSES		
LEVEL OF IMPACT		
MAJOR	**MODERATE**	**MINOR**
☐ Direct damage to infrastructure (water storage tanks, roofs) from high winds ☐ Structural failure of the building ☐ Disruption to building access ☐ Damage to machine rooms ☐ Damage to communication and information systems and assets ☐ Loss or damage of essential supplies (medications, treatments, medical devices, drugs, pharmaceuticals, vaccines, etc.) ☐ Interruption of complex and emergency health care services (surgery, complex treatment, urgent health care, etc.) ☐ Disruption of health care services and operations ☐ Cessation of services or prolonged disruption of services due to loss or damage ☐ Breakdown of routine health care services (such as ambulatory, immunization, maternity room, pharmacy, medication for chronic diseases, and other primary services) ☐ Interruption of diagnosis due to equipment damages ☐ Interruption of supply chains ☐ Long-term effect on the environment, requiring external assistance/interventions ☐ Damage to internal transportation systems (elevators, ramps, corridors, garage, etc.) ☐ Increased treatment demand for infectious, cardiovascular and respiratory diseases ☐ Increase in complex and emergency health care services (complex treatments, outbreaks, etc.)	☐ Structural damage to the building ☐ Damage to road, impairing access ☐ Difficult to transport patients due to damaged or disabled transportation systems ☐ Reduced capacity to deliver health care services due to damaged and reduced supplies ☐ Temporary suspension of service deliveries ☐ Damage to paper medical record storage ☐ Reduced capacity to access clinical and laboratorial supplies ☐ Impacts from trees falling on the facility causing damage to building infrastructure and injuries to people ☐ Increased hospitalization rates requiring extra medical supplies and health workforce ☐ Increased costs due to high demand of critical supplies during and after the event ☐ Increased costs due to necessary financial investment in the recovery of facility infrastructure (structural and nonstructural), postevent	☐ Localized disruption of services with minor losses and damage ☐ Damage or loss of documents and records ☐ No lasting effect on the external environment of the facility ☐ Minimal impact on local operations and equipment, without compromising health care service deliveries ☐ Minimal impact on the supply chain

Sources for tables of vulnerabilities and impacts: (2,3,8,21,27,32,41,42,44–47).

STORMS: PROPOSED ACTIONS TO RESPOND TO THE IDENTIFIED IMPACTS

Health workforce
WASH and health care waste
Energy
Infrastructure, technologies, products and processes