



REPUBLIC OF LEBANON  
MINISTRY OF ENVIRONMENT



# CLIMATE CHANGE IN LEBANON VULNERABILITY AND ADAPTATION OF HEALTH CARE PROVIDERS

and lessons learned from COVID-19 Crisis



2022

**CLIMATE CHANGE IN LEBANON  
VULNERABILITY AND  
ADAPTATION OF  
HEALTH CARE  
SERVICE PROVIDERS  
AND LESSONS LEARNED FROM COVID-19 CRISIS**

**2022**

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## **UNFCCC FOCAL POINT**

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# FOREWORD



**“The report ultimately seeks to make data and analysis available to the public, policy makers and humanitarian and development partners to support evidence-based policies, and to facilitate better planning and programme on healthcare issues.”**

Over the past decade, Lebanon has endured multiple crises, including political instability, the fast changing financial and economic situation, compounded by the COVID-19 outbreak, the Beirut Port explosions and the impact of the Syria crisis. These compounded crises have significantly exacerbated pre-existing development challenges in the country, while contributing to the deterioration of an already vulnerable healthcare system, especially given the immense added pressure on resources since 2019. Within this framework, the Ministry of Environment (MoE) with the support of the United Nations Development Programme (UNDP) and the Global Environment Facility (GEF) and) have partnered to jointly prepare the “Vulnerability and Adaptation of Health Care Service Providers and lessons learned from COVID-19 Crisis”. The purpose of the report is to consolidate, analyse and present the latest available data on health sector vulnerabilities in Lebanon, and how best to overcome them. Each chapter has been drafted and reviewed by experts across the fields of health care and climate change adaptation.

The report ultimately seeks to make data and analysis available to the public, policy makers and humanitarian and development partners to support evidence-based policies, and to facilitate better planning and programme on healthcare issues. It also provides forward looking scenarios for better adaptation of health care service strategies taking into consideration lessons learned from the COVID-19 crisis in Lebanon. These scenarios include (a) a negative outlook that is based on the current situation and status quo and (b) a more positive outlook that considers these crises as opportunities to build Lebanon forward and break the country’s current unsustainable path.

We hope that the report will contribute to a better understanding of the impacts of climate change on the health sector in Lebanon and will foster a renewed commitment among all stakeholders to put in place forward looking, integrated and sustainable solutions for people and planet. The current challenges are many; through our collective engagement, they can also be turned into opportunities to support financial recovery agendas, advocate climate-friendly adaptation measures, promote equitable healthcare accessibility and move Lebanon towards realizing the Sustainable Development Goals, and its own climate ambitions.

**Nasser Yassin, PhD**  
Minister of Environment



**“Through our collective effort, challenges can be turned into opportunities for building equitable environments for everyone.”**

Over the last few years, Lebanon has been at a hazardous crossroads, faced with unprecedented crises: political, financial and economic collapse; suspension of essential services, widespread unemployment, poverty and political instability. This critical situation compounded with a global health crisis has impacted the livelihoods of people especially the most vulnerable. The challenges are immense and the need to immediate measures are needed more than anytime before. We, at the United Nations Development Programme (UNDP) are fully committed in supporting Lebanon’s stability, in these critical times.

UNDP’s strategic plan for Lebanon 2022-2025 aims at working very closely with the Government of Lebanon with the aim of reinforcing national institutions to provide basic services within the current challenges environment. For more than two decades, UNDP has been working closely with the Ministry of Environment to address climate risks and ensuring a sustainable and healthy environment where people are the centre of development.

Unfortunately, given the very fragile economic environment, the COVID-19 crisis have had devastating economic costs — both directly and indirectly and has exacerbated even further the health sector.

The report looks at current challenges facing the healthcare sector and builds on the lessons learned from the COVID-19 response. It identifies vulnerabilities and entry points for improved preparedness, response, and recovery plans for future climate-related issues. Through collective efforts of all sectors of the society, challenges can be turned into opportunities ensuring health, and protection are essential in building equitable environments for everyone.

UNDP is fully committed to a green, inclusive and sustainable recovery. Our long-standing partnership with the Government of Lebanon will help us reach collectively our goals in ensuring the creation of a safe environment for a population struggling to survive and strive.

**Melanie Hauenstein**  
**UNDP Resident Representative**

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<b>ACSAD</b>	Arab Center for the Study of Arid Zones and Dry Lands
<b>AFD</b>	Agence Française de Développement
<b>AFP</b>	Acute Flaccid Paralysis
<b>AIDS</b>	Acquired Immunodeficiency Syndrome
<b>AMA</b>	Australian Medical Association
<b>AR6</b>	Sixth Assessment Report
<b>AUB</b>	American University of Beirut
<b>AUBMC</b>	American University of Beirut Medical Center
<b>AWD</b>	Acute Watery Diarrhea
<b>BBC</b>	British Broadcasting Corporation
<b>BMC</b>	Bellevue Medical Center
<b>CBRN</b>	Chemical, Biological, Radiological and Nuclear
<b>CEDRO</b>	Country Energy Efficiency and Renewable Energy Demonstration
<b>CMC</b>	Clemenceau Medical Center
<b>CNRS</b>	National Council for Scientific Research
<b>COP</b>	Conference of the Parties
<b>COPD</b>	Chronic Obstructive Pulmonary Disease
<b>COVID-19</b>	Coronavirus Disease 2019
<b>CPHL</b>	Central Public Health Lab
<b>DEHP</b>	Di(2-ethylhexyl) phthalate
<b>DHIS2</b>	District Health Information Software 2
<b>DRM</b>	Disaster Risk Management
<b>DRR</b>	Disaster Risk Reduction
<b>EHO</b>	Emergency Health Operations Unit
<b>EIB</b>	European Investment Bank
<b>EMFLU</b>	Eastern Mediterranean Flu
<b>EMS</b>	Emergency Medical Services
<b>ESA</b>	Ecole Supérieure des Affaires
<b>ESCWA</b>	United Nations Economic and Social Commission for Western Asia
<b>ESU</b>	Epidemiological Surveillance Unit
<b>EU</b>	European Union
<b>EWARS</b>	Early Warning Alert and Response System
<b>FFX</b>	First Few X
<b>FMS</b>	Facility Management and Safety
<b>GCC</b>	Gulf Cooperation Council

<b>GDP</b>	Gross Domestic Product
<b>GEF</b>	Global Environment Facility
<b>GHG</b>	Greenhouse Gas
<b>GL</b>	Governance and Leadership
<b>HAZMAT</b>	Hazardous Materials
<b>HC</b>	Human Capital
<b>HCF</b>	Healthcare Facility
<b>HCW</b>	Health Care Waste
<b>HIV</b>	Human Immunodeficiency Virus
<b>HRC</b>	High Relief Council
<b>HRW</b>	Human Rights Watch
<b>ICC</b>	Integrated Comprehensive Care
<b>ICRC</b>	International Committee of the Red Cross
<b>ICU</b>	Intensive Care Unit
<b>IDB</b>	Inter - American Development Bank
<b>IDP</b>	Internally Displaced Persons
<b>IHR</b>	International Health Regulations
<b>IM</b>	Information Management
<b>IPC</b>	Infection Prevention and Control
<b>IPCC</b>	Intergovernmental Panel on Climate Change
<b>ISO</b>	International Standard Organization
<b>ISQua</b>	International Society for Quality in Healthcare
<b>JCI</b>	Joint Commission International
<b>JEE</b>	Joint External Evaluation
<b>LAUMC</b>	Lebanese American University Medical Center
<b>LCEC</b>	Lebanese Center for Energy Conservation
<b>LED</b>	Light-Emitting Diode
<b>LEED</b>	Leadership in Energy and Environmental Design
<b>LEMSIC</b>	Lebanese Medical Students' International Committee
<b>LNCSR</b>	Lebanese National Council for Scientific Research
<b>LRC</b>	Lebanese Red Cross
<b>M&amp;E</b>	Monitoring and Evaluation
<b>MDs</b>	Doctor of Medicine
<b>MENA</b>	Middle East and North Africa
<b>MMS</b>	Medication Management and Safety
<b>MoAg</b>	Ministry of Agriculture
<b>MoE</b>	Ministry of Environment
<b>MoEW</b>	Ministry of Energy and Water
<b>MoIM</b>	Ministry of Interior and Municipalities
<b>MoPH</b>	Ministry of Public Health
<b>MOSA</b>	Ministry of Social Affairs
<b>MRC</b>	Medical Reserve Corp
<b>mRNA</b>	Messenger Ribonucleic Acid
<b>ND-GAIN</b>	Notre Dame Global Adaptation Initiative
<b>NDVP</b>	National Deployment and Vaccination Plan
<b>NERC</b>	National Emergency Response Committee
<b>NGO</b>	Non-Governmental Organization

<b>OCHA</b>	United Nations Office for the Coordination of Humanitarian Affairs
<b>OH&amp;S</b>	Occupational Health and Safety
<b>OH&amp;SMS</b>	Occupational Health and Safety Management System
<b>OPD</b>	Outpatient Department
<b>OSHA</b>	Occupational Safety and Health Administration
<b>PCR</b>	Polymerase Chain Reaction
<b>PHCC</b>	Primary Health Care Center
<b>PM</b>	Prime Minister
<b>POE</b>	Point of Entry
<b>PPE</b>	Personal Protective Equipment
<b>PVC</b>	Polyvinyl Chloride
<b>QMPS</b>	Quality Management and Patient Safety
<b>RCO</b>	United Nations Resident Coordinator's Office
<b>RHUH</b>	Rafic Hariri University Hospital
<b>RICCAR</b>	Regional Initiative for the Assessment of the Impact of Climate Change
<b>RNA</b>	Ribonucleic Acid
<b>RN</b>	Registered Nurse
<b>RUHU</b>	Rafic Hariri University Hospital
<b>SARS</b>	Severe Acute Respiratory Syndrome
<b>SDC</b>	Social Development Centers
<b>SDG</b>	Sustainable Development Goal
<b>SOP</b>	Standard Operational Procedure
<b>SRH</b>	Self-rated Health
<b>UN</b>	United Nations
<b>UNCT</b>	United Nations Country Team
<b>UNDP</b>	United Nations Development Programme
<b>UNDRR</b>	United Nations Office for Disaster Risk Reduction
<b>UNEP</b>	United Nations Environment Programme
<b>UNFCCC</b>	United Nations Framework Convention on Climate Change
<b>UNHCR</b>	United Nations High Commissioner for Refugees
<b>UNICEF</b>	United Nations International Children's Emergency Fund
<b>UNIFIL</b>	United Nations Interim Force in Lebanon
<b>UNOPS</b>	United Nations Office for Project Services
<b>UNTC</b>	United Nations Treaty Collection
<b>UNU-INWEH</b>	United Nations University Institute for Water, Environment and Health
<b>USAID</b>	United States Agency for International Development.
<b>USD</b>	United States Dollar
<b>USEPA</b>	United States Environmental Protection Agency
<b>USJ</b>	Saint-Joseph University
<b>WASH</b>	Water, Sanitation, and Hygiene
<b>WHO</b>	World Health Organization
<b>WHO EMRO</b>	WHO Regional Office for the Eastern Mediterranean

# EXECUTIVE SUMMARY

Lebanon has experienced and will continue to face increased temperatures, as well as increasingly frequent and severe natural disasters related to climate change caused by shifts in temperature, precipitation, and water regimes (e.g. heat waves, drought spells, floods and other climate-driven extreme events). Climate change not only has direct impacts on human health but also threatens the capacity of health care delivery services to manage and protect population health (e.g. through the vulnerability and reliability of infrastructure or critical services and healthcare facilities).

Preliminary assessments of the vulnerability of health care delivery services in Lebanon consider the overall adaptive capacity to be low, as many of them lack the capacity and resources needed to prepare for and respond to this climatic challenge. Furthermore, the COVID-19 crisis has exposed these vulnerabilities and highlighted the urgent need for better disaster preparation and strengthened resilience, not only to withstand future pandemics but also future threats coming from an unstable and changing climate.

In its updated Nationally Determined Contribution to Climate Change (NDC), Lebanon outlined 7 adaptation priorities, which included: “Ensure overall public health and safety through climate resilient health systems”. In addition, Lebanon’s National Health, and Environment Strategy (2020) recommends developing the preparedness and response capacity of the public health sector to manage health effects as the main strategic response to climate change.

In line with the NDC and the National Health and Environment strategy, the purpose of this study is to assess the vulnerability of Lebanon’s health care facilities and provide guidance to increase the resilience of service providers to current and potential climate threats.

## **Climate change impacts and healthcare facilities**

Climate threats are particularly disruptive to individuals and communities when they affect healthcare facilities. Health care facilities are expected to face increased challenges coping with climate-related risks, such as droughts, extreme temperatures, fires, and changed patterns of climate-sensitive diseases which will affect their physical and operational capacity. The increased intensity and frequency of natural hazards can affect the functioning of healthcare facilities, and result in increased demand for services. As such, climate change can affect the delivery of

healthcare services in large hospitals and small facilities, and in high- and low-income settings alike. In addition, healthcare facilities' concerns can be exacerbated by climate change hazards by impacting their infrastructure, support systems, supply chains and workforce.

Consecutively, the healthcare sector is also responsible for emissions of greenhouse gases, through their electricity and energy generation and consumption, transport activities and waste and wastewater generation. And, with the projected increase in the burden of disease from climate change, the demand for healthcare facilities will increase; leading to further increase in GHG emissions generated by the health sector.

Therefore, it is becoming a necessity for healthcare facilities to incorporate low carbon and climate resilience plans into their long-term strategies. The goal is to not only improve the preparedness and adaptation of healthcare facilities to climate change crises and protect population health during emergencies, but also to build environmentally sustainable health facilities. These facilities would improve, maintain, or restore health, while minimizing the negative impacts on the environment, and leveraging opportunities to restore and improve it.

### **Preparedness of health care facilities: Current status and challenges**

According to this study, the level of preparedness of Lebanese healthcare facilities is low and what has been achieved, to date, to improve the preparedness is relatively minimal. The analysis, which is based on the type of accreditation or certification programme that a healthcare facility has, and the degree of compliance it meets, shows that the compliance in addressing the four key vulnerability areas of health workforce, WASH and healthcare management, energy management, and infrastructure, technologies, products, and processes is also minimal, even for facilities accredited by one or more accreditation programs. In addition, the accreditation coverage in Lebanon is still low with only 8% of primary healthcare centers being currently accredited and centers are not evenly distributed throughout the country with a low coverage in the most vulnerable spots such as Baalbeck and Akkar Cazas, (8.5% and 10.4%, respectively). Moreover, major deficiencies in fulfilling health workforce and infrastructure requirements, among non-accredited centers has been documented, especially in centers not supported by International NGOs.

For hospitals, the setting is also complex considering the current socio-economic and financial situation of Lebanon that is hindering accredited hospitals from following up on the Revised National Hospital Accreditation Standard 2019, especially in governmental hospitals that lack the accreditation infrastructure.

The financial crisis that Lebanon has been facing since 2019 further exacerbated these challenges with a hoarding of unpaid bills for hospitals, rejection of coverage from some insurance companies, high cost of pharmaceuticals and medical supplies, unsafe working conditions, low salary wages, and layoffs of healthcare workers and the continued fluctuation of the Lebanese Lira leading the migration of skilled personnel. Moreover, the oil and fossil fuel shortages were some of the major challenges for providing electricity through generators, especially to patients surviving on ventilators, kidney dialysis units, and other medical devices.

## Lessons learned from COVID-19 response in Lebanon

The response to COVID 19 Pandemic, and the August 4<sup>th</sup> Beirut Port Explosion should be considered as “test case studies” to determine Lebanon’s resilience to emergencies including climate change challenges and crises. Globally, COVID-19 pandemic has reshaped the world, amplified gaps in the health systems and aggravated existing inequalities and so similarly, climate change challenges will continue to threaten the ability of health systems to protect and improve population health and wellbeing. It further highlighted the importance of long-term planning in a pandemic response that should be at the core of guiding the health sector’s approach to climate change.

In terms of positive lessons learned, Lebanon was classified among the top 15 countries that responded well to the outbreak. The MoPH adopted a proactive approach and took the necessary measures to activate the country’s preparedness, enhance response capacities, and surveillance for COVID-19 before the first case was detected in Lebanon. It also worked on enhancing preparedness and response through issuance of instruction memos, screenings at points of entry, procurement of medical supplies and testing kits, in addition to the activation of the national committee on infectious diseases and leading coordination with experts and stakeholders.

However, the COVID-19 pandemic has also exposed the health sector weaknesses in Lebanon, where proper response was challenged by various factors including the adoption of a reactive rather than proactive approach, the poor level of preparedness of public and private hospitals and primary health care centers to emergencies, and the limited coordination among sectors.

Lessons learned from COVID-19 emphasized the urgency of enhancing the resilience of healthcare centers to climate change crises through:

- Building the capacities and preparedness of the MoPH and other stakeholders to respond to emergencies and disasters including the establishment of an emergency risk and crisis management unit in MoPH
- Strengthening the health sector governance, including both the internal organization of the MoPH and wider sector governance arrangements
- Providing primary prevention interventions (such as WASH services or vaccination programs)
- Shifting funds to boost preventive care is critical for emergency preparedness of hospitals
- Investing in decentralization and technologies for early detection and tracing
- Providing surveillance for rapid detection of disease outbreak, specifically after a disaster
- Management and referral of patients (community-level triage system)
- Handling diseases related to health emergencies (e.g., mental health, chronic disease interventions, food- and water-borne disease)
- Communicating risks and sharing timely information
- Providing outreach mobile clinic services to disadvantaged populations
- Enhancing public-private health sector engagement and partnerships
- Issuing legislations that define economic/safety packages for healthcare facilities during emergencies and climate change disasters and to exempt healthcare facilities from certain taxes or expenses considering good environmental performance

- Allocating funds from the MoPH budget to the implementation of emergency preparedness and greening initiatives for the health sector
- Implementing The National Health and Environment Strategic Framework of Action 2021-2026 and the National Disaster Risk Reduction Strategy

## Recommendations

Overcoming these barriers necessitates an integrated approach to building climate resilience of the health sector. The current study recommends two types of interventions:

- Direct, at the micro level, that aims to develop set procedures for healthcare facilities to continuously implement and evaluate risk management programs to stay responsive to the facilities' needs under climate change related emergency events.

The most direct approach is to increase resilience at the facility level by increasing the accreditation rate of healthcare centers in Lebanon and integrating basic requirements for: (a) health workforce (human resources, capacity development and communication and awareness raising); (b) WASH and HCW management (monitoring and assessment, risk management and health safety regulations); (c) energy management (monitoring and assessment, risk management and health safety regulations); and (d) infrastructure, technologies, products and processes (adaptation of current systems and infrastructures, promotion of new systems and technologies, and sustainability of health care facility operation), is a must.

### Summary recommendations for increasing climate change preparedness of healthcare facilities

1. Determining the baseline of climate change resilience through assessing the facilities' vulnerability to climate change hazards
2. Integrating WHO's checklist for climate change vulnerability in the accreditation standards and certification systems
3. Increasing the geographical coverage of Primary Health Care Centers to respond to impacts of climate-induced events in vulnerable areas
4. Acquiring accreditation integrating basic requirements for health workforce, WASH, waste/energy management and infrastructure technologies
5. Securing support by international NGOs to improve the provision of a better health workforce and infrastructure
6. Annexing a complementary modified checklist to the Joint Commission International (JCI) Accreditation and the Hospital Accreditation 2019 Standards to enhance the preparedness of hospitals
7. Develop a plan of action for governmental hospitals based on a modified climate change vulnerability checklist, to address direct, intermediate, and long-term interventions

- Indirect, at the macro level, that aims to support healthcare facilities through strengthening health sector's preparedness and response to emergencies.

Complementary national policies and strategies that provide an enabling environment for the health system should be in place and building resilience and preparedness should be a cross-government priority that involves all stakeholders and actors to be able to work in a coordinated manner. WHO recommends the adoption of the 5 building blocks of: (a) health governance and policy, (b) human resources for health, (c) information systems, (d) service delivery, and (e) financing. It is crucial to direct health governance and policy towards protecting human health from climate risks and strengthening partnership with health-determining sectors to benefit mitigation and adaption measures. This can be achieved through:

- Ensuring coordination and communication between stakeholders to raise awareness and ensure policy coherence
- Building technical, organizational, and institutional capacity
- Mobilizing resources to support effective implementation
- Directing Management Systems towards climate change research, translation of research findings to policy-making, and structured risk communication.
- Directing service delivery towards determining health risks related to disasters, water, waste, food, and air pollution and strengthen community-based risk reduction.
- Mobilizing international climate change financing for projects and programs focused on building the health systems' resilience (e.g. the GEF, Adaptation Fund, bilateral donors).

## Conclusion

National efforts should be primarily directed towards developing environmentally sustainable healthcare facilities that can anticipate, respond to, recover from, and adapt to climate change impacts, all while minimizing to restore and improve it, to bring ongoing and sustained health care to their target population and protect the health and well-being of future generations. Greening the health sector is a major strategic response to achieving the sustainable development goals as defined by the National Health and Environment Strategic Framework 2021-2026.

# ملخص تنفيذي

شهد لبنان ارتفاعاً في درجات الحرارة وسيستمر في مواجهة هذه الحالة، فضلاً عن مواجهة الكوارث الطبيعية المتكررة والشديدة بوتيرة متزايدة، وهي تتعلق بتغير المناخ الناجم عن التحوّلات في درجات الحرارة ومعدلات سقوط الأمطار وأنظمة المياه (على سبيل المثال موجات الحر وموجات الجفاف والفيضانات وغيرها من الأحداث القاسية الناجمة عن المناخ). لا يترتب على تغير المناخ تأثيرات مباشرة على صحة الإنسان فحسب، بل إنه يهدد أيضاً قدرة خدمات تقديم الرعاية الصحية على إدارة وحماية صحة السكان (على سبيل المثال من خلال ضعف وموثوقية الهياكل الأساسية أو الخدمات الأساسية ومرافق الرعاية الصحية).

تعتبر التقييمات الأولية للضعف الذي يعترى خدمات تقديم الرعاية الصحية في لبنان أن القدرة الإجمالية على التكيف متدنية، حيث يفتقر الكثير منها إلى القدرات والموارد اللازمة للتأهب لهذا التحدي المناخي والاستجابة له. بالإضافة إلى ذلك، أظهرت الأزمة التي سببها فيروس كورونا (كوفيد-19) نقاط الضعف هذه وسلطت الضوء على الحاجة الملحة للتأهب للكوارث على نحو أفضل وتعزيز القدرة على الصمود، ليس فقط لمقاومة الأوبئة المستقبلية، ولكن أيضاً للتهديدات المستقبلية الناجمة عن مناخ غير مستقر ومتغير.

حدد لبنان في مساهمته المحددة وطنياً لمواجهة تغير المناخ سبع أولويات للتكيف، من بينها "ضمان الصحة والسلامة العامة من خلال النظم الصحية القادرة على مواجهة تغير المناخ". بالإضافة إلى ذلك، توصي الاستراتيجية الوطنية للصحة والبيئة في لبنان (٢٠٢٠) بتنمية قدرات التأهب والاستجابة لدى قطاع الصحة العامة فيما يخص إدارة الآثار الصحية بوصفها الاستجابة الاستراتيجية الرئيسية لتغير المناخ.

تماشياً مع المساهمة المحددة وطنياً لمواجهة تغير المناخ والاستراتيجية الوطنية للصحة والبيئة، تهدف هذه الدراسة إلى تقييم الضعف الذي يصيب مرافق الرعاية الصحية في لبنان، وإلى تقديم التوجيه لزيادة قدرة مقدمي الخدمات على الصمود أمام التهديدات المناخية الحالية والمحتملة.

## تأثيرات تغير المناخ ومرافق الرعاية الصحية

للتهديدات المناخية آثار مدمرة على الأفراد والمجتمعات بوجه خاص عندما تؤثر على مرافق الرعاية الصحية. من المتوقع أن تواجه مرافق الرعاية الصحية تحديات متزايدة في التعامل مع المخاطر المتصلة بالمناخ، مثل الجفاف ودرجات الحرارة القصوى والحرائق والأنماط المتغيرة للأمراض التي تتأثر بالمناخ، مما يمسّ بقدرتها المادية والتشغيلية. ويمكن أن تؤثر شدة وتواتر الأخطار الطبيعية المتزايدة على سير العمل في مرافق الرعاية الصحية، وتسفر عن زيادة الطلب على الخدمات.

بناءً على ذلك، يمكن أن يؤثر تغير المناخ على تقديم خدمات الرعاية الصحية في المستشفيات الكبرى والمرافق الصغيرة، وفي البيئات ذات الدخل المرتفع والمنخفض على حد سواء. بالإضافة إلى ذلك، يمكن أن تتفاقم هواجس مرافق الرعاية الصحية بسبب مخاطر تغير المناخ من خلال التأثير على الهياكل الأساسية ونظم الدعم وسلاسل التوريد والقوى العاملة.

كما أن قطاع الرعاية الصحية مسؤول أيضاً عن انبعاثات غازات الدفيئة من خلال توليد واستهلاك الكهرباء والطاقة، وأنشطة النقل وإنتاج النفايات ومياه الصرف الصحي. ومع الزيادة المرتقبة في الأعباء المرضية الناجمة عن تغير المناخ، سيزداد الطلب على مرافق الرعاية الصحية، مما يتسبب بازدياد في انبعاثات غازات الدفيئة الناتجة عن قطاع الصحة.

لذلك، أصبح من الضروري أن تدمج مرافق الرعاية الصحية خططاً منخفضة الكربون وقادرة على مواجهة آثار تغير المناخ في استراتيجياتها الطويلة الأمد. لا يتمثل الهدف فقط في تحسين تأهب مرافق الرعاية الصحية وتكييفها مع الأزمات ذات الصلة بتغير المناخ وحماية صحة السكان خلال حالات الطوارئ، بل يشمل أيضاً بناء مرافق صحية مستدامة بيئياً. ستعمل هذه المرافق على تحسين الصحة أو الحفاظ عليها أو استعادتها، مع الحد من التأثيرات السلبية على البيئة بأقصى قدر، والاستفادة من الفرص لاستعادتها وتحسينها.

### تأهب مرافق الرعاية الصحية: الحالة والتحديات الراهنة

بحسب هذه الدراسة، لا يزال مستوى تأهب مرافق الرعاية الصحية اللبنانية متدنياً وما تم تحقيقه حتى اليوم لتحسين التأهب قليل نسبياً. يظهر التحليل الذي يستند إلى نوع برنامج الاعتماد أو الشهادة لدى منشأة الرعاية الصحية ودرجة الامتثال، أن الامتثال في معالجة مجالات الضعف الرئيسية الأربعة للقوى العاملة الصحية، وإدارة المياه والصرف الصحي والنظافة الصحية والرعاية الصحية، وإدارة الطاقة، والهياكل الأساسية والتكنولوجيات والمنتجات والعمليات أيضاً محدودة جداً، حتى بالنسبة للمرافق المعتمدة من قبل برنامج اعتماد واحد أو أكثر. بالإضافة إلى ذلك، لا تزال تغطية الاعتماد في لبنان متدنية، حيث أن ٨ في المائة فقط من مراكز الرعاية الصحية الأولية معتمدة حالياً، وهي ليست موزعة بالتساوي في جميع أنحاء البلاد، في حين تسجل تغطية متدنية في المناطق الأكثر ضعفاً مثل قضائي بعليك وعكار (٨,٥ في المائة و ١,٤ في المائة على التوالي). علاوة على ذلك، تم توثيق أوجه القصور الرئيسية في الوفاء بمتطلبات القوى العاملة والهياكل الأساسية الصحية في المراكز غير المعتمدة، خاصة في المراكز التي لا تحظى بدعم المنظمات غير الحكومية الدولية.

بالنسبة للمستشفيات، تعتبر البيئة أيضاً معقدة بالنظر إلى الأوضاع الاجتماعية والاقتصادية والمالية الراهنة في لبنان التي تمنع المستشفيات المعتمدة من متابعة تنفيذ اعتماد المستشفيات المعدلة في لبنان - ٢٠١٩، لا سيما في المستشفيات الحكومية التي تفتقر إلى الهياكل الأساسية للاعتماد.

أدت الأزمة المالية التي يواجهها لبنان منذ عام ٢٠١٩ إلى تفاقم هذه التحديات مع تكديس الفواتير غير المدفوعة للمستشفيات، ورفض التغطية من قبل بعض شركات التأمين، وارتفاع تكلفة الأدوية واللوازم الطبية، وظروف العمل غير الآمنة، وتدني الأجور، وتسريح العاملين في مجال الرعاية الصحية والتقلب المستمر في سعر صرف الليرة اللبنانية، مما أدى إلى هجرة ذوي المهارات. علاوة على ذلك، شكل النقص في النفط والوقود الأحفوري بعضاً من التحديات الرئيسية في توفير الكهرباء من خلال المولدات، ولا سيما بالنسبة للمرضى الذين يعيشون على أجهزة

التنفس الصناعي، ووحدات غسيل الكلى، والأجهزة الطبية الأخرى.

## الدروس المستفادة من الاستجابة لجائحة فيروس كورونا (كوفيد-19) في لبنان

ينبغي اعتبار الاستجابة لجائحة فيروس كورونا (كوفيد-19) والانفجار مرفأ بيروت في ٤ آب بمثابة «اختبارات لدراسات حالات إفرادية»، تهدف إلى تحديد قدرة لبنان على الصمود في حالات الطوارئ، بما في ذلك تحديات وأزمات تغير المناخ. على الصعيد العالمي، أعادت الجائحة تشكيل العالم، وأدت إلى اتساع الفجوات في النظم الصحية وتفاقم حالات عدم المساواة القائمة، وعلى نحو مماثل، ستستمر تحديات تغير المناخ في تهديد قدرة النظم الصحية على حماية وتحسين صحة السكان ورفاههم. وسلطت الجائحة الضوء على أهمية التخطيط الطويل الأمد في الاستجابة للجائحات التي ينبغي أن تكون في صلب توجيه النهج الذي يتبعه قطاع الصحة إزاء تغير المناخ.

فيما يتعلق بالدروس الإيجابية المستفادة، صُنّف لبنان بين أفضل ١٥ دولة استجابت بشكل جيد لتفشي الجائحة. اعتمدت وزارة الصحة العامة نهجاً استباقياً واتخذت الإجراءات اللازمة لتفعيل تأهب البلد، وتعزيز قدرات الاستجابة، ومراقبة جائحة فيروس كورونا (كوفيد-19) قبل اكتشاف الحالة الأولى في لبنان. كما عملت على تعزيز التأهب والاستجابة من خلال إصدار مذكرات تتضمن التعليمات اللازمة، وإجراء الفحوصات عند نقاط الدخول، وشراء اللوازم الطبية ومجموعات أدوات الاختبار، بالإضافة إلى تفعيل اللجنة الوطنية للأمراض الانتقالية، وقيادة التنسيق مع الخبراء وأصحاب المصلحة.

ولكن الجائحة كشفت أيضاً عن جوانب الضعف في قطاع الصحة في لبنان، حيث واجهت الاستجابة الملائمة تحديات من جانب عوامل مختلفة، بما في ذلك اعتماد نهج قائم على رد الفعل بدلاً من النهج الاستباقي، وتدني مستوى التأهب في المستشفيات الحكومية والخاصة ومراكز الرعاية الصحية الأولية لحالات الطوارئ، والتنسيق المحدود بين القطاعات.

أكدت الدروس المستفادة من جائحة فيروس كورونا (كوفيد-19) على الحاجة الملحة لتعزيز قدرة مراكز الرعاية الصحية على الصمود في مواجهة أزمات تغير المناخ من خلال:

- بناء القدرات والتأهب لدى وزارة الصحة العامة وأصحاب المصلحة الآخرين للاستجابة لحالات الطوارئ والكوارث، بما في ذلك إنشاء وحدة لإدارة المخاطر في حالات الطوارئ والأزمات في وزارة الصحة العامة
- تعزيز إدارة قطاع الصحة، بما في ذلك التنظيم الداخلي لوزارة الصحة العامة والترتيبات الأوسع نطاقاً لإدارة القطاع
- توفير التدخلات الوقائية الأولية (مثل خدمات المياه والصرف الصحي والنظافة الصحية أو برامج التلقيح)
- الأهمية البالغة لتحويل الأموال إلى تعزيز الرعاية الوقائية المتعلقة بتأهب المستشفيات لحالات الطوارئ
- الاستثمار في اللامركزية وتقنيات الكشف المبكر والتعقب
- توفير المراقبة للكشف السريع عن تفشي المرض، وعلى وجه التحديد بعد

## الكارثة

- إدارة وإحالة المرضى (نظام الفرز على مستوى المجتمع المحلي)
- التعامل مع الأمراض المتعلقة بحالات الطوارئ الصحية (على سبيل المثال الصحة العقلية، والتدخلات المتصلة بالأمراض المزمنة، والأمراض المنقولة عن طريق الغذاء والمياه)
- الإبلاغ عن المخاطر وتبادل المعلومات في الوقت المناسب
- تقديم خدمات الوصول إلى العيادات المتنقلة للمجموعات السكانية المحرومة
- تعزيز إشراك القطاعين الصحيين العام والخاص والشراكات بينهما
- إصدار التشريعات التي تحدد الحزم الاقتصادية/حزم السلامة لمنشآت الرعاية الصحية أثناء حالات الطوارئ وكوارث تغير المناخ، والتي تعفي مرافق الرعاية الصحية من ضرائب أو نفقات معينة، مع الأخذ بعين الاعتبار الأداء البيئي الجيد
- تخصيص أموال من ميزانية وزارة الصحة العامة لتنفيذ مبادرات التأهب للطوارئ وتخضير قطاع الصحة
- تنفيذ الاستراتيجية الوطنية للصحة والبيئة ٢٠٢١-٢٠٢٦ والاستراتيجية الوطنية للحد من مخاطر الكوارث

## التوصيات

- يستوجب التغلب على هذه العوائق اتباع نهج متكامل لبناء القدرة على مواجهة آثار تغير المناخ في قطاع الصحة. توصي الدراسة الحالية بنوعين من التدخلات:
- التدخل المباشر، على المستوى الصغير، الذي يهدف إلى تطوير مجموعة من الإجراءات لمرافق الرعاية الصحية لتنفيذ برامج إدارة المخاطر وتقييمها باستمرار كي تحتفظ باستجابتها السريعة لاحتياجات المرافق خلال أحداث الطوارئ المتصلة بتغير المناخ.
- يتمثل النهج الأكثر مباشرة في زيادة القدرة على الصمود على مستوى المنشأة من خلال رفع معدل الاعتماد بالنسبة لمراكز الرعاية الصحية في لبنان ودمج المتطلبات الأساسية لـ: (أ) القوى العاملة الصحية (الموارد البشرية وتنمية القدرات والتواصل وإذكاء الوعي)؛ (ب) إدارة المياه والصرف الصحي والنظافة الصحية والعاملين في مجال الرعاية الصحية (الرصد والتقييم، وإدارة المخاطر ولوائح الصحة والسلامة)؛ (ج) إدارة الطاقة (الرصد والتقييم، وإدارة المخاطر ولوائح الصحة والسلامة)؛ و (د) الهياكل الأساسية والتكنولوجيات والمنتجات والعمليات (تكييف النظم والهياكل الأساسية الحالية، وتعزيز النظم والتكنولوجيات الجديدة، واستدامة تشغيل مرافق الرعاية الصحية)؛ وهذه أمور لا بد منه.

## توصيات موجزة لزيادة التأهب في مواجهة تغير المناخ في مرافق الرعاية الصحية

١. تحديد دراسات مرجعية لمواجهة تغير المناخ من خلال تقييم درجة تأثر المرافق بمخاطر تغير المناخ
٢. دمج القائمة المرجعية الصادرة عن منظمة الصحة العالمية بشأن قابلية التأثر بتغير المناخ في معايير الاعتماد ونظم إصدار الشهادات
٣. توسيع رقعة التغطية الجغرافية لمراكز الرعاية الصحية الأولية للاستجابة لتأثيرات الأحداث الناجمة عن تغير المناخ في المناطق المعرضة للخطر
٤. الحصول على الاعتماد الذي يدمج المتطلبات الأساسية للقوى العاملة الصحية، والمياه والصرف الصحي والنظافة الصحية، وإدارة النفايات/الطاقة وتكنولوجيات الهياكل الأساسية
٥. تأمين الدعم من المنظمات غير الحكومية الدولية من أجل تحسين توفير القوى العاملة والهياكل الأساسية الصحية
٦. إرفاق قائمة مرجعية تكميلية معدلة بمعايير اللجنة الدولية المشتركة (ICI) لاعتماد المستشفيات لعام ٢٠١٩ من أجل تعزيز تأهب المستشفيات
٧. وضع خطة عمل للمستشفيات الحكومية بالاستناد إلى قائمة مرجعية معدلة لقابلية التأثر بتغير المناخ، من أجل معالجة التدخلات المباشرة والمتوسطة والطويلة الأمد

• التدخل غير المباشر، على المستوى الكلي، الذي يهدف إلى دعم مرافق الرعاية الصحية من خلال تعزيز تأهب قطاع الصحة والاستجابة لحالات الطوارئ.

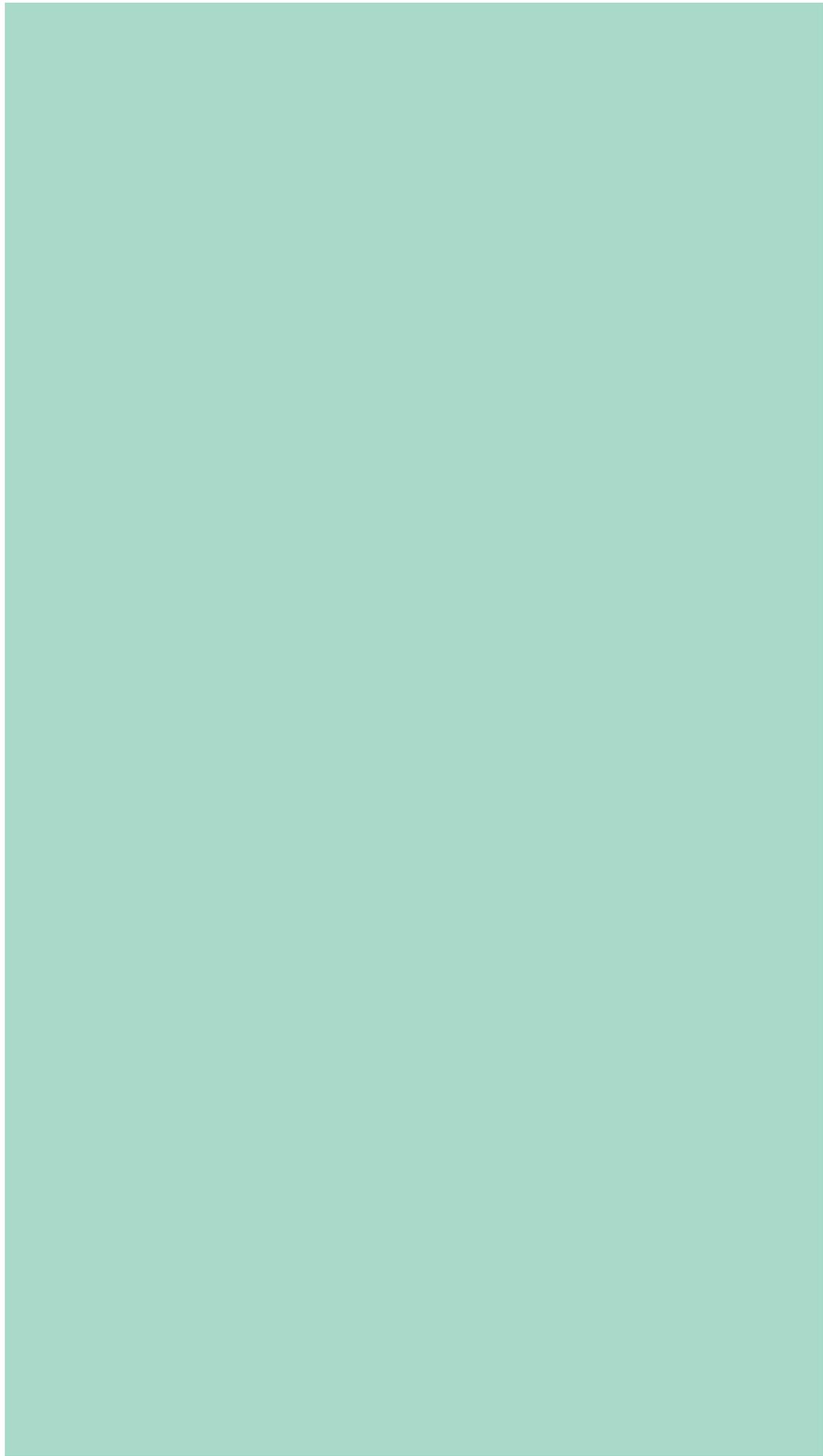
ينبغي وضع سياسات واستراتيجيات وطنية تكميلية توفر بيئة تمكينية للنظام الصحي، كما ينبغي أن يشكل بناء القدرة على التأهب ومواجهة آثار تغير المناخ أولوية مشتركة لجميع القطاعات الحكومية تضم جميع أصحاب المصلحة والجهات الفاعلة كي يكونوا قادرين على العمل بطريقة منسقة. توصي منظمة الصحة العالمية باعتماد الركائز الأساسية الخمس التالية: (أ) الإدارة والسياسة الصحية، (ب) الموارد البشرية لأغراض الصحة، (ج) نظم المعلومات، (د) تقديم الخدمات، و (هـ) التمويل. من المهم جداً توجيه الإدارة والسياسات الصحية نحو حماية صحة الإنسان من المخاطر المناخية وتعزيز الشراكة مع القطاعات المحددة للصحة من أجل تحسين الاستفادة من تدابير التخفيف من آثار تغير المناخ والتكيف معه. يمكن تحقيق ذلك من خلال:

- ضمان التنسيق والتواصل بين أصحاب المصلحة لإذكاء الوعي وضمان اتساق السياسات
- بناء القدرات التقنية والتنظيمية والمؤسسية
- تعبئة الموارد لدعم التنفيذ الفعال
- توجيه نظم الإدارة نحو بحوث تغير المناخ، وترجمة نتائج البحوث إلى صنع السياسات، والإبلاغ المنظم عن المخاطر.
- توجيه تقديم الخدمات نحو تحديد المخاطر الصحية المتعلقة بالكوارث والمياه والنفايات والغذاء وتلوث الهواء وتعزيز الحد من المخاطر بالاستناد إلى المجتمعات المحلية.

- تعبئة التمويل الدولي المتصل بتغير المناخ لدعم المشاريع والبرامج التي تركز على بناء قدرة النظم الصحية على الصمود (مثل مرفق البيئة العالمية، وصندوق التكيف، والجهات المانحة الثنائية).

## خلاصة

ينبغي توجيه الجهود الوطنية بالدرجة الأولى نحو إقامة مرافق للرعاية الصحية مستدامة بيئياً تستطيع توقع تأثيرات تغير المناخ والاستجابة لها والتعافي منها والتكيف معها. كل هذا، إلى جانب الحد من التأثيرات السلبية على البيئة والاستفادة من الفرص لاستعادتها وتحسينها، وتقديم الرعاية الصحية المستمرة والمستدامة للفئات السكانية المستهدفة، وحماية صحة ورفاه الأجيال القادمة. يعتبر تخضير قطاع الصحة استجابة استراتيجية رئيسية لتحقيق أهداف التنمية المستدامة على النحو المحدد في الاستراتيجية الوطنية للصحة والبيئة 2021-2026.



# CHAPTER 1

## VULNERABILITY OF HEALTH CARE SERVICE PROVIDERS TO CLIMATE CHANGE

# 1. BACKGROUND INFORMATION

The global surface temperature has increased by 0.2°C every decade.

## 1.1. Climate Change and Health Impacts: Facts and Figures

Globally, the 2021 Intergovernmental Panel on Climate Change (IPCC) Sixth Assessment Report (AR6) provided the most recent key findings on the current state of the climate, and the future impacts of climate change (IPCC, 2021). Accordingly, it is evident by now that since the pre-industrial period, the global surface temperature has increased by about 1°C, corresponding to an increase of 0.2°C every decade.

As such, since 1850, each of the consecutive decades has been successively warmer than the preceding one. The global average precipitation levels over land have mostly increased since 1950, with an accelerated rate as of the 1980s. In addition, the global upper ocean temperature has warmed since the 1970s, and the global mean sea level has increased by 0.20 m between 1901 and 2018. Moreover, the latest IPCC Report attributes the main drivers of some of the impacts of climate change, mostly, to anthropogenic activities (IPCC, 2021).

The scale of this recent change to the current climate system is unprecedented across centuries and thousands of years, and could be summarized as follows (IPCC, 2021):

- Atmospheric CO<sub>2</sub> levels in 2019 were higher than at any time in at least 2 million years, and CH<sub>4</sub> and N<sub>2</sub>O concentrations were higher than at any time over at least 800,000 years.
- Human-induced climate change is already affecting weather and climate extremes all over the world, with observed changes in heatwaves, heavy precipitation, droughts, and tropical cyclones.
- Hot extremes (including hot waves) have become more intense and frequent across most land regions since the 1950s, while cold extremes (including cold waves) have become less severe and frequent.
- The frequency and intensity of heavy precipitation, over most land areas, has increased since the 1950s.
- The global proportion of major tropical cyclones belonging to Category 3–5 has increased over the last four decades.
- Human influences have likely increased the risk of compound extreme events

(including heatwaves, droughts, fire weather in some regions, and flooding) since the 1950s.

**By 2100,  
1.2 Billion  
people will  
be affected  
by heat stress  
every year.**

Additionally, future projections also reflect on global surface temperature increase, at least until mid-century, under all the emissions scenarios considered<sup>1</sup>. Accordingly, global warming of 1.5°C and 2°C will be exceeded during the 21<sup>st</sup> century, unless significant reduction in CO<sub>2</sub> and other greenhouse gas emissions is achieved over the coming decades. Compared to 1850–1900, the global averaged surface temperature during the 2081–2100 period, is very likely to be higher by 1.0°C - 1.8°C under the very low GHG emissions scenario (SSP1-1.9), by 2.1°C-3.5°C under the intermediate GHG emissions scenario (SSP2-4.5), and by 3.3°C to 5.7°C under the very high GHG emissions scenario (SSP5-8.5) (IPCC, 2021). This would lead to more changes in climate systems that would directly increase global warming.

A summary of the projected changes, at the global scale are as follows (Kirezci et al., 2020; Ross, Gannon & Steinberg, 2020; IPCC, 2021; Pokhrel, 2021; Thomas et al., 2021; UNFCCC, 2021):

- Increased frequency and intensity of hot extremes, including heatwaves, heavy precipitation, in addition to agricultural and ecological droughts in some regions for every additional 0.5°C of global warming.
- Increased heat stress from extreme heat, and increased humidity that could annually affect 1.2 billion people by 2100.
- Doubling of the number of people that would suffer from extreme droughts in <80 years.
- Extension of the fire season becoming three months longer by 2030, mostly in areas already exposed to wildfires.
- Intensified extreme daily precipitation events of about 7% for each 1°C increase in global temperature, increasing the risk of floods.
- Increased proportion of intense tropical cyclones belonging to Category 4–5 and peak wind speeds of these intense tropical cyclones, at the global scale, with increasing global warming (under the 2.5°C global warming scenario the most devastating storms would occur up to twice as now).
- Amplification of permafrost thawing, and loss of seasonal snow cover of land ice and Arctic Sea ice.
- Further intensification of the global water cycle, including variability in available quantities, global monsoon precipitation, and severity of the wet and dry events.
- Magnification of very wet and very dry weather with effects on floods or droughts.

1. This report assesses the climate response to five scenarios that cover the range of possible future development of anthropogenic drivers of climate change found in the literature. They start in 2015 and include scenarios with high and very high GHG emissions by 2100 and 2050 (SSP3-7.0 and SSP5-8.5). Scenarios with intermediate GHG emissions (SSP2-4.5) and with very low GHG emissions decline to net zero around or after 2050, followed by varying levels of net negative CO<sub>2</sub> emissions (SSP1-1.9 and SSP1-2.6).

- Increased monsoon precipitation on the mid to long-term timeline.
- Rise in global mean sea level by about 2 to 3 m if temperature increase is limited to 1.5°C; 2 to 6 m if limited to 2°C; and 19 to 22 m with 5°C.
- Increased coastal flooding events threatening assets worth up to 20% of the global GDP by 2100.
- Doubling in climate-related disasters compared to the last twenty years that would further exacerbate inequalities within and between countries, with, mostly, countries contributing least to global emissions often experiencing the worst impacts of the climate emergency.

The MENA Region, including the Arab countries, is one of the most vulnerable Regions to climate change impacts as countries belonging to this Region are naturally affected by extreme climate conditions such as hot temperatures, limited groundwater, and decreased rainfall levels that challenge agricultural and arable lands (Borghesi and Ticci, 2019). Increased population growth, geographic concentration of populations, and the combination of water and precipitation scarcity make the region one of the water-stressed areas in the world (Borghesi and Ticci, 2019). Climate change impacts have already been observed in countries of the Region and are projected to intensify and accelerate mostly due to the following compounding factors (Borghesi and Ticci, 2019; Göll, 2017):

- Increase in critical levels of water scarcity in several countries that is projected to reach severe levels by 2025 (projected decrease in Euphrates River by 30%; Jordan River by 80%).
- Increase in sea level rise, considering that most of the countries' economic activities are concentrated along coastal areas, including agriculture and population centers (e.g. projected displacement of 6 million people in Egypt).
- Accelerated deteriorating biodiversity in many countries projecting on the extension of up to 40% of existing species with a 2°C temperature rise. Moreover, the unique profiles of ecosystems in some of the countries are particularly vulnerable to climate change (cedar forests in Lebanon and Syria, the mangroves in Qatar, the coastal mountain ranges of red sea, etc.).
- Increased incidence of infectious diseases and changes in the geographical distribution of disease vectors, such as mosquitoes, waterborne pathogens, in addition to poor water quality, and air pollution, that would further challenge the weak health systems. Additionally, higher levels of ambient CO<sub>2</sub> would increase allergic reactions and pulmonary diseases in the Region.
- Increased impacts on 75% of the Region's infrastructure and buildings that are at a direct risk to climate change impacts, including sea level rise, higher intensity and frequency of heatwaves, and storm surges.
- Increased impacts on the tourism sector with an expected significant decline in the index of tourism comfort with an increase of 1-4°C (mainly

due to hotter temperatures, extreme weather events, water scarcity, and ecosystem degradation).

Accordingly, health impacts can be classified into three main categories:

- Direct impacts (injury and illnesses) due to increased frequency and severity of climate change induced extreme weather events.
- Environmental system mediated impacts (e.g., increase in air pollution and change in vector, food, and waterborne disease patterns).
- Social mediated effects resulting from climate change's interaction with social and human systems (e.g. undernutrition, occupational heat stress and mental disorders, increased risk of population displacement, and risks of violent conflicts).

Therefore, climate change can impact health directly, undermine the social determinants of health, and threaten various environmental services provided by the natural systems, by presenting multiple hazards that interact with and exacerbate preexisting vulnerabilities (WHO, 2015). These environmental and climatic changes would affect air, water, and food quality, thus becoming the greatest threat to the healthcare system in emergencies (Costello et al., 2009; WHO, 2015).

Extreme heat exposure, due to increase in global temperatures and more frequent and prolonged heat waves, would increase heat-related morbidity and mortality such as dehydration, heat cramps, heat exhaustion, and heat strokes (Ghazali et al., 2018). It can also exacerbate pre-existing health problems such as cardiovascular diseases and coronary diseases, particularly, among the elderly population (Basu and Samet, 2002). Moreover, it can increase the risk of acute kidney injuries and chronic kidney disease due to heat stress (Glaser et al., 2016).

Increase in levels of air pollutant, caused, or exacerbated by climate change, would lead to an increase in Asthma and Chronic Obstructive Pulmonary Disease (COPD) hospital admissions (Zhang et al., 2015). In fact, numerous climate change impacts have already been linked to an increase or exacerbation in respiratory diseases among the general population (D'Amato et al., 2015). It can also increase the likelihood and frequency of climatic disasters such as storms, droughts, hurricanes, and floods, exposing the population to the risk of drowning, bruises, cuts or sprains, burns, electrocution, and wound infections (Wuebbles et al., 2017).

Human-induced climate change has also been linked to changes in ecosystems, which in turn lead to changes in vector distribution, population susceptibility and population exposure (LaKind et al., 2016). Hence, the risk of Malaria, Dengue and Dengue Hemorrhagic Fever, Yellow Fever, Chikungunya, Zika virus, West Nile fever, Lyme disease, and Leishmaniosis would increase in endemic areas, and could appear in areas that are currently free of such infections (Medlock and Leach, 2015). The spread of rodent-borne diseases, such as leptospirosis and Hantaan virus, would also increase, particularly following flood events (Pijnacker et al., 2016; Hansen et al., 2015; Campbell-Lendrum et al., 2007). The risk of arthropod vectors spreading to unexposed areas have already been reported and it is estimated that by 2050, mosquitoes that carry vector-borne diseases like Malaria, could reach an estimated 500 million more people (Hansen et al., 2015; Ryan et al., 2019).

**Extreme heat exposure would increase heat-related exhaustion and heat strokes and exacerbate cardiovascular and coronary diseases.**

These changes in infectious disease patterns are indirectly linked to changing vector patterns and would increase the risk of food and waterborne diseases. Increasing temperatures, floods, and irregular water accumulation (due to rainfall and stream overflow) would lead to variations in habitats, hibernation patterns and species' reproduction cycles (Ghazali et al., 2018). In addition, induced migratory flows would lead to changes in the geographic distribution of susceptible populations, which will in turn increase the emergence of re-emerging or exotic zoonotic diseases in non-endemic areas (European Academies Science Advisory Council, 2007; Gordon et al., 2016). This would further challenge the access to drinking water in some regions and would accelerate rate of microbial infections (bacterial, viral, and parasitic) (Ghazali et al., 2018).

Over and above, climate change-induced phenomenon and disasters would have mental health consequences (Woodward and Porter, 2016). Extreme weather events could increase post-traumatic stress disorders among the population. Extreme climate events have been geographically linked to increase in suicide rates (Fountoulakis et al., 2016a; Fountoulakis et al., 2016b). And continued exposure to air pollution could also increase admissions to psychiatric emergency units (Oudin et al., 2018). Extreme weather events would also lead to population displacement, referred to as "climate refugees", which would have demographic and socioeconomic impacts on these populations leading to higher rates of stress-related psychiatric disorders (Rataj et al., 2016). A summary of the main globally expected health impacts, and the associated exposures and risks are presented in Table 1 (WHO, 2015).

Table 1. Summary of the Main Expected Health Impacts of Climate Change Globally and the Associated Exposures and Risks (WHO, 2015)

	Exposure Affected by Climate Change	Health Risks	Health Impacts
<b>Direct Effects</b>	Increased numbers of warm days and nights; increase in frequency and intensity of heat waves; increase in fire risk in low rainfall conditions	Excess heat-related mortality; increased incidence of heat exhaustion and heat stroke, particularly for outdoor laborers, athletes, elderly; exacerbated circulatory, cardio-vascular, respiratory, and kidney diseases; increased premature mortality related to ozone, and air pollution produced by fires, particularly during heat waves	Greater risk of injury, disease, and death due to more intense heat waves and fires
	Decreased numbers of cold days and nights	Lower cold-related mortality, reduced cardiovascular, and respiratory disease, particularly for the elderly in cold and temperate climates	Modest improvements in cold-related mortality and morbidity
<b>Effects Mediated through Natural Systems</b>	Higher temperatures and humidity, changing and increasingly variable precipitation, higher sea surface and freshwater temperatures	Accelerated microbial growth, survival, persistence, transmission, virulence of pathogens; shifting geographic and seasonal distributions of e.g. cholera, schistosomiasis, and harmful algal blooms; lack of water for hygiene; flood damage to water and sanitation infrastructure, and contamination of water sources through overflow	Increased risks of food- and water-borne diseases
	Higher temperatures and humidity, changing and increasingly variable precipitation	Accelerated parasite replication and increased biting rates; prolonged transmission seasons; re-emergence of formerly prevalent diseases; changing distribution and abundance of disease vectors; reduced effectiveness of vector control interventions	Increased risks of vector-borne diseases
<b>Effects Heavily Mediated by Human Systems</b>	Higher temperatures and changes in precipitation	Lower food production in tropics; lower access to food due to reduced supply and higher prices; combined effects of undernutrition and infectious diseases; chronic effects of stunting and wasting in children	Increased risk of undernutrition resulting from diminished food production in poor regions
	Higher temperatures and humidity	Outdoor and unprotected workers obliged to work in physiologically unsafe conditions, or to lose income or livelihood opportunities	Consequences for health of lost work capacity and reduced labor productivity in vulnerable populations
<b>Combined Effects</b>	Overall climate change	Combination and interactions of risks above	Negative health effects will outweigh positive effects worldwide

Disaster preparedness should ensure effective and timely response to climate change impacts to protect the health and wellbeing of the population and minimize health risks.

## 1.2. Challenges to Climate Change Emergency Response and Disaster Risk Management: Lessons learned

Climate change risk management, defined as the process of adjustment to actual or expected climate and its effects, plays a crucial role in protecting countries from climate change hazards, risks, and disasters (IPCC, 2014; IPCC, 2021). A disaster risk management plan entails the identification, prevention, and mitigation of climate change risks, and the development of a disaster preparedness and an emergency response recovery plan to lessen its impacts (IDB, 2008). Moreover, disaster preparedness should ensure effective and timely response to climate change impacts to protect the health and wellbeing of the population and minimize health risks (IDB, 2008). Still, the health sector also has a crucial role in protecting the health of the populations from the multitude of impacts associated with climate change through its overall emergency response capacity, and its ability to adjust and adapt its services to climate variations (WHO, 2015). Disruptions of healthcare services would have immediate impacts on health including the increase in disease burden, hunger and displacement, and longer-term impacts associated with disrupted livelihoods and education (UNDRR, 2019).

All countries across the world could face numerous risks to the healthcare system due to climate change hazards and events. The risks and the associated consequences are expected to be more severe in developing countries due to the absence of response capacity (Wuebbles et al., 2017). Nevertheless, the response capacity of a country depends on its ability to identify risks and develop an effective response and recovery framework to ensure preparedness to respond to climate change hazards (Costello et al., 2009). During climate change acute emergencies, healthcare facilities can take precautionary measures to mitigate disruptions in supply and demand surges. However, faced with large-scale adversities, such as pandemics or severe disasters (such as floods), facilities should be prepared by having a well-coordinated emergency response plan across its various sectors, to synchronize its capacity and capabilities to effectively sustain the health system's performance.

However, according to the United Nations Office for Disaster Risk Reduction (UNDRR), there are various challenges hindering adequate climate change emergency response, including (Lavell et al., 2012; UN, 2013; Sorensen et al., 2020; IPCC, 2021; UNDRR, 2021; UNDRR, 2021a):

- The current trajectory in climate change leading to unmanageable disaster risks; climate change is increasing the frequency and intensity of hazards, the exposure, and vulnerabilities of populations, as well the stress on water and food security. Accordingly, the IPCC 2021 projects that the world is on track for a potential 3°C increase in temperature or more. Nonetheless, mitigation measures are currently put in place, yet, they have proven to be insufficient and thus irreversible changes would be expected because of the increase in carbon emissions (e.g. ecosystem collapse).
- The increasing occurrence of physical events at varied locations, which will in turn affect the exposures and vulnerabilities of various communities. In addition, climate change makes it more difficult to anticipate and evaluate the likelihood and consequences of climate change disasters.

- The weak investment in risk-informed adaptation; planning without proper risk identification can create new risks and will result in maladaptation. The current process of risk identification and analysis have been inadequate in setting effective preventive actions to reduce the impacts of climate change-induced disasters.
- The insufficient action to manage long-term impacts and the residual risks of climate change; long-term impacts of climate change such as sea-level rise and ocean acidification are growing concerns that have not been properly addressed in current developmental planning. The failure to account for such risks has hindered the “risk management planning process” and has under-estimated the benefits of rapid climate action. Continuous increase in the number of extreme weather events and its likely impact on population displacement, loss of livelihoods, and access to health and other basic services, is expected to be devastating.
- The improper (unfit) financial systems’ investment currently evaluating climate risks; this is an important concern to long-term investors and sectors such as insurance, pension funds, infrastructure development, and agriculture.
- The increase in inequalities due to climate change and associated disasters leading to a vicious cycle between climate change, vulnerability, and inequality. Disadvantaged groups suffer more adverse effects of climate change, which in turn weaken their ability to reduce their exposure, mitigate the effects, and adapt and recover from climate change impacts leading to even greater inequalities.
- The preparation for climate-related hazards which are challenged by the systems’ wide cooperation and coordination between public health, health care, and municipal communities.
- The lack of legislations and policies that would support emergency management risk assessment.
- The lack of access to data collection and monitoring tools.
- The lack of recognition of disaster risk reduction as a development core.
- The gaps in the understanding of extreme events, between experts and non-experts, that presents an important communication challenge.

# 2. CLIMATE CHANGE HAZARDS AND RISK IMPACTS IN LEBANON

Lebanon will face increase in temperature up to 3.2°C and decrease of precipitation by 11% by 2100 compared to 1986-2005.

## 2.1. Historical and Projected Climate Change Trends in Lebanon

Climate in Lebanon is characterized by hot and dry summers with low precipitation levels (between June and September) and cool and rainy winters (between December and March). Around 70% of precipitation levels occur between November and March as heavy storms. Coastal areas often experience higher temperatures and humidity, with temperatures reaching up to 30°C in the summer, while the mountainous regions have relatively colder temperatures and heavier winter snows (MoE/UNDP/GEF, 2016).

Lebanon's Third National Communication to the UNFCCC indicates that according to the Regional Initiative for the Assessment of the Impact of Climate Change on Water Resources in the Arab Region (RICCAR) led by the United Nations Economic and Social Commission for Western Asia (ESCWA), a temperature increase of 1.2°C and 1.7°C, respectively, under moderate-case scenario, and worst-case scenario<sup>2</sup> by mid-century (2046-2065), and up to 3.2°C by 2100 when compared to the baseline period of 1986-2005, as presented in Figure 1, are expected (ESCWA, 2015; MoE/UNDP/GEF, 2016).

Additionally, a 4 to 11% decrease in precipitation is expected under the moderate-case and worst-case scenarios, respectively, with drier conditions prevailing by the end of the century (up to 5.8 mm decrease in the average/monthly precipitation) as seen in Figure 1 and 2 (ESCWA, 2015; MoE/UNDP/GEF, 2016).

Moreover, the analysis of Lebanon's climatic data since the early 20<sup>th</sup> century, projects climate changes and impacts as presented in Table 2.

2. This report assesses the climate response to five scenarios that cover the range of possible future development of anthropogenic drivers of climate change found in the literature. They start in 2015 and include scenarios with high and very high GHG emissions by 2100 and 2050 (SSP3-7.0 and SSP5-8.5). Scenarios with intermediate GHG emissions (SSP2-4.5) and with very low GHG emissions decline to net zero around or after 2050, followed by varying levels of net negative CO<sub>2</sub> emissions (SSP1-1.9 and SSP1-2.6).

The projections are based on two of the Representative Concentration Pathways (RCPs) developed by the Intergovernmental Panel on Climate Change (IPCC), RCP4.5 (moderate-case scenario) and RCP8.5 (current scenario with the highest levels of potential GHG emissions or worst-case scenario).

Table 2. Historical and Projected Climate Trends in Lebanon (Adapted from USAID, 2016)

*Historical Climate Trends	Projected Climate Trends
0.11°C Increase in the annual mean temperature/ decade	Increase in mean annual temperatures of 1.2– 1.7°C by mid-century (2046-2065) and up to 3.2 °C by 2100
7% Increase in number of hot nights (mostly June - September)	4–11 % Decrease in precipitation by 2100
Average 11 mm/month decrease in precipitation since 1950	Reduction of 40–70 % in snow cover decrease from 110 to 45 days in snow residence time
Rainfall increase in amounts received during one-day extreme event	Increase incidences of drought
Around 20 mm/year rise in Mediterranean Sea levels of roughly 20 mm per year	Continued rise in sea level (30-60 cm) over the next 30 years
1.3°C Increase in Mediterranean Sea surface water temperature since 1982	Increased frequency of heat waves and decreased number of frost days

\* Historical climate trends observed since 1982 unless stated otherwise.

**Lebanon will expect additional 43 days with max temperature higher than 35°C, leading to longer dry summer seasons.**

RICCAR also projects an intensification of temperature and precipitation extremes by the end of the century. Longer drought periods with an expanded geographical extent are expected, in addition to an increasing trend of drier conditions that would be characterized by an increase in number of consecutive dry days (where the precipitation amount is less than 1.0 mm) by the end of the century (ESCWA, 2015; MoE/UNDP/GEF, 2016). This would lead to longer dry summer seasons with an additional number of six consecutive drought days.

An increasing warming trend in Lebanon is also expected, reaching up to 43 additional days with maximum temperatures higher than 35°C. The combination of less rainfall amount and warmer conditions will lead to hotter and drier climate (ESCWA, 2015; MoE/UNDP/GEF, 2016).

Accordingly, projected impacts of climate change on various sectors, resources, and infrastructures in Lebanon, are summarized in Table 3.

Figure 1 . Projected Changes in Temperature in Lebanon (ESCWA 2015; MoE/UNDP/GEF, 2016)

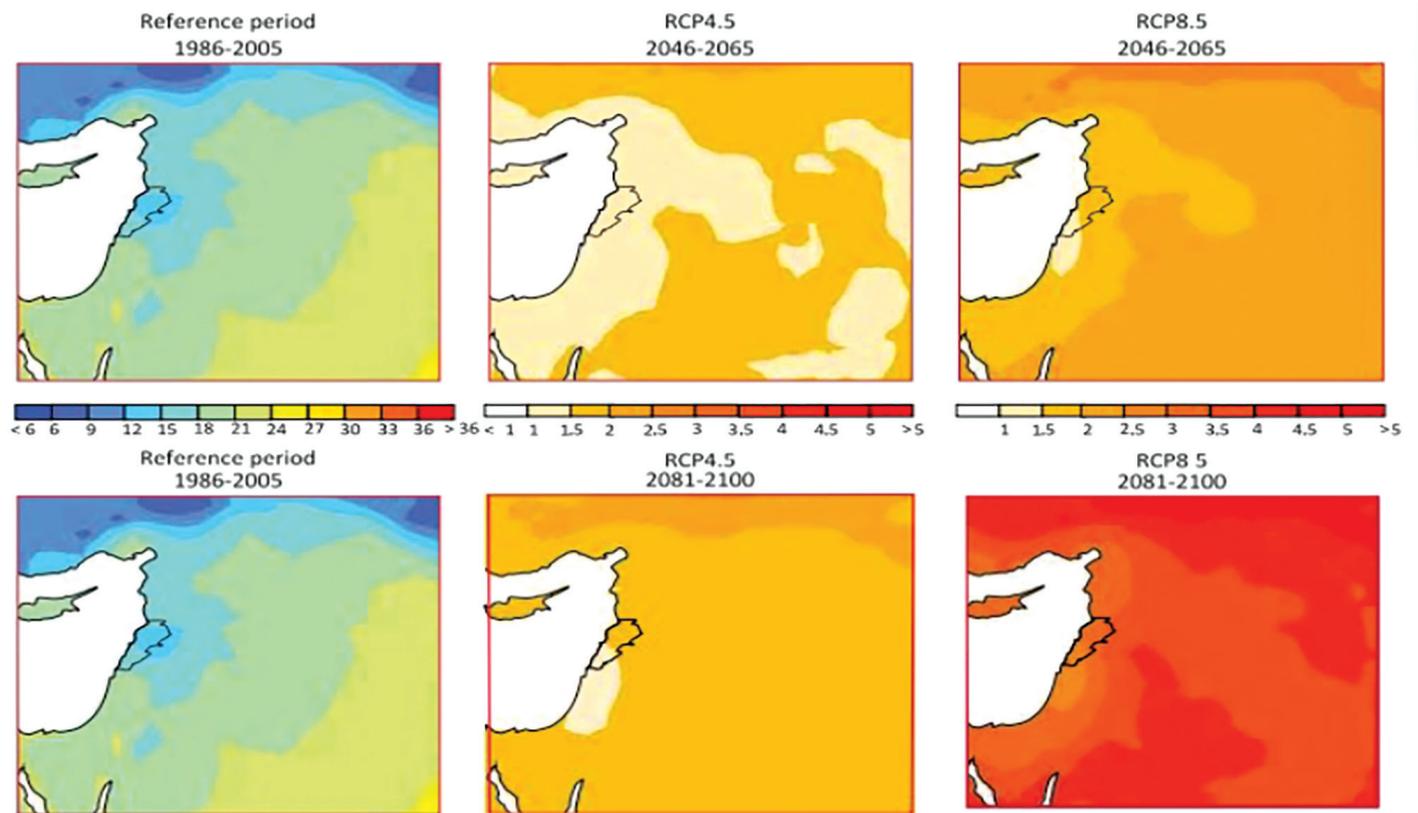


Figure 2 . Projected Changes in Precipitation Levels in Lebanon (Adapted from ESCWA 2015; MoE/UNDP/GEF, 2016)

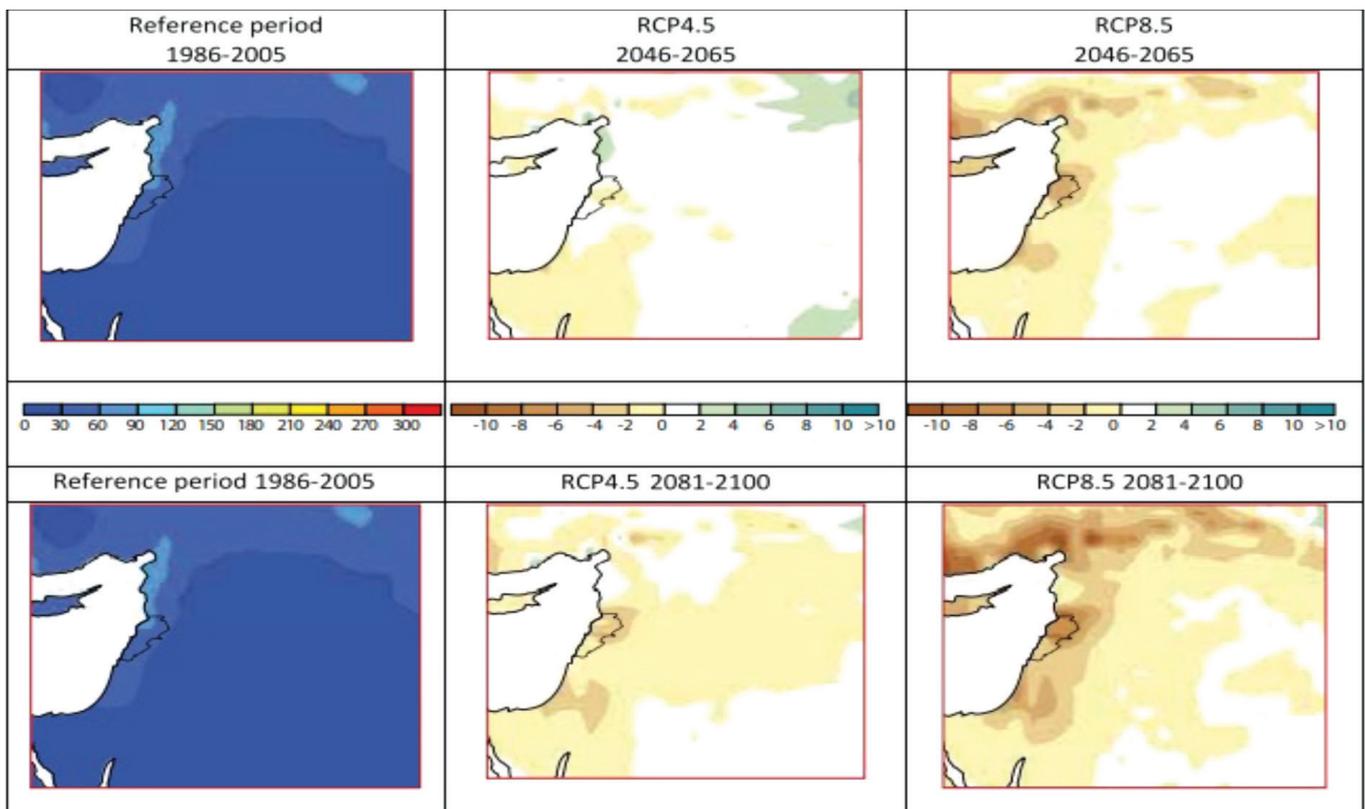


Table 3. Impacts of Climate Change in Lebanon (Adapted from MoE/UNDP/GEF, 2016; USAID, 2016; Netherlands Ministry of Foreign Affairs, 2018)

Type of Impact	Climate stressors	Projected Risks
<b>Less Snow</b>	<ul style="list-style-type: none"> <li>• Increased Temperature</li> <li>• Reduced Rainfall</li> </ul>	<ul style="list-style-type: none"> <li>• Reduction in snow cover by 40%</li> <li>• Shift in snow fall from 1,500 m to 1,700 m by 2050, and to 1,900 m by 2090</li> <li>• Decrease in snow residence time from 110 to 45 days</li> </ul>
<b>Less Water Availability</b>	<ul style="list-style-type: none"> <li>• Increased Temperatures</li> <li>• Reduced Rainfall and Snow Cover</li> <li>• Increased Drought Incidences</li> <li>• Rise in Sea level</li> </ul>	<ul style="list-style-type: none"> <li>• Alteration in seasonal water regimes; recharge of most springs; and increase up to 30% in winter floods (up to 30%)</li> <li>• Reduction in river flows leading to increased strain on limited groundwater sources in the dry season</li> <li>• Increased evaporation of surface water</li> <li>• Increased saltwater intrusion/salinization of coastal aquifers</li> </ul>
<b>Increased Drought Periods</b>	<ul style="list-style-type: none"> <li>• Increased Temperatures</li> <li>• Reduced Rainfall and Snow Cover</li> </ul>	<ul style="list-style-type: none"> <li>• Increased drought periods (occurring 15 days to 1 month earlier)</li> <li>• Extended drought periods (9 days longer by 2040, and 18 days longer by 2090)</li> <li>• Maximal effects in dry regions (e.g., Bekaa, Hermel, and the South)</li> </ul>
<b>Less Agriculture Productivity</b>	<ul style="list-style-type: none"> <li>• Increased Temperature</li> <li>• Reduced Rainfall and Snow Cover</li> <li>• Increased Incidence of Droughts</li> <li>• More frequent Heat Waves and Fewer Frost Days</li> <li>• Rise in Sea Level</li> </ul>	<ul style="list-style-type: none"> <li>• Reduced land productivity (especially wheat, cherries, tomatoes, apples, and olives, and may affect the quality of grapes despite some transient benefits from the expansion of coastal plantations such as banana and tomatoes)</li> <li>• Reduced fruit tree yields (up to 50% through blossom pollination and fecundation of mountainous fruit trees)</li> <li>• Declined soil moisture (high temperatures/ reduced precipitation/ higher evapotranspiration) impacting agricultural yields</li> <li>• Migration of mountain fruit production to higher elevations</li> <li>• Decreased crop quality (particularly wine grapes)</li> <li>• Increased infestation (fungi and bacterial diseases)</li> <li>• Shift in grazing areas and periods for livestock</li> <li>• Increased pumping for irrigation needs</li> </ul>
<b>High Energy Demand</b>	<ul style="list-style-type: none"> <li>• Increased Temperatures</li> </ul>	<ul style="list-style-type: none"> <li>• Increased demand on cooling (1.8% increase in electricity consumption for a 1°C increase, and 5.8% for a 3°C increase)</li> </ul>
<b>Sea level rise</b>	<ul style="list-style-type: none"> <li>• Increased Rise (30-60 cm in 30 Years-2 mm/ year)</li> </ul>	<ul style="list-style-type: none"> <li>• Increased in seawater intrusion into aquifers</li> <li>• Increased risk of coastal flooding and inundation</li> <li>• Increased coastal erosion altering coastal ecosystems in natural reserves and elsewhere</li> </ul>
<b>Forests at risk</b>	<ul style="list-style-type: none"> <li>• Increased Temperatures</li> </ul>	<ul style="list-style-type: none"> <li>• Increased adverse effects on forests suffering from fragmentation, pest outbreaks, forest fires and harm-ful practices</li> </ul>
<b>Increase in morbidity and mortality</b>	<ul style="list-style-type: none"> <li>• Increased changing Temperatures</li> <li>• Increased Extreme Weather Events</li> </ul>	<ul style="list-style-type: none"> <li>• Increased outbreaks of infectious diseases</li> <li>• Increased morbidity and mortality from heat and other extreme weather events</li> <li>• Increased malnutrition from droughts and floods</li> <li>• Increased rates of water-borne, rodent-borne, and vector-borne diseases</li> </ul>
<b>Tourism</b>	<ul style="list-style-type: none"> <li>• Increased Temperatures</li> <li>• Reduced Precipitation</li> </ul>	<ul style="list-style-type: none"> <li>• Diminished winter outdoor tourism</li> <li>• Shortened skiing season</li> <li>• Increased losses of natural attractions (e.g., sandy public beaches)</li> <li>• Increased structural damage to the country's archaeological heritage</li> </ul>

More aggressive projections expect increase in temperature by 6.6°C, with the largest increase in the Northern Lebanon Mountains.

Likewise, more aggressive climate change impacts have also been projected. According to EURO-CORDEX projections, that were produced at a smaller scale of resolution (12.5 km<sup>2</sup>) than those produced by RICCAR for the Arab Region (50 km<sup>2</sup>) up through 2019, temperatures in Lebanon would rise by mid-century by an average of 2.7°C (RCP4.5) to 3.9°C (RCP8.5), with smaller increases toward the coast. The largest increases in temperatures are projected in the Northern Lebanon Mountains. At end-century, temperatures are projected to increase by an average of 3.6°C (RCP4.5) to 6.6°C (RCP8.5) when compared to the reference period (1986-2005). At mid-century, smaller increases in temperatures are projected along the coast, while an increase of at least 1.5°C (RCP4.5) to 3°C (RCP8.5) is expected inland throughout the country (Figure 3 and Figure 4) (ACSAD/MoAg/CNRS/ESCWA, 2019; ESCWA, 2020, Jurdi; 2021).

Changes in precipitation trends are also expected with the central axis of the country becoming significantly drier from the North to the South. EURO-CORDEX projections signal an average decrease of 29 mm/year for RCP4.5 and 45 mm/year for RCP8.5 at mid-century. For end-century, runoff projections indicate an average decline of 49 mm/year (RCP4.5) to 70 mm/year (RCP8.5), compared to the reference period. As such, it is concluded that implications on surface runoff and groundwater recharge will be evident affecting water availability for drinking and agricultural use (Figure 5 and Figure 6) (ACSAD/MoAg/CNRS/ESCWA, 2019; ESCWA, 2020; Jurdi 2021; WHO/ESCWA, 2017).

Figure 3 . Change in Temperature Compared to the Reference Period at Mid Century (a) RCP4.5 and (b) RCP8.5 (0.11 grid resolution) (ACSAD/MoAg/CNRS/ESCWA, 2019)

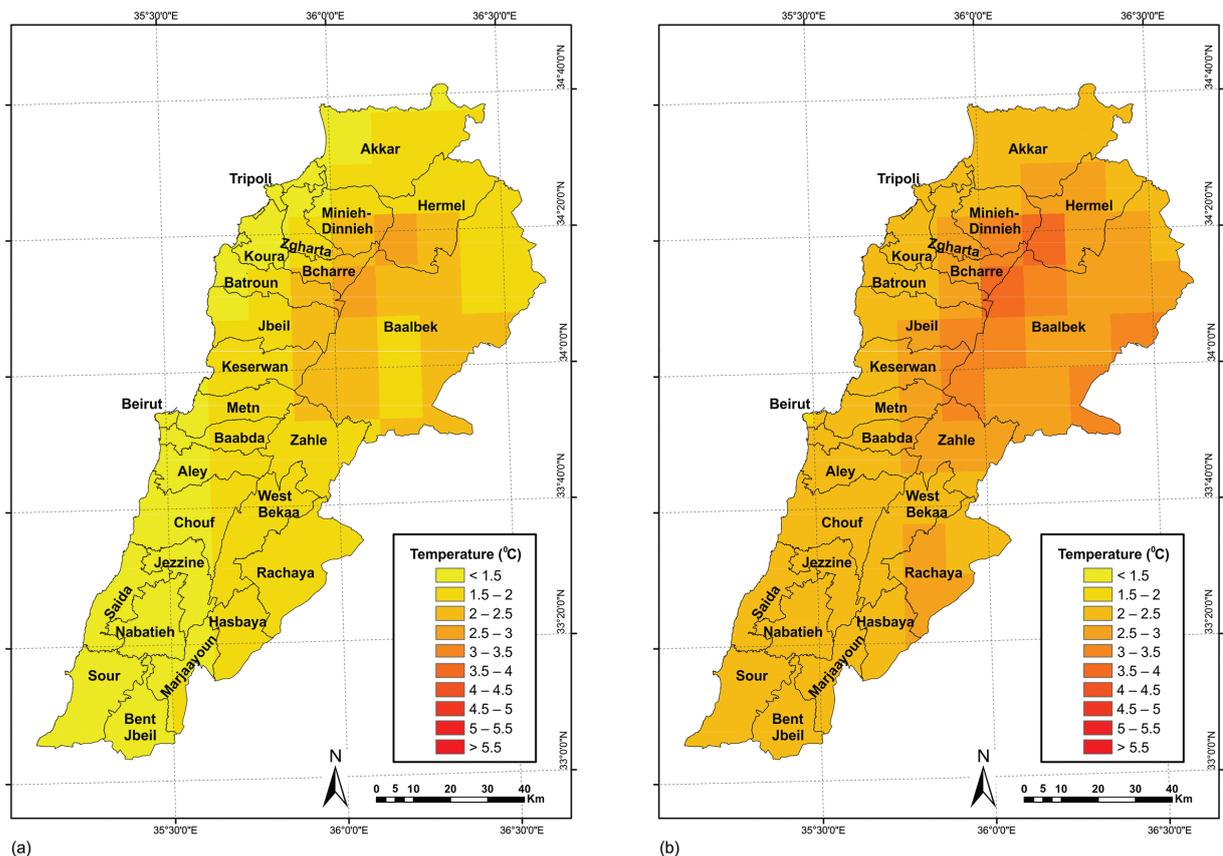


Figure 4 . Change in Temperate Compared to the Reference Period at End of Century (a) RCP4.5 and (b) RCP8.5 (0.11 grid resolution) (ACSAD/MoAg/CNRS/ESCWA, 2019)

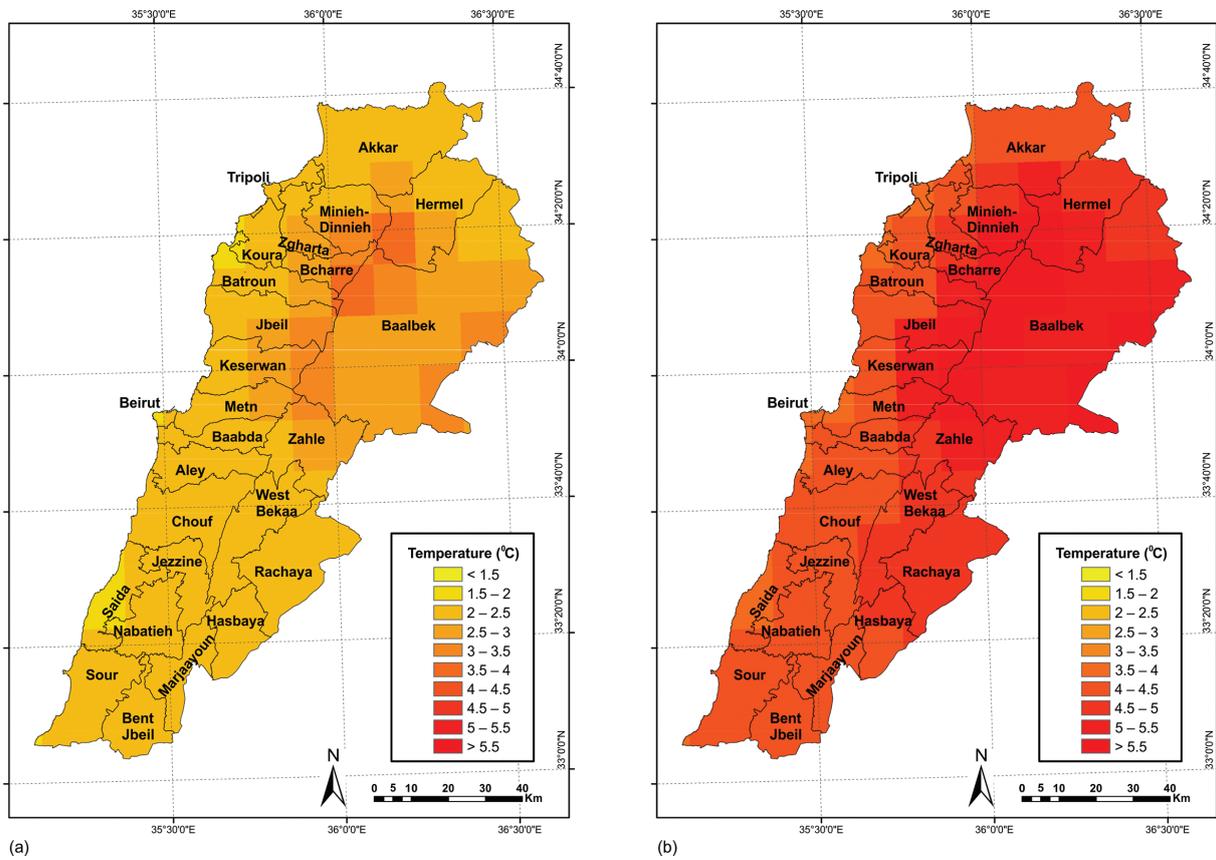


Figure 5 . Change in Precipitation Compared to the Reference Period at Mid Century (a) RCP4.5 and (b) RCP8.5 (0.11 grid resolution) (ACSAD/MoAg/CNRS/ESCWA, 2019)

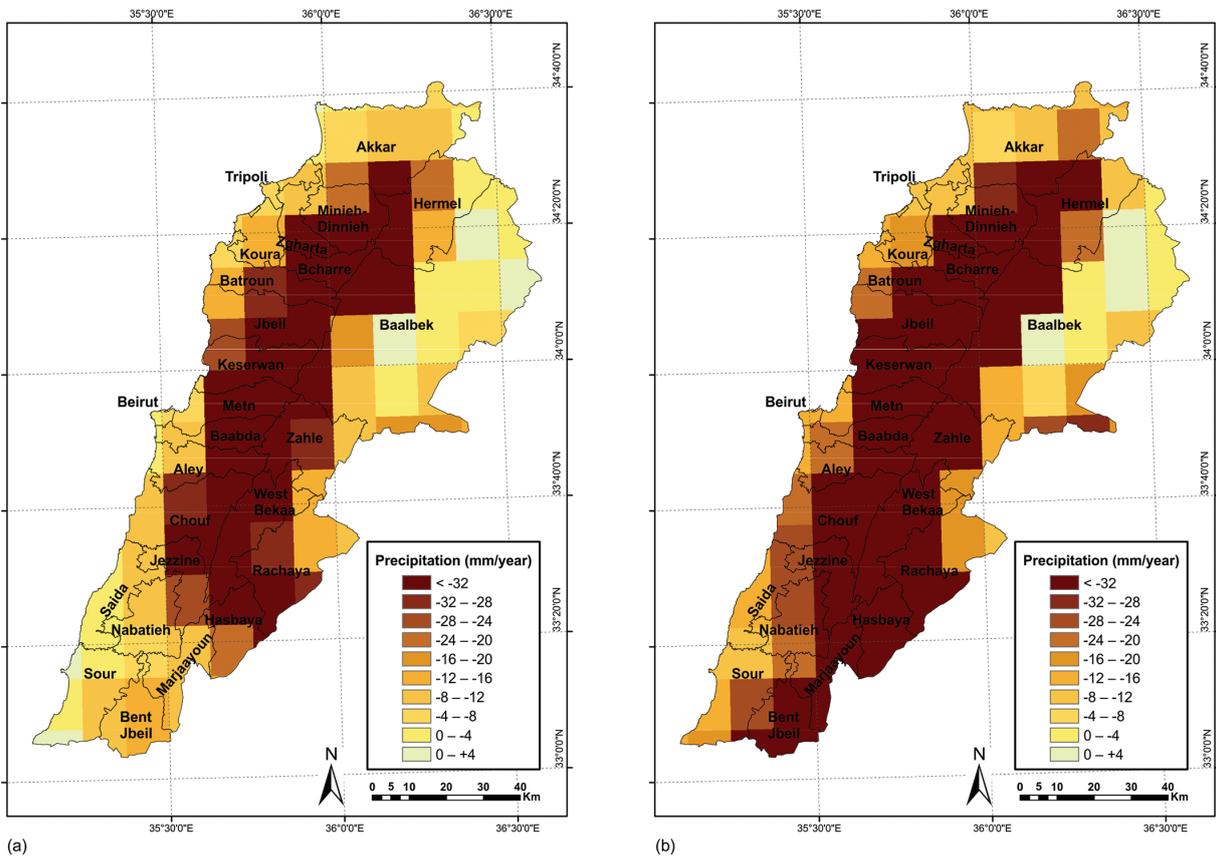
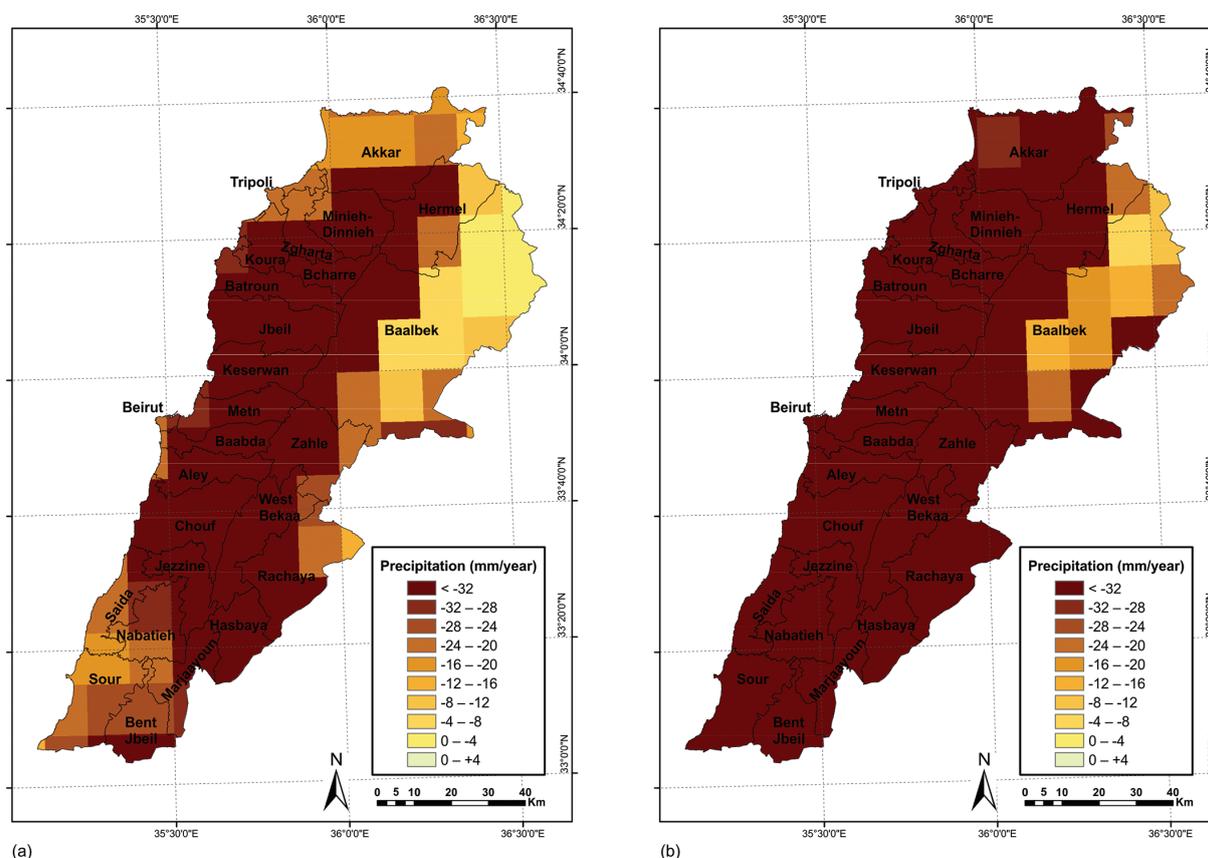


Figure 6 . Change in Precipitation Compared to the Reference Period at the End of the Century (a) RCP4.5 and (b) RCP8.5 (0.11 grid resolution) (ACSAD/MoAg/CNRS/ESCWA, 2019)



Still, it was noted that while the area with the highest projected increase in temperature is not densely populated, it is an important center for agriculture and livestock production which would have implications on food security in Lebanon. The Baalbeck and Akkar Cazas are part of those vulnerable areas which are also highly sensitive to flood risks, as are other parts of the country including Bcharre, Aley, Chouf and Hasbaya. As such, more health care facilities would be needed in those areas to respond to heat stress, waterborne diseases and injuries caused by floods (WHO/ ESCWA, 2017; ACSAD/MoAg/CNRS/ESCWA, 2019; Jurdi, 2021).

## 2.2. Health Impact of Climate Change in Lebanon

Climate change has had direct impacts on population health in Lebanon, in addition to the indirect impacts that would result from the increasingly weakening and challenged health infrastructure. Weakened health infrastructure would intensify the burden of disease and increase the morbidity and mortality rates (AUB, 2011). Increase in temperatures and concurrent heat stress are associated with increased mortality risks from hyperthermia, and respiratory and cardiovascular diseases (MoE/UNDP/GEF, 2015). Exposure to extreme heat can also exacerbate pre-existing conditions such as cerebral, respiratory, and cardiovascular conditions (Portier et al., 2010). Furthermore, intense short-term fluctuations in temperatures cause heat stress (hyperthermia)/ extreme cold (hypothermia) conditions that would result in increased death rates from heart and respiratory diseases and heat-related illnesses (dehydration, rash, cramps, heatstroke, heat exhaustion) (WHO, 2010b; Honda et.

## Heat stress will increase deaths among elderly from 2 to 48 per 100,000 in Lebanon.

al 2015; WHO and UNFCCC, 2021). As such, projections reflect heat stress related deaths in Lebanon among elderly (>65 years) would increase from 2 deaths per 100,000 to 48 per 100,000 (Honda et.al, 2015).

Other extreme weather events, associated with climate change, can also be destructive to human health and well-being by increasing event-related deaths, injuries, infectious diseases, and stress-related disorders (WHO et al., 2003; WHO, 2007a; Nuwayhid et al., 2009, USEPA, 2010; ESCWA et al., 2017). Additionally, victims would be at a high risk of malnutrition, diarrhea, and waterborne diseases caused by crowding and lack of hygiene (ESCWA et al., 2017). Women, children, and the elderly, especially the uninsured, would be highly affected in such events.

Additionally, respiratory diseases could be exacerbated by warming-induced increases in the frequency of smog (ground-level ozone) events and particulate air pollution (USEPA, 2010). Sunlight and high temperatures, combined with other pollutants such as nitrogen oxides and volatile organic compounds, can cause ground-level ozone to increase (WHO et al., 2003; WHO, 2007; Nuwayhid et al., 2009, USEPA, 2010; ESCWA et al., 2017; Jurdi 2021). In Lebanon, the proportion of the urban population with existing respiratory problems would be at a higher risk of damage to lung tissue as rising air temperatures would cause higher build-up of ground-level ozone concentrations (Nuwayhid et al., 2009; MoE/GEF/UNDP, 2016).

Climate change can also affect natural or biogenic sources of Particulate Matter such as wildfires and dust from dry soils (USEPA, 2010). Moreover, infectious diseases that are climate sensitive may occur in Lebanon due to climate changes, as highlighted in Table 4. Furthermore, increases in precipitation levels and intensity can lead to increase in of flood and drought events, which are associated with increased cases of water- and vector-borne diseases such as diarrhea and malaria (MoE/UNDP/GEF, 2015; WHO and UNFCCC, 2021).

Table 4 Climate Sensitive Infectious Diseases (Adapted from Confalonieri et al., 2007, Jurdi 2021; WHO, 2003; WHO, 2010; UNU-INWEH, 2017; WHO and UNFCCC, 2021)

Type of Disease	/Entity	Relevance to Lebanon
<b>Vector-borne diseases transmitted by arthropods, such as mosquitoes, ticks, sandflies, blackflies, and rodents</b>	Malaria	<p>Malaria cases reported by MoPH all originate in Africa. Still, with the expected increase in temperature in Lebanon might widen the area of distribution of the vectors, favoring their growth and development over time. In this case, population groups with lower socio-economic status, no insurance coverage, and lower access to health care, as well as children and the elderly will be more vulnerable.</p> <p>Lebanon does not appear among the countries at risk of dengue transmission (WHO, 2003). However, with the expected increase in temperature and drought periods, dengue transmission might emerge in Lebanon.</p>
	Dengue Fever	
<b>Rodent-borne diseases transmitted directly to humans by contact with rodent urine, feces, or other body fluids</b>		<p>Environmental factors that affect rodent population dynamics include unusually high rainfall, drought, introduction of exotic plant species and food sources (Confalonieri et al., 2007).</p> <p>Diseases associated with rodents and ticks include leptospirosis, tularemia, viral hemorrhagic diseases plague, Lyme disease, tick borne encephalitis and Hantavirus pulmonary syndrome (WHO et al., 2003).</p> <p>Cutaneous Leishmaniosis may emerge in Lebanon through flies nesting on rodents in open fields, which manifests on the skin and is particularly sensitive for women engaged in agriculture (UNU-INWEH, 2017).</p> <p>These diseases might flourish in Lebanon in case of increased floods (Jurdi 2021; WHO and UNFCCC, 2021).</p>
<b>Waterborne and foodborne diseases</b>	Cholera Typhoid Hepatitis A Diarrhea	<p>The potential contamination of drinking water supplies and disruption of sewer systems and/or wastewater treatment plants and flooding that could result from climate change could lead to an increased incidence of cholera, typhoid, and Hepatitis A cases in Lebanon (WHO, 2021).</p> <p>Regions with lower access to sanitation will be more exposed to water-borne diseases, and those with lower access to health care and insurance coverage, in addition to children and the elderly will be more affected (WHO, 2010a; WHO, 10b).</p>

Still, the increased burden on health care facilities (primarily healthcare centers and hospitals) from climate change impacts would be difficult to project due to the following factors: (a) the wide spectrum of disease entities associated with heat stress and short term fluctuations (dehydration, rash, cramps, heatstroke, heat exhaustion, malnutrition, diarrhea and water- and food- borne diseases to respiratory and cardiovascular related diseases), (b) type of effect (direct or long term), (c) intensity, duration and frequency of climate health risk and (d) preparedness of health care facilities to deal with disease output profile. Therefore, further assessments are needed to generate the required information for evidence-based adaptation planning.

Moreover, climate change impacts on water resources and the climate-vulnerable agricultural sector would link to increase in malnutrition (due to higher food insecurity); and an increase in rodent-borne diseases (MoE/UNDP/GEF, 2016) Other foreseen health impacts include lost labor and crop productivity, decreased quality of life, shift in disease patterns due to eroded ecosystems and biodiversity, and increased costs of healthcare (MoE/UNDP/GEF, 2015).

Further, costs associated with potential increases in the risk of death from heat stress, malnutrition, diarrhea, malaria, floods, and cardiovascular disease in Lebanon is estimated at 54,700 M USD in 2040, and costs associated with potential increases in illness and disability at 194,300 M USD, as presented in Table 5 (MoE/GEF/UNDP, 2016; Jurdi, 2021).

Table 5 Number and Potential Economic Costs of Climate-related Risk of Death and Risk of Illness or Disability in Lebanon under the IPCC's Highest-emissions Scenario (MoE/ GEF/ UNDP, 2016)

	Year	Death			Disability Adjusted Life Years		
		2020	2040	2080	2020	2040	2080
Number	Heat stress	3,900	6,600	12,200	620	1,300	3,300
	Malnutrition, diarrhea, malaria, floods, cardi-ovascular disease	31,100	33,900	33,300	811,600	885,400	870,700
	<b>Total</b>	<b>34,900</b>	<b>40,500</b>	<b>45,500</b>	<b>812,300</b>	<b>886,800</b>	<b>874,000</b>
Economic cost	Heat stress (millions)	USD 5,200	USD 9,000	USD 16,400	USD 140	USD 300	USD 730
	Malnutrition, diarrhea, malaria, floods, cardiovascular disease (millions)	USD 41,900	USD 45,800	USD 45,000	USD 177,800	USD 194,000	USD 190,700
	<b>Total</b>	<b>USD 47,200</b>	<b>USD 54,700</b>	<b>USD 61,400</b>	<b>USD 177,900</b>	<b>USD 194,300</b>	<b>USD 191,500</b>

Still, there is an uneven distribution of health impacts due to climate change among the population which is due to different socioeconomic conditions. According to the Lebanese Ministry of Environment, projections in 2015 predict that increases in temperatures will cause 2,483 to 5,254 additional deaths per year between 2010 and 2030 (MoE/UNDP/GEF, 2015). The impacts would affect, mostly, vulnerable groups such as the elderly, children, women, outdoor workers, people with low socio-economic status and diminished access to health services, refugees and displaced populations, and people living in semi-arid areas.

In addition to its impacts on health in Lebanon, climate change would exacerbate the challenges faced by Lebanon's healthcare system; a healthcare system burdened by various socio-economic and political factors including:

- Increased socio-economic stress due to the COVID-19 pandemic and the August 2020 Beirut explosion.
- Change in demographic profile with increase in number of elderly and vulnerable people.
- Increased stress due to presence of refugees in the country.
- An already high disease burden that is progressively increasing.
- Poverty and inequality leading to reduced ability to afford healthcare.
- An increasing gap in service quality between private and public care.
- Shortages in medical equipment and supplies.
- Energy insecurity and continuous electrical shortage.

Further, WHO details examples of the expected health impacts of climate change and risk to health care facilities as presented in Table 6 to Table 8. Impacts result from: (a) direct effects, (b) effects mediated through natural systems, and (c) effects mediated by human systems. The increased frequency and intensity of many natural hazards will challenge the infrastructure, support systems, and supply chains that

Climate change would exacerbate the challenges faced by Lebanon's healthcare system burdened by various socio-economic and political factors

the health care facilities and their communities depend upon. For example, rise in sea level, rain and winds from hurricanes, cyclones, typhoons, and tropical storms, with increased intensity, would cause widespread and prolonged flooding. This would further disrupt vulnerable infrastructures and transportation systems, as well as the delivery of materials and food.

Physically and operationally health care facilities cannot cope with climate-related risks, such as droughts, extreme temperatures, fires and changed patterns of climate-sensitive diseases. In some countries, for example, water scarcity and accordingly, the decrease in water supply would increasingly affect health care facilities WASH services essential for infection prevention and control services. All climate change associated risks can affect the functioning of health care facilities directly and would result in increased demand for their services. For example, flooding can damage hospital mechanical equipment while polluting available water sources. Strong and prolonged high winds can damage rooftop equipment and cause structural damage to buildings, electric transmission lines, and other public infrastructure. Moreover, the health workers, as first responders to emergencies, protecting the health of their communities before, during and after disasters, are also vulnerable to the impacts of extreme weather events (WHO, 2018; WHO, 2020; WHO, 2021).

Table 6 Sample of Direct Expected Health Impacts of Climate Change and Risks to Health Care Facilities (Adapted from WHO, 2020)

Climate Change Effects	Health Risks	Health related Impacts (IPCC rating)	Consequences for Health Care Facilities (Impacted Areas)
Increased number of warm days and nights; increased frequency and intensity of heat waves; increased fire risk in low rainfall conditions	Excess heat-related mortality; increased incidence of heat exhaustion and heat stroke; exacerbated circulatory, cardiovascular, respiratory and kidney diseases; increased premature mortality related to ozone and air pollution produced by fires, particularly during heat waves	Greater likelihood of injury, disease and death due to more intense heat waves and fires (Very high)	Infrastructure damage; increase in energy and water usage; threats to patients from heat and air pollution; sudden increase in community cases of heat stroke, asthma, and other respiratory diseases overwhelming the facility's capacity; mental health impacts on facility staff (health workforce, energy, infrastructure, technologies, and products)

Table 7 Sample of Mediated (through National Systems) Expected Health Impacts of Climate Change and Risks to Health Care Facilities (Adapted from WHO, 2020)

Climate Change Effects	Health Risks	Health related Impacts (IPCC rating)	Consequences for Health Care Facilities (Impacted Areas)
Higher temperatures and humidity; changing and increasingly variable precipitation; higher sea surface and freshwater temperatures	Accelerated microbial growth, survival, persistence, transmission; shifting geographic and seasonal distribution of diseases (such as cholera, schistosomiasis); ecological changes, droughts and warmer temperatures leading to cyanobacterial blooms, pathogen multiplication; extreme events leading	Increased risks of food and waterborne diseases (Very high)	Unexpected outbreaks of food- and water-borne diseases; heat stroke; lack of water or contaminated water in facilities; disrupted supply chain for essential supplies and medicines; issue of boil water advisories; disruption of food supplies; damage to medical equipment (water, sanitation, and health care waste; infrastructure, technologies and products)

	to disruption of water supply system and contamination; insufficient or intermittent water access for health care practices; insufficient quality and quantity of water leading to poor hygiene; flood damage to water and sanitation infrastructures; contamination of water sources through overflow		
Higher temperatures and humidity; changing and increasingly variable precipitation	Accelerated parasite replication and increased biting rates; prolonged transmission seasons; re-emergence of formerly prevalent diseases; changing distribution and abundance of disease vectors; reduced effectiveness of vector control interventions	Increased risks of vector borne diseases (medium)	Unexpected outbreaks of vector-borne diseases overwhelming response capacity; need for increased surveillance of climate sensitive diseases (health workforce, water, sanitation, and health care waste)

Table 8 Sample of Mediated (by Human Systems) Expected Health Impacts of Climate Change and Risks to Health Care Facilities (Adapted from WHO, 2020)

Climate Change Effects	Health Risks	Health related Impacts (IPCC rating)	Consequences for Health Care Facilities (Impacted Areas)
Higher temperatures and changes in precipitation; Lower food production in the tropics	Lower access to food due to reduced supply and higher prices; combined effects of undernutrition and infectious diseases; chronic effects of stunting and wasting in children	Increased likelihood of undernutrition resulting from diminished food production in poor regions (high)	Increased number of patients (particularly children) with diseases related to, or made worse by, undernutrition (health workforce)
Higher temperatures and humidity	Outdoor and unprotected health workers obliged to work either in physiologically unsafe conditions or to lose income and livelihood opportunities	Consequences on workers' health include risks from lost work capacity and reduced productivity (high)	Risk to health care workers and patients from higher temperatures; mental health impacts on facility staff; power outages (health workforce; infrastructure, technologies, and products)

### 2.3. Climate Vulnerability in Lebanon

According to the Notre Dame Global Adaptation Initiative (ND-GAIN) index, Lebanon ranked 117<sup>th</sup> (out of 182 countries) in 2020, and was considered to have a relatively low vulnerability, and at the same time low readiness to tackle climate change (86<sup>th</sup> most vulnerable country and the 158<sup>th</sup> least ready country out of 182 countries). This index measures vulnerability by the "exposure, sensitivity, and ability to cope with climate related hazards by accounting for the overall status of food, water, environment, health, and infrastructure within a country". Additionally, it measures readiness by the "country's ability to leverage investments and convert them to adaptation actions by looking at the country's economic, governance and social readiness" (ND GAIN, 2022). Still, it is important to note that since 2020 (the most recent index score), the quality of governance, climate readiness and adaptive capacity have further deteriorated in Lebanon, due to the compounded crisis

## Lebanon ranked 158<sup>th</sup> least ready country out of 182 countries in 2020.

the country is facing. Therefore, it is likely that the ND-Gain index considerably changed for the years 2020-2021, a period during which multidimensional poverty in Lebanon rose from 42% to 82% of the total population (ESCWA, 2021).

The main climate-driven biophysical and socioeconomic vulnerabilities in Lebanon include the following (USAID, 2016; the Netherlands Ministry of Foreign Affairs, 2018; ICRC, 2021; WHO and UNFCCC, 2021):

- Biophysical Vulnerabilities for climate change adaptation:
  - o The 225 Km<sup>2</sup> of Lebanon's surface area extending along the coastline. In addition, 90% of the country's infrastructures are located along the Mediterranean Sea, which is projected increased exposure to sea-level rise and floods.
  - o The diverse natural environment covering various areas, including coastal, agricultural, forest and mountainous areas, all of which have unique ecosystems and biodiversity that are sensitive to climate change (farmlands, rangelands, forests, and groundwater aquifers).
  - o The topography and land structure with steep slopes, which are disposed to water erosion, leading to loss of topsoil and decreased capacity to retain water. In turn, degraded sandy soils can lead to dust and sandstorms, which are also hazardous to human health and livestock.
  - o The country's both winter and summer (sun and snow) touristic attractions (e.g. ski resorts, beaches) that are highly dependent on weather conditions and are vulnerable to climate change.
- Socio-economic Vulnerabilities
  - o High rates of urbanization
  - o Large influx of refugee population into the country (currently estimated at about 1.5 million refugees) which is adding pressure on Lebanon's natural resources and infrastructure, increasing demand and consumption of water and energy, increasing the generation of municipal solid waste and wastewater, increasing demand on food, and impacting air quality and land use.
  - o Conflicts and wars over decades have damaged infrastructures, which to date is challenged by underinvestment and poor management.
  - o Lebanon's economy that is highly dependent on imports of food and fuel and as such highly vulnerable to regional and international market shocks.

# 3.VULNERABILITY ASSESSMENT OF THE HEALTH CARE FACILITIES TO CLIMATE CHANGE

## 3.1. Overview of the Health Sector in Lebanon

The healthcare system in Lebanon is currently diverse due to the public–private partnerships involved in the provision and financing of healthcare services (WHO, 2017). This has been a result of a long history of civil wars, economic turmoil, and political instability, which has weakened the health sector and the public sector, leading to the rapid unregulated growth of private institutions and Non-Governmental Organizations (NGOs) (WHO, 2017).

The first call for the development of healthcare system in Lebanon dates to 1977, with the first National Strategy for Primary Healthcare published in 1994 (WHO, 2017; Hamadeh et.al. 2020). Currently, 212 Primary HealthCare Centers (PHCCs) are included in the National Primary Healthcare Network (WHO, 2017; Hamadeh et.al, 2020). Several entities are involved in the primary healthcare centers in Lebanon, including the Ministry of Public Health (MoPH), the Ministry of Social Affairs (MoSA), Non-Governmental Organizations, and municipalities, with the majority affiliated with nongovernmental organizations and municipalities (El-Jardali et al., 2014; Hamadeh et.al., 2020).

Moreover, in 2009, the Ministry of Public Health in collaboration with Accreditation Canada, published the first national Primary Care Accreditation Standard in Lebanon. In 2010, the accreditation standard was developed and piloted among several primary healthcare centers. The standard addressed the following key aspects (1) building an effective primary care clinic; (2) maintaining a safe primary care clinic; (3) having the right people work together to deliver care; (4) delivering and coordinating primary health care; (5) maintaining accessible and efficient health information systems; and (6) monitoring quality and achieving positive outcomes.

Accordingly, primary healthcare centers, based on national accreditation standards, should deliver the following services at a facility: (1) family medicine (FM)/ general consultation services; (2) dental services; (3) pediatric services; (4) reproductive, maternal, and newborn health services; (5) non-communicable disease management; (6) mental health services; (7) diagnostic imaging services; (8) basic laboratory services; and (9) pharmaceutical services. The latest network facility assessment conducted in 2020, summarized the characteristics of the Primary Health Care Centers as presented in Table 9.

There are 212 PHCCs within the MoPH Primary Healthcare Network distributed across all Lebanese governorates with more than 50% of PHCCs located in rural

areas (n = 125, 59.0%). Mount Lebanon included the largest number of PHCCs (n = 55, 25.9%) while the lowest was in Beirut (n = 14, 6.6%). Still, Baalbeck and Akkar Cazas that are among the more vulnerable spots, as presented in section 2.1, have low coverage of PHCCs of 8.5% and 10.4%, respectively. This is important to note as more health care facilities would be needed to respond to heat stress, waterborne diseases and injuries caused by floods (WHO/ ESCWA, 2017; ACSAD/ MoAg/ CNRS/ ESCWA, 2019; Jurdi, 2021).

Table 9 PHCC Characteristics (Adapted from Hamadeh et al, 2020)

Characteristic	n	Valid Percentage (%)
<b>Governorate</b>		
Beirut	14	6.6
Mount Lebanon	55	25.0
North	30	14.2
Akkar	22	10.4
Baalbak-Hermel	18	8.5
Bekaa	19	9.0
South	27	12.7
Nabatieh	27	12.7
<b>Accreditation Lebanon Primary Health Care Standards 2015</b>		
Yes	17	8
<b>Settlement Type</b>		
Urban	87	41.0
Rural	125	50.0
<b>Facility Type</b>		
*PHCC	199	93.9
**PHCC with Hospital OPD	13	6.1
<b>International NGO Support</b>		
Yes	95	44.8
<b>Total</b>	<b>212</b>	<b>100.00</b>

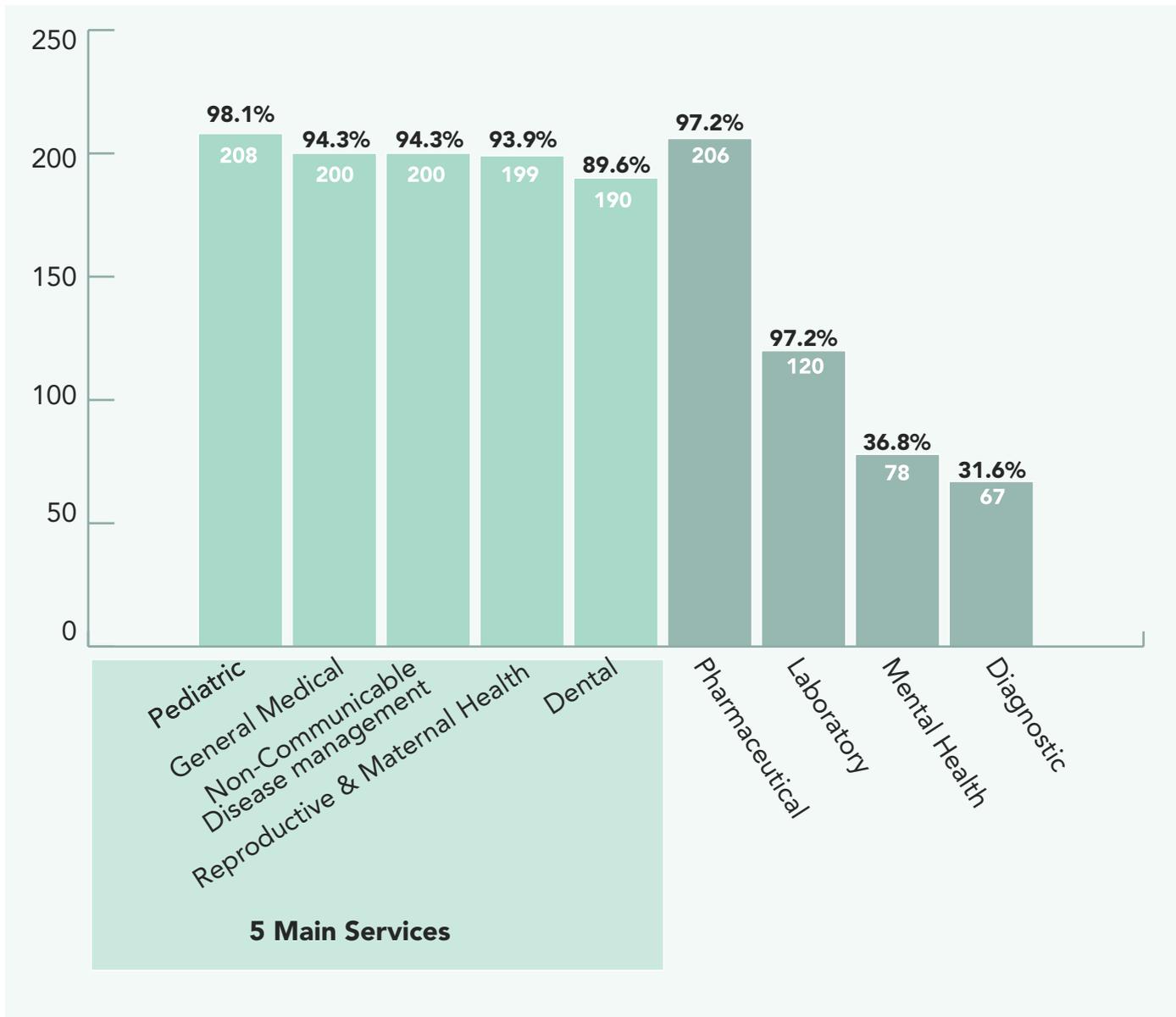
\*PHCC (Primary Health Care Center)

\*\*OPD (Outpatient Department)

Service readiness were also evaluated for the 5 basic services required by the national PHC standards: (1) FM/general consultation services; (2) dental services; (3) pediatric services; (4) reproductive, maternal, and newborn health services; and (5) non-communicable disease management. Overall, 165 PHCCs (77.8%) provide these 5 main services as presented in Figure 9. However, only 78 (36.8%) and 67 (31.6%) of PHCCs offer mental health and diagnostic services. This was mainly attributed to the lack of advanced medical equipment, absence of written clinical guidelines for quality improvement, adequate capacity building, and sufficient resource provision (Figure 7).

Overall, the majority of PHCCs in the network (88.7%) had the basic equipment necessary for care delivery, and (85.4%) had viable means of communication including internet access and a backup electrical supply.

Figure 7 Availability of Services at Primary Healthcare Centers in Lebanon



Further, assessing the fulfilment of staffing and health infrastructure national standards, Table 10 shows that the greatest proportion of centers that fulfilled these requirements are in Mount Lebanon (76.4%) and Beirut (71.4%). To the contrary, in Akkar, its 36.4%, the lowest among Lebanese governorates. Consistently, a greater proportion of PHCCs in urban areas (73.6%) fulfilled the staffing requirements as compared to rural areas (46.4%). Additionally, most accredited centers (88.2%) fulfilled the staffing requirements in comparison to 54.9% among non-accredited PHCCs with a significant difference in proportion ( $P = 0.008$ ).

Moreover, international NGO support (44.8%, 95 out of 212 PHCCs) and accreditation status (8% 17 out of 212 PHCCs) were both significantly associated with fulfilling health infrastructure requirements ( $P = 0.044$  and  $0.001$ , respectively). Still, and due to the presented deficiencies, to date, only 17 (8.0%) of the PHCCs have been accredited through the national PHC Accreditation Program (Hamadeh et.al. 2020).

Table 10 Facility Characteristics and Fulfilment of Staffing and Health Infrastructure Requirements\* (Hamadeh et.al. 2020).

Variable	Staffing Requirement fulfilled n %	Staffing Requirement not fulfilled n%	P	Infrastructure Requirement fulfilled n %	Infrastructure Requirement not fulfilled n %	P
<b>Governorate</b>						
Beirut	10 (71.4)	4 (28.6)	0.006	2 (14.1)	12 (85.7)	0.309
Mount Lebanon	42 (76.4)	13 (23.6)		14 (25.4)	41 (74.6)	
North	19 (63.4)	11 (36.7)		9 (30.0)	21 (70.0)	
Akkar	8 (36.4)	14 (63.6)		4 (13.6)	18 (86.4)	
Baalbak-Hermel	11 (61.1)	7 (38.9)		3 (16.7)	15 (83.3)	
Bekaa	8 (42.1)	11 (57.9)		4 (21.1)	15 (78.9)	
South	13 (48.2)	14 (51.8)		12 (40.7)	15 (59.3)	
Nabatieh	11 (40.7)	16 (56.3)		9 (33.3)	18 (66.7)	
<b>Settlement Type</b>						
Urban	58 (46.4)	67 (53.6)	0.001	33 (24.8)	92 (75.2)	0.848
Rural	64 (73.6)	23 (26.4)		24 (27.6)	63 (72.4)	
<b>Accreditation Status</b>						
No	107 (54.9)	88 (45.1)	0.008	46 (23.1)	149 (76.9)	0.001
Yes	15 (88.2)	2 (11.7)		11 (58.8)	6 (41.2)	
<b>NGO Support</b>						
No	64 (54.7)	53 (45.3)	0.352	25 (21.4)	92 (78.6)	0.044
Yes	58 (61.1)	37 (38.9)		32 (31.6)	63 (68.4)	

NGO= Nongovernmental Organization; PHCC: Primary Health care Center

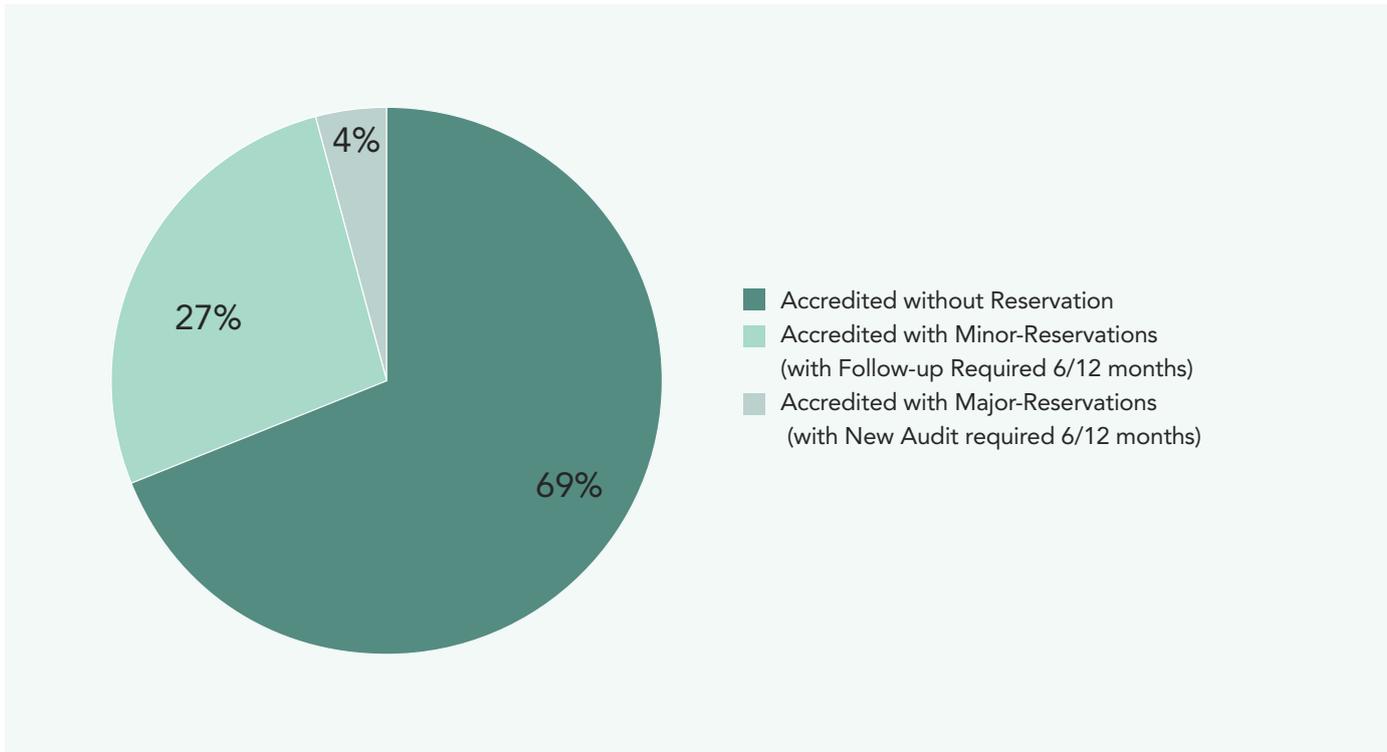
\* Health Infrastructure: (a) basic amenities (b) basic equipment (c) means of communication and (d) infection control.

Health Human Resources: (a) part-time and full-time physicians (b) part-time and full-time supporting staff and (c) part-time and fulltime administrative staff.

Moreover, in 2000, MoPH initiated a national hospital accreditation scheme to enhance and ensure the quality of the care provided. This accreditation scheme introduced a paradigm shift from a traditional focus on physical structure and equipment of hospitals, to a multidimensional approach, to quality improvement with focus on clinical and managerial processes and performance. This work was done in cooperation with the French Health Authority (HAS) that supported the Ministry in the development and institutionalization of this Hospital Accreditation Program (MoPH, 2016).

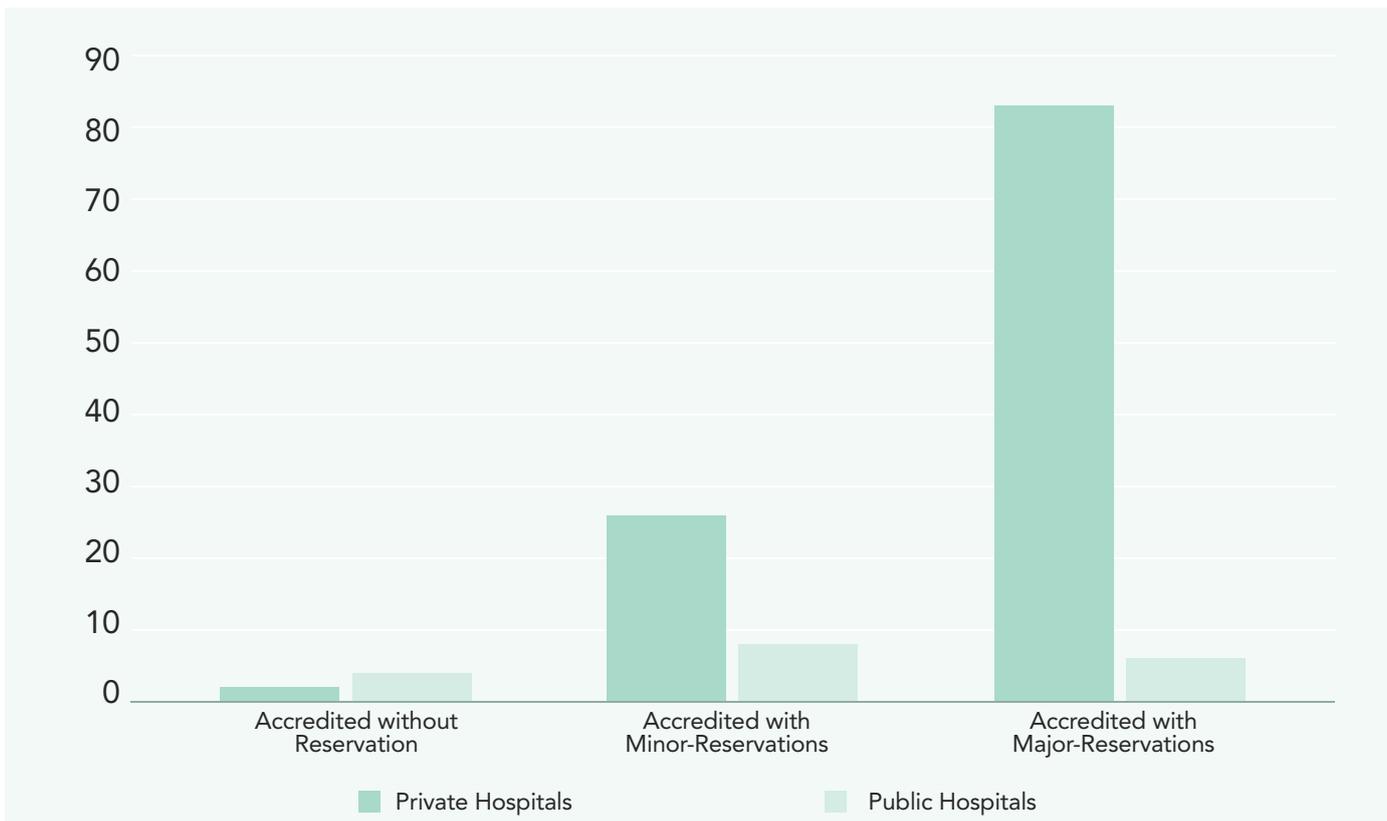
The approach adopted focused on quality assurance, continuous improvement of quality, as well as risk management. The latest accreditation survey conducted in 2016 showed that, 89 hospitals/healthcare facilities were accredited without reservation, including both public and private hospitals, as presented in Figure 8 (MoPH, 2016).

Figure 8 Percentage of Hospital Accredited by the earlier 2009 National Accreditation Standards (MoPH, 2016)



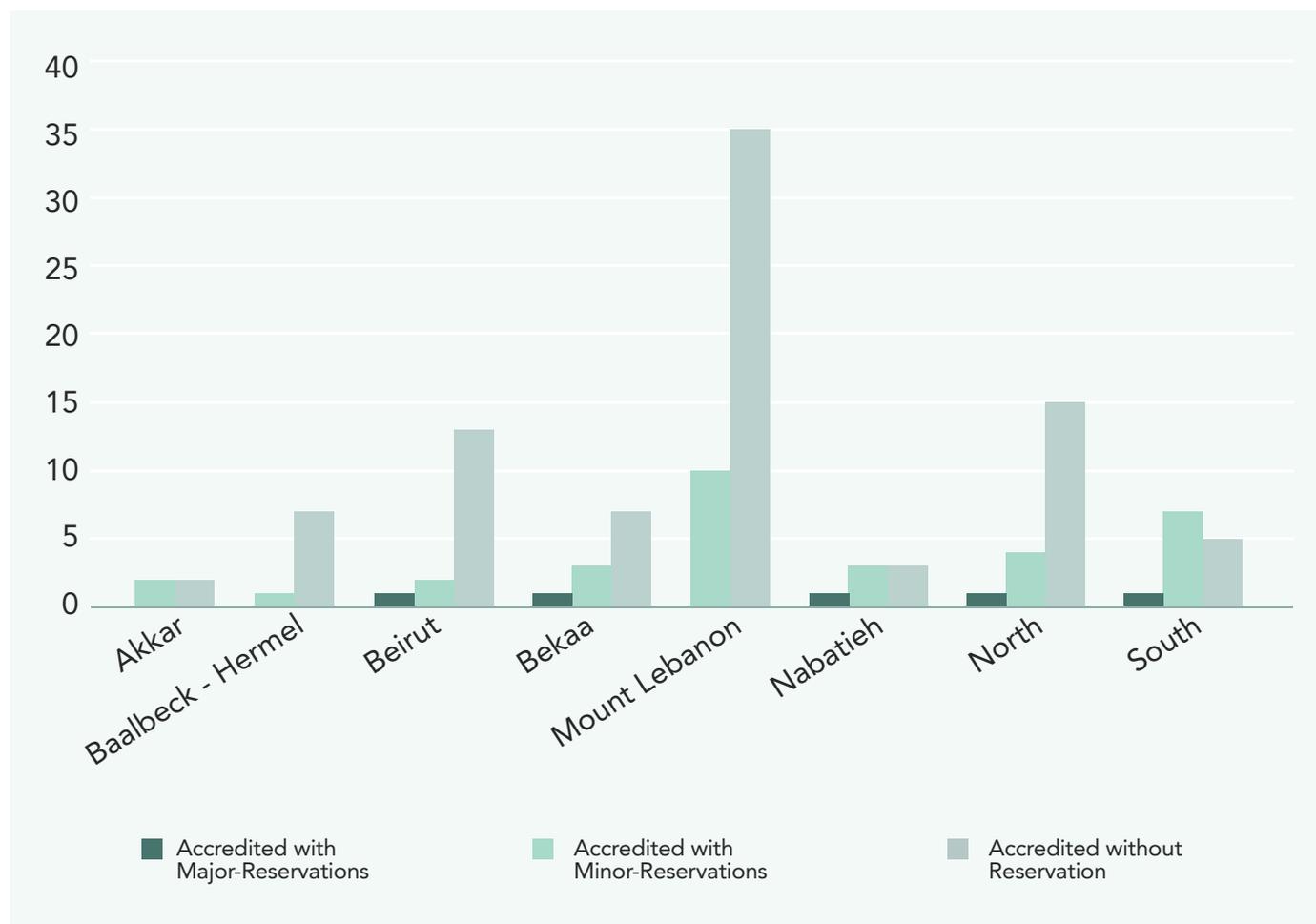
As seen in Figure 9, most hospitals accredited without reservation were private hospitals (n=84), while the remaining 5 were public hospitals. In addition, those that are accredited with major reservation were public hospitals (n=4), compared to only 1 private hospital.

Figure 9 Accreditation Status by Type of Hospital (Adopted from MoPH, 2016)



As for the geographical distribution, as presented in Figure 10, most accredited hospitals are concentrated in Mount Lebanon governorate (n=45 hospitals), followed by North (n=20), and Beirut governorate (n=17). The rest of the hospitals are distributed across the remaining governorates.

Figure 10 Accreditation Status by Geographical Distribution (Adopted from MoPH, 2016)



In 2019, the MoPH updated the 2009 National Accreditation Standards, based on the latest evidence available and best practices to comply with the International Society for Quality in Healthcare (ISQua) requirements. This was accomplished through a partnership with the HAS and in collaboration with the Ecole Supérieure des Affaires (ESA) Business School in Beirut. MoPH planned to start the first accreditation visits to hospitals in September 2019. Currently, the updated 2019 Accreditation Standards are not in effect, mainly due to COVID-19 and economic crisis challenges.

Additionally, several private hospitals in Lebanon are accredited by international accreditation bodies. Hospitals, such as American University of Beirut Medical Center (AUBMC), Clemenceau Medical Center (CMC), Bellevue Medical Center (BMC), Mount Lebanon Hospital, among others, are accredited by the Joint Commission International (JCI) Accreditation. JCI provides international standards for hospitals and addresses issues related to the implementation of Clinical Practice Guidelines and laboratory services, quality improvement and patient safety, safety of care environment, confidentiality, and security of patient information, etc.

Also, many hospitals, such as Rizk Hospital - Lebanese American University Medical Center (LAUMC) and Makassed hospital have the ISO 9001 certification, which sets out the criteria for a quality management system. Other international accreditation/health and safety standards Lebanese include the ISO 14001, which specifies the requirements for an environmental management system that can enhance the environmental performance of organizations and the Occupational Safety and Health Administration (OSHA) Guidelines on Hospital Safety and Health Management Systems. Currently, there are no available data on the number of hospitals in Lebanon accredited by these international standards and certification systems.

## 3.2. Vulnerability Assessment: Methodology

### 3.2.1 Vulnerability Assessment Checklist Development

The 2020 WHO guidance for climate-resilient and environmentally sustainable health care facilities specify vulnerability areas to climate change challenges and accordingly, sets the objectives, for each of the vulnerability key areas, as presented in Table 11. The aim of this guidance is to enhance the capacity and preparedness of health care facilities to protect and improve the health of communities under unstable and changing climate. Health care facilities can become environmentally sustainable, by optimizing the use of resources and minimizing the generation of waste; a major environmental pollutant (WHO 2020; WHO, 2021). The development of climate-resilient and environmentally sustainable health care facilities will feed back into high quality and accessible care services at reduced costs and better affordability. Hence, it can contribute towards SDG 3 goals and targets (WHO 2020; WHO, 2021).

Table 11 Assessing the Vulnerability of the Health Care Facilities to Climate Change Challenges (WHO 2020; WHO, 2021).

Vulnerability Key Areas	Objectives of the Key Vulnerability Areas Specified by WHO Checklists
Health Workforce	<p><b>Human resources:</b> HCF with capacity to deal with climate change health risks; having healthy and safe working conditions and enough health workers (aware and empowered to ensure environmentally sustainable actions).</p> <p><b>Capacity development:</b> Training and providing information and knowledge to health care workers, to respond to climate risks and minimize environmental threats resulting from the operation of the health care facility.</p> <p><b>Communication and awareness raising:</b> Communicating coordinating and increasing awareness related to climate resilience and environmental sustainability among health workers, patients, visitors, target communities, and with other sectors.</p>
WASH and Health Care Waste Management	<p><b>Monitoring and assessment:</b> Informing on water, sanitation, chemical use and health care waste management while considering climate-resilience and environmental sustainability for promoting action.</p> <p><b>Risk management:</b> Strengthening capacity of health care facilities to manage water, sanitation, chemicals and health care waste risks to workers, patients and served communities, by including assessments of climate-resilience and environmental sustainability in responding to hazards and identifying and reducing exposures and vulnerabilities.</p> <p><b>Health and safety regulation:</b> Implementation of water, sanitation, chemical safety, and health care waste regulations taking into consideration climate variability and change, and environmental sustainability.</p>

<b>Energy Management</b>	<p><b>Monitoring and assessment:</b> Providing information regarding energy services while considering climate-resilience and environmental sustainability for promoting action.</p> <p><b>Risk management:</b> Strengthening capacity of health care facilities to manage energy related risks to workers, patients and served communities, by including assessments of climate-resilience and environmental sustainability in responding to hazards and identifying and reducing exposures and vulnerabilities.</p> <p><b>Health and safety regulation:</b> Regulating energy use and access taking into consideration climate variability and change, and environmental sustainability.</p>
<b>Infrastructure, Technologies, Products and Processes</b>	<p><b>Adaptation of current systems and infrastructures:</b> Implementing building regulations in the construction and retrofitting of health care facilities to ensure climate-resilience and environmental sustainability.</p> <p><b>Promotion of new systems and technologies:</b> Adopting new technologies and processes that can provide climate-resilience, environmental sustainability, and enhanced health service delivery.</p> <p><b>Sustainability of health care facility operations:</b> Adopting and procuring low environmental impact technologies, products, processes, and services to enhance climate-resilience and environmental sustainability.</p>

Accordingly, checklists for assessing vulnerability of health care facilities to all the climate challenges were developed, to address the four indicated key vulnerability areas of healthy workforce, WASH and waste management, energy management and infrastructure.

A sample table of Climate Change Hazards and Vulnerability Areas is hereby presented; the completed assessment is presented in Appendix 2, table 2.1.

Table 12 Sample of Climate Change Hazards and Vulnerability Areas (WHO, 2021)

Climate Hazard Type	Exposure to Hazard Yes/No	Vulnerability Areas to be addressed			
		Healthy Workforce	WASH and HCW Management	Energy Management	Infrastructure, Technologies, Products and Processes
Flood					
Storm					
Sea-level					
Drought					
Heatwave					
Wildfire					
Cold wave					
<p><b>Vulnerability level</b></p> <ul style="list-style-type: none"> <li>• <b>High risk:</b> unprepared; unable to respond (Higher risk)</li> <li>• <b>Medium risk:</b> basic or incomplete preparation; low level of response (Medium risk)</li> <li>• <b>Low risk:</b> able to respond (Lower risk)</li> </ul>					

Hence, the checklists to assess vulnerabilities are divided based on objectives for the implementation of each component as presented in Table 10. It follows the process and rating levels proposed by the WHO Guidance for Climate – resilient and environmentally sustainable healthcare facilities (WHO, 2020). These checklists are in the form of questions to identify if a healthcare facility is implementing measures to respond to climate hazard by reducing vulnerabilities to lessen or avoid potential damage and disruptions to service delivery. The level of vulnerability for each item in the list can be assessed as “high” (unprepared; or unable to respond), “medium” (basic or incomplete preparation; or low level of response) or “low” (prepared; or able to respond). Hence, the vulnerability is reflected by the presence of entities that would reflect on better performance.

For the purpose of this study, and to reduce redundancy, as each of the seven hazard types has a separate checklist with entities that are overlapping across the hazard types, a simpler combined checklist was developed with all commonalities and inclusion of particularities.

The adapted developed checklist covers all climate change hazards (floods, storms, sea-level rise, droughts, heatwaves, wildfires, and cold waves), and addresses all the key vulnerability areas of health workforce, WASH and health care waste management, energy management, infrastructure, and technologies, as presented in Appendix 1 Table 1.1 (WHO 2020; WHO, 2021).

### 3.2.2. Vulnerability Assessment Study

To check the vulnerability of the health care facilities/ health care providers to climate change challenges, all health care sector accreditation and certification programs were screened and used as proxy-indicators to evaluate the vulnerability and preparedness of health care facilities to climate change. This is due to the documented, consistent evidence that shows that general accreditation programs improve the process of care provision by healthcare services (Alkhenizan and Shaw, 2011; Guptp, and Sahu, 2013; El-Jardali, Hamadeh, Jaafar et al, 2014; Mehralian, Khashij and Malekahmadi, 2017).

Evidence shows that general accreditation programs do not just improve clinical outcomes of a wide spectrum of clinical conditions, but also improve the quality of healthcare services by increasing and improving the structure of medical staff organization, nursing organization, and physical facilities and safety. Hence, accreditation and certification programs are associated with major benefits that will (a) improve patient outcomes and mitigation of risks, (b) identify programs and processes, strengths and gaps, (c) enhance communication, (d) empower staff, (e) use standard facilities, (f) create a culture of quality and safety, and (g) decrease the cost of risks and liabilities (Alkhenizan and Shaw, 2011; Guptp, and Sahu, 2013; El-Jardali, Hamadeh, Jaafar et al, 2014; Mehralian, Khashij and Malekahmadi, 2017). Moreover, and in the absence of any national initiative on how to empower Health Care Facilities to decrease vulnerability to climate change challenges, the presented assessment is based on the requirements specified by accreditation and certification programs governing PHCC and hospitals. As such, the impacts and significance of all entities of the key areas that determine the level of vulnerability (major, moderate, or minor) of health care facilities, as presented in Section 3.3. This approach is direct, comprehensive and did not require field assessment as it

**Evidence shows that Hospital Accreditation programs improve the Quality of healthcare services by improving staff organization and physical safety.**

## The approach of the study assumes that a facility with no accreditation is at high risk.

encompasses all PHCCs and hospitals in Lebanon. This approach assumes that a facility with no accreditation is at high risk, and a facility with one or more certification is at low or medium risk, as further explained in Table 13 and Table 14. The approach of the studies assumes that a facility with no accreditation is at high risk.

The screened accreditation programs and certification systems in this study are as follows:

- Lebanon Primary Health Care Standards 2015:  
The objectives of the Primary Health Care Standards is to enhance diagnosis, treatment and management of common health illnesses in patients through, addressing accessibility, appropriateness, continuity of care, effectiveness, efficiency, safety, and continuous improvement of performance (Accreditation Canada, 2011; Accreditation Canada, 2015).  
As such, the Primary Health Care Standards address (1) building an effective primary care clinic; (2) maintaining a safe primary care clinic; (3) having the right people work together to deliver care; (4) delivering and coordinating primary health care; (5) maintaining accessible/efficient health information systems; (6) monitoring quality and achieving positive outcomes (Accreditation Canada, 2011; Accreditation Canada, 2015).

- Lebanon Revised Hospital Accreditation Standards 2019:  
Lebanon revised its 2009 hospital accreditation standards in 2019. The updated standards sets new hospital accreditation standards in line with the latest scientific evidence and international best practices and complies with the International Society for Quality in Healthcare (ISQua) requirements (MoPH, 2016; MoPH, 2019). Still, the upgrade of the Hospital Accreditation Standards did not further the response to the climate change vulnerability areas and sub entities.

The 2019 Revised Hospital Accreditation Standards address the entities of (1) hospital management including governance and leadership (GL), human capital (HC), information management (IM) and facility management and safety (FMS); quality and risk management including medication management and safety (MMS), Infection prevention and control (IPC); quality management and patient safety (QMPS); and (3) patient centered care. Still, comparing to the old national standard on which hospitals have been accredited with the updated one, showed that the entities reflecting on vulnerability are still the same and covered in both the old and updated standards (MoPH, 2016; MoPH, 2019).

- Joint Commission International (JCI) Standards:  
These standards cover access to care and continuity of services, assessment and care of patients, anesthesia and surgical care, medication management, patient/family rights and education, quality improvement and patient safety, prevention and control of infections, governance and leadership, facility management and safety, staff qualifications and education, and information management (Joint Commission International, 2022).

Accordingly, it addresses (1) provision of high-risk services and care, (2) implementation of clinical practice guidelines, (3) radiology/diagnostic

## The level of preparedness of Lebanese Healthcare facilities is low.

imaging services and laboratory services, (4) programs for quality improvement and patient safety, (5) supply chain management, (6) safety of care environment, (7) health care practitioner privileging and credentialing, and (8) confidentiality and security of patient information (Joint Commission International, 2022).

- International Standard Organization ISO 9001:  
Implementing quality management systems is a strategic decision by organizations to improve performance sustainably. It (1) enhances the ability to, consistently, provide products and services conforming to legal and regulatory requirements, (2) facilitate opportunities to enhance customers' satisfaction, (3) addresses risks and opportunities associated with context and objectives, and (4) enhances the ability to demonstrate conformity in the quality management system (International Standard Organization, 2015).
- International Standard Organization ISO 14000:  
This environmental management system is a systematic approach to environmental management. It contributes to sustainable development by (1) preventing/mitigating adverse environmental impacts by organization, (2) preventing/mitigating potential adverse environmental effects on organization; (3) assisting in compliance obligations, (4) enhancing environmental performance, (5) controlling/influencing the way products and services are designed, (6) achieving financial/operational benefits from the use of environmentally sound alternatives, and (7) communicating environmental information (International Standard Organization, 2015a).
- OSHA Hospital Safety and Health Management System:  
The US Occupational Safety and Health Administration (OSHA) sets regulations to ensure that employees have a safe and healthful workplace that complies with the Occupational Safety and Health Regulations. Although it provides regulations for all industries, employees of hospitals, must adhere to additional regulations specific to their industry.  
  
It addresses issues relating to: (1) management leadership; (2) employee participation; (3) hazard identification; (4) hazard prevention and control; (5) education and training; and (6) program evaluation and Improvement. Establishing such effective certification systems is an essential strategy to eliminate/control hazards that lead to injuries, illnesses, and death (U.S. Department of Labor-OSHA, 2020; US Department of Labor-OSHA, 2020a).

### 3.3. Vulnerability Assessment of the Health Care facilities to Climate Change: Results and Recommendations

Analyzing the vulnerability of the health facilities based on the type of adopted accreditation and certification programs (Appendix 2 Table 2.1, and Table 13- Table 14) shows clearly that the level of preparedness of Lebanese health care facilities is low, and what can be achieved to reduce the vulnerability to climate change challenges and disasters, is relatively a basic minimal.

The high risk is reflected by non compliance in addressing key vulnerability areas of about 83.7% to 97.65% of health care facilities, as presented in table 13.

However, adopting more than one system of accreditation with certification systems of ISO 9001, ISO 9014, and OSHA certification, did not prove to significantly enhance preparedness to address the climate change challenges and disasters.

Looking at the overall coverage, it is noted that the Primary Care Standards 2015, the Hospital Accreditation Standard 2019 and the JCI Standard, address, even partially, all the identified vulnerability areas of:

- (1) Health Workforce (human resources, capacity development and communication and awareness raising)
- (2) WASH and Health Care Management (monitoring and assessment, risk management and health safety regulations)
- (3) Energy Management (monitoring and assessment, risk management and health safety regulations)
- (4) Infrastructure, technologies, Products and Processes (adaptation of current systems and infrastructures, promotion of new systems and technologies, and sustainability of health care facility operation)

Whereas ISO 9001 and ISO 14001 do not touch on WASH and Health Care Management and Energy Management in the context of preparedness to climate change challenges and disasters. Further OSHA health care sector requirements relate minimally to workforce protection and enhancement of supportive environment faced with climate change challenges (Table 14).

Table 13 Vulnerability/Preparedness of Health Care Service Providers to Climate Change based on Standard Accreditation and Certification Systems

Vulnerability Assessment	PHC Standards 2015		Hospital Accreditation Standards 2019		JCI		ISO 9001		ISO 14001		OSHA	
	N	%	N	%	N	%	N	%	N	%	N	%
● <b>Low Risk</b>	2	1.1	14	8.2	7	4.1	2	1.1	5	2.9	1	0.06
● <b>Medium Risk</b>	4	2.3	14	8.2	12	7.1	8	4.7	10	5.9	3	1.7
● <b>High Risk</b>	163	95.8	141	83.4	150	88.7	159	94.06	154	91.1	165	97.6

Table 14 Vulnerability Key Areas Addressed Partially/Fully by the Various Standard Accreditation and Certification Systems

Vulnerability Key Areas Addressed	PHC Standards 2015	Hospital Accreditation Standards 2019	JCI	ISO 9001	ISO 14001	OSHA
*Health Workforce	2/39	7/39	5/39	3/39	5/39	2/39
*WASH and Healthcare Waste Management	2/36	4/36	3/36	0/36	0/36	0/36
*Energy Management	2/21	5/21	2/21	0/21	0/21	0/21
*Infrastructure, Technologies, Products and Processes	0/73	12/73	9/73	7/73	10/73	2/73
<b>*Vulnerability Entities Addressed Fully or at Basic Levels</b>	<b>6/169</b>	<b>28/169</b>	<b>19/169</b>	<b>10/169</b>	<b>15/169</b>	<b>4/169</b>

\*Sub entities that govern compliance define each of the four major Vulnerability Areas

1. Health Workforce Area: 39 Sub-entities
2. WASH and Healthcare Waste Management: 36 Sub-entities
3. Energy Management: 21 Sub-entities
4. Infrastructure, Technologies, Products and Processes: 71 Sub-entities

To conclude, the Hospital Accreditation Standard 2019 and the JCI Standard have the required infrastructure to relate to all four vulnerability assessment areas; still the levels achieved by facilities are basic. Further analyzing the data in Table 13, Table 14, Table 15, and Table 16, when the key vulnerability areas and sub entities within each category are addressed as part of the accreditation standards and programs, the level specified is basic, reflecting on incomplete preparation and accordingly, classified as medium risk (Table 15). In comparison, Primary Care Standards 2015 also addresses the 4 vulnerability areas but with minimal coverage.

Still, few sub entities are addressed and accordingly, prepare systems to respond and reduces the vulnerability to low risk (Table 12). To sum up, the data shows vulnerability key areas and sub entities that are addressed (partially/fully) relate to the following:

• **Workforce in terms of human resources, capacity building and communication and awareness raising:**

o Health workforce:

- The support of volunteers in emergencies to support health care providers (JCI)
- Personal care protective equipment, mostly provision of barrier equipment (e.g., gowns, gloves, masks, eye protection) and programs to ensure that inhabitants inside the facility are safe from fire, smoke, or other non-fire emergencies (National Accreditation Standard 2019 and OSHA)

- Programs for mitigation of illness and injury in health care workers (National Accreditation Standard 2019 and JCI)
- Emergency plans for shift relay or replacement of health care providers to insure proper rest (National Primary Care Standard 2015)
- o Capacity Building:
  - Training on emergency preparedness and response (National Primary Care Standard 2015, ISO 9001, and ISO 14000)
  - Contingency plans to provide services at other facilities (National Accreditation Standard 2019, JCI and ISO 14000)
  - Training on management of hazardous materials in emergencies (National Accreditation Standard 2019)
- o Communication and Awareness:
  - Safe internal system of communication in emergency situations (National Primary Care Standard 2015, National Accreditation Standard 2019, ISO 9001, and ISO14000)
- **Water, Sanitation, and Healthcare Waste:**
  - o Monitoring and Assessment :
    - Water quality monitoring plan for human consumption and drinking water during and after the emergency event (National Primary Care Standard 2015, National Accreditation Standard 2019)
  - o Risk Management
    - Safe waste disposal system (National Primary Care Standard 2015, National Accreditation Standard 2019)
  - o Health and Safety Regulations
    - Emergency water supply plan (alternative water source) (National Accreditation Standard 2019)
    - A mechanism or regulation to carry out sanitary inspections of water supply and alternative sources (electrical power) checked/ tested and documented biannually (National Primary Care Standard 2015, National Accreditation Standard 2019)
- **Energy:**
  - o Monitoring and Assessment
    - Availability of a backup electrical power system is in place and tested regularly (National Primary Care Standard 2015, National Accreditation Standard 2019 and JCI)
    - Condition of all emergency power systems and equipment assessed biannually (National Accreditation Standard 2019 and JCI)
    - Identification of priority areas within the facility which would require emergency power during and after an emergency event (National Primary Care Standard 2015 and National Accreditation Standard 2019)
  - o Risk Management
    - Safe storage of refrigerated medical supplies (temperature range)
    - Training annually on comprehensive facility management and safety programs (National Accreditation Standard 2019)

- **Infrastructure, Technologies, Products and Processes**

- o Adaptation of Current Systems and Infrastructures

- Identified list of partners for emergencies (fires, spillage, clean-up services) (ISO 14000)
- Maintenance of the facility physical structure (National Primary Care Standard 2015, National Accreditation Standard 2019 and OSHA)
- Plan and procedures in place to respond to emergencies (ISO 9001, and ISO 14000)
- Safe evacuation of personnel (emergency drills) (National Primary Care Standard 2015, National Accreditation Standard 2019, ISO 9001, and ISO 14000)
- Established procedures for managing orders (National Primary Care Standard 2015)
- Emergency procedures for managing clinical services in emergencies (National Accreditation Standard 2019, JCI)

- o Promotion of New Systems and Technologies

- Policy and procedures for emergency management (annually/periodically updated) (JCI, ISO 9001, ISO 14000)
- Availability of patients' electronic records (data protection) (National Accreditation Standard 2019)
- Data information backup systems (National Accreditation Standard 2019, ISO 9001, ISO 14000)
- Tracking system to monitor health of employee exposed to hazards (ISO 9001)
- Procedures for mitigating environmental impacts (ISO 9001 and ISO 14000)

- **Sustainability of Health Care Facility Operations:**

- Regular identification of risks and hazards associated with facility
- Partnership with community to enhance delivery of health care services (National Accreditation Standard 2019 and JCI)
- Emergency response plan to manage resources during events, including alternative sources (National Accreditation Standard 2019)
- Linkage with other care settings within/ outside organization (National Accreditation Standard 2019 and JCI).
- Secure access to backup services from neighboring organizations (ISO 14000)
- Relocating clinical activities during events (alternative care sites) (National Accreditation Standard 2019)
- Occupational health and safety programs (National Accreditation Standard 2019, ISO 9001 and OSHA)

Table 15 Vulnerability Areas Sub-Entities Items Addressed in Accreditation and Certification Programs

Health workforce	
Human resources	
Is the health workforce	
1. Equipped with a coordinated plan, including volunteers on standby, to assist during an emergency or to support health professionals?	<b>JCI:</b> Role of volunteers and integration of federal health care workers
2. Provided with full personal protective equipment:	<b>National Hospital Accreditation Standard 2019:</b> Appropriate indications for barrier equipment (e.g. gowns, gloves, masks, eye protection) <b>JCI:</b> Gloves, masks, eye protection, other protective equipment, soap, and disinfectants are available and used correctly when required. <b>OSHA:</b> control hazards to workers according to the "hierarchy of controls": elimination, engineering controls, administrative controls, and PPE
2a. Equipped with a plan to identify and protect health workers at risk of smoke and ash exposure, and heat stress	<b>National Hospital Accreditation Standard 2019:</b> The hospital has a program to ensure that inhabitants inside the facility are safe from fire, smoke, or other non-fire emergencies <b>JCI:</b> Identify penetrations of smoke, fire, or corridor walls
3. Aware of the potential risks of climate hazards on the facility and themselves (for example, risk of sea-level rise)?	<b>National Hospital Accreditation Standard 2019:</b> Executive management approves and monitors the implementation of a systematic process of identifying and analyzing actual or potential risks and safety issues; A process exists to properly identify the impact of each type of disasters on care and services <b>ISO 14001:</b> Determine the risks and opportunities, related to the potential for external environmental conditions to affect the organization <b>OSHA:</b> We identify hazards associated with emergencies and non-routine operation
4. Provided with programs for supporting staff with regards to mental health, injuries due to climate-related hazards (such as eye and skin irritation due to smoke exposure, diseases related to hot temperatures, air pollution and ash and smoke exposure, chronic respiratory and cardiovascular diseases), medical treatment, and related support measures?	<b>JCI:</b> The hospital provides a staff health and safety program that addresses staff physical and mental health and safe working conditions. <b>ISO 9001:</b> Does the procedure provide for the prevention and mitigation of the illness and injury that may be associated with them? <b>ISO 14001:</b> Does the procedure provide for the prevention and mitigation of the illness and injury that may be associated with them?
5. Equipped with an emergency plan for shift relay or replacement of health professionals to ensure that staff get adequate rest?	<b>National Hospital Accreditation Standard 2019:</b> The workload is assigned, divided, and reviewed in a way to ensure patient and staff safety.
Capacity Development	
6. Trained on public health and climate change hazards including health impacts related to floods/storms/drought/heatwaves/wildfires/cold waves	<b>Primary Health Care Standard 2015:</b> Trained to identify and manage risk <b>ISO 9001:</b> Evidence that risks and opportunities related to OH&S hazards & risks, compliance obligations and other issues have been identified and addressed.
7. Equipped with knowledge, experience, training, and resources to manage climate change-related hazards reduction at the facility and in the local communities?	<b>ISO 14001:</b> Provide relevant information and training related to emergency preparedness and response, as appropriate, to relevant interested parties, including persons working under its control.

8. Prepared with a contingency plan for continuing to provide services at other facilities or in the local communities (health primary care), if necessary?	<p><b>National Hospital Accreditation Standard 2019:</b> Hospital executive management members identify partnerships with community leaders, organizations, and primary healthcare centers, when applicable, to adequately deliver and coordinate healthcare services; the program identifies the response to emergencies including the following: Managing of clinical activities during an event, including alternative care sites.</p> <p><b>JCI:</b> Linkages with other care settings within and/or outside your organization</p> <p><b>ISO 14001:</b> The possibility of mutual assistance from neighboring organizations</p>
9. Trained to manage hazardous chemicals in emergency situations?	<p><b>National Hospital Accreditation Standard 2019:</b> Evidence of staff training on dealing with hazardous wastes; evidence of staff education and training on signs and symptoms of exposure to hazardous materials and the appropriate treatment according to Material Safety Data Sheets (MSDS).</p>
<b>Communication and Awareness Raising</b>	
10. Provided with a safe internal communication system, especially in emergency situations?	<p><b>Primary Health Care Standard 2015:</b> Participate in regular safety briefings to share information about potential safety problems.</p> <p><b>National Hospital Accreditation Standard 2019:</b> The program identifies the response to emergencies including the following: Communication strategies for events.</p> <p><b>ISO 9001:</b> Evidence that process for internal &amp; external communications has been established consistent with ISO 45001:2018</p> <p><b>ISO 14001:</b> Appropriate communication processes are established within the different functions</p>
<b>Water, Sanitation, and Healthcare waste</b>	
<b>Monitoring and assessment</b>	
<b>Does the healthcare facility</b>	
11a. Have a water quality monitoring plan for human consumption and drinking water during and after the emergency event?	<p><b>National Hospital Accreditation Standard 2019:</b> Monitoring water quality, including the water used in renal dialysis, is done at least quarterly or more frequently based on local laws and regulations, conditions of the sources for water, and the results of the testing are properly documented.</p> <p><b>JCI:</b> Designated individuals or authorities monitor water quality regularly.</p>
<b>Risk management</b>	
11b. Have a safe waste disposal system?	<p><b>Primary Health Care Standard 2015:</b> The clinic follows procedures to properly dispose of biomedical and hazardous waste; the clinic makes arrangements for the proper disposal of sharps and other biomedical and hazardous waste.</p> <p><b>National Hospital Accreditation Standard 2019:</b> Staff demonstrates /describe their role in disposing medical gases and hazardous materials and wastes; program for safe handling, storage and use of hazardous materials and wastes.</p> <p><b>JCI:</b> The hospital reduces the risk of infections through proper disposal of waste, proper management of human tissues, and safe handling and disposal of sharps and needles; the hospital develops and implements a program for the management of hazardous materials and waste.</p>
<b>Health and safety regulation</b>	
12. Have an emergency water supply plan (alternative water source) and a long-term drought management plan?	<p><b>Primary Health Care Standard 2015:</b> The clinic has backup systems for water, electricity, and heating</p> <p><b>National Hospital Accreditation Standard 2019:</b> The program identifies the response to emergencies including the following: managing of resources during events, including alternative sources.</p> <p><b>JCI:</b> The hospital utility systems program ensures that essential utilities, including power, water, and medical gases, are always available and alternative sources for essential utilities are established and tested.</p>

13. Have a mechanism or regulation to carry out sanitary inspections of water supply and alternative sources (e.g. wells, dams, cisterns, fountains and water trucks), and when necessary, establish a temporary ban on use, until improvements are made?	<b>National Hospital Accreditation Standard 2019:</b> Alternative resources of water/ electrical power are tested at least biannually or more frequently if required by local laws and regulations, manufacturers' recommendations, or conditions of the source of water/electricity and the results of
<b>Energy</b>	
<b>Monitoring and assessment</b>	
<b>Does the healthcare facility</b>	
14. Have an emergency backup generator (including fuel, where relevant) that can cover at least all critical service areas and equipment during and after an emergency event?	<b>Primary Health Care Standard 2015:</b> The clinic has back-up systems for water, electricity, and heating. <b>National Hospital Accreditation Standard 2019:</b> A back up electrical system is in place and tested regularly. <b>JCI:</b> Verify that there is a reliable emergency power system that supplies electricity when normal electricity is interrupted to the following areas: exit route illumination, emergency/ urgent care areas, areas where electrically powered life-support equipment is used, operating rooms, and postoperative recover rooms.
15. Periodically check emergency backup generators (including fuel, where relevant)?	<b>National Hospital Accreditation Standard 2019:</b> Alternative resources of water/electrical power are tested at least biannually or more frequently if required by local laws and regulations, manufacturers' recommendations, or conditions of the source of water/ electricity and the results of the testing are properly documented. <b>JCI:</b> Assess the condition of all emergency power systems and equipment.
16. Assess regularly and monitor the heating, ventilation, and air conditioning systems to control the functioning of all critical medical equipment?	<b>National Hospital Accreditation Standard 2019:</b> Utility systems and components are inspected, tested, maintained, and improved when necessary; a plan for heating, ventilating and air conditioning is in place (preventive maintenance, control of temperature and humidity, etc.).
17. Identify priority areas within the facility which would require emergency power during and after an emergency event?	<b>National Hospital Accreditation Standard 2019:</b> Areas and services which are at the greatest risk are identified in case of power failure and water interruption or contamination.
<b>Risk Management</b>	
18. Have appliance thermometers in the refrigerator and freezer to determine if food, vaccines, and other essential refrigeration dependent medical supplies are safe?	<b>Primary Health Care Standard 2015:</b> Fridges should have minimum-maximum thermometers to verify that vaccines have not been exposed
19. 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, do not use electrical equipment that has been exposed to heat from a fire until checked by an electrician; use extreme caution when equipment is moved near overhead power lines; do not stand or work in areas with thick smoke (smoke hides electrical lines and equipment)?	<b>National Hospital Accreditation Standard 2019:</b> Education is provided annually on comprehensive facility management and safety programs; requirements for programs dealing with extreme and urgent situations are in place.

## Infrastructure, Technologies, Products and Processes

### Adaptation of current systems and infrastructures

#### Does the healthcare facility

<p>20. Maintain partnerships with key partners and stakeholders (e.g. air quality agencies, local health providers, health departments, fire department, land management agencies, and others) for effective wildfire response and recovery?</p>	<p><b>ISO 14001:</b> A list of key personnel and aid agencies, including contact details (e.g., fire department)</p>
<p>21. Have a schedule to inspect the facility regularly, both internally and externally, for signs of deterioration (e.g. cracks or sinking structural elements, broken plaster, cracks or sinking structural elements) to avoid or reduce impacts of climate change related events?</p>	<p><b>Primary Health Care Standard 2015:</b> The clinic regularly maintains the physical facility  <b>National Hospital Accreditation Standard 2019:</b> Current inspections of the hospital's physical facilities are documented by the responsible department/staff.  <b>JCI:</b> The hospital develops and implements a program to provide a safe physical facility through inspection and planning to reduce risks.  <b>OSHA:</b> We regularly inspect the hospital physical environment to identify conditions that pose or could pose a worker safety or health concern.</p>
<p>22. Have a plan to respond during a climate change related emergency, including:</p>	<p><b>ISO 9001:</b> Has the organization established and maintained procedures to identify potential for and respond to incidents and emergency situations?  <b>ISO 14001:</b> Has the organization established and maintained procedures to identify potential for and respond to incidents and emergency situations?</p>
<p>22a. Have a contingency plan in place for safe and efficient personnel evacuation (including health staff and patients) before, during and following an emergency event?</p>	<p><b>Primary Health Care Standard 2015:</b> The clinic's leaders train staff on how to evacuate through regular fire drills.  <b>National Hospital Accreditation Standard 2019:</b> Evidence that fire drills are conducted regularly through different.  <b>JCI:</b> The fire safety program includes measures to ensure safe exit from the facility when fire and non-fire emergencies occur.  <b>ISO 9001:</b> Ensure emergency drills are being carried out periodically.  <b>ISO 14001:</b> Ensure emergency drills are being carried out periodically.</p>
<p>22b. Have health care agreements with other health care providers for</p>	<p><b>ISO 14001:</b> The possibility of mutual assistance from neighboring organizations.</p>
<p>22c. Established procedures for procuring, and safely transporting and storing medical devices, pharmaceuticals, vaccines, laboratorial supplies, parenteral nutrition and blood supplies, and other essential medical supplies?</p>	<p><b>National Hospital Accreditation Standard 2019:</b> There is a process for managing special orders such as emergency, standing, or automatic stop orders.</p>
<p>22d. Have a plan on continuity of operational processes during an emergency and for building back better through training and workshops?</p>	<p><b>National Hospital Accreditation Standard 2019:</b> The program identifies the response to emergencies including the following: Managing of clinical activities during an event, including alternative care sites.  <b>JCI:</b> Emergency Plan, including the Continuity of operations and succession plans; the hospital designs and carries out processes to provide continuity of patient care services in the hospital, coordination among health care practitioners, and access to information related to the patient's care.</p>

Promotion of new systems and technologies	
23. Have an established set of procedures to continually evaluate and implement risk management plans to stay responsive to the needs of the facility in climate change related emergency events?	<p><b>JCI:</b> Annual update of policy and procedures related to emergency management plan; the hospital develops and documents a comprehensive risk assessment based on facility management and safety risks identified throughout the organization, prioritizes the risks, establishes goals, and implements improvements to reduce and eliminate risks; the hospital develops, maintains, and tests an emergency management program to respond to internal and external emergencies and disasters that have the potential of occurring within the hospital and community.</p> <p><b>ISO 9001:</b> Evidence of effective continual improvement of OH&amp;SMS to enhance OH&amp;S performance.</p> <p><b>ISO 14001:</b> Periodically review and revise the process(es) and planned response actions, in particular after the occurrence of emergency situations or tests.</p>
24. Have electronic patient health records to make available to other receiving health care facilities, in case of evacuation?	<p><b>National Hospital Accreditation Standard 2019:</b> Measures to protect data and information in case of disasters are tested, evaluated and improvements are made accordingly.</p>
25. Have information and communication systems safely secured with backup arrangements (via cloud, satellite) to satisfy the facility's demand?	<p><b>National Hospital Accreditation Standard 2019:</b> The organization has an implemented process for data and information backup.</p> <p><b>JCI:</b> The hospital develops, maintains, and tests a program for response to planned and unplanned downtime of data systems.</p> <p><b>ISO 9001:</b> Are computer records backed up and suitably stored?</p> <p><b>ISO 14001:</b> Are computer records backed up and suitably stored?</p>
26. Have an information system for tracking and monitoring diseases following climate change related events (such as flood, drought, heatwave, cold wave events)?	<p><b>ISO 9001:</b> Is there a program to monitor health of the employees that are exposed to health hazards?</p>
27. Have mitigation measures in place to respond to climate change scenarios and threats identified, including engineering, planning, as well as preparedness solutions for the facility and community surroundings (e.g. storm water pump stations, floodplain mapping, assessing future climate change impacts)?	<p><b>ISO 9001:</b> Does the procedure allow for preventing and mitigating the environmental impacts that may be associated with them?</p> <p><b>ISO 14001:</b> Take action to prevent or mitigate the consequences of emergency situations, appropriate to the magnitude of the emergency and the potential environmental impact</p>
Sustainability of health care facility operations	
28. Have adaptive governance capacity regarding evaluation and measures for risk identification, risk reduction and response?	<p><b>National Hospital Accreditation Standard 2019:</b> The committee performs regular and as needed safety tours for identifying risks and hazards related to the facility and evaluating the staff knowledge, as per policies and procedures</p>
29. Have partnerships established between the facility, community and local authorities to reduce vulnerabilities in the surrounding areas?	<p><b>National Hospital Accreditation Standard 2019:</b> Hospital executive management members identify partnerships with community leaders, organizations and primary healthcare centers, when applicable, to adequately deliver and coordinate healthcare services</p> <p><b>JCI:</b> Your organization's involvement with your community and its relationship with other health care organizations.</p>
30. Have a secure plan to ensure continuity of the facility's supply and delivery chain?	<p><b>National Hospital Accreditation Standard 2019:</b> The program identifies the response to emergencies including the following: Managing of resources during events, including alternative sources</p>

<p>31. 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?</p>	<p><b>ISO 14001:</b> The possibility of mutual assistance from neighboring organizations</p>
<p>32. Have secure access to essential backup food sources via multiple agreements with different vendors, and through cooperative agreements with other facilities to maintain functioning of critical services?</p>	<p><b>ISO 14001:</b> The possibility of mutual assistance from neighboring organizations</p>
<p>33. Have health care coalitions and partnerships with local health care providers for strategic decision-making on health services and clinical resources?</p>	<p><b>National Hospital Accreditation Standard 2019:</b> Hospital executive management members identify partnerships with community leaders, organizations and primary healthcare centers, when applicable, to adequately deliver and coordinate healthcare services; the program identifies the response to emergencies including the following: managing of clinical activities during an event, including alternative care sites.  <b>JCI:</b> Linkages with other care settings within and/or outside your organization  <b>ISO 14001:</b> The possibility of mutual assistance from neighboring organizations</p>
<p>34. Have a coordinated plan with municipal health department heads to ensure appropriate preparations for climate change emergencies (such as ongoing sea-level rise and heatwave/cold-wave conditions)?</p>	<p><b>JCI:</b> Documentation of collaboration with local, tribal, regional, state, and federal EM officials</p>
<p>35. Have a plan to consider relocating the facility?</p>	<p><b>National Hospital Accreditation Standard 2019:</b> The program identifies the response to emergencies including the following: managing of clinical activities during an event, including alternative care sites</p>
<p>36. Have a trained and prepared team or a dedicated person for occupational health and safety, to manage hazards (e.g. providing respirator masks that are appropriate for the hazard and work situation; medical evaluation for safe respirator use; fit testing for tight-fitting respirators; training on topics such as how to use and maintain respirator masks; and program evaluation) during wildfire event?</p>	<p><b>National Hospital Accreditation Standard 2019:</b> The hospital has an occupational health and safety program that is managed by an occupational health and safety officer/coordinator and coordinated with quality management and patient safety program, risk management program, infection control program, medical administration and human resources.  <b>JCI:</b> The hospital provides a staff health and safety program that addresses staff physical and mental health and safe working conditions.  <b>ISO 9001:</b> Evidence that organization is monitoring, measuring, analyzing, and evaluating OH&amp;S performance.  <b>OSHA:</b> Top hospital management assigns responsibility and accountability for the implementation and maintenance of the program.</p>

Table 16 Medium and Low Risk Vulnerability Areas /sub entities Addressed by Standards and Certification Programs

1. Lebanon Primary Health Care Standards 2015 2. Lebanon Revised Hospital Accreditation Standards 2019 3. The Joint Commission International (JCI) Standards 4. International Standard Organization ISO 9001 5. International Standard Organization ISO 14001 6. OSHA Hospital Safety and Health Management System	Accreditation and Certification Programs					
	1	2	3	4	5	6
<b>Health workforce</b>						
<b>Human resources</b>						
<b>Is the health workforce</b>						
1. Equipped with a coordinated plan to ensure facility operation after climate related emergency including 1a. Plan to ensure facility operation during and after climate-related emergency, including volunteers on standby, to strengthen performance capacity			●			
2. Provided with full personal protective equipment:		●	●			●
2a. Equipped with a plan to identify and protect health workers at risk of smoke and ash exposure, and heat stress?		●	●			
3. Aware of the potential risks of climate hazards on the facility and themselves (for example: risk of seawater rise)		●			●	●
4. Provided with programs for supporting staff with regards to mental health, injuries due to climate-related hazards (such as eye and skin irritation due to smoke exposure, diseases related to hot temperatures, air pollution and ash and smoke exposure, chronic respiratory and cardiovascular diseases), medical treatment, and related support measures?			●	●	●	
5. Equipped with an emergency plan for shift relay or replacement of health professionals to ensure that staff get adequate rest?		●				
<b>Capacity Development</b>						
6. Trained on public health and climate change hazards including health impacts related to floods/storms/drought/heatwaves/wildfires/cold waves?	●			●		
7. Equipped with knowledge, experience, training, and resources to manage climate change-related hazards reduction at the facility and in the local communities?					●	
8. Prepared with a contingency plan for continuing to provide services at other facilities or in the local communities (health primary care), if necessary?		●	●		●	
9. Trained to manage hazardous chemicals in emergency situations?		●				
<b>Communication and Awareness Raising</b>						
10. Provided with a safe internal communication system, especially in emergency situations?	●	●		●	●	

Water, Sanitation, and Healthcare Waste						
<b>Monitoring and Assessment</b>						
<b>Does the health care facility</b>						
11a. Have a water quality monitoring plan for domestic water use and drinking water during and after the emergency event?		●	●			
<b>Risk management</b>						
11b. Have a safe waste disposal system?	●	●	●			
<b>Health and safety regulation</b>						
12. Have an emergency water supply plan (alternative water source) and a long-term drought management plan?	●	●	●			
13. Have a mechanism or regulation to carry out sanitary inspections of water supply and alternative sources (e.g. wells, dams, cisterns, fountains and water trucks), and when necessary, establish a temporary ban on use, until improvements are made?		●				
<b>Energy</b>						
<b>Monitoring and Assessment</b>						
<b>Does the healthcare facility</b>						
14. 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 an emergency event?	●	●	●			
15. Periodically check emergency backup generators (including fuel, where relevant)?		●	●			
16. Assess regularly and monitor the heating, ventilation, and air conditioning systems to control the functioning of all critical medical equipment?		●				
17. Identify priority areas within the facility which would require emergency power during and after an emergency event?		●				
<b>Risk management</b>						
18. Have appliance thermometers in the refrigerator and freezer to determine if food, vaccines, and other essential refrigeration-dependent medical supplies are safe?	●					
19. 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, do not use electrical equipment that has been exposed to heat from a fire until checked by an electrician; use extreme caution when equipment is moved near overhead power lines; do not stand or work in areas with thick smoke (smoke hides electrical lines and equipment)?		●				

Infrastructure, Technologies, Products and Processes						
Adaptation of current systems and infrastructures						
Does the healthcare facility						
20. Maintain partnerships with key partners and stakeholders (e.g. air quality agencies, local health providers, health departments, fire department, land management agencies, and others) for effective wildfire response and recovery?					●	
21. Have a schedule to inspect the facility regularly, both internally and externally, for signs of deterioration (e.g. cracks or sinking structural elements, broken plaster, cracks or sinking structural elements) to avoid or reduce impacts of climate change related events?	●	●	●			●
22. Have a plan to respond during a climate change related emergency, including:				●	●	
22a. Have a contingency plan in place for safe and efficient personnel evacuation (including health staff and patients) before, during and following an emergency event?	●	●	●	●	●	
22b. Have health care agreements with other health care providers for additional health services and clinical resources?					●	
22c. Have established procedures for procuring, and safely transporting and storing medical devices, pharmaceuticals, vaccines, laboratorial supplies, parenteral nutrition and blood supplies, and other essential medical supplies?		●				
22d. Have a plan on continuity of operational processes during an emergency and for building back better through training and workshops?		●	●			
Promotion of new systems and technologies						
23. Have an established set of procedures to continually evaluate and implement risk management plans to stay responsive to the needs of the facility in climate change related emergency events?			●	●	●	
24. Have electronic patient health records to make available to other receiving health care facilities, in case of evacuation?		●				
25. Have information and communication systems safely secured with backup arrangements (via cloud, satellite) to satisfy the facility's demand?		●	●	●	●	
26. Have an information system for tracking and monitoring diseases following climate change related events (such as flood, drought, heatwave, cold wave events)?				●		
27. Have mitigation measures in place to respond to climate change scenarios and threats identified, including engineering, planning, as well as preparedness solutions for the facility and community surroundings (e.g. storm water pump stations, floodplain mapping, assessing future climate change impacts)?				●	●	
Sustainability of health care facility operations						
28. Have adaptive governance capacity regarding evaluation and measures for risk identification, risk reduction and response?		●				
29. Have partnerships established between the facility, community, and local authorities to reduce vulnerabilities in the surrounding areas?		●	●			

30. Have a secure plan to ensure continuity of the facility's supply and delivery chain?		●				
31. 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?					●	
32. Have secure access to essential backup food sources via multiple agreements with different vendors, and through cooperative agreements with other facilities to maintain functioning of critical services?					●	
33. Have health care coalitions and partnerships with local health care providers for strategic decision-making on health services and clinical resources?		●	●		●	
34. Have a coordinated plan with municipal health department heads to ensure appropriate preparations for climate change emergencies (such as ongoing sea-level rise and heatwave/cold-wave conditions)?			●			
35. Have a plan to consider relocating the facility?		●				
36. Have a trained and prepared team or a dedicated person for occupational health and safety, to manage hazards (e.g. providing respirator masks that are appropriate for the hazard and work situation; medical evaluation for safe respirator use; fit testing for tight-fitting respirators; training on topics such as how to use and maintain respirator masks; and program evaluation) during climate change related emergency such as wildfire event?		●	●	●		●

- Entity is partially met/Medium Risk (level basic or incomplete preparation, low level of response)
- Entity is met/Low Risk (Prepared, able to respond)

To conclude, on a positive note, having structured management systems that are accredited and accordingly sustained, can help in the integration of the needed preparedness to enhance the response of the healthcare facilities, and reduce its vulnerability to climate changes and crises.

To further elaborate, one major limitation is the accreditation coverage as was presented in Section 3.1. A minimal percentage of PHCCs not exceeding 8% (17 PHCCs) are just accredited to date. So, introducing measures to reduce vulnerability to climate change would be completely challenged by sustainability of such interventions. Further, not all PHCCs of this important network cover all types of services specified by the "Lebanon Primary Health Care Standards 2015". Moreover, centers are not evenly distributed throughout the country: Mount Lebanon has the largest number of PHCCs (n = 55, 25.9%) Beirut has the lowest (n = 14, 6.6%), and in the more vulnerable spots for climate changes (Baalbeck and Akkar Cazas) coverage is low (8.5% and 10.4%, respectively). As indicated before, high vulnerability spots would require an increased coverage of PHCCs to respond to heat stress, waterborne diseases and injuries caused by floods in these vulnerable areas. Moreover, the latest conducted survey of PHCCs highlighted major deficiencies in fulfilment of health workforce and infrastructure requirements, among non-accredited centers. Moreover, acquiring accreditation and securing support by International NGOs were significantly associated the provision of a better health workforce and infrastructure (Hamadeh et al, 2020).

As such moving with accreditation and integrating the basic requirements for (a)

**Having structured systems accredited and sustained can enhance the response of healthcare facilities to climate change events.**

## A plan of action based on a modified checklist can enhance the preparedness of healthcare facilities to climate change events.

health workforce (human resources, capacity development and communication and awareness raising), (b) WASH and HCW management (monitoring and assessment, risk management and health safety regulations), (c) energy management (monitoring and assessment, risk management and health safety regulations), and (d) infrastructure, technologies, products and processes (adaptation of current systems and infrastructures, promotion of new systems and technologies, and sustainability of health care facility operation), is a must. A plan of action, based on a modified checklist to enhance the preparedness of PHCCs can be developed to address direct, intermediate and long term interventions based on the identified basic gaps as reflected in the recommendations below. This is crucial to increase the resilience of healthcare centers to climate change crises to capitalize more on the role of PHCCs to (a) provide primary prevention interventions (such as WASH services or vaccination programs) and surveillance systems for rapid detection of disease outbreak following a disaster, (b) understand health needs and identify vulnerable groups in disaster-affected communities, (c) alleviate burden on overloaded hospitals through acting as a community-level triage system, where patients with minor illnesses are treated and those with serious injuries are referred to hospitals, (d) manage diseases related to health emergencies, including mental health, chronic disease interventions, food- and water-borne disease, etc., (e) promote community engagement by effectively communicate risks and share timely information, and (f) provide outreach services mobile clinic services to provide non-communicable disease interventions, mental health services and other primary healthcare services to vulnerable and disadvantaged populations (Bou-Karroum et al., 2020; WHO, 2018).

For hospitals, the setting is also complex as 69 % of the private and public hospitals are only accredited without reservation. Further, the follow up on introducing and implementing the revised National Hospital Accreditation Standard 2019 is challenged by the “survival mode” under the current socio-economic crises. To add to this the major problem is with governmental hospitals were the percentages of those accredited without reservation, with minor reservations, and with major reservation do not exceed 10%.

Since, as noted before, the Hospital Accreditation 2019 and the JCI Standards, address all the identified vulnerability areas even though at a basic level, a complementary modified checklist to enhance the preparedness should be annexed to these 2 sets of standards.

On the other hand, for governmental hospitals a plan of action, based on a modified climate change vulnerability checklist can be developed to address direct, intermediate and long-term interventions centered on the basic identified gaps as reflected in the recommendations below.

### **Main recommendations:**

As such, the vulnerability level of the health care sector is high and combining various accreditation and certification systems does not induce a significant difference (Table 9 to Table 12). As such, a clear guidance program should be developed and implemented to reduce vulnerability and enhance preparedness. This is needed to address the following major deficiencies that constitute high risk:

This is needed to address the following major deficiencies that constitute higher risk:

**Human Resources:**

→ Develop a National Contingency Plan to ensure the provision of additional needed workforce during and post emergency and recovery.

This is critical to ensure facility operation during and after climate-related emergencies and is in line with the Health and Environment Strategy National Framework of Action 2021-26, Priority 6: Environmental Health Management in Emergencies:

[Strategic Activity 2c. Establish a National Network of qualified Environmental Health Specialists who can be mobilized and deployed in a timely manner to support countries in need] and

[Strategic Activity 2d. Establish a National Medical Reserve Corp (MRC) of public health professionals and nonpublic health backgrounds community volunteers to strengthen public health, improve emergency response capabilities, and build community resiliency].

→ Develop a National Health Support Program for health care providers

This is urgently needed to address mental health, stressors, and injuries due to climate-related hazards (such as eye and skin irritation due to smoke exposure, diseases related to hot temperatures, air pollution and ash and smoke exposure, chronic respiratory and cardiovascular diseases), medical treatment, and related support measures. Lessons learned from COVID-19 Management and its impact on the health work force should guide this initiative that can be coordinated by a National Health Service Network (MoPH, Professional Syndicates...)

→ Develop Emergency Plans and Programs at the health care facilities to protect health workers from exposure to multiple biological and chemical hazards.

This can be boosted once the national HAZMAT team of first responders (Lebanese Army, Red Cross, Civil defense) for CBRN (chemical, biological, radiological, and nuclear events) has been fully developed [Health and Environment Strategy National Framework of Action 2021-26

Priority 6: Environmental Health Management in Emergencies: [Strategic Activity 2d coordinated by MoPH and Lebanese National Council for Scientific Research and the National Coordination Committee for CBRN].

→ Develop and Deliver Training Programs directed to health facilities on: (a) Public health and climate change hazards including health impacts related to floods/ storms/ drought/ heatwaves/ wildfires/ cold waves; (b) Multi-hazard assessments; (c) Information systems to manage occupational safety and health in the facility during climate-related emergency (for example: flood/storm/heatwave/ cold wave); (d) Training on the provision of resources needed to manage climate change-related hazards reduction at the facility and in the local communities.

This is partly in line with "Health and Environment Strategy National Framework of Action 2021-26 Priority 7: Climate Change and Health":

[Strategic Activity 1aiii. Build the capacity of health sector professionals (technical people, authorities and policy makers) in the identification of health impacts from other sectors (e.g. transport, energy, food, water, housing and urban development) that have bearings on health].

### **Water, Sanitation and Hygiene:**

→ Develop a National Program to improve WASH Services and Waste Management in health care facilities.

This is in line with the Health and Environment Strategy National Framework of Action 2021-26 priority 5: Waste Management and Environmental Health Services in the Health Sector:

[Strategic Activity 3a. Conduct a national survey to assess environmental health services in health care facilities, and accordingly, determine compliance WHO essential standards on environmental health services in HCFs. As indicated before this should be part of 1ai and should include comprehensive survey based on WHO Standards for HCFs]

[Strategic Activity 3b. Develop national standards for environmental health services in HCFs in compliance with WHO Guidelines].

[Strategic Activity 3c. Develop/Implement a system to monitor compliance with developed environmental health national adopted National Environmental levels].

→ Develop simple guidelines to help health care facilities acquire and continuously update an assessment plan that maps risks to the water and sanitation infrastructure in place, identify where services (quantity and quality) could be disrupted from climate-change related hazards, and how to direct emergency management, accordingly.

→ Develop guidelines to help health care facilities develop a safe health care waste management system (safe storage, safe disposal, and safe transport) in place, before, during, and a after climate change related event.

### **Energy Management**

→ Direct the health care facilities to develop a procedure to periodically assess the energy system to ensure that it can cope with climate change related events and have an emergency plan for power outages in the short- and long-term, before, during and after an emergency event.

→ Develop a national network of community based and national providers that will help the health sector to overcome shortage in energy supplies (including fuel, generators, batteries, filters...)

→ Greening of the health sector will help reduce dependence on conventional sources of energy, enhance energy efficiency, promote on site use of renewable energy (emergency setting); enhance passive cooling, heating and ventilation, conserve and maintain safe water supply, enhance facility management of wastewater and solid waste.

This is in line with the Health and Environment Strategy National Framework of Action 2021-26 Priority 8: Sustainable Development and Health Strategic Response 3 on Greening of the Health Sector:

[Strategic Activity 3a: Develop a sustainable system for financing the greening initiative of the health sector]

[Strategic Activity 3b: Set national targets for Environmental resource utilization, and increase efficiency of use of resources in the health sector, and  
[Strategic Activity 3c: Develop targets for environmental resource utilization and increase efficiency of use of resources in the health sector].

### **Infrastructure, Technologies, Products and Processes**

→ Direct health care facilities to develop simple guidelines to evaluate the condition and safety of structural and nonstructural elements that are impacted by previous exposure to climate change related events.

→ Develop a National Coordinated Mechanism across the Health Sector, and at different levels, to manage the response and risks resulting from public health emergencies and disasters (including sharing of resources and supplies, transferring of patients, and health workforce support).

This should be an essential component of Disaster Risk Management (DRM) in coordination with the Ministry of Public Health; disaster preparedness would ensure the effective and timely response to the impacts of climate change to protect the health and wellbeing of the population and minimize risks.

→ Develop a National Procedures for Procuring, Sharing, and Safely Transporting and Storing medical devices, pharmaceuticals, vaccines, laboratorial supplies, parenteral nutrition and blood supplies, PPEs (including respirator masks such as fitting N-95 respirator, leather gloves, safety glasses or goggles, clothes such as long-sleeved shirts and long pants, windproof and waterproof clothes, thermal underwear, shoes with rugged soles, waterproof safety boots, goggles, work gloves and masks., that cover all ranges of climate change emergencies), and other essential medical supplies.

→ Develop a National Information System between the health sector and meteorological services to communicate about climate hazards (such as storm surge hazards, risk of wildfires, hazards-reduction burning, expected number of hot and smoky days or the likelihood of forthcoming extreme cold weather conditions) to activate emergency response.

This can be embedded as part of the National Air Quality Monitoring Network (that channels meteorological data), when reactivated.

→ Direct and Support health care facilities to develop information and communication systems that can be safely secured with backup arrangements (via cloud, satellite) to satisfy the facility's demand, and patients' care.

### **Sustainability of Health Care Facility Operation**

→ Direct the Health Care Facilities to develop set procedures for continually evaluating and implementing risk management programs to stay responsive to the needs of the facilities under climate change related emergency events.

→ Health Care Facilities should develop back up plans that consider relocating part of the medical services provided by the facility through a national network of

health care providers managed by the ministry of public health.

Hence, the need for complementary measures to enhance the preparedness of the health care sector and reduce its vulnerability to climate change events becomes evident. And, as presented by the recommended interventions, some of the deficiencies in preparation and response can be addressed by developing a simple guidance tool that will compliment standard accreditation requirements. Others should be governed by national coordination activities/programs, with the support of Disaster Risk Management (DRM) Unit.

# 4. CONCLUSION

In conclusion, the result of the chapter shows high vulnerability of healthcare facilities/health care providers to climate change challenges and emergencies. Standard accreditation and certification processes cannot handle the challenges as it minimally provides preparation and response at basic levels.

And, although general accreditation and certification programs have been associated with major benefits such as improvement in patient outcomes and mitigation of risks; identification of strengths and gaps in programs and processes; promotion of communication and staff empowerment across organizations; adoption of standard facilities; fostering a culture of quality and safety; and decreasing risks and liability costs, still it does not provide significant preparedness to climate change challenges.

Moreover, and in the absence of any national initiative on how to empower the health sector and decrease its vulnerability, it is critical to address this issue to guide health care professionals in understanding and effectively preparing the management of additional health risks that would be posed by climate change related events. Furthermore, the national health capacity should further be developed to effectively conduct surveillance of climate-related diseases and monitor, anticipate, manage, and adapt to the health risks associated with climate change.

Environmental sustainability of the health care sector is critical to: (a) promote environmentally sustainable practices to secure resources and provide services (in particular water and energy and sustainable procurement), (b) manage safely hazardous waste (biological, chemical, radiological) to reducing pollution and the cost of environmental deterioration (c) provide appropriate infrastructures, technologies, products and processes to support the efficient performance of health care facilities.

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# CHAPTER 2

## ADAPTIVE CAPACITY OF HEALTHCARE SERVICE PROVIDERS TO CLIMATE CHANGE

# 1. RESPONDING TO HEALTH EMERGENCIES

COVID-19 and Climate change are both life threatening invisible threats, that require clear evidence-based understanding of them.

## 1.1 Similarities and Differences between the Response to COVID-19 Pandemic and Climate Change Crises

Reflecting on a country's ongoing emergency response and preventive actions taken during the COVID-19 pandemic provides valuable insight on the overall emergency preparedness including climate change crises, and as such the Country's resilience to shocks during emergency events (Vinke et al., 2020). Since the first recorded case of Severe Acute Respiratory Syndrome Coronavirus 2 (SARS-CoV-2) infection in Wuhan, Hubei, China in December 2019, COVID-19 has been recognized as a pandemic by the World Health Organization (WHO), with more than 200 countries impacted (WHO, 2020). The COVID-19 pandemic prompted countries to activate emergency response actions and mobilize all resources (including financial and medical) to address and reduce the spread of the virus. In this section, we discuss some of the prominent differences and similarities between the COVID-19 pandemic and climate change crises, which would influence a country's emergency responses.

The first similarity between both COVID-19 pandemic and climate change is that they are both life-threatening invisible threats. Another similarity characterizing both threats is the prevailing scientific uncertainties, and its impact on policy response and action. COVID-19 virus is a relatively new disease and science requires time to construct a clear evidence-based understanding of it (Pearce, 2020). And climate change most fundamental uncertainties relate to climate sensitivity and the long-term temperature increases due to increase in GHG emissions, which would influence the different policy options (Grundmann & Rödder, 2019). Additionally, a fundamental goal shared by both is to reduce likelihood of occurrence and impacts; reducing the spread of the virus by wearing masks and reducing GHG emissions and environmental pollution and degradation for climate change (Ruiu et al., 2020). However, the characterization of these threats and the way in which they are communicated can impact the perception and actions of the public in addressing response. In fact, the characteristics of the crisis, which differ between the COVID-19 pandemic and climate change threats, can be summarized as follows (van der Ven and Sun, 2021):

→ **Immediacy:** The COVID-19 pandemic started in the late 2019 in China, but very quickly spread across the globe impacting millions of lives. The unparalleled outbreak prompted immediate actions to reduce its spread (Cheng et al., 2020). While, for climate change impacts, although the problem has been discussed by

## The high immediacy of the COVID-19 crises was key to mobilize resources immediately to respond, as compared to the slower-moving crises of climate change.

policy makers for decades, no major drastic efforts have been taken so far. The high immediacy of the COVID-19 crises was key to mobilize resources immediately to respond, as compared to the slower-moving crises of climate change (Rosenbloom and Markard, 2020; van der Ven and Sun, 2021).

→ **Transience:** In the case of COVID-19, most people were willing to accept significant changes to their lives as they were convinced that their lives will soon return to normal (Oppenheimer, 2015). However, when addressing the climate crisis, one does not expect the world to go back to normal; climate change will extend beyond the life of most living humans and would lead to permanent disruptions and changes in the political, social, and economic systems at the global level, thus implying a shift to an unknown new norm (van der Ven and Sun, 2021).

→ **Visibility:** The COVID-19 pandemic is highly visible, and its impact are sensed by every individual (pictures and videos by media outlets, people wearing masks, and people getting infected). However, climate change is relatively less visible with makes its impacts seem remote and abstract to most people (Shields, 2019; van der Ven and Sun, 2021).

→ **Proximity:** The COVID-19 pandemic aggressive impacts in almost every country around the globe makes policy makers see it as a proximate threat. To the contrary, climate change crisis suffers from the “spatial optimism” dilemma, wherein the industrialized world sees the consequences of the climate crisis happening elsewhere. Moreover, the COVID-19 pandemic has become a concrete threat because its characterization as a “global” pandemic and its imminent threat to human health and wellbeing, while climate change extreme events (such as floods and droughts) are mostly experienced by vulnerable communities, and in developing countries (Dolsak and Prakash, 2020; Ruiu et al., 2020; van der Ven and Sun, 2021).

→ **Accountability:** The degree to which individuals feel personally accountable for their own health and safety during a crisis is critical to drive interventions. Accountability seems higher in COVID-19 because the pandemic directly threatens individuals and health systems. On the contrary, in the climate crises impacts on human lives is still perceived, by many, as indirect through changes in natural systems (Roberts and Parks 2007; Dorn et al. 2020; Rosenbloom and Markard 2020; van der Ven and Sun, 2021).

→ **Expertise:** It captures the degree of trust in the epistemic community with the most knowledge about a crisis. Responses to COVID-19 draw on the expertise of doctors and epidemiologists, arguably the most authoritative of epistemic communities due to the perceived infallibility of medical research methodologies. Quite the reverse, there is some degree of mistrust among policy makers when it comes to climate experts drawing on knowledge from multiple disciplines. This degree of trust in experts closely relates to public dissent and, consequently, to the capacity to respond quickly and decisively (Lovbrand 2009; Elbe 2011; Leão and Gil 2019; Chinn et al. 2020; van der Ven and Sun, 2021).

→ **Legibility:** In a pandemic, individuals limit exposure to disease agents, and governments mostly enact public policy to support it with the prospects of

**Building on the unprecedented international action around COVID-19 is needed to enhance the health system resilience to both climate change and future pandemics.**

delivering either a vaccine or a feasible treatment. As such, the response is a clear cause–effect relationship. On the contrary, climate change crisis is far less legible at all scales, and often requires complex underlying chains where a successful outcome at one scale, often depends on conditions at another. Accordingly, the difficulty of identifying connections of climate change interventions, explains the low legibility of climate governance (Bernstein and Hoffmann 2018; van der Ven and Sun, 2021).

These eight crisis characteristics provide a lens through which scholars, activists, and policy makers could compare crises. Moreover, these characteristics provides explanatory and predictive values across multiple characteristics that would govern responses (van der Ven and Sun, 2021).

Beyond the eight crisis characteristics, the time-dimension is a significant factor between COVID-19 and climate change threats. Since the 1960s, experts have been warning about climate change as a long-term future challenge whose impacts will be observed in decades and centuries. For COVID-19 pandemic the timeline is different; occurs fast within days, weeks and months and impacts are immediately visible. Accordingly, this difference has been leading to a disparity in the sense of urgency of response towards these threats (Grundmann, 2021).

Hence, identifying/knowing the differences and similarities between the COVID-19 pandemic and climate change can help evaluate responses to future climate change events, and should guide policy makers in developing a sound approach to risk reduction and emergency preparedness. The COVID-19 can be considered as a “test case study” to determine our resilience to emergencies including that to climate change challenges. Moreover, the COVID-19 pandemic has reshaped the world amplifying gaps of the health systems and aggravating existing inequalities. Similarly, climate change challenges will also continue to threaten the ability of health systems to protect and improve population health and wellbeing. It further highlighted the importance of long-term planning in a pandemic response that should also be at the core in guiding the health sector’s approach to climate change. So, building on the unprecedented international action around COVID-19 is needed to enhance the health system resilience to both climate change and future pandemics. Building back better requires an integrated approach to promoting strong and durable recovery and growth by providing a greener, more inclusive, and resilient recovery from the COVID-19 crisis (ICF and WB, 2021).

Striking a balance between the pandemic response and climate protection requires a high degree of innovation and collaboration across sectors. In the next section, we draw lessons learned from the current response COVID-19 pandemic in Lebanon to direct and enhance the country’s response to the even more daunting challenges of climate change.

## **1.2 Lebanon’s Response to the COVID-19 Pandemic: Lesson Learned**

### **1.2.1 Role of the MoPH**

On March 10, 2020, the MoPH launched the “Coronavirus Disease 2019 (COVID-2019) Health Strategic Preparedness and Response Plan” which outlined a national plan of action to scale up the national preparedness and response capacities for prevention, early detection, and rapid response to COVID-19 (MoPH, 2020).

The mitigation measures outlined by the response plan include the following:

- Awareness raising activities
- Risk communication and community engagement activities
- Surveillance activities
- Implementation of Infection Prevention and Control (IPC) Programs especially in all hospitals and all other health facilities
- Designation of additional referral hospitals
- Development of new Standard Operational Procedures (SOPs) for patient diagnosis and referral and Home Care
- Development of quarantine protocols (self-quarantine, isolation canters, etc.)
- Provision of sufficient stock of Personal Protective Equipment (PPEs) with focus on the health care workers
- Support to referral laboratories (MoPH and partners) by providing needed testing kits and PPEs.

Accordingly, the MoPH response interventions included the following actions as summarized in the below table.

Table 17 MoPH COVID-19 Pandemic Summary Response Interventions (Implemented and In Process)  
(adapted from MoPH, 2020)

Area of Work	Activities Implemented and In Process	Partners to MoPH
<b>Partnership and Coordination</b>	<ul style="list-style-type: none"> <li>• Establish a National Crisis Multi- Ministerial committee is established</li> <li>• Establish a National Inter- Ministerial Crisis Task Force is established</li> <li>• Activating a standing National Infectious Diseases Committee</li> <li>• Activating the MoPH IHR team</li> <li>• Enhancing more active engagement of Non-health Stakeholders (Crisis response funding, self-quarantine monitoring, points of entry screening)</li> </ul>	WHO; UNCT; OCHA; DRM Unit
<b>Points of Entry</b>	<ul style="list-style-type: none"> <li>• Writing SOPs for Travelers Screening</li> <li>• Updating Travelers Screening Form</li> <li>• Developing Awareness Roll ups and Brochures</li> <li>• Providing PPEs for Airport and Land crossing Health and Security Staff</li> <li>• Issuing PM Decisions regarding measures at Airport</li> <li>• Providing a Surge of additional staff for screening travelers (9 RNs by WHO, 3 MDs volunteers)</li> <li>• Repurposing 23 RNs (UNICEF) for Land Crossings</li> <li>• Training Land Crossing Health and Security Staff</li> <li>• Stock Piling of PPEs for all POE</li> </ul>	WHO; UNICEF; Ministry of Public Works; Academic Institutions; Professional Orders
<b>Surveillance</b>	<ul style="list-style-type: none"> <li>• Updating Case definitions</li> <li>• Training and Equipping Teams</li> <li>• Activating Call Center</li> <li>• Updating Case Investigation SOPs</li> <li>• Contact Tracing and Referral SOPs updated</li> <li>• FFX Investigation</li> <li>• Providing Logistics Support (drivers for coordination in all governorates of surveillance activities)</li> <li>• Securing Human Resources for call center, and patient and contact tracing and investigation</li> </ul>	WHO; Health Societies: Infectious Diseases, Epidemiology, Pulmonary; Academic Institutions; Professional Orders and Syndicates

<b>Diagnosis and treatment</b>	<ul style="list-style-type: none"> <li>• Equipping Reference Lab at Rafic Hariri University Hospital (RHUH) (fully and safely equipped for testing 4 isolation rooms, 128 beds dedicated, additional 64 beds under preparation at RHUH)</li> <li>• Providing Stock of PPEs for One Month at RHUH</li> <li>• Developing Guidelines for Testing, Referral, Case management and IPC and disseminating to all Health Professionals, and UN Medical Team (ESCWA and UNIFIL)</li> <li>• Assessing of 5 Public Hospitals for Potential Patient Referral</li> <li>• Securing enough Reagents and Primers and Lab Supplies at Reference Lab</li> <li>• Updating all Hospitals Contingency Plans</li> <li>• Designating and Upgrading Referral Hospitals in each Governorate</li> <li>• Clarifying Role of Private Sector in Crisis Response and Case Management</li> <li>• Ensuring a National Contingency Stock of advanced PPEs for Hospital Case Management</li> </ul>	WHO: Health Societies; Infectious Diseases, Epidemiology, Pulmonary; Academic Institutions; Professional Orders and Syndicates
<b>Risk communication</b>	<ul style="list-style-type: none"> <li>• Providing Awareness Brochures to the Public and Travelers</li> <li>• Conducting TV Radio and Social Media Interviews</li> <li>• Issuing Daily Situation Report by WHO and Periodical Preparedness Briefs</li> <li>• Conducting Sensitization Meetings to Scientific Societies at Order of Physicians</li> <li>• Recruiting Community Volunteers (NGOs and LEMSIC) for Awareness raising</li> <li>• Providing Media support Staff at MoPH for Daily Communication and Updates</li> <li>• Conducting additional Community Sensitization and Active Engagement</li> </ul>	WHO; UNICEF; UNCT; RCO; Media; Ministry of Information; DRM

Moreover, monitoring and evaluation of the national preparedness and response was to be routinely conducted by MoPH. The developed key performance and impact indicators would be continuously monitored, and the implementation of the planned activities would be evaluated, as well, to assess the overall performance of the program, generate evidence and lessons learnt to adjust, accordingly, the operation. Further, a progress report on operational readiness, strengths, weakness, gaps, and recommendations on how to address challenges would be generated, continuously updated, and shared with the National Committee to document progress. The list of key performance indicators is presented in Table 18.

Table 18 MoPH COVID-19 Pandemic Summary Response Interventions (Implemented and In Process) (adapted from MoPH, 2020)

Monitoring Framework			
Type	Indicator	Target containment Scenario	Target mitigation Scenario
<b>Points of Entry</b>	<ul style="list-style-type: none"> <li>→ Number of POE that have capacity to detect suspected/confirmed cases</li> <li>→ Number of POE that have isolation</li> </ul>	3 4	0 0
<b>Health Information Management</b>	<ul style="list-style-type: none"> <li>→ Number of POE that have capacity to detect suspected/confirmed cases</li> <li>→ Number of POE that have isolation</li> </ul>	3 4	0 0
<b>Case Management</b>	→ % of HCF where surveillance guidelines are disseminated to healthcare workers including private sector	100%	100%

<b>Health Information Management</b>	→ Number of POE that have capacity to detect suspected/ confirmed cases	3	0
	→ Number of POE that have isolation	4	0
<b>Case Management</b>	→ % of HCF where surveillance guidelines are disseminated to healthcare workers including private sector	100%	100%
<b>Infection Prevention and Control</b>	→ Public designated hospitals to treat COVID-19 cases	1	5
	→ % of Hospitals where case management were disseminated	100%	100%
<b>Rapid Response Team</b>	→ % of acute healthcare facilities with triage capacity	50%	100%
	→ % of acute healthcare facilities with isolation capacity	5%	100%
	→ % of alerts have been verified and investigated within 48 hours	100%	100%
<b>Laboratory Diagnostics</b>	→ Number of laboratories that can provide results within 72 hours	1	5
	→ Number of national reference laboratories with capacity to test COVID-19	1	1
	→ Number of national laboratories with trained laboratory technicians on COVID-19 testing	1	5
	→ Number of national reference laboratories reporting virological data through EMFLU or FluNet	1	5
<b>Risk Communication and Community Engagement</b>	→ Presence of health communication plan that was updated according to the new situation	1	1
	→ Frequency of media interviews and press release in different languages	Daily	Weekly
<b>Operation support and logistics</b>	→ Number of hospitals experiencing stock-outs of critical items	0	0
	→ Number of labs receiving IPC medical supplies and laboratory reagents in response to COVID-19	1	5
<b>Program Management</b>	% of surge deployment resources from the external and internal rosters of experts	0	TBD

However, although a response plan and a monitoring framework were developed, still, responding to the COVID-19 pandemic in Lebanon is a continuous challenge. When compared to other countries, Lebanon's response plan required a more aggressive approach, given the extensive resource deficiency and the various challenges in the country (Khoury et al., 2020). These identified challenges relate to: (a) the fragmented health sector with hospitals of varying capabilities, (b) the geographic distribution and ownership of hospitals (more than 80% of the hospitals are private hospitals and mainly located in large cities), (c) the focus of the health care budget mostly on acute care, (d) under resourced public hospitals, (e) reliance on foreign supply chains with limited local manufacturing capability to produce the required supplies for COVID-19 prevention ( e.g. N95 masks and ventilators), (f) weak case tracing capabilities that requires technology that is unavailable in Lebanon (many countries had unified health registries with mobile phone tracking and messaging prior to the pandemic), so Lebanon had to build these capabilities and registries as part of its response to COVID-19 (Khoury et al., 2020).

Faced with these challenges, MoPH directed all resources and efforts toward preparing public hospitals to receive and treat COVID19 patients, particularly the Rafic Hariri University Hospital (RHUH) (Bizri et al., 2021; El-Jardali et al., 2020). The hospital assumed the responsibility of delivering all the spectrum of care related to COVID19: triage, laboratory testing, quarantine, and medical management of cases of all severity levels (El-Jardali et al., 2020). However, this shift in diverting funds to public

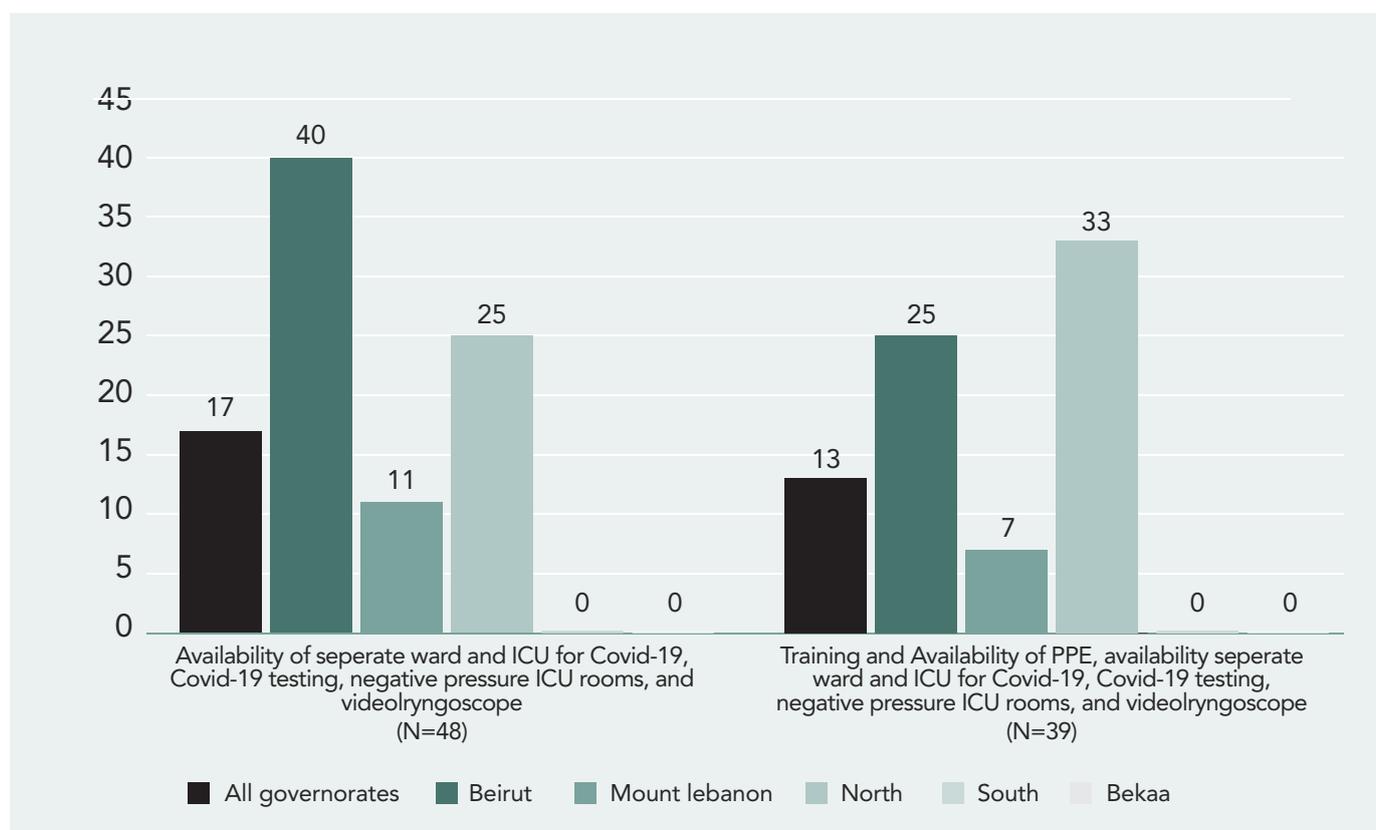
**Only 17% of Lebanon's major hospitals' ICUs had the needed resources on-site to respond to the COVID-19 pandemic.**

hospitals rendered some of the private health facilities with depleted resources. This in turn threatened the continuity of some services in these health units.

So, at the early stages of COVID-19 epidemic, very few hospitals were utilized as isolation zones other than Rafik Hariri University Hospital. Almost all the 131 private hospitals were hesitant to admit COVID-19 patients due to a lack of sufficient personal protective equipment and essential medical devices (DeJong, 2020). Still, with the progressive increase in the number of COVID-19 cases private hospitals were drawn into the combat, but with scarce resources and medical equipment needed to fight the pandemic (Bizri et al., 2021). Additionally, the lack of a clear operation plan for the coordination of efforts between the public and private hospitals lead to inefficient and delayed responses (El-Jardali et al., 2020). A study conducted by Chami et al. (2020) to assess the preparedness to COVID-19 among 51 major Lebanese hospitals' Intensive Care Unit (ICU), found that only 17% of units had the needed resources on-site (such as dedicated wards and ICU for COVID-19 patients, negative pressure ICU rooms, video-laryngoscopes, and COVID-19 testing). Only 34% had the recommended PPEs (N95 masks, face shields and impermeable body-gowns), and have been trained on the use of PPEs.

Another study that was conducted in 2020 assessed the level of emergency and disaster preparedness at 24 Lebanese hospitals and their readiness to deal with complex emergencies and humanitarian crises. The results showed that almost all hospitals: (a) have established procedures of emergency preparedness activation in place; (b) conduct periodical drills and staff training, (c) frequently review their existing medical and pharmaceutical facilities and accordingly set plans to expand their intensive care units (ICUs) and to secure additional equipment, and (d) conduct capacity building and emergency training to provide essential emergency skills and knowledge to hospital staff. Yet, they were unable to quickly respond to the COVID-19 pandemic. (Al Hajj et al., 2020).

Figure 11 : COVID-19 Preparedness at Respondent's Hospitals by Region (N = 51) (Chami et al., 2020)



And, although the World Health Bank offered Lebanon \$40 M for the supply of personal protective equipment (PPE) and other medical devices, these supplies weren't evenly distributed among health care facilities (DeJong, 2020; reliefweb, 2022). Additionally, administrative, and clinical sustenance was also provided through the World Bank and the European Union to proactively support the vulnerable population, including Lebanese poor citizens, and Syrian refugees (Hamadeh et al, 2021). Therefore, the improper management of medical services is due to the weak governance and the lack of a strong infrastructure; a system driven by political leaders (Khoury et al., 2020).

So, although many of surveyed hospitals scored well on the preparedness scale, major deficiencies were identified. The ICU capacity, in terms of availability of sophisticated equipment and continuous monitoring, was completely missing in some hospitals, while deficient in others. Surge capacity and the ability of hospitals to accommodate large influx of patients without disrupting the hospitals daily operations was also identified as a major deficiency across the assessed hospitals. In addition, many hospitals lacked mental health services and some hospitals had weak communication and coordination plans which hinders their capacity to effectively respond to disasters and emergencies. Additionally, deficiencies in Integrated Comprehensive Care (ICC), decontamination practices, and the unavailability of disaster-only medical carts and supplies were also identified limitation among Lebanese hospitals (Al Hajj et al., 2020). Moreover, the discrepancy in the access to emergency kits by the various Humanitarian Aid Groups, and the incongruity in staff training to deal with COVID emergencies boosted the challenges (Al Hajj et al., 2020; Khoury et al., 2020).

## Under COVID-19, the role of Primary Health Centers was not capitalized to provide primary prevention and alleviate the burden on overloaded hospitals.

Still, it is evident to note that the health sector including hospitals is suffering from the financial crisis. This resulted from unpaid bills and other financial obligations to the National security Fund. Accordingly, Insurance Companies excluded some hospitals from their services due to high costs. Consequently, low salary wages were being offered to healthcare workers, and more critically, this resulted in layoffs. Moreover, the continued fluctuations in the Lebanese Lira exchange rate affected, additionally, employees' salaries at hospitals, leading to the migration of skilled personnel thus rendering hospitals and medical care centers understaffed. (DeJong, 2020). Hence, the financial crisis terminated the operation of many medical services while prioritizing emergencies (DeJong, 2020; Isma'eel et al., 2020),

Moreover, nurses and medical staff were functioning in unsafe working conditions (HRW, 2020). The high surge in COVID-19 cases (e.g., 21.2 % in January 2022) aggravated the medical services, noting that 2,345 cases were among the health workers (NDVP, 2021). In addition, the lack of preparedness and effective health and safety plan in the RHUH put healthcare workers and staff at a greater risk of infection. This prompted the employees to go on strike demanding the hospital to implement proper safety measures to protect them while caring for COVID-19 patients; further delaying response activities (El-Jardali et al., 2020). Additionally, the mental health of nurses and health care workers has been negatively affected because of the lack of support and being overworked. Most of them are deprived of decent medical services coverage (Relief Web, 2022).

Also, the lack of authorized laboratory centers to perform the COVID-19 tests, and the unequal geographic distribution across all regions the Country led to a delay in diagnosis and consequently in response (El-Jardali et al., 2020). Most centers are located around Beirut, which rendered rural community with limited access to testing (Khoury et al., 2020). As such, the availability of the PCR at the early stages of the pandemic was limited to a few hospitals and only 47 laboratories across the country (Khoury et al., 2020). This created a disparity in the pattern of disease identification across different Regions hence affecting the reliability of the results, and the pattern of collected data (DeJong, 2020). So, the reliability of computerized contact tracing techniques along with the lack of the implementation of a solid plan by all health care facilities aggravated further the situation (Khoury et al., 2020).

At the level of the provision of pharmaceuticals and medical supplies, the cost was very high reaching \$ 1.98 bn which was mostly utilized to cover 85% of the price of imported medical devices and pharmaceuticals (Isma'eel et al., 2020). Ventilators and equipment are all mostly imported since Lebanon relies on external supply chains (DeJong, 2020; Khoury et al., 2020).

Additionally, one of the main challenges was the inability of the MoPH to regulate service provisions and coordinate response among privatized hospitals including those that are operated by NGOs. This is important to consider as the latter has more than 85 % of hospital beds, while having public hospitals under-resourced (DeJong, 2020; Khoury et al., 2020).

Moreover, the role of PHC centers was minimal and was not capitalized to: (a) provide primary prevention interventions (such as WASH services or vaccination programs) and surveillance systems for rapid detection of disease outbreak following a disaster, (b) understand health needs and identify vulnerable groups in disaster-affected

communities, (c) alleviate burden on overloaded hospitals through acting as a community-level triage system, where patients with minor illnesses are treated and those with serious injuries are referred to hospitals, (d) manage diseases related to health emergencies, including mental health, chronic disease interventions, food- and water-borne disease, etc., (e) promote community engagement by effectively communicate risks and share timely information, and (f) provide outreach services mobile clinic services to provide non-communicable disease interventions, mental health services and other primary health care services to vulnerable and disadvantaged populations (Bou-Karroum et al., 2020; WHO, 2018).

And, although the Lebanese Government secured 6.3 million vaccines in 2021; still this was considered insufficient to vaccinate 80% of the population (Todman, 2021). Other limitations include the type of vaccines (a) mRNA vaccines were considered relatively expensive and cannot be evenly distributed across all health care centers, hence restricting them to limited private hospitals, and (b) Viral vector vaccines were still being evaluated relative to their efficacy for immunosuppressed individuals The Lebanese health sector doesn't have an independent drug regulation authority and the lack of MoPH resources lead to the disruption of the vaccination plan, hence exacerbating existing inequalities among citizens (MoPH, 2021; Todman, 2021).

To add to these challenges, crude oil and fossil fuel shortage were some of the major challenges for providing electricity through generators, especially to patients surviving on ventilators, kidney dialysis units, and other medical devices. Fuel had to be secured by the army to rural hospitals, such as Akkar hospitals. However, it was reported that the retained fuel wasn't distributed freely (Khouri, 2021). As such, the army requested external support during the economic crisis to secure fuel and medical supplies. Thus, the impact of the Lebanese economic crisis has aggravated the limitation in health care provision, just as a natural disaster or war would do (Martins, 2021).

And, although issues relating to WASH Challenges have not been reported, still, providing water, sanitation, and hygiene (WASH) services is critical to help protect against major threatening infectious outbreaks such as the COVID-19 Pandemic. And, although mostly respiratory in nature, the epidemiological and microbiological data provides evidence that contaminated hands can transmit the novel coronavirus when in contact with the mouth, nose or eyes and can transfer the virus from one surface to another. Therefore, maintaining recommended water and sanitation practices is very important for reducing the spread of COVID-19. Subsequently, the WHO has called on practitioners to improve the provision of safe water to promote and enable proper hygienic practices, and the access to sanitation services to help contain the spread of the COVID-19. A further environmental health concern that has not been fully reported relates to the management of larger amounts of hazardous waste during the ongoing pandemic.

### 1.2.2 Role of the Disaster Risk Management Unit

The Disaster Risk Management (DRM) Unit at the Prime Minister's Office was one of the main governmental partners in the MoPH's strategic response to COVID-19. At the start of COVID-19, a National Emergency Task Force was established headed by the Prime Minister's (PM) office. The secretariate of this task force was assumed by the Disaster Risk Management unit at the PM office. The task force met weekly and on ad-hoc basis as needed and followed up on preventive measures and country preparedness activities (MoPH, 2020).

**The impact of the Lebanese economic crisis has aggravated the limitation in health care provision, just as a natural disaster or war would do.**

During the pandemic, the DRM Unit has played a crucial role in (DRM, 2020; Jurdi, 2021; WHO, 2020b):

- Coordinating the development of the National COVID19 Response Plan
- Establishing of a monitoring and evaluation dashboard of the response as well as real time illustrations.
- Coordinating the activation of National Operation Room and generation of daily situation reports.
- Supporting the development of business and safety continuity plans for key Ministries and Sectors.
- Creating a hospitals occupancy interactive dashboard.
- Coordinating the development of reference manual for isolation centers and coordinating the establishment of Isolation Centers (with interactive dash boards) among different Ministries, UN Agencies and Civil Society Organizations.
- Coordinating the activation of preparedness and response at the Governorate level including, awareness, tracing of contact, situation reports, support and back up through the designation of focal points at Governorate level.
- Supporting the coordination on COVID19 among all UN agencies as part of the WHO pillars and National response plan.
- Facilitating a well-coordinated whole-of-Government response and ensuring the engagement with national and international partners.
- Contributing to the development of several awareness material.
- Issuing on daily basis the National Situation Report on COVID19.

The DRM unit, in coordination with the Ministry of Interior and Municipalities (MoIM), the MoPH, and UN agencies have supported municipalities and facilitated the implementation of the local public health response. Such support included helping the municipalities to establish isolation shelters and defining a proper mechanism for self-isolation, including access for patients to support services such as medicines, social assistance, food, mental health and psycho-social support, and catering to people with special needs in consideration of age, gender, and disability. This approach built on and further strengthened the capacities of PHCs and Social Development Centers (SDCs) (WHO, 2020c). In addition, the DRM unit also played a role in drafting COVID-19 guidelines for construction workers and citizens who use public transport; this was done in collaboration with the Ministry of Public Works, UN-Habitat and UNDP (WHO, 2020c).

### 1.2.3 Role of Syndicate of Hospitals

The Syndicate of hospitals was one of the non-governmental partners in the MoPH's strategic response to COVID-19 (MoPH, 2020b). The syndicate of hospitals played a role in capacity building, contingency plans, quality, and safety SOPs, procuring PPEs, case reporting and case management, coaching and twinning with public hospitals (MoPH, 2020b). The syndicate of hospitals also attended regular meeting with other stakeholders involved in the response plan including the national scientific committee and UN agencies (Ambiss and Ammar, 2020).

The syndicate of hospitals can also play an important role in strengthening emergency medical services in the country to improve overall response during

climate change emergencies through and in partnership with other concerned stakeholders (El Bawab et al., 2017):

1. Developing evidence-based standards and Standard Operating Procedures (SOP) that should be based on international standards and adapted to the Lebanese healthcare system; which include (a) system organization and management, (b) financial management (c) staffing/ training, (d) equipment and facilities (e) communication and inter-agency relations, (f) response/ transportation, (g) facilities/ critical care, (h) clinical standards (i) data collection/ system evaluation, (j) public evaluation and education, and (k) disaster management response.
2. Creating or designating a unified dispatch center, which includes (a) facility, equipment, and staffing, (b) Developing Standard Operating Procedures (SOPs) based on international best practices, (c) Training of dispatch center staff on best practices, (d) Integrating a unified communication system among all agencies that provide EMS, (e) Implement fast communication routes with hospitals to determine the closest most adequate hospital, including the use of the MoPH application.
3. Developing unified EMS training and education standards based on international standards and adapted to the Lebanese system.

### 1.3 Lessons Learned and Main Recommendations

In terms of positive lesson learned, Lebanon was classified among the top 15 countries that responded well to the outbreak (Ambiss and Ammar, 2020). The MoPH adopted a proactive approach and took the necessary measures to activate the country's preparedness, enhance response capacities, and surveillance for COVID-19 before the first case was detected in Lebanon on January 30, 2020, and even before WHO declared the outbreak as a pandemic (Ambiss and Ammar, 2020). MoPH worked on enhancing preparedness and response through numerous activities (1) issuance of memos for case definition and identifying countries with local transmission to follow up on travelers coming from these countries for 2 weeks, (2) screening at points of entry, (3) activation of national committee on infectious disease and coordination with experts from different specialties for situation analysis, and (4) procurement of medical supplies and testing kits with the help of WHO (Ambiss and Ammar, 2020).

Efforts to flatten the curve of cases that require hospitalization were also implemented and included awareness raising, risk communication and development of mobile application for self-assessment. Closure of schools and religious establishments such as churches and mosques, suspension of flights and border control also played a positive role in the response (Ambiss and Ammar, 2020).

However, the COVID-19 pandemic has also exposed the weakness of the health sector in Lebanon. The pandemic has highlighted the need for investing in the public health sector and build its capacities and preparedness, including the capacities of MoPH to respond to emergencies and disasters. This is key to respond to future threats. In addition, responding to this pandemic showed that investing in decentralization and technologies for early detection and tracing is also an important aspect in emergency response. Shifting funds to boost preventive care is critical for emergency preparedness of hospitals. And, having a well-developed occupational health and safety plan to protect healthcare workers in cases of emergencies, is crucial.

**Lebanon was classified among the top 15 countries that responded well to the outbreak. However, the COVID-19 pandemic has also exposed the weakness of the health sector in Lebanon.**

However, the COVID-19 pandemic has also exposed health sector weaknesses in Lebanon. The pandemic has highlighted the need for investing in the public health sector and build its capacities and preparedness, including the capacities of MoPH to respond to emergencies and disasters. This is key to respond to future threats. In addition, responding to this pandemic showed that investing in decentralization and technologies for early detection and tracing is also an important aspect in emergency response. Shifting funds to boost preventive care is critical for emergency preparedness of hospitals. And, having a well-developed occupational health and safety plan to protect healthcare workers in cases of emergencies, is crucial.

More importantly, the COVID19 pandemic highlighted the deficiencies in the national response strategies and the absence of a well-coordinated and communicated command structure between the relevant stakeholders involved in the response (El Sayed, 2013; El Sayed et al., 2015; Al Hajj et al., 2020). To sum up, effectively responding to the COVID19 pandemic in Lebanon was challenged by various factors including (a) following a reactive rather than proactive approach; (b) having a poor level of preparedness of public and private hospitals and primary health care centers; and (c) prevailing limited coordination among sectors.

Analyzing these challenges and limitation, lessons learned highlight the importance of the recommended intervention in the various key areas that should be addressed to reduce the vulnerability of the health care facilities to any type of disaster including climate change crises. The recommended interventions were discussed in detail in Chapter 1, are further summarized in Table 19.

Table 19 Main recommendations to decrease vulnerability of health care facilities to future crisis, including climate change

Climate Change Vulnerability Areas	Interventions to Enhance Emergency Preparedness
<b>Human Resources:</b>	<ul style="list-style-type: none"> <li>→ Develop a National Contingency Plan to ensure the provision of additional needed workforce during and post emergency and recovery</li> <li>→ Develop a National Health Support Program for Health Care Providers</li> <li>→ Develop Emergency Plans and Programs at the Health Care Facilities to protect health workers from exposure to multiple biological and chemical hazards</li> <li>→ Develop and Deliver</li> </ul>
<b>Water, Sanitation and Hygiene</b>	<ul style="list-style-type: none"> <li>→ Develop a National Program to Improve WASH Services and Waste Management in Health Care Facilities</li> <li>→ Develop simple Guidelines to help Health Care Facilities acquire and continuously update an Assessment Plan that maps risks to the Water and Sanitation Infrastructure in place</li> <li>→ Develop Guidelines to help Health Care Facilities develop a safe Health Care Waste Management System (safe storage, safe disposal, and safe transport) in place, before, during, and after climate change related event</li> </ul>
<b>Energy Management</b>	<ul style="list-style-type: none"> <li>→ Direct the Health Care Facilities to develop a Procedure to Periodically Assess the Energy System to ensure that it can cope with climate change related events, and have an emergency plan for power outages in the short- and long-term, before, during and after an emergency event</li> <li>→ Develop a National Network of Community based and National Providers that will help the health sector to overcome shortage in Energy Supplies (including fuel, generators, batteries, filters...)</li> </ul>

	<p>→ Greening of the Health Sector will help reduce dependence on conventional sources of energy, enhance energy efficiency, promote on site use of renewable energy (emergency setting); enhance passive cooling, heating and ventilation, conserve and maintain safe water supply, enhance facility management of wastewater and solid waste</p>
<p><b>Infrastructure, Technologies, Products and Processes</b></p>	<p>→ Direct Health Care Facilities to develop simple guidelines to evaluate the condition and safety of structural and nonstructural elements that are impacted by previous exposure to climate change related events</p> <p>→ Develop a National Coordinated Mechanism across the Health Sector, and at different levels, to manage the response and risks resulting from public health emergencies and disasters (including sharing of resources and supplies, transferring of patients, and health workforce support)</p> <p>→ Develop a National Procedures for Procuring, Sharing, and Safely Transporting and Storing medical devices, pharmaceuticals, vaccines, laboratorial supplies, parenteral nutrition and blood supplies, PPEs (including respirator masks such as fitting N-95 respirator, leather gloves, safety glasses or goggles, clothes such as long-sleeved shirts and long pants, windproof and waterproof clothes, thermal underwear, shoes with rugged soles, waterproof safety boots, goggles, work gloves and masks....., that cover all ranges of climate change emergencies), and other essential medical supplies</p> <p>→ Develop a National Information System between the Health sector and Meteorological Services to communicate about Climate Hazards (such as storm surge hazards, risk of wildfires, hazards-reduction burning, expected number of hot and smoky days or the likelihood of forthcoming extreme cold weather conditions) to activate emergency response</p> <p>→ Direct and Support Health Care Facilities to develop Information and Communication Systems that can be safely secured with backup arrangements (via cloud, satellite) to satisfy the facility's demand, and patient's care</p>

To accomplish the recommendations discussed in the Table 19, which aims to reduce the vulnerability of health care facilities to future crises, including climate change, an integrated national framework under which these actions can be undertaken is required. To achieve the latter, the following is recommended.

**At the level of the MoPH:**

→ One main limitation that has hindered the sector's efforts to enhance emergency preparedness is the absence of a dedicated team/unit at the MoPH for emergency risk and crisis management. As such, reorganization of the organogram of the MoPH to include emergency risk and crisis management unit is required. A unit comprised of a multi-disciplinary team of experts in various fields, including environment, finance, public health, etc., is needed with the following mandates:

- o The unit shall be the focal point of all emergency risk and management plans.
- o Develop and implement multi-sectorial national strategic plans and frameworks (Table 19) to enhance environmental performance and emergency preparedness of healthcare facilities and monitor their implementation.
- o Establish a standard environment health and sanitation surveillance system for the health sector
- o Conduct regular inspection visits to healthcare facilities to ensure compliance
- o Follow-up with non-compliant healthcare facilities.
- o Develop centralized or decentralized (at the district/regional/local level) plans for environmental health issues of concerns in healthcare facilities, such as healthcare waste management, WASH services, procurement and transportation of needed equipment during emergencies, relocation of services during emergencies, sharing of resources, etc.
- o Coordinate the developed plans and frameworks between all concerned stakeholder (health and non-health), including hospitals, PHCs, Emergency

Medical Services, Civil Defense, etc.

- o Develop and implement an effective information sharing and communication plan between all concerned stakeholders during emergencies.
- o Develop a human resource plan for all healthcare facilities (including during emergencies)
- o Develop a plan to strengthen emergency medical services
- o Implement health care waste management standards in all health facilities
- o Develop contingency planning at the district level.
- o Develop an IT platform to allow flow of information to and from epidemiological and surveillance unit and establish periodical alerts monitoring system linked to all involved partners
- o Collaborate with donors and international organizations (such WHO, UNDP, AFD) to support (both technically and financially) healthcare facilities in implementing greening initiatives and improve environmental performance to achieve climate resilient.
- o Conduct nation-wide training for healthcare providers and managers on environmental compliance and emergency preparedness to improve technical capacities of the facilities.

→ Strengthen the health sector governance, including both the internal organization of the MoPH and wider sector governance arrangements. In addition, strengthening the regulatory bodies of the MoPH is required.

→ Enhance public-private health sector engagement and partnerships.

#### **At the Regulatory Level:**

The following regulations and decisions are needed:

- Legislations that define economic/safety packages for healthcare facilities during emergencies and climate change disasters.
- Decisions that enforce regular environmental and energy audits for healthcare facilities.
- Regulations that exempt healthcare facilities from certain taxes or expenses considering good environmental performance
- Regulations that enforce the reporting of GHG emissions of healthcare facilities

#### **At the Financial Level:**

- Allocation of MoPH budget to the implementation of emergency preparedness and greening initiatives for the health sector.
- Investment funds and low/zero interest loans to incentivize healthcare facilities to implement greening initiatives are also required.

# 2. HEALTH SECTOR CLIMATE CHANGE ADAPTATION STRATEGIES

In terms of adaptation and preparedness to climate change, there has been minimal direct effort toward increasing the healthcare facilities capacities to address climate change and enhance their climate resilience. The main initiatives conducted at the micro-level mainly focused on increasing the healthcare facilities' capacities in terms of emergency preparedness and early warning signs during disease outbreaks, which are a few of the manifestations of climate change hazards. These initiatives are not sufficient to ensure climate resilience of healthcare facilities but could be used as basis to expand the programs and efforts directed toward increasing the adaptation and preparedness of healthcare facilities to climate change,

## 2.1. MoPH Strategy to Enhance Emergency Preparedness in the Health Sector

Since the 2006 war, the MoPH, and with the support of WHO, focused its efforts on disaster risk reduction activities and communicable disease outbreaks. The health strategy was, accordingly, revised to improve the national emergency health preparedness and response capacity. MoPH efforts focused on: (a) reinforcing the national surveillance system; (b) capacity building to enhance MoPH emergency preparedness, (c) implementation of the International Health Regulations (IHR), and (d) developing health Emergency Contingency plan (MoPH, 2012; Ambiss and Ammar, 2020).

### 2.1.1. Reinforcing the National Surveillance System:

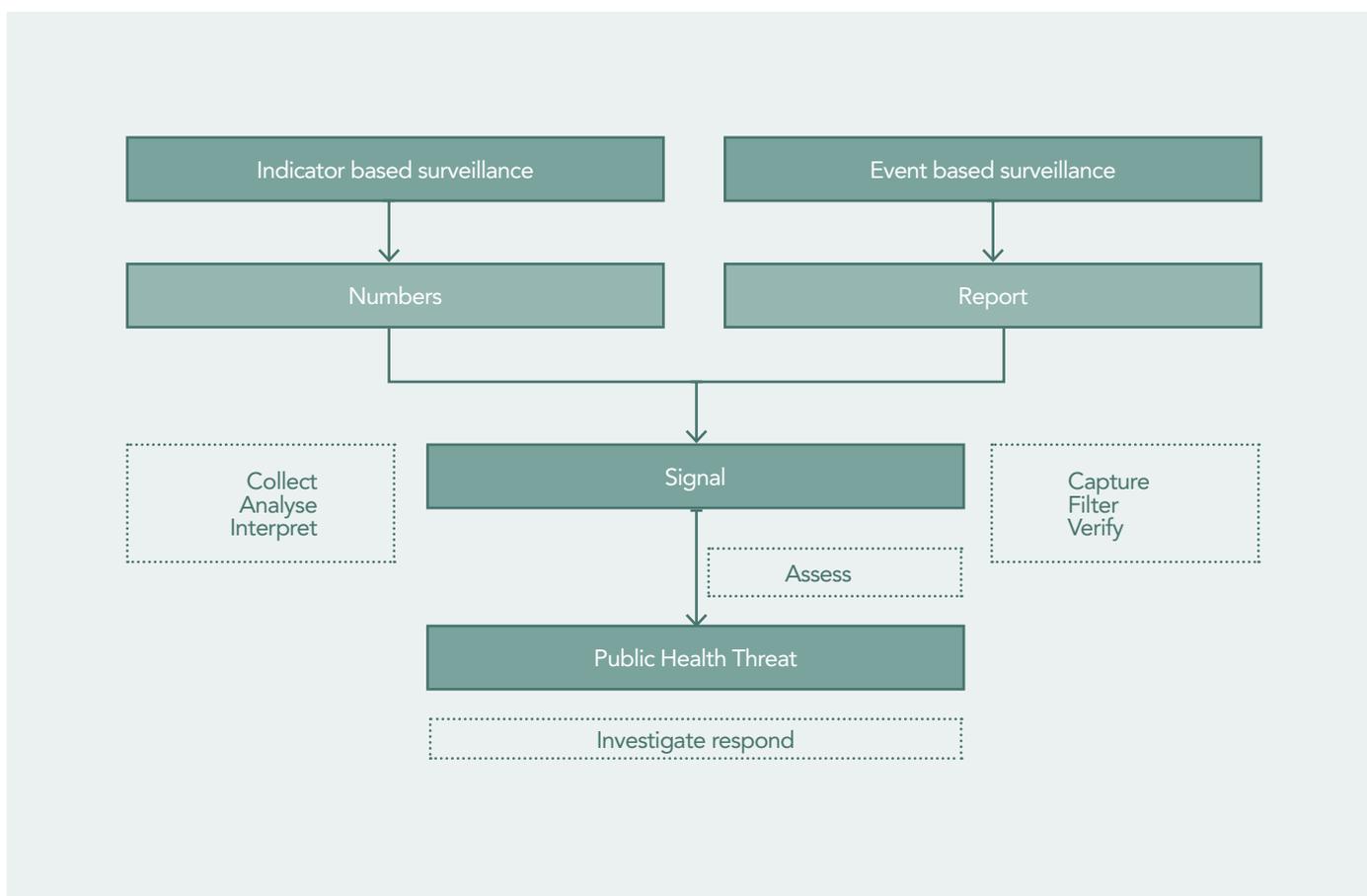
The Epidemiological Surveillance Unit (ESU) was established in 1994 under the Directorate of Prevention with a direct supervision of the Director General. Since its inception, ESU has expanded its scope of work and work force. In 2005, it was decentralized and includes ten surveillance subsystems (including selected non-communicable diseases): (i) ICU-based surveillance, (ii) hospital-based mortality, (iii) aggregate laboratory data, (iv) reporting from medical centers, (v) school absence reporting, (vi) national cancer registry, (vii) road traffic injury, (viii) snake bite surveillance, (ix) chemical surveillance, and (x) environmental surveillance (Ambiss and Ammar, 2020).

Accordingly, in 2006, MoPH established the first Early Warning Alert and Response System (EWARS) based on epidemiologic surveillance at the level of primary healthcare centers network. The EWARS currently includes priority epidemic prone

diseases in humanitarian emergencies; (a) acute watery diarrhea, (b) bloody diarrhea, (c) acute respiratory infections, (d) measles, (e) AFP and (f) viral hepatitis. Moreover, the scope of EWARS was expanded to include the private sector and the armed forces and was upgraded from a paper-based system to an electronic reporting system that provides real time information using the DHIS2 tool (Ambiss and Ammar, 2020). The EWARS is integrated within a central National Communicable Diseases Surveillance System, which was set up in 2003 and generates indicator-based alerts (MoPH, 2012). With the influx of Syrian refugees into the country starting 2011, there was an urgent need to update the system, so four Regional Observatories were established in Bekaa (Zahleh), North (Tripoli), South (Saida), and Nabatieh. The health data collected through the Regional Observatories is analyzed and used in the development of the emergency response plans, as presented in Figure 12 (MoPH, 2012).

Hence, the main objectives of the EWARS are to (a) ensure timely detection, development of appropriate response and control of epidemic prone diseases, and (b) effective monitoring of priority disease trends to guide public health response. Moreover, the EWARS was developed for the purpose of early warning and response in the context of displaced Syrian population to report target diseases including (a) vaccine-preventable diseases (such as measles, mumps, rabies, rubella, etc.), (b) water and food-borne diseases (such as bloody diarrhea, cholera, acute watery diarrhea, typhoid fever, viral Hepatitis A and E, etc.), (c) other diseases, such as leishmaniasis, meningitis, novel influenza, novel coronavirus, and (d) any public health emergency event of international concern (MoPH, 2012; MoPH, 2015).

Figure 12 Schematic Presentation of EWARS (MoE, 2013)



The following have been achieved through the Early Warning Alert and Response System (EWARS) (MoPH, 2012; MoPH, 2015):

- The training of health workers on EWARS at the levels of hospitals, PHC, Army and Internal Security Forces.
- The provision of tools and equipment needed for establishing the reporting mechanism at the level of Primary Health Care, Army and selected Private Practitioners.
- The development of a “Rumor” Investigation System.
- The development of a School-based Surveillance System.
- The development of a Detailed List of Communicable Diseases.
- The enhancement of MoPH Surveillance Unit by recruiting additional staff both centrally and at Mohafaza level.
- The issuing of Ministerial Decrees on Reporting Infectious Diseases, and Mandatory Preparedness at hospital level, etc.

In 2014, an EU-funded project “Conflict Reduction through improving Healthcare Services for the Vulnerable Population in Lebanon”, further supported the MoPH in strengthening the EWARS by (MoPH, 2016):

- Updating Standard Operation Procedures for the Surveillance of Response to 43 selected Diseases and Hazards.
- Developing 9 new Surveillance Guidelines and Updating Existing Surveillance Forms.
- Training of 133 personnel from various organizations on standard Operating Surveillance and Response procedures for the priority notifiable diseases.
- Training 1,624 health educators from private and public schools on School-based Surveillance and Response System.
- Recruiting and Training of 16 laboratory staff on Water Sampling and Water Testing Techniques.
- Establishing 8 Negative Pressure Rooms for outbreak containment in five hospitals.

MoPH also developed databases on: (a) all health facilities including PHC centers, private and public hospitals, laboratories, pharmacies, etc., (b) list and contact details of Qadas’ doctors, and (c) private hospitals physical environment, ownership, available resources, equipment (including human resources), types of services provided, ISO qualification, etc. And, in 2010, MoPH assessed public hospital laboratories to determine capacity in diagnosing outbreaks and identifying health hazards. Accordingly, the Central Public Health Lab (CPHL) is being reconstructed and a plan to reinforce the public labs was developed. The MoPH also initiated the expansion process of the National Network of Primary Health Care Corporation in terms of number and package of services. Additionally, controlled Central and five Regional (Mohafazat) Warehouses for medications and drugs were established. The Central Drug Warehouse is equipped with (a) temperature monitoring system, (b) logistics and supply system, whereby the staff was trained to monitor the distribution of medications and supplies, and (c) a new reporting system to monitor and validate the drugs distribution. In addition, the “Essential Drug List” was updated in 2014 based on the WHO Recommendations (MoPH, 2012, MoPH, 2015).

Additionally, an evidence-based Epidemic Preparedness and Response Plan was developed by MoPH (MoPH, 2016) to:

- Strengthen surveillance for communicable diseases, with universal case reporting at high-risk informal settlements,
- Standardize procedure for early detection and laboratory confirmation of an outbreak,
- Manage cases properly in the event of an outbreak, Reinforce environmental control measures for outbreak response, and
- Stock piling of serums and medicines.

Moreover, the following contingency stocks (Table 20) were to be provided by MoPH (MoPH, 2016).

Table 20 Sample of Contingency Stocks Provided by MoPH (MoPH, 2016; Jurdi, 2021)

Category	Item	Location	Quantities
<b>Human Resources</b>	Roster of Infectious Diseases Focal Points	MoPH Website	One in each Mohafaza
<b>Medications and Supplies</b>	Standard Cholera and AWD kits	MoPH Warehouse	6
	Diagnostic lab reagents for Cholera and Other Diseases	MoPH/ Rafic Hariri	200
	Diagnostic Rapid Test for Cholera	University Hospital Lab	100
	Confirmatory Test for Cholera	In process	---
	Chlorine tablets	Pasteur Merieux/ USJ	1,000,000
	Pneumonia kits	MoPH Warehouse	300
<b>Information Education and Communication Material</b>	Brochures on: Acute Watery/ Diarrhea/ Hand Hygiene/ Hepatitis A; MERS-CoV/ Ebola etc.	MoPH/ Airport/ Health facilities/ NGOS	
<b>Personal Protective Equipment for CBRN Events</b>	Level C and Level D	MoPH Response and Surveillance teams/ Lebanese Red Cross/ Airport Health team	
<b>Health Information System</b>	District HIS2, ARC	MoPH	<b>3,000 sets</b>

As discussed previously, increase in communicable diseases and outbreaks are one of the health consequences of climate change. As such, enhancing national surveillance of communicable diseases and early warning sign systems and providing contingency stocks to healthcare facilities can help reduce the vulnerabilities of healthcare facilities when responding to pandemics and disease outbreaks and ensure continuing of service.

### 2.1.2. Capacity Building in Emergency Preparedness

In 2009, MoPH, additionally, established the Emergency Health Operations Unit (EHO) at Rafic Hariri University Hospital (RHUH) to coordinate hospital emergencies. This includes advanced information and communication equipment allowing satellite connections in case of emergencies. The unit would coordinate closely with the High Relief Council (HRC), the Army, and the Lebanese Red Cross (LRC) (MoPH, 2012).

However, data collected by the Joint External Evaluation (JEE) Report shows that since its establishment in RHUH in 2007, the Emergency Health Operations Unit (EHO) has not been activated and operated and that it is not linked to Lebanon's Emergency Response Plans. It has no Standard Operating Procedures or designated technical staff, except the IT staff to maintain the technological infrastructure. The EHO was being expanded to collect data from the field, and to act as a backup repository (WHO, 2016; WHO, 2017).

Several training sessions on Emergency Preparedness and Contingency Planning were also conducted to create a team of professionals who share similar understanding and approach to emergency preparedness and response based on the National Health Emergency Preparedness, the Health Emergency Guidebook, and the MoPH Emergency Contingency Plan in Hospitals that were developed earlier (2002) by MoPH after the SARS Corona Outbreak, and updated in 2009 following the H1N1 Pandemic (Ambiss and Ammar, 2020).

Participants in the training sessions included a wide range of health professionals and related institutions (including governmental institutions, NGOs, armed forces, and professional health societies).

The Health Emergency Guidebook was disseminated to all PHCCs, hospitals, concerned Ministries, and NGOs. The guidebook proposes unified definitions, experience-based approaches, and described Standard Operating Procedures for the preparedness and management of health response in emergencies. Contingency, Preparedness and Management Plans were also developed for Avian Influenza Pandemic, H1N1 Novel Influenza Pandemic, and EBOLA (MoPH, 2012). More than 3,000 health workers were accordingly trained on: (a), Emergency Disease Surveillance and Response, (b) Infection control, (c) Vaccine management, (d) Primary Health Care Clinical Management, (e) Mental Health Care, (f) Integrated Management of Childhood Diseases, (g) Non communicable Diseases Early Detection and Care, (h) Water Quality Monitoring, (i) Food Safety Inspection, and (j) Infectious Diseases Transmission and Management (MoPH, 2012).

And, in collaboration with the WHO Lebanon office and in coordination with the Syndicate of Hospitals in Lebanon, and the Lebanese Society of Emergency Medicine, MoPH organized workshops on emergency preparedness in health that were attended by 90 public and private hospitals from all regions of the Country. The workshop trained more than 4,000 health professionals on emergency

preparedness in health and provided the participating hospitals with a contingency planning template to be used in preparing their own (Ambiss and Ammar, 2020). Environmental health training was also conducted by the MoPH targeting Public Health Inspectors. The training was on water quality standards and water quality monitoring, hospital waste management, and rodent control. Hence, 8 water quality monitoring labs were established across the country to insure safe water provision (RHUH, Dahr El Bacheq, Tripoli, Halba, Zahle, Baalbeck, Saida and Marjeoun) (MoPH, 2012; MoPH, 2015, Jurdi, 2021).

Training and capacity building, in addition to providing guidelines on standard operating procedures for the preparedness and management of health responses during emergencies can help unify the health sector response during disasters and enhance the country's preparedness capacity.

### 2.1.3. Implementing of International Health Regulations (IHR)

In 2007, Lebanon ratified the International Health Regulations (IHR) and officially signed it in 2010. The implementation of the IHR identifies Emergency Preparedness as one of its critical pillars, and includes the following actions that focus, mainly, on Infectious Disease Management (MoPH, 2012):

- Strengthening the national disease surveillance, prevention, control, and response systems
- Strengthening the public health security in travel and transport.
- Establishing a National Committee and a technical committee for IHR implementation and a Chemical, Biological, Radiological and Nuclear (CBRN) Committee at Prime Minister Cabinet with a set mechanism for coordination between all committees and relevant sectors as well as with the national supreme commission for relief at the council of minister's level.
- Preparing HAZMAT teams to respond to chemical, biological, radiological, and nuclear events (teams included staff from Public and Private Hospitals, Lebanese Army, Fire Fighters Department, Civil Defense, and Lebanese Red Cross).
- Training on the management and transport of potentially infectious patients in the community and at points of entry.
- Developing the capacity of the Lebanese Red Cross and Civil Defense for referral and transport of patients with an infectious disease or contaminated with chemical or radiation hazards.
- Preparing national stockpiles of Personal Protective Equipment (PPEs) for emergencies. Large quantities of PPEs levels D and C are available at the Ministry.
- Developing contingency plans for Ebola, Cholera, Influenza, and Polio pandemics.
- Upgrading communication platforms to address with citizens and communities using the Ministry website, social media platforms and phone application.
- Training all relevant staff (medical and non-medical) at all points of entry (airport, land ports and seaports).

The MoPH also established the Joint External Evaluation (JEE) to enhance the national capacity to meet core capacity requirements under the IHR. Still, in a

2016 Report, Lebanon scored a 2/5 on preparedness and emergency response operation. The scores evaluated (i) Development and implementation of Multi-hazard National Public Health Emergency Preparedness and Response Plan, (ii) Mapping and utilization of priority public health risks and resources, (iii) Capacity to activate emergency operations (iv) Emergency Operations Centre operating procedures and plans, (v) Emergency operations program, and (vi) Implementation of case management procedures for IHR relevant hazards. According to the JEE Report, although Lebanon has developed a National Emergency Preparedness and Response Plan, still:

- The plan was not based on comprehensive hazard and capacity analysis.
- The plan doesn't include the role of all sectors/partners (other than health) in the response plan.
- The MoPH plan lacks proper coordination between relevant stakeholders and is not in line with other emergency plans (e.g., those developed by the Red Crescent or hospitals).
- Some hospitals have their own established emergency procedures and are not part of the national emergency response framework.

Enhancing IHR activities in the country will (1) enhance Infectious Disease Management, (2) improve healthcare facilities response to Chemical, Biological, Radiological and Nuclear (CBRN) hazards, and (3) improve coordination and communication platforms during emergencies. The latter will increase the country's preparedness capacity against disease outbreaks and other CBRN disasters caused by climate change related hazards.

#### 2.1.4. Developing of the MoPH's Emergency Health Contingency Plan

The Emergency Health Contingency Plan developed by MoPH and revised in 2012, is a tool that describes the level of preparedness and the arrangements made in terms of health response in case of a crisis. It is directed to ensure appropriate health and humanitarian assistance and protection. The contingency plan divides the disasters into natural disasters, such as earthquakes, tsunamis, floods, snowstorms, fires, pandemics, and man-made disasters such as internal and external conflicts, and chemical/nuclear leaks. Through the Emergency Health Contingency Plan, the MoPH focuses on 4 pillars (MoPH, 2012; MoPH, 2020):

- Pillar One: Assessment of health needs
- Pillar Two: Preventing, monitoring, and controlling outbreaks
- Pillar Three: Maintaining health facilities operational capacity
- Pillar Four: Coordinating with main partners in health

The Emergency Contingency Plan in Hospitals also included a section related to climate change, mainly introducing the climate change hazards present in Lebanon. However, the plan does not contain strategic short and long-term targets/goals and action items to be conducted by healthcare facilities to improve their emergency preparedness during disasters. No recommendations on how to improve their climate resilience was included. In addition, the emergency plan mainly focused on preventing, monitoring, and controlling outbreaks, while disregarding all other climate change hazards who may present a risk to the facilities.

**The  
Emergency  
Health  
Contingency  
Plan revised  
in 2012  
included a  
section related  
to climate  
change  
hazards in  
Lebanon.**

Additionally, the roles and responsibilities of the Health Clusters that would be activated during emergencies and would be headed by the WHO and several partners, as presented in Table 21 (MoPH, 2012; MoPH, 2020). Still, the provision and management of environmental health services is, not clearly outlined. Basic environmental health services such as WASH, solid waste, and vector control are not properly designated and are mostly lumped under UN agencies (MoPH, 2015, Jurdi, 2022).

Table 21 Roles and Responsibilities of Partners in the Health Cluster during Emergencies (MoPH 2012; MoPH, 2020; Jurdi, 2021)

Partner	Details	Role
<b>DRM National</b>	<ul style="list-style-type: none"> <li>• DRM unit</li> </ul>	<ul style="list-style-type: none"> <li>• Activate National Operation room</li> <li>• Coordinate with various Governorates and Agencies</li> </ul>
<b>Ministry of Social Affairs (MOSA)</b>	<ul style="list-style-type: none"> <li>• MOSA centers across the Country</li> <li>• Large network of Non-Government Organizations (NGOs)</li> <li>• Special Programs for elderly, out of school children, disabled, violence against women and children, youth and SRH</li> </ul>	<ul style="list-style-type: none"> <li>• Provide Primary Healthcare (PHC) services and protection</li> <li>• Distribute food and nonfood supplies</li> <li>• Support local NGOs</li> </ul>
<b>Ministry of Education and Higher Education</b>	<ul style="list-style-type: none"> <li>• Public Schools</li> <li>• School-based Surveillance System</li> </ul>	<ul style="list-style-type: none"> <li>• Transform Schools into temporary shelters</li> <li>• Coordinate with International Organization for Migration regarding Internally Displaced Persons' (IDPs) needs</li> </ul>
<b>Ministry of Agriculture/Ministry of Environment</b>	<ul style="list-style-type: none"> <li>• Joint Environment and Zoonotic Diseases Task Force</li> </ul>	<ul style="list-style-type: none"> <li>• Acute Pollution Control Interventions</li> <li>• Animal/zoonotic Diseases Control</li> </ul>
<b>Ministry of Industry / Ministry of National Defense /Lebanese Red Cross</b>	<ul style="list-style-type: none"> <li>• Medical Team</li> <li>• Relief Team</li> <li>• Ambulance System</li> </ul>	<ul style="list-style-type: none"> <li>• Evacuation of Casualties</li> <li>• First Aid at Emergency Site</li> <li>• Transport coordination with Emergency Operation Room at MoPH/Rafik Hariri University Hospital</li> <li>• Transport Medications and Supplies</li> </ul>
<b>Private sector</b>	<ul style="list-style-type: none"> <li>• Local and international NGOs</li> </ul>	<ul style="list-style-type: none"> <li>• Work in coordination with the Health Cluster</li> <li>• Provide PHC services and IDP Medical and Non-Medical Services</li> </ul>
<b>Academic Institutions</b>	<ul style="list-style-type: none"> <li>• Large number of well-known institutions</li> <li>• Experienced experts in emergency</li> </ul>	<ul style="list-style-type: none"> <li>• Provide Technical Support to Interventions</li> <li>• Support/implement Outreach Activities</li> </ul>

<b>United Nations agencies</b>	<ul style="list-style-type: none"> <li>• Clusters (Health/nutrition, WASH, protection)</li> </ul>	<ul style="list-style-type: none"> <li>• Coordinate between various Partners and Stakeholders</li> <li>• Prepare Appeals and Fund Raising</li> <li>• Deploy Experts as needed</li> <li>• Provide Technical Support</li> <li>• Fill the Gaps when needed</li> <li>• Support Monitoring the progress of Emergency Impact on Health</li> <li>• Channel Donations (funds and in kind)</li> </ul>
<b>Donors</b>	<ul style="list-style-type: none"> <li>• Bilateral and other</li> </ul>	<ul style="list-style-type: none"> <li>• Coordinate Donations within respective Clusters</li> </ul>

However, the plan does not contain strategic short and long-term targets/goals and action items to be conducted by healthcare facilities to improve their emergency preparedness during disasters. No recommendations on how to improve their climate resilience was included. In addition, the emergency plan mainly focused on preventing, monitoring, and controlling outbreaks, while disregarding all other climate change hazards who may present a risk to the facilities.

Additionally, the roles and responsibilities of the Health Clusters that would be activated during emergencies and would be headed by the WHO and several partners, as presented in Table 21 (MoPH, 2012; MoPH, 2020). Still, the provision and management of environmental health services is, not clearly outlined. Basic environmental health services such as WASH, solid waste, and vector control are not properly designated and are mostly lumped under UN agencies (MoPH, 2015, Jurdi, 2022).

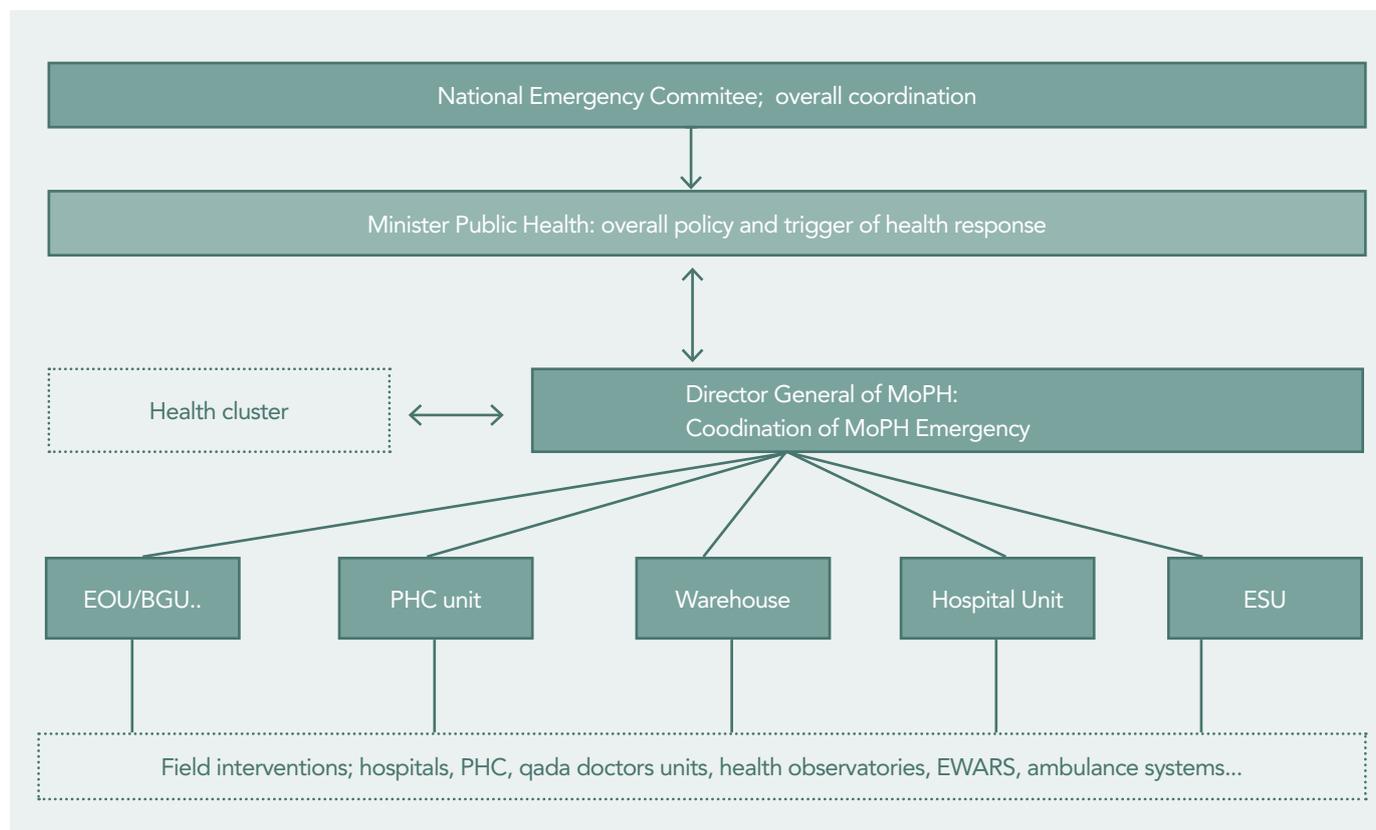
The Emergency Health Contingency Plan, also, outlines a health cluster response plan strategy which aims to contribute in reducing avoidable losses of life and burden of disease and disability of the Lebanese population by (MoPH, 2012):

- Ensuring an indispensable health information management system including rapid assessment
- Providing essential monitoring and surveillance of key diseases
- Coordinating the humanitarian health assistance
- Contributing to filling gaps in humanitarian health assistance, particularly to vulnerable groups
- Building on existing local capacities for emergency health response

The chain of command of the National Emergency Committee under the MoPH is presented in Figure 13 (MoPH, 2012).

Implementing an Emergency Health Contingency Plan which clearly delineate the roles and responsibilities of concerned stakeholders will help enhance coordination between the stakeholders during emergencies. The plan also aims to prevent, monitor, and control climate-change related outbreaks, maintain health facilities operational capacity after an emergency/disaster, and improve coordination with main partners in the health sector before and after a climate change emergency.

Figure 13 Chain of Command of the National Emergency Committee under the MoPH (MoPH, 2012)



## 2.2. The National Health and Environment Strategic Framework of Action 2021-2026

Lebanon re-iterated its commitment to increase its resilience to climate change. As such, Lebanon continuously prioritizes the harmonization of adaptation action with the enactment of the Sendai Framework for Disaster Risk Reduction, the Agenda 2030 for Sustainable Development, the United Nations Convention to Combat Desertification, and the United Nations Convention on Biological Diversity. Specifically, Adaptation priority 6 is on “ensuring overall public health and safety through climate-resilient health systems”.

Accordingly, the following key activities have been proposed by the National Health and Environment Strategic Framework of Action 2021-26 relate to the following (WHO EMRO/ Arab League/ UNEP, 2016; Jurdi, 2021):

- Assess the vulnerability of public health sector to climate change, identifying the current and future health effects and establishing early warning systems.
- Build the capacity of health sector professionals in the identification of health impacts from other sectors (e.g., transport, energy, food, water, housing, and urban development).
- Empower and ensure sustainability of existing environmental health functions and services to face challenges of water security for health, water quality degradation, droughts, heat waves, food security and safety, vectors redistribution, air quality degradation, floods and other climate related natural disasters.
- Upgrade epidemiological surveillance to incorporate new health

outcomes in the Epidemiological Surveillance Unit.

- Develop a mechanism to incorporate climate data in the national health information system.
- Develop health system response strategies, plans and projects and integrate them into national health strategies.

Implementation of the National Health and Environment Strategic Framework of Action 2021-26 will help assess the vulnerability of the public health sector to climate change and thus identify areas to reduce vulnerability and enhance their preparedness to climate change. The latter will also enhance the sustainability of environmental health services in the health sector and build the capacity of the health sector to upgrade epidemiological surveillance and enhance their overall response to climate change.

### 2.3. National Disaster Risk Reduction Strategy

Lebanon adopted in March 2015 the Sendai Framework for Disaster Risk Reduction which outlines four priorities for action to prevent new and reduce existing disaster risks: (a) understanding disaster risk, (b) strengthening disaster risk governance to manage disaster risk, (c) investing in disaster reduction for resilience, and (d) enhancing disaster preparedness for effective response, and a "Build Back Better" approach in recovery, rehabilitation, and reconstruction. Such national disaster risk reduction strategies are essential to provide a framework to coordinate efforts during emergencies, and under which the health sector can effectively respond. However, a study examining the preparedness of Arab cities, including Egypt, Jordan, Lebanon, Tunisia, GCC countries, showed that the execution of DRR strategies in Arab countries is minimal due to limited capacities and funds (El-Kholei, 2019).

In 2009, the Lebanese Government launched the project on "Strengthening National Disaster Risk Reduction Capacities" in collaboration with the United Nations Development Programme and established the Disaster Management Unit at the Presidency of the Council of Ministers. In addition, the government appointed a National Emergency Response Committee (NERC) Ministerial Decision 103/2010. NERC included members representing various concerned stakeholders including Ministries of National Defense, Interior and Municipalities, Public Health, Public Works and Transport, Telecommunications, Environment, Social Affairs, Energy and Water, Education and Higher Education, and Information as well as the Civil Defense and the Lebanese Red Cross. The objectives of the Committee were to develop a general framework for combating disasters, a detailed contingency plan to respond to threats from various types of disaster such as earthquakes, floods, forest-fires, landslides, weapons of mass destruction, wars, and radioactive threats, and an emergency management plan when a disaster occurs (MoE/UNDP/ECODIT, 2011). Since 2015, the DRM Unit has achieved the following milestones (DRM, 2020; Jurdi, 2021):

- Developed the National Disaster Risk Reduction (DRR) Strategy (the strategy is pending final approval and adoption by the Lebanese Government).
- Annually updated the disaster-information management system to support the strengthening of disaster risk modelling, assessment, mapping, monitoring, and multi-hazard early warning systems.
- Embedded disaster risk assessment as part of planning and governance to improve the understanding of disaster risk and building a safer and more sustainable future.
- Shifted focus from response to prevention and preparedness through several

## The effective implementation of the national disaster risk reduction strategy will enhance preparedness of future Climate disasters.

success models, such as flooding in Baalbek El Hermel.

→ Updated and enhancing early warning protocols and systems with success models in forest fires.

→ Supported 6 out of 8 Governorates in developing and implementing local DRR strategies.

As seen above in Section 1.2.2, the DRR unit has played an important and active role during the COVID-19 pandemic. In addition, the unit also had an instrumental role in Response to the Beirut Port Explosion, in:

→ Activating the National Operation Room and National Response.

→ Activating an EU mechanism for support reflecting on needed emergency response.

→ Coordinating shelter and evacuation with Field Agencies and Governorates (Created the temporary shelters dashboard).

→ Developing the early response plan based on five pillars: affected areas, humanitarian assistance, infrastructure, socio-economic support, and security.

→ Coordinating waste management and developing awareness materials on debris removal.

→ Issuing weekly situation reports.

→ Creating the hospitals needs and aid interactive dashboard.

The effective implementation of the national disaster risk reduction strategy will help improve the understanding of disaster risks, including natural disaster caused by climate change patterns. The strategy will strengthen the country's disaster risk governance to manage these disaster risk, allocate funds for disaster reduction for resilience, and enhance disaster preparedness for effective response and recovery. The health sector is the core of the response and recovery plan during climate change emergencies and thus will benefit from the strategy's implementation and enhance their resilience.

### 2.4. Donor-Funded Projects to enhance preparedness of the Health Sector

In addition to the above-mentioned strategies and plans, there are several donor-funded projects that aim to enhance environmental performance and energy efficiency of private establishments and public institutions in Lebanon. Some healthcare facilities have benefited from such projects and improved their climate resilience; mainly through enhancing their energy efficiency. Some of these projects include:

→ UNDP Country Energy Efficiency and Renewable Energy Demonstration (CEDRO) Project: The project, co-funded by the European Union, supports selected public buildings and facilities to install energy efficiency and renewable energy equipment, including in hospitals. CEDRO has provided large-scale solar water heaters for four public hospitals in 2019 and is currently implementing the Solar for Health Project with the European Union.

### Solar For Health project

The Solar for Health project was launched in 2021 to assist the public health-care sector (15 institutions) in freeing income for backstopping services in a budget-constrained environment, such as energy provision services, and provide more resilience and sustainability in the provision of healthcare.

The project, with the Support of UNDP-CEDRO and funded by the European Union, the initiative has already installed lighting retrofit solutions, solar water heating systems, PV systems, computerized maintenance and building management systems, and HVAC and chilled water retrofit systems in governmental hospitals across Lebanon that are tasked to deal with the COVID-19 pandemic. Throughout the different implemented interventions, the project's ensured the below outcomes:

- Provide hot water throughout the year by using solar energy to heat the water
- Ensure energy savings and reduce energy consumptions by installing energy-efficient LED lighting together with improvements to the quality and comfort levels at the hospitals
- Increase energy supply from renewable energy through the provision of PV systems
- Improve operation and maintenance practices by providing Computerized Maintenance Management Systems and Building Management Systems
- Improve the efficiency of the equipment regardless of power cuts

→ UNOPS, in coordination with Japan has provided solar power systems for two governmental hospitals in Lebanon (UN, 2022).

→ Lebanon Health Resilience Project in Collaboration with the World Bank and International Bank for Reconstruction and Development and implemented by the MoPH to increase access to quality healthcare services and strengthen the government capacity to respond to COVID-19.

→ Lebanese Center for Energy Conservation (LCEC) has provided solar water heaters for not-for-profit facilities, in coordination with the Ministry of Energy and Water, and supported several establishments including hospitals.

## 2.5. Gaps and Barriers to Healthcare Providers' Preparedness to Respond to Climate Change Crisis

Climate change related disasters have increased and are expected to increase further in intensity and frequency at an unprecedented rate. In addition, the burden of disasters falls disproportionately on low- and middle-income countries, where more than 80% of the disasters take place (UNDP, 2016). Many of these countries are challenged by limited resources and lack of proper infrastructure and healthcare system to cope with the impacts of the disaster (Al-Hajj et al., 2020).

In Lebanon, the same applies with several challenges and barriers hindering the preparedness of healthcare providers to handle climate change crises. Various past dramatic exposures in Lebanon, have amplified the country's vulnerabilities, and impacted its capacity to respond to emergencies. The country experienced a 16-year civil war and chronic political unrest which resulted in continuous government instability, man-made disasters, and complex emergencies.

The country is also burdened by poor infrastructure and under-resourced public services (Al-Hajj et al., 2020). These challenges exacerbate the government's

vulnerability to crises, including climate change risks. Moreover, the influx of more than a million refugees into the country has exerted further pressure on Lebanon's infrastructure and limited resources and has progressively aggravated Lebanon's humanitarian and disaster situations. The refugee crises in the Country, particularly, impacted the overburdened healthcare system and compromised the sector's capacity to cope with the rising emergency needs (Cherri et al., 2016).

Additionally, the Syrian crisis led to the mushrooming of several additional NGOs and donors, which in turn resulted in more fragmentation of the health system and overlap for patients and among healthcare providers (Blanchet et al., 2016; Hamadeh et al., 2019). In fact, over the years, the increasing number and variety of stakeholders involved in the provision of healthcare has shaped the complex and intermingled dimensions of the current health sector (Hamadeh et al., 2019). Hence, the health system has been weakened, fragmented, and left unregulated for several years due to various challenges and instabilities (El-Jardali et al., 2020).

Moreover, the health sector is severely underfunded, understaffed, and ill-equipped. Only 1.8% of the MoPH budget is allocated to public hospitals, while 80% is invested in private hospitals and pharmaceuticals. In addition, only 15% of hospital beds belong to the public health sector, while the rest (85%) to the private sector. As such, public sector services were rendered inefficient and insufficient due to underfunding and fragmented facilities and are mostly utilized by those who cannot access to privatized for-profit healthcare providers (Hamadeh et al., 2021). This reality left the MoPH with insufficient resources (human and financial), and marginal authority to guide and coordinate the public healthcare services in the country (Hamadeh et al., 2021). Additionally, the health information system is fragmented with sporadic response capacity. For instance, the epidemiological surveillance system does not include laboratories, public and private health facilities, and other relevant institutions. The health system also has limited capacity to collect, analyze and interpret health data to make informed strategic decisions, as well as there are gaps in data that are important to guide the decision-making process (for example utilization rates and response capacity of hospitals in specific geographical areas). Furthermore, the health sector in Lebanon is disconnected from other Ministries and Sectors, with high dependency on unregulated private sector in healthcare provisions, and financing. Overall, the privatization of healthcare and the absence of a legal mandate and supervisory authority to guide healthcare provision, have weakened the capacities of the health sector in Lebanon for years, implying that the sector would fall short of responding and recovering when faced with future climate change crises (Hamadeh et al., 2021).

Furthermore, the COVID-19 Pandemic, the unprecedented economic collapse, the political unrest and protests, and the Beirut Port Explosion are added challenges to be faced. These challenges further exacerbate the harsh reality of the capabilities and functionality of the health sector and would hinder the preparedness to climate change crises (DeJong, 2020; The Economist, 2020; Hamadeh et al., 2021). Overall, these challenges have:

- Reduced the health facilities' ability to import medical supplies, essential drugs, and equipment.
- Impacted access to basic services such as electricity and water due to increased cost and shortages in fuel.
- Reduced capacity of health facilities to operate at full capacity, limiting

**The privatization of healthcare and the absence of a legal mandate and supervisory authority have weakened the capacities of the health sector in Lebanon.**

the use of available resources for emergency cases, while delaying routine operations and elective surgeries.

- Reduced available funds at the Ministry of Finance which limited the funding for the sector.
- Increased costs incurred by Primary Healthcare Center due to devaluation of the Lebanese pounds and costs required to operate generators to compensate for persistent, and frequent electrical outages.
- Loss of human resources due to the immigration/drainage of qualified health professionals seeking better living conditions and career development opportunities.
- Increased losses due to the Beirut blast thus impacting the MoPH service capacity; 3 damaged hospitals, 12 PHCCs and main warehouses.

The National Disaster Risk Reduction Strategy (once adopted) can help boost the preparedness of healthcare facilities not only to disasters, but also to climate induced events. However, there are various factors that hinder the work of DRR strategies, the most important being the limited understanding and acknowledgment of the importance of integrating DRR measures into projects, plans and strategies, and in line with sustainable development goals. Still, additional challenges include (UNDP Lebanon, 2012; 2012a; 2014; 2017; Moghnieh et al., 2016; DRM, 2020, Jurdi, 2021):

- Political divisions, and the quota-based political system which have delayed the development of an integrated approach to disaster risk management.
- Lack of financial commitment from the government to support the implementation of DRR policies and to allocate funds for disaster risk management.
- Poor coordination during emergency responses between the different state sectors, ministries, and between the different regions (DRM can play a leading role).
- Minimal investments in prevention and mitigation measures are still minimal, with a focus on relief efforts; most resources are generally directed at relief, rehabilitation, and reconstruction activities rather than disaster risk prevention and reduction.
- Delays in legislating and approving the draft law on how to respond in disasters and conflicts.
- Unavailability and lack of data on available infrastructures, resources, and populations' mobility which is needed information to make informed decisions during emergencies.
- Lack of data analysis on previous and current crises impact and local response, and limited long-term risk assessment.
- Deficient information sharing and coordination for DRR remains a challenge among the ministries, civil society, healthcare centers, private sector, and international organizations.

# 3. RECOMMENDED ADAPTATION MEASURES TO RESPOND TO CLIMATE CHANGE RISKS AND ENSURE CONTINUITY OF CARE

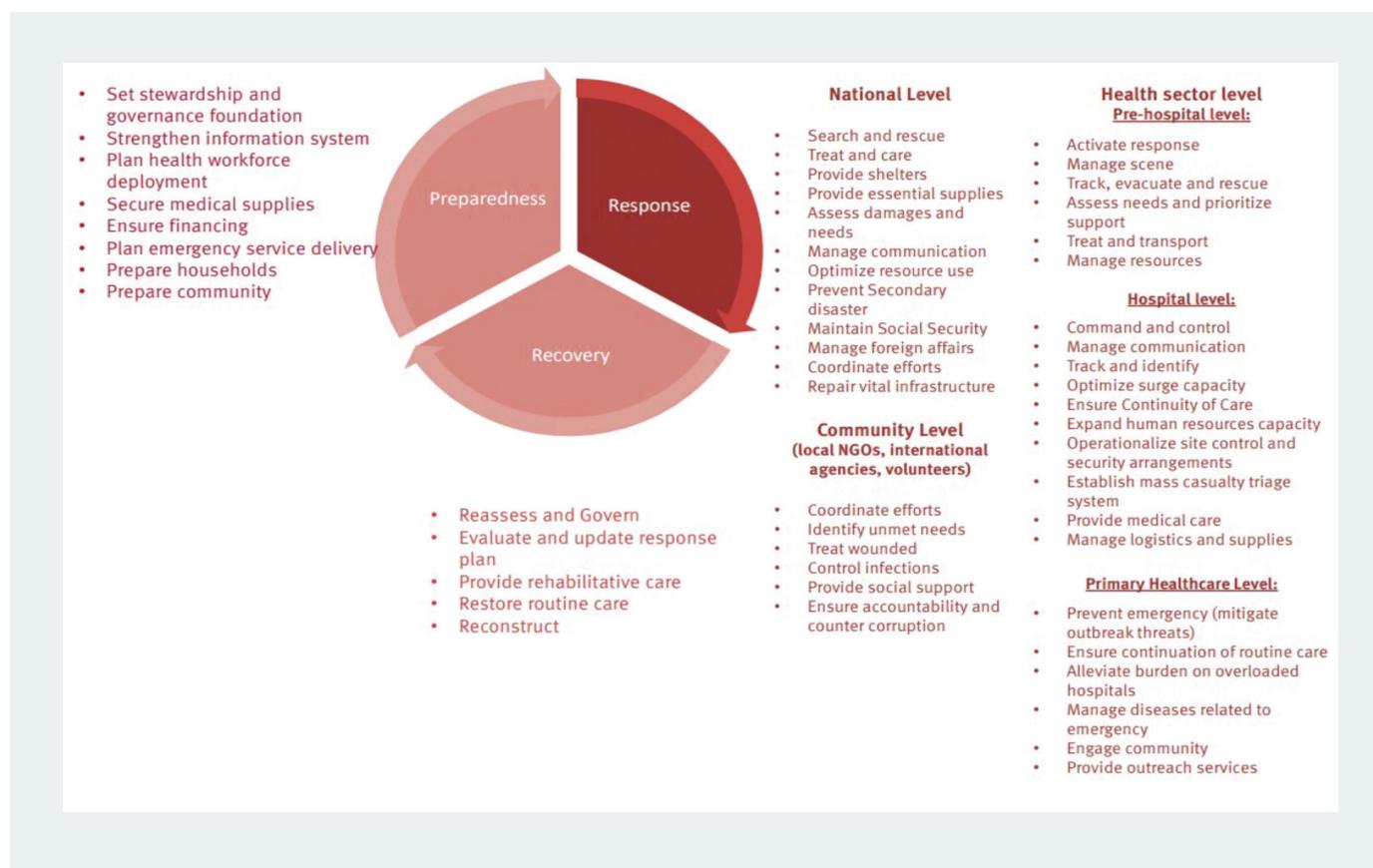
## 3.1. Revising and Updating Strategic Disaster Plans Based on Lessons Learned

As evident throughout this report, there is an urgent need for a strategic disaster plan that clearly outlines the appropriate actions required to efficiently respond in emergency situations, including climate-induced events. At the frontline of this plan, is boosting the role of healthcare systems in disaster plans as they play an important role in mitigating the impact of disasters. Adopting an effective national emergency preparedness plan is key to improve hospital preparedness. As such, based on COVID19 lessons learned, it is recommended to (El Jardali and Fadlallah, 2020):

- Re-assess and develop a comprehensive multi-sectoral emergency preparedness plan: all stakeholders involved in emergency response should reassess and update their emergency preparedness plans based on lessons learned from COVID-19 and the Beirut Port Explosion to address stewardship and governance, information management systems, human resources, medical products and supplies, financing through contingency fund, service delivery and community preparedness.
- Invest in public health sector infrastructure to strengthen the healthcare workforce, improve capacities of public health laboratories, and advance data collection and analysis capabilities.
- Reinforce the role and capacity of government to coordinate and regulate the health sector, to optimize the capacities and resources of state and non-state actors involved in the health sector.
- Redefine the relationship between private and public sector through regulatory frameworks and legislations to coordinate efforts in a way where resources and responsibilities, risks and costs are shared between both parties.
- Establish a human resource policy and plan for health sector to provide strategic direction for education, recruitment, retention, and capacity building of the healthcare workforce. In addition, plan for awareness and training activities on mainstreaming climate change adaptation into emergency response plans.

As such, a holistic response plan is required to enhance the country's adaptation to disasters, including climate change hazards as presented in Figure 14.

Figure 14 Disaster Response Framework Adopted from the European Commission Science Hub (European Commission, 2017)



### 3.2. Enhancing the Preparedness of Health Sector in Emergency Response

As presented in Figure 14, the health sector has a central role to play in any Emergency Response plan. In addition, the reliance of the Lebanese health system mainly on private hospitals calls for an integrated plan across all departments and regions to enhance communication and coordination between the hospitals and emergency medical service providers. Accordingly, the following adaptation measures and corresponding activities have been proposed by Bou-Karroum et al., as part of a Rapid Guide to Support Health & Social Care Systems in Response to Beirut Explosion and are presented in Table 22. Preparing health care systems to respond to emergencies in an efficient and coordinated manner increases the adaptive capacity of the system to plan and respond to potential climate-related events and disasters.

Table 22. Adaptation Measures to be addressed to Boost Preparedness of the Health Sector in Emergency Response (Adapted from Bou-Karroum et al., 2020)

Adaptation Measures	
<b>I. Prehospital Care: Emergency Medical Services:</b>	<ul style="list-style-type: none"> <li>→ Activation of emergency response and responding to calls at dispatch centers</li> <li>→ Scene management</li> <li>→ Tracking, evacuation, and rescuing</li> <li>→ Assessment and triage by medical providers</li> <li>→ Treatment</li> <li>→ Patient transport and handover to health facilities</li> <li>→ Communication</li> <li>→ Resources (manpower and logistics)</li> <li>→ Quality and governance</li> </ul>
<b>II. Hospitals:</b>	<ul style="list-style-type: none"> <li>→ Establishment of hospital incident command system</li> <li>→ Operationalization of site control and security arrangements</li> <li>→ Timely communication and exchange of information</li> <li>→ Establishment of mass casualty triage system with designated triage area</li> <li>→ Surge capacity</li> <li>→ Identification of alternative care sites</li> <li>→ Human resource management and protection</li> <li>→ Management of logistics, supplies and continuity of care</li> <li>→ Patient tracking and identification</li> <li>→ Hospital evacuation considerations</li> </ul>
<b>III. Primary Healthcare Centers:</b>	<ul style="list-style-type: none"> <li>→ Emergency prevention (mitigation of outbreak threats following a disaster)</li> <li>→ Continuation of routine health services</li> <li>→ Alleviation of burden on overloaded hospitals (hospital surge)</li> <li>→ Management of diseases related to health emergencies</li> <li>→ Community engagement</li> <li>→ Outreach activities</li> </ul>

### 3.3. Environmental Health Management in the Health Sector during Emergencies

Adaptation measures to enhance Environmental Health Management in the health sector during emergencies are also crucial to ensure full preparedness. The Arab Health and Environment Strategy 2017- 2030 was prepared in 2016 and endorsed by respective governments to assess environmental health risks and vulnerabilities, improve capacities to protect from and manage environmental health emergencies including climate change (WHO EMRO/Arab League/UNEP, 2016). Based on these directives, Lebanon prepared its own National Health and Strategic Framework 2021-2026, which proposes strategic initiatives for environmental health management in Emergencies (Table 23).

Table 23 Environmental Health Management in Emergencies under the National Strategic Framework of Action 2021-2026 (Adapted from Jurdi, 2022)

Strategic Response	Strategic Activity
<b>1. Developing the capacities of the health sector to manage environmental health services throughout the life cycle of emergencies</b>	1. Develop environmental health emergency profiles and establish/update environmental health plans for emergencies
	1a. Develop an environmental health interactive data program that will channel data and information across the health sector, and nationally for informed decision-making
	1b. Determine the vulnerability of basic environmental health services to emergencies (water, sanitation etc.)
	1c. Develop environmental health emergency profiles for all basic environmental health services including safety plans (based on 1b)
	1d. Continue efforts to enhance the Preparedness, Response, and Recovery from Disasters and Emergencies of all relevant bodies
	1e. Regularly update and restructure the Emergency Health Contingency Plan to synchronize with the national DRM Framework and relate to recovery operations
	1f. Develop (with the help of WHO) systems for the prediction and early warning
	1g. Develop rapid assessment tools needed to assess damages and plan and monitor recovery
<b>2. Providing adequate environmental health services in health care facilities during emergencies</b>	2. Operationalize policies, programs and management systems pertinent to environmental health services in health care facilities, including assessment, provision and restoration of services
	2a. Develop functional plans to implement the updated, restructured emergency health contingency plan once adopted
	2ai. Develop program for each Mohafaza and Caza in line with National Response Framework for each Region
	2b. Enhance the capabilities of the Early Warning and Response Network as part of the Disaster Risk Management Program
	2bi. Map the needs and communicate them to DRM
	2c. Establish a National Network of qualified Environmental Health Specialists who can be mobilized and deployed in a timely manner to support countries in need
	2d. Establish a National Medical Reserve Corp of public health professionals and nonpublic health backgrounds community volunteers to strengthen public health, improve emergency response capabilities, and build community resiliency
	2e. Establish/ Empower a national HAZMAT team first responder (Lebanese Army. Red cross, Civil defense) for CBRN (chemical, biological, radiological, and nuclear events)

Additionally, the national health and environment strategic framework recommends under priority 8 "Climate Change and Health", major strategic responses directed toward developing the preparedness and response capacity of the public health sector to manage the health effects of climate change. as presented in Table 24.

Table 24 Climate change and health measures under the National Strategic Framework of Action 2021-2026 (Adapted from Jurdi, 2022)

Strategic Response	Strategic Activity
<b>Developing the preparedness and response capacity of the public health sector to manage the health effects of climate change.</b>	<p>1a. Assess the vulnerability of public health sector to climate change, identify the current and future health effects and establish early warning systems</p> <ul style="list-style-type: none"> <li>- Conduct health vulnerability assessment of to identify the short, medium, and long-term additional direct and indirect threats to health from climate change</li> <li>- Build the capacity of health sector professionals (technical people, authorities and policy makers) in the identification of health impacts from other sectors (e.g., transport, energy, food, water, housing and urban development) that have bearings on health.</li> <li>- Map health resources available to cope with additional burden of climate change on health</li> <li>- Map and identify gaps that challenge health systems' preparedness to handle priority groups of diseases: water-borne diseases, food-borne disease, malnutrition associated with food insecurity, health effects of heat waves and extreme cold conditions, respiratory and other diseases associated with air pollution, vector-borne diseases and health effects of climate related disaster</li> <li>- Strengthen coordination with MoPH to ensure the sustainability of existing environmental health functions and services</li> <li>- Upgrade health system monitoring and coordinate the development of early warning on a specific set of indicators such as meteorological conditions, environmental determinants related to energy, emissions, pollution standards index (PSI), water security indicators, vector profile distribution and food security (e.g., Heat-Health action plans)</li> <li>- Upgrade health system monitoring and coordinate the development of early warning on a specific set of indicators such as meteorological conditions, environmental determinants related to energy, emissions, pollution standards index (PSI), water security indicators, vector profile distribution and food security (e.g., Heat-Health action plans)</li> <li>- Develop a mechanism to incorporate climate data in the national health information system</li> <li>- Raise awareness on the health effects of climate change (starting with the accredited health care facilities) through organizing awareness events and training health care practitioners</li> <li>- Develop and rollout public awareness campaigns on climate change and health impacts and protection measures (e.g., health risks of high temperatures and appropriate responses including, improved ventilation and avoidance behavior)</li> </ul>
	<p>1b. Develop a clearly documented mechanism for mainstreaming of climate change response into all national and subnational planning regimes, to ensure that policies, strategies, legislation, regulations and plans include climate change considerations.</p>

# 4. CONCLUSION

The response to COVID-19 Pandemic and the August 4<sup>th</sup> Beirut Port Explosion should be considered as “test case studies” to determine the resilience of Lebanon’s Health care system to emergencies including climate-related events, and consequently, direct national policies and strategies of emergency preparedness, response, and recovery.

Moreover, as the COVID-19 pandemic has reshaped the world, amplified gaps of the health systems and aggravated existing inequalities, climate change will continue to threaten the ability of health systems to protect and improve population health and wellbeing.

As such, Chapter 3 will propose priority adaptation measures to build climate-resilience in health care service providers so that they will be able to anticipate, respond to, cope with, recover from and adapt to climate-related shocks and stress. Chapter 3 will be based on results of Chapter 1- the vulnerability assessment, and Chapter 2 - the assessment of the adaptive capacity of health care facilities.

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# CHAPTER 3

## ROADMAP TO CLIMATE RESILIENCE OF HEALTHCARE FACILITIES

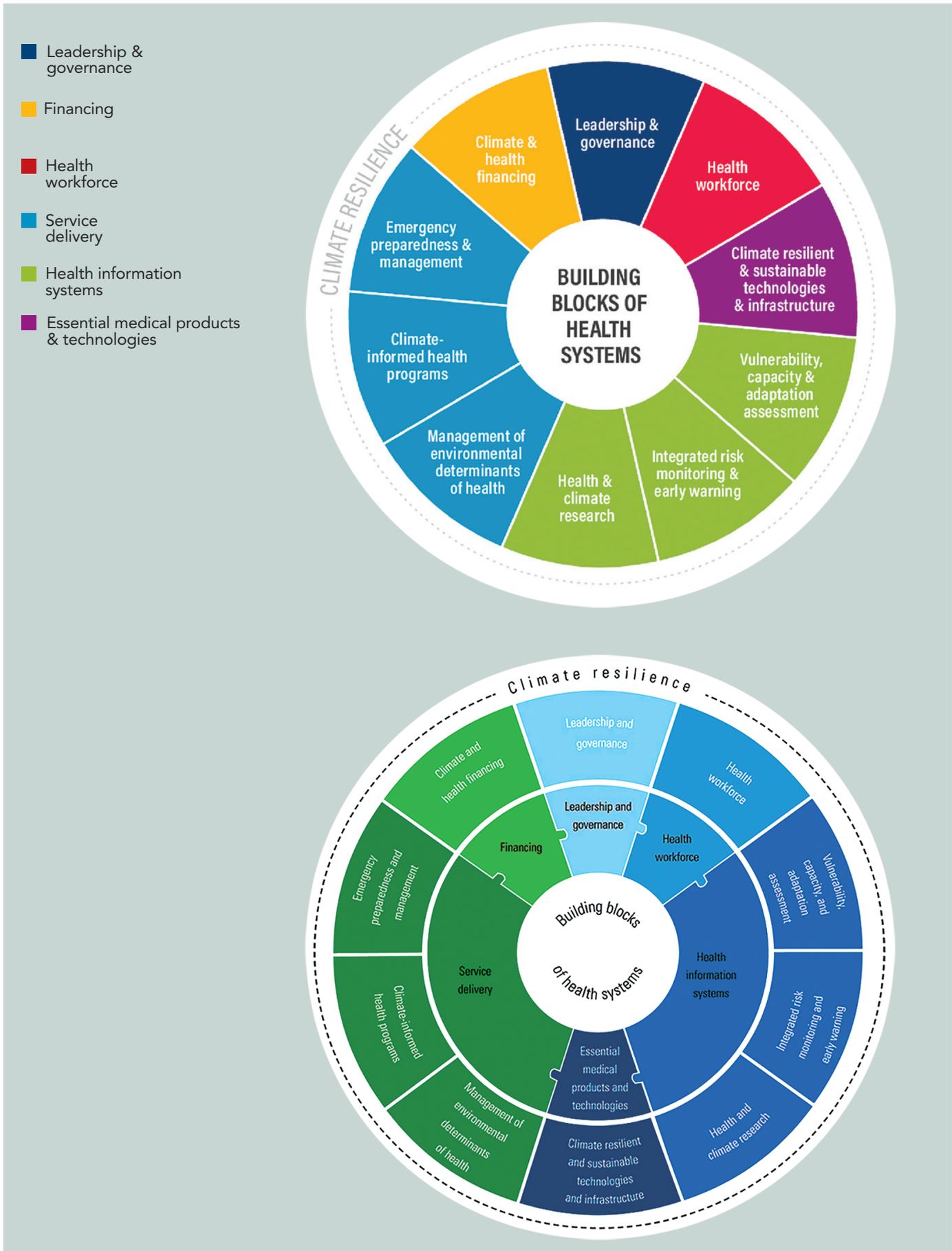
# 1. HEALTHCARE FACILITIES' RISKS TO CLIMATE CHANGE

Risks to healthcare systems and facilities, including hospitals and Primary Health Care Centers (PHCC), are increasing as the climate continues to change, limiting healthcare providers' ability to protect people from a variety of climate hazards. Healthcare facilities are the first and last line of defense against climate change. As such, building the adaptation and resilience of healthcare facilities is the first step in responding to climate change hazards (WHO, 2015; WHO 2020).

According to WHO (2020), as detailed in chapters 1 and 2, climate resilience and environmental sustainability of healthcare facilities requires four fundamental pillars (Figure 15):

- 1. Health Workforce:** the provision of adequate number of skilled workers with decent working conditions, who are informed and able to respond to environmental challenges.
- 2. Water, Sanitation, Hygiene and Healthcare Waste Management:** the sustainable and safe management of such services.
- 3. Energy:** the provision of sustainable energy services.
- 4. Infrastructure, Technologies, and Products:** the provision of appropriate infrastructure, technologies, products, and processes for efficient functioning of healthcare facilities.

Figure 15 Pillars of Climate Resilience and Environmental Sustainability of Healthcare Facilities (WHO, 2020)



## 1.1. Environmental Health Aspects of Healthcare Facilities

Before discussing the impacts of climate change on healthcare facilities and services, below are the major environmental health challenges of concern to healthcare facilities, mostly in developing countries as they relate to:

- **Quality of water and sanitation services:** most of healthcare facilities located in developing countries including Lebanon still lack access to adequate safe water supply and proper wastewater management; these deficiencies are exacerbated in drought-prone areas due to climate change. These service provisions are primitive to provide quality healthcare services (from hand hygiene, drinking and cooking, showering, and bathing, to a variety of general and specialized medical procedures, such as dialysis that would require specified water quality beyond the safety of the public water supply). As for the management of wastewater, onsite pre-treatment may be required to manage certain chemical and organic loads in the wastewater effluent.
- **Air pollution:** healthcare facilities contribute to ambient air pollution through on-site fossil fuel energy combustion, generation of medical and hazardous waste that require incineration and procurement of goods produced and transported using fossil fuels. Facility vehicle fleets, as well as patient and staff transport systems also contribute to air quality degradation.
- **Management of chemicals:** Chemicals are omnipresent in healthcare facilities; used for various applications from simple disinfectants for cleaning and sterilization to chemotherapy for cancer treatment. It is critical to (a) identify chemicals in use, (b) determine the potential exposure and related environmental health risks in health care facilities, and (c) recommend interventions to protect the health of patient, the health workforce, and surrounding communities (WHO, 2016; WHO, 2017; WHO, 2020).
- **Management of healthcare waste:** the improper management of healthcare waste exposes over half of the world's population to the risks of environmental, occupational, and public health hazards. Improper healthcare waste management is mainly due to the lack of appropriate regulations or the absence of enforcement of existing regulations, lack of infrastructure or energy systems, lack of awareness on health hazards related to healthcare waste, and inadequate training. For example, inadequate incineration, inappropriate incinerator technology, or the incineration of unsuitable materials would result in GHG emissions.
- **Management of radiation:** overall, direct patient exposure to ionizing radiation during medical procedures constitutes the largest anthropogenic source of population radiation exposure. Annually worldwide, more than 3,600 million radiography examinations, 37 Million nuclear medicine procedures, and 7.5 Million radiotherapy procedures are done (WHO, 2022). It is further estimated that around 7 million health workers are exposed to radiation due to their professional activities. And although, new health technologies are being introduced, and applications and equipment are improving the safety and efficacy of procedures, the inappropriate/poor handling of these technologies remains a major challenge.
- **Food and management of food waste:** Healthcare facilities are major consumers of food and should accordingly, model and promote health and sustainability

through their food choices. A growing number of health care facilities in high income and low- and middle-income countries that purchase and serve food to patients and workers are reducing their environmental footprint and improving the management of food waste by composting. Moreover, facilities promote sustainability by holding farmers' markets for local producers to sell healthy food to the community leading to community resilience.

## 1.2. Impacts of Healthcare Facilities on and from Climate Change

Climate threats are particularly disruptive to individuals and communities when they affect healthcare facilities. As discussed in Chapter 1, the expected health impacts of climate change and the risks to healthcare facilities result from direct effects or are mediated either through natural or human systems.

In terms of physical and operational capacity, health care facilities are facing challenges in coping with climate-related risks, such as droughts, extreme temperatures, fires and changed patterns of climate-sensitive diseases. The increased intensity and frequency of natural hazards can affect the functioning of healthcare facilities, and result in increased demand for services. As such, climate change can affect the delivery of healthcare services in large hospitals and small facilities, in high- and low-income settings alike. In addition, environmental aspects of concerns of healthcare facilities can be exacerbated by climate change hazards by impacting healthcare facilities' infrastructure, support systems, supply chains and workforce. Table 25 summarizes the consequences of climate change hazards on health and healthcare facilities.

On the other hand, the healthcare sector is responsible for about 5% of global greenhouse gas emissions, and projections indicate that under a 'business as usual' scenario, the emissions from healthcare facilities could triple by 2050. And, with the projected increase in the burden of disease from climate change, the demand for healthcare facilities will increase worldwide; leading to further increase in the emissions generated from the health sector (The Health Policy Partnership, 2022). Health care facilities contribute to climate change mostly through generating GHG emissions which can be under direct control of the healthcare facility (such as fleet vehicles) or derived from electricity production and use at the facility, in addition to indirect emissions from supply chains - production, transport and disposal of medications, food, medical devices, and hospital equipment. (WHO, 2020).

Therefore, it is becoming a necessity for healthcare facilities to incorporate low carbon and climate resilience plans into their long-term strategies. The goal is not only to improve the preparedness and adaptation of healthcare facilities to climate change crises and to protect the health of the population during emergencies, but also to build environmentally sustainable health facilities. These facilities would improve, maintain, or restore health, while minimizing the negative impacts on the environment, and leveraging opportunities to restore and improve it (WHO Europe, 2017).

A minimum requirement for climate resilient healthcare facilities while ensuring safe and quality care is the access to reliable sources of energy and safe water; yet many health care facilities lack even these basic resources. Environmental sustainability, from this perspective, means implementing interventions that optimize the consumption

of resources (such as water, energy, food), and reduce waste generation (including biological, chemical, radiological and wastewater). It also includes procuring goods and services that follow the principles of environmental sustainability. Importantly, the performance and functionality of sustainability measures should be evaluated, as maintaining good quality of care should be the most important criteria. Therefore, more sustainable goods, materials and services should be considered when they do not compromise health care provision, and do not adversely affect the health and safety of healthcare workers (WHO Europe, 2017; WHO, 2020). Table 26 lists examples of potential impacts of unsustainable environmental practices of health care facilities on patients, health workforce, and the surrounding communities.

In addition, striving to net zero health services can not only reduce the carbon footprint of health systems but also protect and improve the health of people globally. "Health care is a significant contributor of environmental pollution, which goes against 'first, do no harm,'" we need to figure out how to make health care safe for planetary health as well as patient health (Yale School of Medicine, 2021). For example in 2020, England became the world's first National Health Service to announce a plan to become a net-zero health system. The plan aims to decarbonize care in several ways such as constructing net-zero hospitals, acquiring zero-emission vehicles, installing LED light bulbs, and optimizing localized provision of care (e.g. moving care closer to home, reducing hospital visits and travel emissions) (Smith, 2022).

Building climate resilient and environmentally sustainable healthcare facilities would contribute to achieving SDGs related to SDG 3 (Good Health and Wellbeing); SDG 6 (Clean Water and Sanitation); SDG 7 (Affordable and Clean Energy); SDG 8 (Decent Work and Economic growth); SDG 9 (Industry Innovation and Infrastructure) and SDG 13 (Climate Action). Table 27 presents selected SDGs and Targets with Implication for health Care facilities. Overall, it is a win/win situation to sustainably reduce environmental impacts of healthcare facilities and related consequences.

Table 25 Climate Change Effects, Health Risks, and Consequences on Healthcare Facilities (WHO, 2020)

Climate Change Effects	Health Risks	Health related Impacts (IPCC rating)	Consequences for Healthcare Facilities
<ul style="list-style-type: none"> <li>→ Increased number of warm days and nights; increased frequency and intensity of heat waves</li> <li>→ Increased fire risk in low rainfall conditions</li> </ul>	<ul style="list-style-type: none"> <li>• Excess heat-related mortality; increased incidence of heat exhaustion and heat stroke; exacerbated circulatory, cardiovascular, respiratory and kidney diseases</li> <li>• Increased premature mortality related to ozone and air pollution produced by fires, particularly during heat waves</li> </ul>	<ul style="list-style-type: none"> <li>❖ Greater likelihood of injury, disease, and death due to more intense heat waves and fires (Very high)</li> </ul>	<ul style="list-style-type: none"> <li>→ Infrastructure damage; increase in energy and water usage; threats to patients from heat and air pollution</li> <li>→ Sudden increase in community cases of heat stroke, asthma and other respiratory diseases overwhelming the facility's capacity</li> <li>→ Mental health impacts on facility staff</li> </ul>

<p>→ Higher temperatures and humidity; changing and increasingly variable precipitation</p> <p>→ Higher sea surface and freshwater temperatures</p>	<ul style="list-style-type: none"> <li>• Accelerated microbial growth, survival, persistence, and transmission</li> <li>• Shifting geographic and seasonal distribution of diseases (such as cholera, schistosomiasis)</li> <li>• Ecological changes, droughts and warmer temperatures leading to cyanobacterial blooms, pathogen multiplication</li> <li>• Extreme events leading to disruption of water</li> <li>• Supply system and contamination</li> <li>• Insufficient or intermittent water access for health care practices</li> <li>• Insufficient quality and quantity of water leading to poor hygiene</li> <li>• Flood damage to water and sanitation</li> <li>• Infrastructures</li> <li>• Contamination of water sources through overflow</li> </ul>	<p>❖ Increased risks of food- and waterborne diseases (Very high)</p>	<p>→ Unexpected outbreaks of food- and water-borne diseases, heat stroke, lack of water or contaminated water in facilities</p> <p>→ Disrupted supply chain for essential supplies and medicines</p> <p>→ Issue of boil water advisories; Disruption of food supplies</p> <p>→ Damage to medical equipment</p>
<p>→ Higher temperatures and humidity</p> <p>→ Changing and increasingly variable precipitation</p>	<ul style="list-style-type: none"> <li>• Accelerated parasite replication and increased biting rates</li> <li>• Prolonged transmission seasons</li> <li>• Re-emergence of formerly prevalent diseases</li> <li>• Changing distribution and abundance of disease vectors</li> <li>• Reduced effectiveness of vector control interventions.</li> </ul>	<p>❖ Increased risks of vector-borne diseases (Medium)</p>	<p>→ Unexpected outbreaks of vector-borne diseases overwhelming response capacity</p> <p>→ Need for increased surveillance of climate sensitive diseases</p>
<p>→ Higher temperatures and changes in precipitation</p>	<ul style="list-style-type: none"> <li>• Lower food production in the tropics</li> <li>• Lower access to food due to reduced supply and higher prices</li> <li>• Combined effects of undernutrition and infectious diseases</li> <li>• Chronic effects of stunting and wasting in children.</li> </ul>	<p>→ Increased likelihood of undernutrition resulting from diminished food production in poor regions (High)</p>	<p>→ Increased number of patients (particularly children) with diseases related to, or made worse by, undernutrition</p>

Table 26 Examples of Potential Impacts Associated with Unsustainable Environmental Practices of Healthcare Facilities (Adapted from WHO, 2020)

Environmental Sustainability Concerns from HCF Operations	Health Risks to Patients/Workforce/ Wider Community	Health Impacts to Patients/Health Care Workforce/Wider Community	Consequences for Healthcare Facilities (Impacted Areas)
<b>Water</b>	<ul style="list-style-type: none"> <li>• Excess water withdrawals → water shortages</li> <li>• Water inefficiency (broken pipes and plumbing) → water shortages</li> <li>• Lack of rainwater harvesting, where its available/feasible</li> <li>• Improper water storage → increased Vector breeding sites</li> <li>• Potential concentration of pathogens, nutrients/chemicals in water sources</li> </ul>	<ul style="list-style-type: none"> <li>→ Exposure to infectious disease agents</li> <li>→ Increased risks of water- vector borne diseases through reduced water access and untreated wastewater reuse for food production</li> <li>→ Increased likelihood of impacts from concentration of arsenic iron, manganese, fluorides, phosphorus</li> <li>→ Increased risk of liver damage, neurotoxicity, risk of cancer, cardiovascular disease</li> </ul>	<ul style="list-style-type: none"> <li>→ Declining water supply reduces function of water-dependent sanitation systems and hygiene practices (flush toilets, sewerage, treatment, hand washing, medical procedures)</li> <li>→ Unexpected outbreaks of food- vector- and water-borne diseases</li> <li>→ Disrupted medical procedures and treatments</li> <li>→ Increased likelihood of hospital admissions and complex treatment for liver damage, neurotoxicity, cancer</li> </ul> <p><b>Impacted Areas:</b> health workforce; water, sanitation and health care waste</p>
<b>Sanitation</b>	<ul style="list-style-type: none"> <li>• Insufficient numbers and/or unsanitary toilets</li> <li>• Damaged and unrepaired sewers resulting in overflow during storms and floods</li> <li>• Insufficient cleaning, laundry, and sterilization practices</li> </ul>	<ul style="list-style-type: none"> <li>→ Increased risk of diseases from exposure to pathogens and hazardous substances through increased environmental contamination and unhygienic practices</li> </ul>	<ul style="list-style-type: none"> <li>→ Additional risks to health care workers depending on their work context and level of adopted occupational health and safety measures</li> <li>→ Unexpected outbreaks of infectious diseases</li> </ul> <p><b>Impacted Areas:</b> health workforce; water, sanitation and health care waste</p>
<b>Health Care Waste (HCW); Chemical and radiological Hazards</b>	<ul style="list-style-type: none"> <li>• Untreated / insufficiently treated HCW in or near the facility.</li> <li>• Exposure to multiple hazardous chemicals (pesticides, lead, mercury, silver, cleaning products), and pharmaceuticals</li> <li>• Accidents from improper handling and disposal of radioactive wastes</li> <li>• Waste anesthetic gases and refrigerants</li> </ul>	<ul style="list-style-type: none"> <li>→ Exposure to hazardous waste (biological, chemical, radiological)</li> <li>→ Physical injuries (chemical burns), increased non-communicable diseases (respiratory, dermal)</li> <li>→ Increased risk of intoxication from absorption, inhalation, or ingestion of chemicals</li> </ul>	<ul style="list-style-type: none"> <li>→ Increased infectious disease cases from HCW contamination</li> <li>→ Increased threat to the health workforce resulting in infectious diseases, physical injuries, intoxications, and reproductive problems, leading to psychological stress</li> </ul> <p>technologies, and products</p>

	<ul style="list-style-type: none"> <li>• Untreated wastewater used for agricultural irrigation</li> <li>• Environmental pollution from waste dumping</li> <li>• Production of dioxins and furans from open burning and low temperature incineration</li> </ul>	<ul style="list-style-type: none"> <li>→ Radioactive poisoning, injuries with tissue damage, and DNA damage</li> <li>→ Increased risk of absorption, inhalation, ingestion, or injection of pathogens resulting in infectious diseases (tuberculosis, HIV/AIDS, hepatitis, SARS)</li> </ul>	<ul style="list-style-type: none"> <li>→ Long-term impacts related to non-communicable diseases (cancers, respiratory diseases)</li> <li>→ Increased admissions for complex treatments</li> <li>→ Increased workforce absenteeism</li> </ul> <p><b>Impacted Areas:</b> health workforce; infrastructure,</p>
<b>Energy</b>	<ul style="list-style-type: none"> <li>• Fossil fuel-based energy leading to air pollution and GHG emissions from transport, medical waste incineration, heating spaces and other equipment and operation processes powered by fossil fuels</li> <li>• Insufficient or intermittent access to electricity leading to malfunction or failure of medical equipment and devices (refrigeration of vaccines and some medications, sterilization processes, diagnosis, and therapy equipment)</li> </ul>	<ul style="list-style-type: none"> <li>→ Increased health impacts of air pollution on the health workforce, patients and visitors including respiratory and cardiovascular diseases</li> <li>→ Increased risk of infectious diseases and deaths due to lack of power for medical electrical equipment and devices</li> </ul>	<ul style="list-style-type: none"> <li>→ Increase in respiratory disease in patients, communities, or staff, overwhelming the facility's capacity</li> <li>→ Long-term impact to staff (cardiovascular diseases, cancers); increased threat to the health workforce and patients from infectious diseases</li> </ul> <p><b>Impacted Areas:</b> health workforce; energy</p>
<b>Procurement and Supply Chain</b>	<ul style="list-style-type: none"> <li>• Inadequate, unsafe and unsustainable procurement (Mercury containing medical equipment and devices, lack of energy efficient technologies and renewable energy production, steam equipment, mechanical equipment, refrigerants, transportation, chemical and radioactive products, pharmaceuticals, food, building materials) leading to hazardous waste disposal, air pollution and GHG emissions</li> <li>• Unsustainable supply chain products and services leading to air pollution, soil, and water, and possibly food contamination</li> <li>• Unsafe storage of products</li> </ul>	<ul style="list-style-type: none"> <li>→ Increased health impacts of air pollution on staff, patients and visitors including respiratory and cardiovascular diseases</li> <li>→ Increased water- and food-borne diseases from contaminated products</li> <li>→ Increased risk to human health from biological, chemical, radiological hazards, causing chemical intoxication, infectious diseases, cancers, cardiovascular diseases, and respiratory diseases</li> </ul>	<ul style="list-style-type: none"> <li>→ Increased likelihood of intoxication, infectious diseases, cancers, acute and chronic respiratory diseases, cardiovascular diseases overwhelming the health system and increasing medical expenses</li> </ul> <p><b>Impacted Areas:</b> health workforce; infrastructure, technologies, and products</p>

Table 27 Selected SDGs and Targets with Implication for Healthcare Facilities (Adapted from WHO, 2020)

SDG	Selective SDG Targets	Relevance to Healthcare Facilities Fundamental Areas
<b>SDG 3. Ensure healthy lives and promote well-being for all at all ages</b>	3.8 Achieve universal health coverage, including financial risk protection, access to quality essential health-care services and access to safe, effective, quality, and affordable essential medicines and vaccines for all	Access to healthcare facilities

	3.9 By 2030, substantially reduce the number of deaths and illnesses from hazardous chemicals and air, water and soil pollution and contamination	Water, sanitation, and healthcare waste; chemicals management, energy
<b>SDG 6.</b> Ensure availability and Sustainable management of water and sanitation for all	6.1 By 2030, achieve universal and equitable access to safe and affordable drinking water for all	Water, sanitation, and healthcare waste
	6.3 By 2030, improve water quality by reducing pollution, eliminating dumping, and minimizing release of hazardous chemicals and materials, halving the proportion of untreated wastewater and substantially increasing recycling and safe reuse globally	Water, sanitation, and healthcare waste; chemicals management
	6.4 By 2030, substantially increase water-use efficiency across all sectors and ensure sustainable withdrawals and supply of freshwater to address water scarcity and substantially reduce the number of people suffering from water scarcity	Water, sanitation, and healthcare waste
<b>SDG 7.</b> Ensure access to affordable, reliable, sustainable and modern energy for all	7.1 By 2030, ensure universal access to affordable, reliable, and modern energy services	Energy
	7.2 By 2030, increase substantially the share of renewable energy in the global energy mix	Energy
	7.3 By 2030, double the global rate of improvement in energy efficiency	Energy
<b>SDG 8.</b> Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all	8.8 Protect labor rights and promote safe and secure working environments for all workers, including migrant workers, in particular women migrants, and those in precarious employment	Health Workforce
<b>SDG 9</b> Build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation	9.4 By 2030, upgrade infrastructure and retrofit industries to make them sustainable, with increased resource-use efficiency and greater adoption of clean and environmentally sound technologies and industrial processes, with all countries acting in accordance with their respective capabilities	Infrastructure, technologies and products; chemicals management; energy
<b>SDG 12.</b> Ensure sustainable consumption and production patterns	12.4 By 2020, achieve the environmentally sound management of chemicals and all wastes throughout their life cycle, in accordance with agreed international frameworks, and significantly reduce their release to air, water and soil in order to minimize their adverse impacts on human health and the environment	Water, sanitation and healthcare waste; chemicals management
	12.5 By 2030, substantially reduce waste generation through prevention, reduction, recycling, and reuse	Water, sanitation, and healthcare waste; chemicals management
	12.7 Promote public procurement practices that are sustainable, in accordance with national policies and priorities	Infrastructure, technologies and products
<b>SDG 13.</b> Take urgent action to combat climate change and its impacts	13.1 Strengthen resilience and adaptive capacity to climate-related hazards and natural disasters in all countries	Health workforce. infrastructure, technologies and products Health workforce
	13.2 Integrate climate change measures into national policies, strategies and planning	Infrastructure, technologies and products
	13.3 Improve education, awareness-raising and human and institutional capacity on climate change mitigation, adaptation, impact reduction and early warning	Health workforce

# 2. ROADMAP TO CLIMATE RESILIENCE OF HEALTHCARE FACILITIES

Building climate resilience of healthcare facilities is crucial to make them anticipate, respond to, cope with, recover from and adapt to climate-related hazards, and associated extreme weather events. Figure 16 illustrates how climate change hazards (whether a sudden disaster or slow-onset hazard) can affect key facility elements leading to a reduction in the healthcare facilities' level of performance and capacity. The level of vulnerability of the healthcare facility determines the level of risk of the hazard, and the healthcare facilities' level of resilience defines its ability to recover either to its pre-event state, to a state worse than the pre-event state, or fully recover and attain an enhanced level of climate resilience (Corvalan, et.al, 2020; WHO, 2020).

Figure 16 Dynamics of Climate Resilience of Healthcare Facilities (Corvalan, et.al, 2020; WHO, 2020)

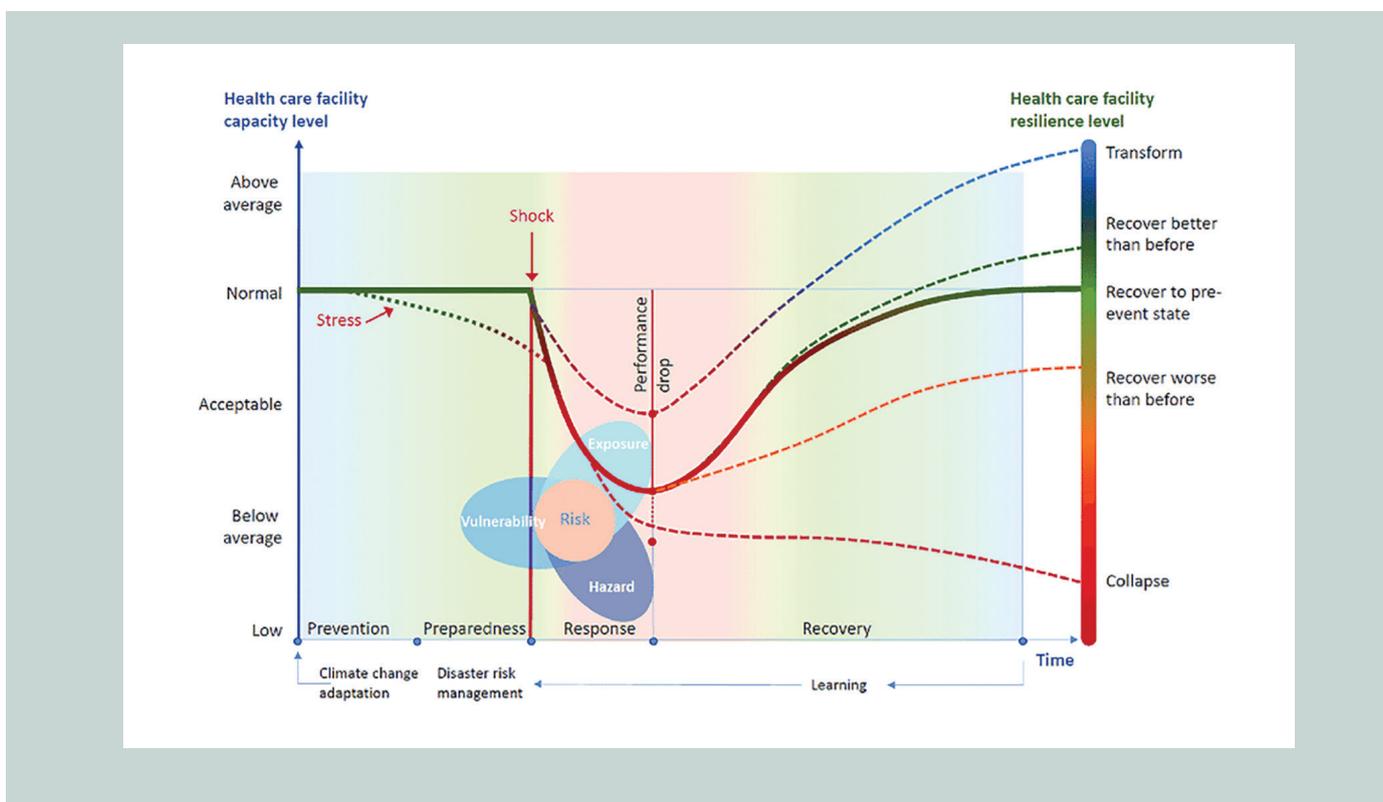
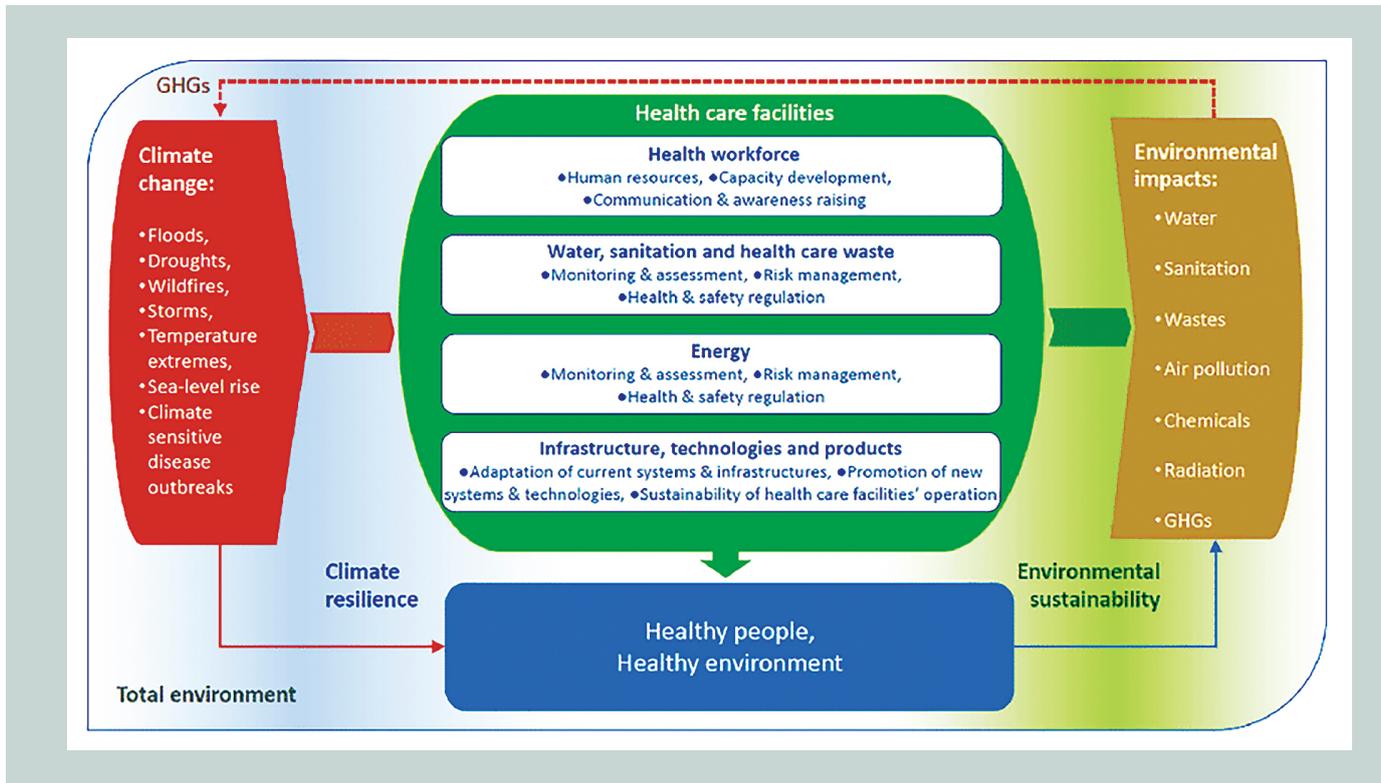


Figure 16 further highlights the importance of the risk management approach reflected in prevention, preparedness, response, and management. Hence, the WHO proposed framework to building resilience of the health care facilities as presented in Figure 17. So, the aim is to increase the climate resilience of healthcare facilities to protect and improve the health of their communities under unstable climate.

Figure 17 Framework for Building Climate Resilient Healthcare Facilities (WHO, 2020)



Moreover, this framework as presented in the figure 3, lays the roadmap to decreasing vulnerability of healthcare facilities through 1) climate change preparedness, 2) response and recovery and 3) climate mitigation.

## 2.1. Climate Change Preparedness

The first step to climate change adaptation of the healthcare facilities is determining the baseline, i.e., determining the current condition of climate change resilience through assessing the facilities' vulnerability to climate change hazards (WHO, 2020).

As previously evaluated in chapter 1, in general, the level of preparedness of Lebanese healthcare facilities is low and what has been achieved, to date, to improve the preparedness is relatively minimal. The analysis shows evidently that the compliance in addressing the four key vulnerability areas of health workforce, WASH and healthcare management, energy management, and infrastructure, technologies, products and processes is relatively minimal, even if the healthcare facilities are accredited by one or more accreditation and /or certification programs. Further, the assessment shows that the Primary Care Standards 2015, the Hospital Accreditation Standard 2019 and the JCI Standard do address all the identified vulnerability areas, although partially. Still, on a positive note, having structured management systems that are accredited and accordingly, sustained can help in the integration of the needed preparedness to enhance the response of the health care sector in Lebanon, and reduce its vulnerability. Thus, integrating the WHO checklist for climate change vulnerability in the accreditation standards and certification systems is essential to improve and ensure the preparedness and accordingly the response of the healthcare facilities to climate change hazards and crises (WHO, 2021).

## Acquiring accreditation and securing support by International NGOs is significantly associated with the provision of a better health workforce and infrastructure.

Still, for Primary Health Care Facilities (PHCC), one major limitation is the accreditation coverage: A minimal percentage of PHCCs not exceeding 8% (17 PHCCs) are accredited to date in Lebanon. So, introducing measures to reduce vulnerability to climate change would be completely challenged by sustainability of such interventions. Further, not all PHCCs of this important network cover all types of services specified by the “Lebanon Primary Health Care Standards 2015”. Moreover, centers are not evenly distributed throughout the country: Mount Lebanon has the largest number of PHCCs (n = 55, 25.9%) Beirut has the lowest (n = 14, 6.6%), and in the more vulnerable spots such as Baalbeck and Akkar Cazas, the coverage is still low (8.5% and 10.4%, respectively). So, it is critical to increase the geographical coverage of PHCCs to respond to heat stress, waterborne diseases and injuries caused by climate-induced events in these vulnerable areas.

Moreover, major deficiencies in fulfilling health workforce and infrastructure requirements, among non-accredited centers has been documented. Acquiring accreditation and securing support by International NGOs is significantly associated with the provision of a better health workforce and infrastructure (Hamadeh et al, 2020). As such moving with accreditation and integrating the basic requirements for (a) health workforce (human resources, capacity development and communication and awareness raising), (b) WASH and HCW management (monitoring and assessment, risk management and health safety regulations), (c) energy management (monitoring and assessment, risk management and health safety regulations), and (d) infrastructure, technologies, products and processes (adaptation of current systems and infrastructures, promotion of new systems and technologies, and sustainability of health care facility operation), is a must.

A plan of action, based on a modified checklist to enhance the preparedness can be developed to address direct, intermediate and long-term interventions based on the identified basic gaps. This is crucial to increase the resilience of healthcare centers to climate change crises and to capitalize more on their role to:

- (a) provide primary prevention interventions (such as WASH services or vaccination programs) and surveillance systems for rapid detection of disease outbreak following a disaster,
- (b) understand health needs and identify vulnerable groups in disaster-affected communities,
- (c) alleviate burden on overloaded hospitals through acting as a community-level triage system, where patients with minor illnesses are treated and those with serious injuries are referred to hospitals,
- (d) manage diseases related to health emergencies, including mental health, chronic disease interventions, food- and water-borne disease, etc.,
- (e) promote community engagement by effectively communicate risks and share timely information,
- (f) provide outreach services mobile clinic services to provide non-communicable disease interventions, mental health services and other primary healthcare services to vulnerable and disadvantaged populations (Bou-Karroum et al., 2020; WHO, 2018).

For hospitals, the setting is also complex as 69 % of the private and public hospitals are only accredited without reservation. In addition, the follow-up on introducing and implementing the Revised National Hospital Accreditation Standard 2019 is challenged by the “survival mode” under the current socio-economic crises. To add

to this, the major problem is with governmental hospitals where the percentages accredited without reservation, with minor reservations, and with major reservation do not exceed, for each entity, the 10% in comparison to around 85% of private hospitals accredited without reservations. Additionally, numerous private hospitals in Lebanon have acquired the Joint Commission International (JCI) Accreditation. As such, and since the Hospital Accreditation 2019 and the JCI Standards, address all the identified vulnerability areas even though at a basic level, a complementary modified checklist to enhance the preparedness should be annexed to these 2 sets of standards. On the other hand, for governmental hospitals, a plan of action based on a modified climate change vulnerability checklist can be developed to address direct, intermediate, and long-term interventions centered on the basic identified gaps. This action plan should complement effort to enhance accreditation.

### **Summary recommendations for increasing climate change preparedness**

1. Determining the baseline of climate change resilience through assessing the facilities' vulnerability to climate change hazards
2. Integrating the WHO checklist for climate change vulnerability in the accreditation standards and certification systems
3. Increasing the geographical coverage of PHCCs to respond to impacts of climate-induced events in vulnerable areas
4. Acquiring accreditation integrating the basic requirements for health workforce, WASH, waste/ energy management and infrastructure technologies
5. Securing support by international NGOs to improve the provision of a better health workforce and infrastructure.
6. Annexing a complementary modified checklist to the Joint Commission International (JCI) Accreditation and the Hospital Accreditation 2019 Standards to enhance the preparedness of hospitals
7. Develop a plan of action for governmental hospitals, based on a modified climate change vulnerability checklist to address direct, intermediate, and long-term interventions

Based on the vulnerability assessment, two types of interventions are recommended: Direct interventions, at the micro level, that aim to develop set procedures for healthcare facilities for continually implement and evaluate risk management programs and Indirect, at the macro level that aim to support healthcare facilities through strengthening health sector preparedness and response to emergencies.

### **Adaptation Measures at the Micro-Level**

At the level of healthcare facilities, Table 28 summarizes the main interventions required to improve climate resilience of healthcare facilities and their overall preparedness to climate change hazards.

Table 28: Micro-Level Recommended Intervention to Improve Healthcare Facilities Preparedness to Climate Change

Key Vulnerability Area	Recommended Direct Interventions	Potential /Relevant Partners
Health Workforce	<p>→ Develop Emergency Plans and Programs at the healthcare facilities to protect health workers from exposure to multiple biological and chemical hazards.</p> <ul style="list-style-type: none"> <li>• A targeted Risk Assessment Checklist can be developed based on WHO checklists to identify hazards, and develop an onsite management response process (WHO, 2020) =&gt;Can be appended to the National Hospital Accreditation 2019, JCI Standards, and Lebanon Primary Healthcare 2015 Standards;</li> <li>• This process would be boosted once the national HAZMAT team of first responders (Lebanese Army, Red Cross, Civil defense) for CBRN (chemical, biological, radiological and nuclear events) has been fully developed [Health and Environment Strategy National Framework of Action 2021-26 Priority 6: Environmental Health Management in Emergencies: [Strategic Activity 2d] (Jurdi, 2021);</li> <li>• This is also in line with the implementation of IHR (Lebanon officially committed since 2010) that identifies Emergency Preparedness as one of its pillars and identifies the need to focus on “Preparing HAZMAT teams to respond to chemical, biological, radiological, and nuclear events (teams included staff from Public and Private Hospitals, Lebanese Army, Fire Fighters Department, Civil Defense, and Lebanese Red Cross)”.</li> </ul> <p>→ Develop and deliver training programs directed to healthcare facilities on:</p> <ol style="list-style-type: none"> <li>1.1.1 Public health and climate change hazards including health impacts related to floods/storms/drought/heatwaves/ wildfires/ cold waves;</li> <li>1.1.2 Multi-hazard assessments;</li> <li>1.1.3 Information systems to manage occupational safety and health in the facility during climate-related emergency (for example: flood/storm/heatwave/cold wave);</li> <li>1.1.4 Training on the provision of resources needed to manage climate change-related hazards reduction at the facility and in the local communities.</li> </ol> <ul style="list-style-type: none"> <li>• This is partly in line with “Health and Environment Strategy National Framework of Action 2021-26 Priority 7: Climate Change and Health” (Jurdi, 2021):</li> </ul> <p>[Strategic Activity 1aiii. Build the capacity of health professionals (technical people, authorities and policy makers) in the identification of health impacts from other sectors (e.g., transport, energy, food, water, housing and urban development) that have bearings on health].</p>	<p>→ MoPH in collaboration/ coordination with:</p> <ul style="list-style-type: none"> <li>→ Lebanese National Council for Scientific Research</li> <li>→ National Coordination Committee for CBRN</li> </ul> <p>→ MoPH → MoE → WHO</p>

<p><b>Water, Sanitation, and Hygiene and</b></p>	<p>→ Develop guidelines to help healthcare facilities acquire and continuously update an assessment plan that maps risks to the water and sanitation infrastructure in place identify where services (quantity and quality) could be disrupted from climate-change related hazards, and how to direct emergency management, accordingly.</p> <ul style="list-style-type: none"> <li>• A targeted Risk Assessment Checklist can be developed based on WHO checklists to identify hazards and develop an onsite management response process (WHO, 2020). =&gt;Can be appended to the National Hospital Accreditation 2019 and JCI Standards, and Lebanon Primary Healthcare 2015 Standards.</li> </ul>	<p>→ MoPH → MoE → MoEW → WHO</p>
<p><b>Healthcare Waste</b></p>	<p>→ Develop guidelines to help healthcare facilities develop and implement a safe health care waste management system (safe storage, safe disposal, and safe transport) in place, before, during, and after a climate change related event.</p> <ul style="list-style-type: none"> <li>• A Targeted Risk Assessment Checklist can be developed based on WHO checklists to identify hazards and develop an onsite management response process (WHO, 2020). =&gt;Can be appended to National Hospital Accreditation 2019, JCI Standards, and Lebanon Primary Healthcare 2015 Standards.</li> </ul>	<p>→ MoPH → MoE → WHO</p>
<p><b>Energy Management</b></p>	<p>→ Direct the healthcare facilities to develop a procedure to periodically assess the energy system to ensure that it can cope with climate change related events and have an emergency plan for power outages in the short- and long-term, before, during and after an emergency event.</p> <ul style="list-style-type: none"> <li>• A Targeted Risk Assessment Checklist can be developed based on WHO checklists to identify hazards and develop an onsite management response process (WHO, 2020). =&gt;Can be appended to the National Hospital Accreditation 2019, JCI Standards, and Lebanon Primary Healthcare 2015 Standards.</li> </ul>	<p>→ MoPH → MoE → MoEW → Donors</p>
<p><b>Infrastructure, Technologies, Products and Processes</b></p>	<p>→ Direct healthcare facilities to develop guidelines to evaluate the condition and safety of structural and nonstructural elements based on local conditions.</p> <p>→ Direct and support healthcare facilities to develop information and communication systems that can be safely secured with backup arrangements (via cloud, satellite) to satisfy the facility's demand, and patient's care.</p>	<p>→ MoPH /MoE → Syndicate of hospitals → Syndicates of Engineers</p> <p>→ MoPH/Syndicate of hospitals → Ministry of Telecommunication</p>
<p><b>Sustainability of Healthcare Facility Operations</b></p>	<p>→ Direct the healthcare facilities to develop set procedures for continually evaluating and implementing risk management programs to stay responsive to the needs of the facilities under climate change related emergency events.</p> <ul style="list-style-type: none"> <li>• Lessons learned from response to COVID-19 through the implementation of the (Coronavirus Disease 2019 Health Strategic Preparedness and Response Plan).</li> </ul>	<p>→ MoE → WHO → Syndicate of Hospitals</p>

### Adaptation Measures at the Macro-Level

Building resilience of healthcare facilities cannot be achieved without complimentary national policies and strategies that provide an enabling environment for the health system to build climate resilience. Building resilience and preparedness is a cross-government priority that involves all stakeholders and actors to be able to work in a coordinated manner, ideally under a “single climate change strategy” (WHO, 2015). Table 29 summarizes the adaptation measures, needed, and as linked to national level strategies and programs.

Table 29 Recommended Intervention at the Macro-Level to Improve Healthcare Facilities Preparedness to Climate

Key Vulnerability Area	Recommended Intervention	Complementarity to National Strategies	National Partners
Human Resources	→ Develop a National Contingency Plan to ensure the provision of additional needed workforce during and post emergency and recovery, which is in turn is critical to ensure facility operation during and after climate-related emergencies.	<p>→ Health and Environment Strategy National Framework of Action 2021-2026 (Jurdi, 2021)</p> <p>Priority 6: Environmental Health Management in Emergencies:</p> <ul style="list-style-type: none"> <li>o Strategic Activity 2c: Establish a National Network of qualified Environmental Health Specialists who can be mobilized and deployed in a timely manner to support countries in need</li> <li>o Strategic Activity 2d: Establish a National Medical Reserve Corp (MRC) of public health professionals and nonpublic health backgrounds community volunteers to strengthen public health, improve emergency response capabilities, and build community resiliency</li> </ul>	<p>MoPH in collaboration with:</p> <ul style="list-style-type: none"> <li>• WHO</li> <li>• Relevant Ministres (MoE, MoEW, MoIM, MoSA etc.)</li> <li>• CDR</li> <li>• LNCSR</li> <li>• Academic Institutions</li> <li>• UN Organizations</li> </ul> <p>MoPH in collaboration with:</p> <ul style="list-style-type: none"> <li>• Medical Reserve Units at Caza levels</li> <li>• Academic Institutions</li> <li>• Research Centers (CNRS...)</li> <li>• NGOs and other</li> <li>• Relevant Stakeholders</li> </ul>
	→ Develop a National Health Support Program for healthcare providers. This is urgently needed to address mental health, stressors, and injuries due to climate-related hazards (such as eye and skin irritation due to smoke exposure, diseases related to hot temperatures, air pollution and ash and smoke exposure, chronic respiratory and cardiovascular diseases), medical treatment, and related support measures.	<p>→ Coronavirus Disease 2019 Health Strategic Preparedness and Response Plan</p> <ul style="list-style-type: none"> <li>• Lesson learned from the Implementation of the MoPH’s COVID-19 Health Strategic Preparedness and Response Plan</li> </ul>	<p>MoPH and:</p> <ul style="list-style-type: none"> <li>• Professional Syndicates</li> <li>• Other members of the National Health Service Network</li> </ul>

	<p>→ Development of the national HAZMAT team of first responders (Lebanese Army, Red Cross, Civil defense) for CBRN (chemical, biological, radiological, and nuclear events) (In Process)</p>	<p>→ Health and Environment Strategy National Framework of Action 2021-2026 (Jurdi, 2021)</p> <p>Priority 6: Environmental Health Management in Emergencies:</p> <p>Strategic Activity 2e: Establish a National Medical Reserve Corp (MRC) of public health professionals and nonpublic health backgrounds community volunteers to strengthen public health, improve emergency response capabilities, and build community resiliency</p>	<p>MoPH in coordination with:</p> <ul style="list-style-type: none"> <li>• Lebanese National Council for Scientific Research</li> <li>• National Coordination Committee for CBRN</li> </ul>
<p><b>Water, Sanitation, and Hygiene and Healthcare Waste</b></p>	<p>→ Develop a National Program to Improve WASH Services and Waste Management in health care facilities.</p>	<p>→ Health and Environment Strategy National Framework of Action 2021-2026</p> <p>Priority 5: Waste Management and Environmental Health Services in the Health Sector:</p> <p>o Strategic Activity 3a: Conduct a national survey to assess environmental health services in health care facilities, and accordingly, determine compliance WHO essential standards on environmental health services in HCFs.</p> <p>o Strategic Activity 3b: Develop national standards for environmental health services in HCFs in compliance with WHO Guidelines.</p> <p>o Strategic Activity 3c: Develop/ Implement a system to monitor compliance with developed environmental health national adopted National Environmental levels.</p>	<p>MoPH in collaboration with MoE and:</p> <ul style="list-style-type: none"> <li>• Academic Institutions</li> <li>• UN Organizations (WHO and UNICEF)</li> </ul> <p>MoPH in collaboration with:</p> <ul style="list-style-type: none"> <li>• MoE</li> <li>• WHO/UNICEF</li> </ul> <p>MoPH in collaboration with MoE</p>
<p><b>Energy Management</b></p>	<p>→ Develop a national network of community based and national providers that will help the health sector to overcome shortage in energy supplies (including fuel, generators, batteries, filters...).</p>	<p>→ Coronavirus Disease 2019 Health Strategic Preparedness and Response Plan</p> <p>Lessons learned from crude oil and fossil fuel shortage and its implications on continuity of care to patient's surviving on ventilators, kidney dialysis units, and other medical devices (Role of Lebanese Army).</p>	<ul style="list-style-type: none"> <li>• MoPH/ DRM Unit</li> </ul>

	<p>→ Promote greening of the health sector to help reduce dependence on conventional sources of energy, enhance energy efficiency, promote on site use of renewable energy (emergency setting); enhance passive cooling, heating and ventilation, conserve and maintain safe water supply, enhance facility management of wastewater and solid waste (See Section 2.2 on Climate Change Mitigation).</p>	<p>→ Health and Environment Strategy National Framework of Action 2021-2026</p> <ul style="list-style-type: none"> <li>• Priority 8: Sustainable Development and Health Strategic Response 3 on Greening of the Health Sector: <ul style="list-style-type: none"> <li>o Strategic Activity 2a: Develop a sustainable system for financing the greening initiative of the health sector</li> <li>o Strategic Activity 2b: Set national targets for environmental resource utilization, and increase efficiency of use of resources in the health sector (Energy efficiency, on-site renewable energy use, use of reduced energy devices, management facilities for solid waste and wastewater, carbon footprint)</li> <li>o Strategic Activity 2biii: Develop a system to monitor progress towards greening of the health sector in compliance with set targets. <ul style="list-style-type: none"> <li>• Link to Climate Change Donor funded Projects</li> </ul> </li> </ul> </li> </ul>	
<b>Infrastructure, Technologies, Products and Processes</b>	<p>→ Develop a Nationally Coordinated Mechanism across the Health Sector, and at different levels, to manage the response and risks resulting from public health emergencies and disasters (including sharing of resources and supplies, transferring of patients, and health workforce support).</p>		<p>MoPH/ Emergency Health Operation Unit at Rafic Hariri University Hospital AND DRM</p>
	<p>→ Develop a National Procedures for Procuring, Sharing, and Safely Transporting and Storing medical devices, pharmaceuticals, vaccines, laboratorial supplies, parenteral nutrition and blood supplies, PPEs (including respirator masks such as fitting N-95 respirator, leather gloves, safety glasses or goggles, clothes such as long- sleeved shirts and long pants, windproof and waterproof clothes, thermal underwear, shoes with rugged soles, waterproof safety boots, goggles, work gloves and masks, and other PPEs that cover all ranges of climate change emergencies), and other essential medical supplies.</p>	<p>→ Coronavirus Disease 2019 Health Strategic Preparedness and Response Plan</p> <p>Lesson learned from the Implementation of the MoPH's COVID-19 Health Strategic Preparedness and Response Plan</p>	<p>MoPH /MoE in collaboration with</p> <ul style="list-style-type: none"> <li>• Ministry of Industry</li> <li>• Ministry of Economy and Trade</li> <li>• Ministry of Public Works and Transport</li> <li>• Lebanese National Defense</li> </ul>

	→ Develop a National Information System between the health sector and meteorological services to communicate about climate hazards (such as storm surge hazards, risk of wildfires, hazards-reduction burning, expected number of hot and smoky days or the likelihood of forthcoming extreme cold weather conditions) to activate emergency response.	→ Health and Environment Strategy National Framework of Action 2021-2026 (Jurdi, 2021) Priority 2: Air Pollution and Health.  • This can be developed once the National Air Quality Monitoring Network is reactivated.	MoE in collaboration and coordination with MoPH.
<b>Sustainability of Healthcare Facility Operations</b>	→ Develop back up plans for healthcare facilities that consider relocating part of the medical services provided by the facility through a national network of health care providers	MoPH Emergency Health Contingency Plan developed since 2012 as it is based on 4 major pillars: (i) assessment of health needs, (ii) preventing, monitoring and controlling outbreaks, (iii) maintaining health facilities operational capacity, and (iv) coordinating with main partners in health.	MoPH in collaboration with: • Professional Syndicates • Other members of the National Health Service Network

Further, it is to be noted, as outlined in Chapter 2, Lebanon has developed various strategies and plans to improve health disaster preparedness at the national level, including the preparedness of healthcare facilities. However, these strategies have fell short, as witnessed during the COVID-19 pandemic and the Beirut port explosion. Hence, it is evident that there is an urgent need for a strategic disaster planning that clearly outlines the appropriate actions required to effectively to respond in emergency situations.

Based on lessons learned from the COVID-19 pandemic and the Beirut port explosion, it is imperative to:

- Reassess and update emergency preparedness plans of all involved stakeholders and integrate them into one comprehensive multi-sectoral emergency preparedness plan.
- Invest in the public health sector infrastructure to strengthen the healthcare workforce, improve capacities of public health laboratories, and advance data collection and analysis capabilities.
- Reinforce the role and capacity of government to coordinate and regulate the health sector to optimize the capacities and resources of state and non-state actors involved in the health sector.
- Develop regulatory frameworks and legislations to coordinate efforts between the public and private health sector in a way where resources and responsibilities, risks and costs are shared between both parties.

Additionally, it is recommended to strengthen the MoPH's Early Warning Alert and Response System (EWARS) and surveillance unit to ensure early detection of communicable diseases; thus, ensuring early and effective response. This can be done by expanding their financial resources and human resources through recruitment of skilled personnel and capacity building and training (such as training on updated surveillance forms and surveillance guidelines). EWARS is an integral

part to reducing the vulnerabilities of healthcare facilities through ensuring their preparedness.

Boosting the capabilities of the Emergency Health Operation Unit at Rafic Hariri University Hospital and enhancing their coordination with stakeholders involved in disaster risk management plans (such as the Lebanese Red Cross, Lebanese Civil Defense, High Relief Council, private and hospitals and PHC, Syndicate of hospitals, Lebanese Army, Firefighters, etc.) is also crucial.

Further, although Lebanon has ratified and officially signed the International Health Regulations (IHR) which identifies Emergency Preparedness as one of its core pillars, the national capacity of the country still does not meet the core capacity requirements under the IHR. Based on IHR recommendations, it is essential to improve the MoPH's Emergency Preparedness and Response plan by (a) integrating a comprehensive hazard and capacity analysis, (b) allocating proper roles and responsibilities for all sectors/partners (other than health) in the response plan, (c) establishing a feasible and effective plan to enhance coordination between relevant stakeholders, (d) ensuring the MoPH's plan is in line with other emergencies plans, and (d) establishing one unified national emergency response framework for all hospitals (hospitals should not have their own established emergency procedures that are not part of the national framework).

Moreover, as part of Lebanon's commitment to the Sendai Framework for Disaster Risk Reduction, the National Disaster Risk Reduction Strategy, which is still pending approval, should be adopted by the Lebanese Government and implemented in all its entities. Implementing this strategy will strengthen disaster risk governance to manage disaster risk, invest in disaster reduction for resilience, and enhance disaster preparedness for effective response, and a "Build Back Better" approach in recovery, rehabilitation, and reconstruction.

Finally, implementing the Health and Environment National Strategic Framework 2021-2026, which has been launched in 2022, particularly activities under (a) developing the capacities of the health sector to manage environmental health services throughout the life cycle of emergencies and (b) providing adequate environmental health services in health care facilities during emergencies, will also help improve the national capacity in terms of emergency preparedness.

## 2.2. Response and Recovery

All the presented micro and macro level would influence the healthcare facilities ability to respond and further recover from climate change crises. Hence, as recommended by WHO, a well-developed emergency plan, would guide proper response implementation (WHO, 2021). This can be implemented through:

**1. Training of the health workforce** on disaster preparedness and response plans (including exercises and simulations) and on how to communicate effectively in emergency situations.

**2. Improving community response** through proper communication, community engagement. Strengthening local assets, fostering community resilience and promoting environmental sustainability locally. As such healthcare facilities can play a role in:

- Regularly organizing and participating in community disaster planning committees to improve knowledge on how to reduce climate change risks, be prepared and respond to these risks, and recover better than before through adaptation measures.
- Participating in community educational programs to assist the local community in reducing climate risks.
- Conducting ongoing awareness raising for the community on the risks to health from climate related hazards and effective health protection measures.
- Engaging in community health programs to improve community health during climate risks (such in case of floods, heatwaves, etc.).
- Establishing partnerships with the community and local authorities to reduce climate vulnerability in the surrounding areas.

**3. Developing a well-defined recovery plan** that includes an action plan for infrastructural and non-infrastructural facilities, a recovery assistance program based on staff needs, and a plan for establishing partnerships with key partners and stakeholder involved in the recovery plan.

The recovery phase should be an opportunity to “Build Back Better” by evaluating and improving disaster risk reduction measures and integrating them into development measures. Cross-cutting issues can be integrated into healthcare facilities’ operations more easily during recovery than if they were introduced afterwards. Table 30 summarizes the key areas required to develop a health sector recovery plan (Global Facility for Disaster Reduction and Recovery, 2017).

#### The Three Phases of Recovery:

→ Immediate (initial recovery efforts when transitioning from response to recovery); “Make Safe, Provide, Plan, and Repair”

→ Short-term (recovery planning and initial implementation); “Begin to Rebuild, Return Services, and Reduce Obstacles”

→ Medium to long term (reconstruction efforts); “Complete Rebuild, Restore, and Improve”

(Global Facility for Disaster Reduction and Recovery, 2017)

Table 30 Elements of a Health Sector Recovery Plan (Developed from Recommendations of Global Facility for Disaster Reduction and Recovery, 2017)

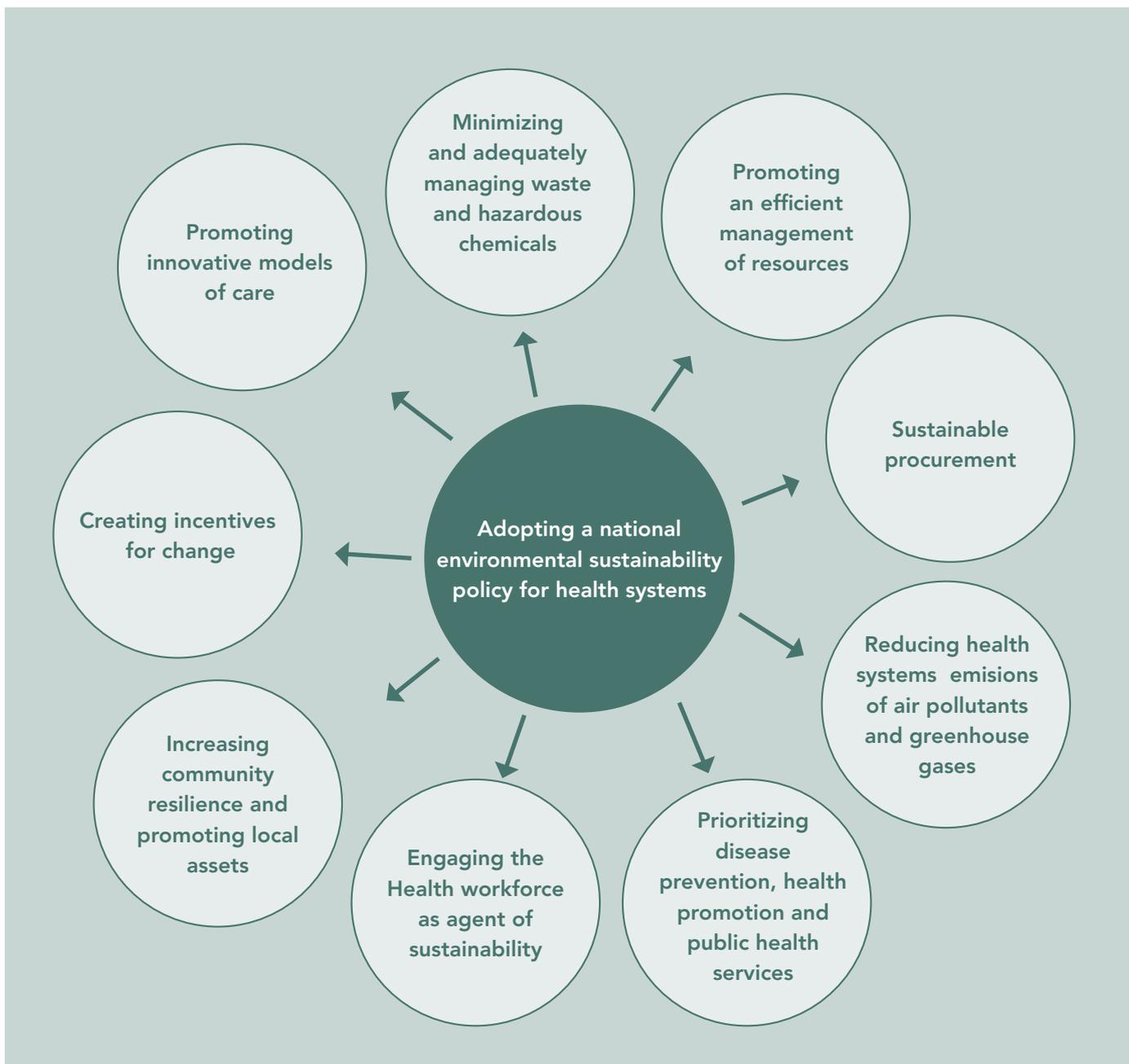
Key Area	Type of Intervention
<b>Leadership Governance and Coordination</b>	<ul style="list-style-type: none"> <li>→ Pre-develop/ activate a high-level Post-Disaster Health Sector Governance and Leadership Framework that outlines roles, responsibilities, and commitments after a disaster event</li> <li>→ Specifically, clarify and communicate health sector recovery roles</li> </ul>
<b>Data Collection</b>	<ul style="list-style-type: none"> <li>→ Conduct post-disaster needs assessment and risk assessment to identify damaged health facilities, determine losses associated with the reduction in health service delivery, and identify/quantify community needs for the recovery of the health sector</li> </ul>
<b>Communication</b>	<ul style="list-style-type: none"> <li>→ Develop/implement a cross-key agency communications plan (ideally developed and drafted with partners' pre-disaster) as part of the Post-Disaster Governance and Leadership Framework, to provide consistent and clear communications to partners and all affected stakeholders. Under this plan, all key messages should be clearly defined and agreed among sector recovery leaders (single source of truth)</li> </ul>
<b>Funding</b>	<ul style="list-style-type: none"> <li>→ Determine the overall recovery funding needs</li> <li>→ Confirm funding needs and allocations for health sector recovery</li> </ul>
<b>Human Resources</b>	<ul style="list-style-type: none"> <li>→ Address the capacity and capability of the health workforce based on recovery needs and well-being</li> </ul>
<b>Health Service Delivery</b>	<ul style="list-style-type: none"> <li>→ Develop a plan to address immediate health and safety issues, meet health needs, and re-establish critical health services</li> </ul>
<b>Medicines, Supplies, and Technology</b>	<ul style="list-style-type: none"> <li>→ Ensure that medical or other supply arrangements are functioning and bringing in needed supplies</li> </ul>
<b>Infrastructure</b>	<ul style="list-style-type: none"> <li>→ Have a plan to re-establish health sector lifelines, including power, sewerage, and piped water network</li> <li>→ Develop a plan to make functional buildings safe</li> <li>→ Develop a plan to initiate repairs to critical infrastructure, where able</li> </ul>
<b>Monitoring and Evaluation (M&amp;E)</b>	<ul style="list-style-type: none"> <li>→ Develop/activate an M&amp;E framework that would reflect the recovery plan vision, goals, and activities and projected outputs</li> </ul>

# 3. CLIMATE CHANGE MITIGATION

Climate change mitigation provides a proactive approach to improve the environmental sustainability of healthcare facilities' operations, and to reduce the associated environmental impacts and concurrently the overall health sector's contribution to climate change. Overall, the adaptive capacity and development of the health sector would be highly reduced by unsustainable operations (WHO, 2017). Accordingly, the overarching critical action is to adopt a national environmental sustainability policy for health systems. Although, there is "no one-size-fits-all" approach to integrating environmental sustainability measure into the operations and functions of health systems, still, developing formal policy framework and plan, through a consultative process involving health workers and all other major stakeholders is valued. A strategy or action plan with measurable performance indicators and clearly defined roles and responsibilities would ensure transparency, accountability, and effective continued partnerships among stakeholders.

As big consumers of water and energy, and a major producer of hazardous waste and wastewater, healthcare facilities have both direct and indirect environmental implications. Therefore, there is an urgent need to start improving the environmental sustainability of healthcare facilities. This is also in line with the Arab Health and Environmental Strategy 2017-2030, which identified greening of the health sector as a strategic response to sustainable development. Direct initiatives at the healthcare facility level would be implemented, with a long-term national framework and action plan for greening of the overall health sector (Jurdi, 2021).

Figure 18 Elements of a National Environmental Sustainability Policy for Health Systems (WHO, 2017).



The long-term measures required to ensure an environmentally sustainable health system employ a diverse portfolio of planning and practices that combine subsets of initiatives and directed interventions (WHO, 2017):

- Prioritizing disease prevention, health promotion and public health services;
- Promoting efficient management of resources;
- Promoting sustainable procurement;
- Reducing health systems' emissions of greenhouse gases and air pollution;
- Engaging the health workforce as an agent of sustainability;

- Increasing community resilience and promoting local assets;
- Optimizing technological processes;
- Reinforcing institutional and behavioral change.

Table 31 presents a list of examples of mitigation measures that could be implemented directly to promote environmental sustainability of healthcare facilities, many of which can overlap with the adaptation measures by healthcare facilities (In fact, most of the interventions required for climate resilience can address multiple objectives and serve to enhance climate change mitigation, adaptation, preparedness, response, and recovery of healthcare facilities.

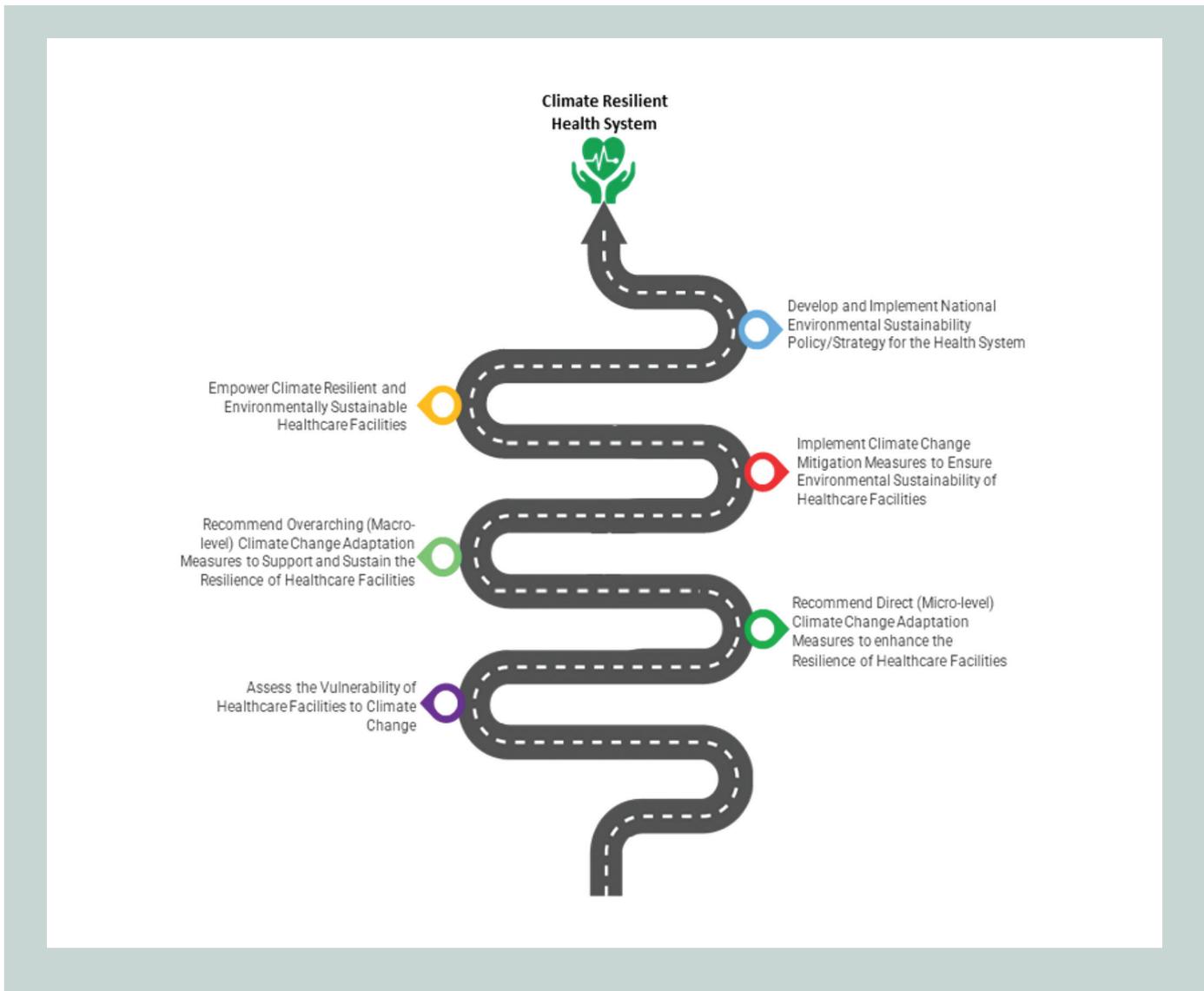
Table 31 Measures to Build Environmentally Sustainable Healthcare Facilities (Summarized from: Healthcare without Harm, 2016; 2020; Fischel et al., 2020)

Key Area of Action	Measures
<b>Improve Energy Efficiency</b>	<ul style="list-style-type: none"> <li>→ Use of tech-enhanced renewable energy systems (such as solar power).</li> <li>→ Improve building insulation (such as the use of super insulated roofs) and ventilation.</li> <li>→ Use of energy-efficient lighting systems and medical equipment.</li> <li>→ Install energy-efficient ceiling fans (such as Energy Star), motion sensor lights, and low-flow plumbing systems.</li> <li>→ Utilize high-efficiency large windows for natural lighting and ventilation.</li> <li>→ Ensure proper sealing of windows and doors to avoid air leakage.</li> <li>→ Install automatic doors to better manage airflow from high foot traffic.</li> <li>→ Use indoor plants as natural air purifiers and plant trees to provide shade outside.</li> <li>→ Adopt LEED (Leadership in Energy and Environmental Design) certification which is the most widely used green building rating system.</li> <li>→ Conduct regular energy audits and use the results to inform awareness and retrofit programs.</li> <li>→ Identify potential co-benefits of climate mitigation efforts that reduce greenhouse gas emissions and local health threats, while saving money at the same time.</li> </ul>
<b>Substitute Harmful Chemicals with Safer Alternative</b>	<ul style="list-style-type: none"> <li>→ Adopt policies that require disclosure of chemical ingredients in products and materials and seek to ensure that all ingredients have undergone at least basic toxicity testing.</li> <li>→ Develop institution-wide chemicals and materials policy and protocols to protect patient, worker, and community health and the environment.</li> <li>→ Implement a facility -specific chemicals action plan with benchmarks and timelines.</li> <li>→ Phase out the use of chemicals of concern, including, for example, glutaraldehyde, halogenated fire retardants, PVC, DEHP and BPA, and seek safer alternatives and substitutes.</li> </ul>

<p><b>Reduce Solid Waste Generation and Enhance Recycling</b></p>	<ul style="list-style-type: none"> <li>→ Set up a waste management committee and allocate a dedicated budget for waste management.</li> <li>→ Adopt/implement a sustainable waste management plan. e.g., Separate different waste types – organic, recyclables (paper and plastic), e-waste (batteries and light bulbs), infectious, sharps, and hazardous waste, etc. The plan should aim to improve the efficiency of recycling processes and reduce the amount of hazardous waste generated, thus reducing costs required for special treatment of hazardous wastes.</li> <li>→ Implement a comprehensive waste reduction program, including avoiding, where feasible, injectable medicines where oral treatments are as effective.</li> <li>→ Implement a comprehensive waste management training program, including injection safety and safe handling of sharps and other waste categories.</li> <li>→ Green purchasing to reduce waste: Hospitals can implement green purchasing policies to procure products that are eco-friendly with minimal packaging and those that can be sterilized and reused.</li> <li>→ Support and participate in the development and implementation of “zero waste” policies that significantly reduce the amount of waste generated at the hospital, municipal and national levels.</li> </ul>
<p><b>Reduce Water Consumption and Wastage</b></p>	<ul style="list-style-type: none"> <li>→ Use of water-efficient landscaping (such as using drought-resistant plants to minimize water use).</li> <li>→ Establish a framework that aspires to “net zero water use” within a hospital system.</li> <li>→ Install low-flow toilets, faucets, and shower heads, maintain and repair regularly and replace outdated pump systems.</li> <li>→ Switch from film-based radiological imaging equipment, which uses large quantities of water, to digital imaging, which uses no water and no polluting radiological chemicals.</li> <li>→ Upgrade to more efficient heating, ventilation, air conditioning and refrigeration systems.</li> <li>→ Phase out bottled water use if high quality potable water is available.</li> <li>→ Develop joint projects with the community to improve and protect water supplies; support initiatives for public systems to improve water quality, water delivery and wastewater systems for the entire population.</li> </ul>
<p><b>Improve Transportation Strategies for Patients and Staff</b></p>	<ul style="list-style-type: none"> <li>→ Develop strategies for telemedicine, communication by e-mail and other alternatives to face-to-face encounters between caregivers and patients.</li> <li>→ Encourage staff, patients, and visitors to walk or use carpools, public transport, or bicycles whenever possible. Install showers, lockers, and bicycle storage facilities to encourage staff to adopt healthy modes of transportation.</li> <li>→ Purchase from local suppliers, and/or suppliers who use fuel efficient transportation.</li> </ul>

<b>Improve Resilience to Climate Change</b>	<p>→ Implement “Climate-Smart Healthcare” to decarbonize the healthcare facilities, increase resilience to climate change. Actions include:</p> <ul style="list-style-type: none"> <li>o Reducing dependence on fossil fuel to reduce emissions by investing in renewable energy</li> <li>o Integrating climate changes risks in hospital’s business plans, and recognizing the co-benefits of both mitigation and resilience actions,</li> <li>o Investing in zero-emission buildings and infrastructure</li> <li>o Transitioning to zero emissions, sustainable travel, and transportation</li> <li>o Implementing circular healthcare and sustainable healthcare waste management</li> </ul>
<b>Create a Sustainable Healthcare Culture</b>	<ul style="list-style-type: none"> <li>→ Form a multi-disciplinary team to allocate focused attention to achieving sustainability goals</li> <li>→ Develop a green mission statement to outline sustainability goals</li> <li>→ Promote engagement from staff across all occupations and departments. Participation and leadership from upper management is critical for facility-wide success</li> <li>→ Foster research on environmental health and sustainability</li> <li>→ Educate and train staff on how to implement green practices in the workplace and at home</li> <li>→ Track and analyze progress routinely. Seek feedback from staff to further evaluate green initiatives</li> <li>→ Assure that strategic and operating plans and budgets reflect the commitment to a green and healthy hospital</li> <li>→ Collaborate with other stakeholders to map environmental health risks and monitor diseases associated or potentially associated with environmental factors</li> <li>→ Engage the community: educating the community about sustainable practices</li> <li>→ Collaborate with other stakeholders such as corporate sponsors, sustainability associations, government organizations, educational institutions, and environmental legislation compliance bodies</li> </ul>

Figure 19 summarizes the proposed roadmap to achieving climate resilience in healthcare facilities and the health system.



# 4. CONCLUSION: BARRIERS TO ROADMAP IMPLEMENTATION

The roadmap outlines the necessary actions required to build climate resilience of the health sector. However, various barriers such as financial resources and human capital, policies and procedures, and institutional and technical capacities, challenge the proper implementation of a roadmap to resilient healthcare facilities.

Barriers include:

- Lack of recognition of climate change as a significant problem or stressor on public health by policy and decisions makers at the national and healthcare facility level
- Restrictions on national and regional budget policies/processes which constrain the potential for altering or strengthening current management practices
- Lack of incentives at both the micro and macro-level to take risks that hinder the development of creative sustainable projects
- Poor coordination between stakeholders involved in the decision-making process and between health and non-health sectors involved in the strategy to improve climate resilience of the health sector.
- Limited/absent climate expertise within many management units at the national and healthcare facilities level.
- Weak institutional structures and weak enforcement of policies and strategies.
- Compounding problems of poor/worsening local political, social, and economic conditions.
- Low investment in environment-friendly technologies at the national and healthcare facility levels.

Overcoming these barriers necessitates an integrated approach to building climate resilience of the health sector. Ensuring coordination and communication between stakeholders is essential in this integrative approach. Additionally, raising awareness and ensuring policy coherence, building technical, organizational, and institutional capacity, and mobilizing resources to support effective implementation are complementary.

As such WHO recommends the building blocks of (a) health governance and policy, (b) human resources for health, (c) information systems, (d) service delivery, and (e) financing. Health governance and policy should be directed to protect human health from climate risks and strengthening partnership with health-determining sectors to benefit mitigation and adaptation measures. Human resources for health be directed to raise awareness on climate change and health and start a process of stakeholder engagement as an entry-points to health adaptation in other sectors. Management Systems should be direct climate change research, translation of research findings to policy making, and structured risk communication. As for service delivery it should be direct attention on health risks related to disasters, water, waste, food, and air pollution (e.g., food safety, diarrheal disease control, Integrated Vector Management) and empower communities to strengthen community-based risk reduction. Finally, projects and programs to build the health systems' resilience should seek international climate change funds (e.g., the GEF, Adaptation Fund, bilateral donors). These building blocks will provide an enabling environment to achieve climate resilience of the health sector.

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# APPENDICES

## Appendix 1: Vulnerability assessment sample table

**Table 1.1:** Developed Survey Tool (Checklist) for Assessing Vulnerability to Climate Hazards: Floods, Storms, Sea-level Rise, Droughts, Heatwaves, Wildfires, and Cold Waves (Adapted from WHO, 2020 and WHO, 2021)

Vulnerability level			
● High risk: unprepared; unable to respond (Higher risk)	●	●	●
● Medium risk: basic or incomplete preparation; low level of response (Medium risk)			
● Low risk: able to respond (Lower risk)			
Health workforce			
Human resources			
Is the health workforce			
1. Prepared with a plan to ensure facility operation after climate-related emergency including:			
a. Prepared with a contingency plan for accessing additional health workforce to strengthen performance capacity?			
b. Equipped with a plan to identify minimum needs for health workers to ensure operational sufficiency care services?			
c. Equipped with a coordinated plan, including volunteers on standby, to assist during an emergency or to support health professionals?			
d. Provided with a post-emergency employee recovery assistance program according to staff needs?			
2. Provided with full personal protective equipment:			
a. PPEs during floods, especially for clean-up crews, including waterproof safety boots, goggles, work gloves and masks?			
b. PPEs during cold snaps (warm, windproof and waterproof clothes, thermal underwear, boots)?			
c. PPEs during wildfires, especially for cleaners (respirator masks such as fitting N-95 respirator, leather gloves, safety glasses or goggles, clothes such as long-sleeved shirts and long pants, and shoes with rugged soles)?			
d. PPEs for workers during heat waves (for example: sunscreen, hats, etc.) especially for staff carrying out outdoor activities?			
3. Provided with a plan to reduce extreme temperature exposure during hot/cold waves:			
a. Equipped with a plan for scheduling outdoor work for cooler time of the day and reducing physical demand during hot days and rescheduling during cold waves?			
b. Provided with drinking water and stimulated regularly for appropriate water intake?			
c. Equipped with a plan to identify and protect health workers at risk of heat stress/cold waves' impacts?			
d. Provided with a cool space/warm resting place or a shower room for staff?			
4. Equipped with a plan to reduce smoke/ash exposure during wildfires:			

a. Equipped with an alternative action plan for the health workforce with outdoor functions to avoid or limit their outdoor activity to avoid smoke and ash exposure (e.g. postponing or shortening time spent outdoors, relocating workers or rescheduling work tasks to areas or times of the day that are smoke-free or have less smoke; as well as encouraging and ensuring workers take frequent breaks inside clean air spaces; focusing on only performing high priority tasks, with workers' protection measures in place)?			
b. Equipped with a plan to identify and protect health workers at risk of smoke and ash exposure, and heat stress?			
c. Prepared with clear messages on reduction measures for short- and long-term exposures to indoor and outdoor air pollution and smoke (e.g., providing cleaner air spaces; using respirator masks; reducing outdoor activities; setting air conditioners to recirculation mode where safe; avoiding the use of exhaust fans in the kitchen, bathroom, clothes dryer and other facility rooms with exhaust fans)?			
d. Prepared with clear guidance on actions to reduce heat and respiratory risk factors for staff?			
5. Aware of the potential risks of climate hazards on the facility and themselves (for example: risk of sea-level rise)?			
6. Protected from impacts of storm surges?			
7. Provided with programs for supporting staff with regards to mental health, injuries due to climate-related hazards (such as eye and skin irritation due to smoke exposure, diseases related to hot temperatures, air pollution and ash and smoke exposure, chronic respiratory and cardiovascular diseases), medical treatment, and related support measures?			
8. Participating in drought, water and climate change adaptation plan and policies?			
9. Equipped with an emergency plan for shift relay or replacement of health professionals to ensure that staff get adequate rest?			
10. Provided with an information system to manage occupational safety and health in the facility during climate-related emergency (for example: flood/storm/heatwave/cold wave)?			
11. Equipped with an emergency plan to protect health workers from multiple biological and chemical hazards?			
12. Provided with safe water and food during an event?			
<b>Capacity Development</b>			
131. Trained on public health and climate change hazards including health impacts related to floods/storms/drought/heatwaves/wildfires/cold waves?			
14. Equipped with knowledge, experience, training, and resources to manage climate change-related hazards reduction at the facility and in the local communities?			
15. Engaged in the development of plans and responses to climate change-related risks?			
164. Prepared with a contingency plan for continuing to provide services at other facilities or in the local communities (health primary care), if necessary?			
17. Trained to detect posttraumatic stress disorder among staff to take prompt action?			

18. Trained to manage hazardous chemicals in emergency situations?			
19. Trained in multi-hazard assessments?			
20. Trained to maintain correct level of water safety, quality control and treatment supplies, and alternative sources and electrical power supply, in both routine and emergency/disaster situations			
21. Trained on how to treat stored water for human consumption?			
22. Trained or prepared to quantify drought-sensitive diseases taking into account the special drought patterns?			
23. Able to convey protective strategies for public health emergencies, in case of high temperature effects, and water and food contamination to patients, staff and communities?			
24. Prepared and trained on a contingency plan for climate-related health impacts (including rapid increase in health workforce respiratory and cardiovascular problems, increased temperatures and heat stress, water- and air-borne diseases, and smoke and ash exposures)?			
25. Provided with a mechanism to learn about air pollution advisories and warnings, including air quality monitoring information?			
26. Trained on risk factors related to heating (e.g., carbon monoxide poisoning from certain heating appliances)?			
27. Trained on actions to reduce personal levels of cardiac workload risk factors for staff?			
28. Able to manage peak electricity demand?			
<b>Communication and Awareness Raising</b>			
29. Aware of the impacts of climate change related hazards on human health			
a. Impacts of drought on human health?			
b. Impacts of hot temperatures on human health via water quality and quantity (including water- and food-borne diseases) and air quality?			
c. Impacts of wildfire on human health due to poor air quality?			
d. The risk factors of patients and symptoms expected during a cold/heat wave?			
30. Following guidance on risk assessments to assist in the identification, planning, monitoring and evaluation of risk reduction and adaptation strategies associated with direct and indirect impacts of climate change related hazards including drought and wildfires?			
31. Aware of preventive measures to reduce impact during climate change related emergency:			
a. Aware of the need to keep hydrated and wear appropriate clothing during heatwaves?			
b. Aware that they must use cool compresses, misting, and showers during heat waves?			
c. Aware of appropriate strategies to reduce smoke exposure during evacuation, when necessary, because of danger from wildfires?			
d. Aware of wearing tight-fitting respirators to filter ash particles from the air to protect lungs (e.g., N95 respirator mask#), particularly for cleaners and outdoor workers during wildfires?			
e. Aware of having to change shoes and clothing before leaving a clean-up site to avoid taking ash offsite during wildfires?			
f. Aware of not bringing food or eating at the affected site (and keeping food in a sealed container) and washing hands well before eating during wildfires?			

g. Aware of the need to wear appropriate clothing (ensuring that head, nose, mouth, neck, hands and feet are covered properly; wearing appropriate boots that keep feet warm and prevent from slipping and falling; using several layers of clothing and ensuring the top one is windproof and waterproof), specifically for outdoor activities during cold waves?			
h. Aware of avoiding getting their clothes wet during cold waves?			
i. Aware of keeping the facility environment cool (e.g., keep windows that are exposed to the sun closed during the day and open at night when the temperature has dropped; close curtains that receive morning or afternoon sun; turn off nonessential lights and electrical equipment that generate heat; sleeping in a cooler room or use electric fans for some relief if temperatures are below 35°C) during drought and heat wave events?			
j. Aware of the need for an alternative action plan for the health workforce with outdoor responsibilities to reduce or avoid activity during excessive cold?			
k. Aware of the need to take breaks in a warm place that is sheltered from wind and snowfall, when needing to stay outdoors for long periods of time during cold waves?			
l. Aware of the risk factors that can increase impacts on health (e.g., smoking and drinking alcohol may lower the body temperature leading to hypothermia; some medications can make people more sensitive to cold; certain diseases can be aggravated from cold temperatures, such as heart diseases, lung diseases, malnutrition) during cold waves?			
32. Provided with a safe internal communication system, especially in emergency situations?			
33. Informed on how to use and follow a surveillance system to track health outcomes?			
34. Aware of contingency plans for accessing and leaving/evacuating the facility during climate change related emergencies, and health workforce transportation?			
35. Regularly participating in community disaster planning committees to: improve knowledge on how to reduce risks and vulnerabilities, be prepared and respond to climate-change related emergencies, and recover better than before through adaptation measures?			
36. Prepared with clear messaging about water and food safety during and after a climate change related emergency?			
37. Equipped with a flood plan or program with clear instructions on how to proceed during flood emergency situations?			
38. Equipped with a community health educational program to improve community health in the face of climate change related risks?			
39. Informed on how to reduce risks and vulnerabilities to flood and storm surge events resulting from sea-level rise?			
<b>Water, sanitation and healthcare waste</b>			
<b>Monitoring and assessment</b>			
<b>Does the health care facility</b>			
40. Assess the capacity of the existing storm water management system, to ensure adequacy for anticipated 50- or 100-year storm events today?			
41. Have an evaluation system to monitor its water system and supply and reduce contaminate concentrations before, during and after a climate change related emergency (such as storm surge/ cold wave event/wildfire)?			
42. Have a water quality monitoring plan for human consumption and drinking water during and after the emergency event?			
43. Have information on water system installation that ensures lower risk of freezing and contamination?			
44. Have an updated assessment plan to map risks to the water and sanitation infrastructure in place, and to identify where services could be disrupted from climate-change related hazards and water scarcity?			

45. Verify water safety conditions, including updated risk assessments to map water resources and water supplies for the facility and ensure proper functioning of all elements of the system and monitor water drips, leaks and unnecessary flows in bathrooms, laundry facilities, kitchen, etc.; and perform prompt repairs to avoid loss?			
46. Regularly assess its sanitation system for any possible damage in the event of climate change related hazards (such as flooding, storm and sever winds, sea-level rise)?			
47. Monitor sewer overflows in order to fix pumps in advance of the emergency event (such as flood or storm) and after the event?			
48. Conduct a waste audit to reduce waste as much as possible?			
49. Regularly inspect the rainwater harvesting system for damage and contamination?			
<b>Risk management</b>			
50. Have a water management plan able:			
a. To identify water contamination			
b. To avoid or reduce vector breeding sites			
51. Have a storm water management system able:			
a. To cope with storm-caused floods			
b. To avoid standing water near the facility			
52. Have a natural floodwater infiltration system to reduce risk of facility flooding?			
53. Have a rainwater catchment system with safe water storage?			
54. Have anti-mosquito breeding measures?			
55. Have water storage tanks with appropriate covers that is protected from direct sunlight and excessive heat and that prevents access or contamination, damage and saline water intrusion and safety located for an emergency event?			
56. Have chemicals stored away from excessive heat/cold waves or wildfires?			
57. Provide sufficient drinking water to staff, patients, and visitors?			
58. Have a schedule for emptying latrines in advance of the flood season/storm events to avoid overflows?			
59. Have onsite water treatment and water purification equipment to provide sufficient quantity of safe drinking water?			
60. Have non-return valves installed on water supply pipes to prevent backflows?			
61. Have a surveillance system for diseases related to water quality and sanitation?			
62. Have a mechanism to protect freshwater sources around the facility from all types of contamination, including saline intrusion?			
63. Have a safe water and wastewater management system for sea-level rise impacts, including standing water near the facility?			
64. Have direct communication with water providers to ensure that water supply is safe to drink?			
65. Have a safe health care waste management system in place before, during and after climate change related event including:			
a. Have a safe storage place, away from excessive heat in cool and covered spaces?			
b. Have a safe waste disposal system?			
c. Have an established safe management approach to health care waste transport (including hazardous waste)?			

d. Have chemical, radioactive and biological hazardous waste stored in a safe place and on a level above the ground floor?			
e. Have waste pits able to withstand flood events?			
f. Have waste storage tanks supported and anchored to resist strong winds and rainfall?			
g. Keep waste sealed in rubbish bins to avoid rodents?			
h. Have safe waste disposal of debris after a high tide event?			
<b>Health and safety regulation</b>			
66. Have an emergency water supply plan (alternative water source) and a long-term drought management plan?			
67. Have a water safety plan in place, in case:			
a. Water contamination			
b. Freezing waters?			
68. Have a mechanism or regulation to carry out sanitary inspections of water supply and alternative sources (e.g., wells, dams, cisterns, fountains and water trucks), and when necessary, establish a temporary ban on use, until improvements are made?			
69. Have a contingency plan to ensure effective and timely delivery of safe water during extreme temperatures, floods, droughts, cold waves, and other climate change related emergencies over the short, medium, and long-term?			
70. Have a plan to provide and maintain adequate cleaning and disinfection supplies (such as chlorine, filters or other water treatment technology, rapid water testing kit) for water safety?			
71. Have an emergency plan for maintenance and restoration of waste management systems?			
72. Work with water utility agencies to prevent suspension of services.			
73. Have a coordinated cross-sectoral water management plan to protect local or alternative water sources?			
74. Have a plan to conserve and manage water to reduce water usage, specifically in case of prolonged drought?			
75. Have additional water treatment and storage capacity to account for interruption, quality and quantity?			
<b>Energy</b>			
<b>Monitoring and assessment</b>			
<b>Does the health care facility</b>			
76. Regularly assess its energy system to ensure that it can cope with climate change related events and minimize their impacts?			
77. 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 an emergency event?			
78. Periodically check emergency backup generators (including fuel, where relevant)?			
79. Assess whether renewable energy (if available, such as solar) is sufficient to power critical equipment?			
80. Assess regularly and monitor the heating, ventilation, and air conditioning systems to control the functioning of all critical medical equipment?			
81. Regularly assess whether the heating system can cope with unexpected cold temperatures?			
82. Monitor building humidity and if needed adjust the cooling system to control the humidity in operating room areas?			
83. Identify priority areas within the facility which would require emergency power during and after an emergency event?			

<b>Risk management</b>			
84. Have a secure place to protect the backup generator (e.g. an elevated place; including fuel or battery storage, where relevant) from flood waters or damage during an emergency event?			
85. Have adequate daylight to ensure proper visibility during a power outage?			
86. Have power-operated doors that can easily be opened manually to permit exit in case of power failure?			
87. Have appliance thermometers in the refrigerator and freezer to determine if food, vaccines, and other essential refrigeration-dependent medical supplies are safe?			
88. 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, do not use electrical equipment that has been exposed to heat from a fire until checked by an electrician; use extreme caution when equipment is moved near overhead power lines; do not stand or work in areas with thick smoke (smoke hides electrical lines and equipment))?			
89. Have a clear guidance on heat/cold-risk management for the maintenance of critical infrastructure (e.g. air-conditioning, heating systems medical devices, computers, diagnostic equipment, boiling water)?			
<b>Health and safety regulation</b>			
90. Have an emergency plan for power outages in the short- and long-term before, during and after an emergency event?			
91. Work with energy utility agencies to prevent suspension of electricity services?			
92. Have a management plan for intermittent energy supplies or system failure?			
93. Have a generator backup or renewable energy sources (e.g. solar, wind power, small-scale hydroelectric power plants) that can be used for water pumping?			
94. Have a plan or regulation to determine ways to reduce overall energy use?			
95. Have an emergency plan to ensure availability of adequate lighting, communication and information systems, and refrigeration and sterilization equipment during an emergency event?			
96. Have a plan to evacuate patients to a cooling/heating stations if the facility has lost power and has no other source of energy?			
<b>Infrastructure, technologies, products and processes</b>			
<b>Adaptation of current systems and infrastructures</b>			
<b>Does the health care facility</b>			
97. Have necessary training and preparedness to minimize the impacts of cold waves including:			
a. Have preparedness and training for periods of extreme cold exposure?			
b. Perform necessary and appropriate maintenance work to prepare the facility for winter or severe cold temperatures?			
c. Ensure that the rooms are well ventilated, when using an auxiliary heating system, such as oil-burning furnaces, wood-burning fireplaces, wood-burning stoves, propane heaters generators?			
d. Have caulked windows and doors to prevent cold air from coming in?			
e. Provide sufficient and necessary materials to supporting staff in outdoor activities, when necessary (e.g., in the case of vehicle breakdown having bottled water, food, blankets, cell phone and charger, shovel, snow brush, traction aids and medication)?			

98. Have necessary training and preparedness to minimize the impacts of wildfires including:			
a. Have an indoor air quality contingency plan in place for hazard-reduction burning, before the start of the fire season, as well as during and after a wildfire to assist in planning and decision-making?			
b. Regularly monitor air quality (temperature and humidity), especially during and after wildfire exposures?			
c. Have available appropriate air filters in indoor working areas to reduce overall smoke and dust exposure?			
d. Assess if the filters of the heating, ventilating and air conditioning systems are not dirty, damaged, dislodged or leaking around the edges, before the wildfire season and during smoke events to ensure necessary repairs and appropriate maintenance?			
e. Have appropriate portable air cleaners to reduce indoor particle levels?			
f. Have appropriate ceiling fans or portable fans for room cooling?			
g. Have a management plan for the use of personal protective equipment for wildfires in the medical stockpile?			
h. Maintain partnerships with key partners and stakeholders (e.g. air quality agencies, local health providers, health departments, fire department, land management agencies, and others) for effective wildfire response and recovery?			
99. Have necessary training and preparedness to minimize the impacts of floods including:			
a. Have a safe location for critical services and equipment in a flood emergency situation?			
b. Have a safety plan to prevent medical and laboratorial equipment and supplies, and food packages to be exposed to flood waters?			
c. 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?			
d. Have evacuation routes above flood elevation?			
e. Have water-resistant interior construction?			
f. Have walls protected and insulated against moisture and mold?			
g. Have roof drainage systems for rainfall?			
h. Have rooftop structures and equipment revised for anticipated increased rainfall?			
i. Have roofs that are leak-proof and insulated?			
j. Ensure removal of equipment and power supplies from basements and ground floor level to avoid damage from flooding?			
100. Have necessary training and preparedness to minimize the impacts of heat waves including:			
a. Assess the capacity of heating, ventilation and air-conditioning systems to deal with increasing heat and humidity?			
b. Have exterior shading devices, trees or other architectural features that mitigate heat and dryness?			
c. Have openable windows to provide for ventilation and to maintain habitable conditions?			
d. Install reflective white roofs to reduce heat impacts?			
e. Install green roofs to mitigate heat impacts?			
f. Have pavements and roofs designed to withstand extreme temperatures or solar radiation?			
g. Have light colored paving on parking areas and walkways around the facility?			
h. Provide an extra medical supply in case of increased demand for treatment of heat stress/cold effects?			
i. Have insulated loft and cavity walls?			

101. Have necessary training and preparedness to minimize the impacts of drought including:			
a. Have a mechanism to filter indoor and ambient air pollutants?			
b. Have a system for cooling the environment?			
c. Stimulate increase of water intake by staff and patients?			
d. Conduct ongoing and post-drought evaluations to identify success and weakness to improve preventive measures?			
e. Perform assessments of drought conditions – current, past trends and future changes – to implement preventive actions?			
102. Have necessary training and preparedness to minimize the impacts of storms including:			
a. Have safe roofing designed to withstand wind velocity of 175–250 kph (e.g. in a high intensity tropical storm)?			
b. Have rooftop structures and equipment which have been reviewed for anticipated storm and high wind speeds?			
c. Have machine rooms that are resistant to flooding or rooftop damage?			
d. Have stairwell construction fortified against high-wind events?			
e. Have glass walls, doors and windows able to resist basic wind speeds up to 200–250 kph?			
f. Have laminated or protected glass windows to prevent risk of shattering during a storm?			
g. Have leak proof windows and doors with wind protection devices?			
103. Have knowledge, experience (considering previous damages) and resources (including human, material, financial, supplies chain and logistics) to manage and reduce risk of climate change related emergency?			
104. Provide greater advocacy on health workforce education to cover climate change risks and responses?			
105. Work with the local government to support vulnerable local populations to actively participate in risk reduction management, policy making, planning and implementation?			
106. Conduct climate risk and vulnerability assessments for all facility sectors to identify risk scenarios, vulnerabilities, and the facility's response capacity?			
107. Utilize the assessed information as a basis to plan and prioritize measures to reduce risk impact?			
108. In their annual planning consider how climate risks may change in the future?			
109. Map the facility's location relative to sea-level rise hazards and wildfire hazards?			
110. Have resources available to adopt risk reduction measures on the building and its infrastructure, technologies, products, and processes?			
111. Regularly update these assessments, considering emerging scientific information?			
112. Have a schedule to inspect the facility regularly, both internally and externally, for signs of deterioration (e.g., cracks or sinking structural elements, broken plaster, cracks or sinking structural elements) to avoid or reduce impacts of climate change related events?			
113. Evaluate the condition and safety of structural and nonstructural elements impacted by previous exposure to climate change related events?			
114. Explore the relationship between social learning and adaptation measures in the face of climate change related threats to identify and implement the best behavioral responses from successful health facilities?			
115. Have a plan for assessing vulnerable public infrastructure along the coastal area of the health facility (e.g. transit systems and roads, water and sewage systems, energy infrastructure, alternative route for other health care facilities, logistics and supply chain for medical and laboratorial supplies, drinking water, food and other supplies) during sea-level rise event?			

116. Have a plan to respond during a climate change related emergency, including:			
a. 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?			
b. Have a contingency plan in place for safe and efficient personnel evacuation (including health staff and patients) before, during and following an emergency event?			
c. Have a plan to transfer critical equipment and medical supplies to another health care facility or to a secure storage?			
d. Have a mechanism for providing prompt maintenance and repair of equipment required for essential services?			
e. Have a mechanism to rapidly supply or restore water services to the facility?			
f. Have an effective emergency risk communication plan to reduce risks and impacts for health workers and patients?			
g. Have a plan for arranging for extra staffing for emergency support services?			
h. Have a coordinated mechanism across the health sector in different levels of government, to manage the response and risks resulting from public health emergencies and disasters (including sharing of resources and supplies, transferring of patients, and health workforce support)?			
i. Have health care agreements with other health care providers for additional health services and clinical resources?			
j. Have established procedures for procuring, and safely transporting and storing medical devices, pharmaceuticals, vaccines, laboratorial supplies, parenteral nutrition and blood supplies, and other essential medical supplies?			
k. Have established procedures or plans for procuring, transporting, and storing bottled water and food supplies during an emergency?			
l. 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?			
m. Have a plan to house staff at the health care facility if shelter is required (sleeping areas, food, water)?			
n. Have an established post-emergency recovery plan of all infrastructure facilities (structural and nonstructural elements)?			
o. Have a plan on continuity of operational processes during an emergency and for building back better through training and workshops?			
117. Conduct site and building maintenance procedures that include specifications on how the weather may affect the safety and continued functioning of the facility?			
118. Calculate possible losses and implement measures to reduce impacts?			
119. Gave a monitoring and early warning system to manage and reduce the risks of climate change related hazards health effects?			
<b>Promotion of new systems and technologies</b>			
120. Have an information system between the health sector and meteorological services to communicate about climate hazards (such as storm surge hazards, risk of wildfires, hazards-reduction burning, expected number of hot and smoky days or the likelihood of forthcoming extreme cold weather conditions)?			
121. Monitor information alerts from local announcements, air quality forecasts, and changing smoke conditions?			
122. Have emergency plan and procedures in place related to wildfire effects (such as hot temperature, air pollution, smoke, ash) on the facility?			
123. Have a calibrated carbon monoxide alarm with a digital display and battery backup function to identify air contamination?			
124. Have a syndromic surveillance system for drought-, heat- and cold-related illnesses?			

125. Have an updated training program for the health workforce to detect and track climate change-related human heat stress?			
126. Have an assessment plan for identifying vulnerability conditions considering the degree or extent of potential damage or loss in the event of a drought?			
127. Have identified capacities, resources and needs to better cope and manage climate change related emergency event?			
128. Have an established set of procedures to continually evaluate and implement risk management plans to stay responsive to the needs of the facility in climate change related emergency events?			
129. Have an established plan to review, evaluate and catalogue climate risks for the health care facility's location and supply chain?			
130. Have electronic patient health records to make available to other receiving health care facilities, in case of evacuation?			
131. Have information and communication systems safely secured with backup arrangements (via cloud, satellite) to satisfy the facility's demand?			
132. Ensure information and communication flow between the health workforce and policy makers, particularly during high-stress situations and demands created by emergencies?			
133. Have an established, clear and consistent knowledge transfer procedure for a public health emergency?			
134. Perform site and building maintenance procedures that include specifications on how the weather may affect the safety and continued functioning of the facility?			
135. Have an information system for tracking and monitoring diseases following climate change related events (such as flood, drought, heatwave, cold wave events)?			
136. Have measures that improve health performance, based on a history of climate variability in the region or locality?			
137. Have more than one access route, especially if the facility is critical to higher demand following a storm event?			
138. Have mitigation measures in place to respond to climate change scenarios and threats identified, including engineering, planning, as well as preparedness solutions for the facility and community surroundings (e.g. storm water pump stations, floodplain mapping, assessing future climate change impacts)?			
139. Have trees and plants which are resilient to drought surrounding the facility?			
140. Have a long-term strategy for reducing heat and cold effects, such as through building insulation?			
141. Perform risk assessments to assist with adaptation measures for heatwaves/cold waves?			
142. Perform evaluations to predict heatwave conditions 1–5 days in advance?			
143. Coordinate public broadcasts of information about the anticipated timing, severity and duration of heatwave/cold wave conditions in its surrounding communities?			
<b>Sustainability of health care facility operations</b>			
144. Offer a pleasant cool and protected environment that can avoid any kind of stress from high temperatures and smoke?			
145. Have adaptive governance capacity regarding evaluation and measures for risk identification, risk reduction and response?			
146. Have partnerships established between the facility, community, and local authorities to reduce vulnerabilities in the surrounding areas?			
147. Have a secure storage for hazardous chemicals to avoid their damage or release during an emergency event?			
148. Have a safe location for fuel storage systems (e.g., gas, gasoline, and diesel) or other protection measures in place?			
149. Have a defined and sustained budget as part of core budgeting for emergency preparedness and response during climate change related emergency event?			

150. Have an access route for public transportation which is likely to remain operational during or immediately following an event?			
151. Review building code design baselines against rainfall volumes, storm, wind speeds, extreme heat, cold temperatures, wildfires and map each risk?			
152. Have trees planted in a secure place that will not block access to the facility or fall on the building during an event?			
153. Have trees and leafy plants near windows to provide natural cooling?			
154. Have salt-resistant trees and plants?			
155. Have a plan to conserve and manage water to reduce water usage, specifically in case of prolonged drought?			
156. Have established requirements or provide incentives to encourage water conservation in the facility and in the communities?			
157. Have estimates of the consumption (such as amount used per week) of essential medical, pharmaceutical, nutritional and laboratorial supplies, personal protective equipment, food, etc., using the most likely climate change emergency scenario?			
158. Undertake risk assessments of the supply chain for essential medical and nonmedical products?			
159. Have a secure plan to ensure continuity of the facility's supply and delivery chain?			
160. 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?			
161. Have secure access to essential backup food sources via multiple agreements with different vendors, and through cooperative agreements with other facilities to maintain functioning of critical services?			
162. Have health care coalitions and partnerships with local health care providers for strategic decision-making on health services and clinical resources?			
163. Have a coordinated plan with municipal health department heads to ensure appropriate preparations for climate change emergencies (such as ongoing sea-level rise and heatwave/cold-wave conditions)?			
164. Have a plan to consider relocating the facility?			
165. Assess the length of time people can remain in a place before it gets overheated, requiring evacuation to another facility?			
166. Have a thermal stress device to assess temperature and identify heat warning environment?			
167. Have arrangements to transfer patients to temporary safe shelters?			
168. Have a clean-up plan with appropriate measures to avoid contamination and stir up ash in the air (e.g., store in plastic bags or other containers to prevent stirring up; avoid washing ash into storm drains; use a high-efficiency particulate air vacuum to clean dusty surfaces; avoid stirring up or sifting through ash) during wildfire event?			
169. Have a trained and prepared team or a dedicated person for occupational health and safety, to manage hazards (e.g., providing respirator masks that are appropriate for the hazard and work situation; medical evaluation for safe respirator use; fit testing for tight-fitting respirators; training on topics such as how to use and maintain respirator masks; and program evaluation) during climate change related emergency such as wildfire event?			

## Appendix 2: Vulnerability assessment of Lebanese Health care providers

**Table 2.1:** Vulnerability Key Areas/sub entities Addressed/Partially Addressed/Not Addressed by Accreditation Standards and Certification Programs

1. Lebanon Primary Health Care Standards 2015 2. Lebanon Revised Hospital Accreditation Standards 2019 3. The Joint Commission International (JCI) Standards 4. International Standard Organization ISO 9001 5. International Standard Organization ISO 14001 6. OSHA Hospital Safety and Health Management System	Accreditation and Certification programs					
	1	2	3	4	5	6
<b>Health workforce</b>						
<b>Human resources</b>						
<b>Is the health workforce</b>						
1. Prepared with a plan to ensure facility operation after climate-related emergency including:	●	●	●	●	●	●
a. Prepared with a contingency plan for accessing additional health workforce to strengthen performance capacity?	●	●	●	●	●	●
b. Equipped with a plan to identify minimum needs for health workers to ensure operational sufficiency care services?	●	●	●	●	●	●
c. Equipped with a coordinated plan, including volunteers on standby, to assist during an emergency or to support health professionals?	●	●	●	●	●	●
d. Provided with a post-emergency employee recovery assistance program according to staff needs?	●	●	●	●	●	●
2. Provided with full personal protective equipment:	●	●	●	●	●	●
a. PPEs during floods, especially for clean-up crews, including waterproof safety boots, goggles, work gloves and masks?	●	●	●	●	●	●
b. PPEs during cold snaps (warm, windproof and waterproof clothes, thermal underwear, boots)?	●	●	●	●	●	●
c. PPEs during wildfires, especially for cleaners (respirator masks such as fitting N-95 respirator, leather gloves, safety glasses or goggles, clothes such as long- sleeved shirts and long pants, and shoes with rugged soles)?	●	●	●	●	●	●
d. PPEs for workers during heat waves (for example: sunscreen, hats, etc.) especially for staff carrying out outdoor activities?	●	●	●	●	●	●
3. Provided with a plan to reduce extreme temperature exposure during hot/cold waves:	●	●	●	●	●	●
a. Equipped with a plan for scheduling outdoor work for cooler time of the day and reducing physical demand during hot days and rescheduling during cold waves?	●	●	●	●	●	●
b. Provided with drinking water and stimulated regularly for appropriate water intake?	●	●	●	●	●	●
c. Equipped with a plan to identify and protect health workers at risk of heat stress/cold waves' impacts?	●	●	●	●	●	●
d. Provided with a cool space/warm resting place or a shower room for staff?	●	●	●	●	●	●
4. Equipped with a plan to reduce smoke/ash exposure during wildfires:	●	●	●	●	●	●

a. Equipped with an alternative action plan for the health workforce with outdoor functions to avoid or limit their outdoor activity to avoid smoke and ash exposure (e.g. postponing or shortening time spent outdoors, relocating workers or rescheduling work tasks to areas or times of the day that are smoke-free or have less smoke; as well as encouraging and ensuring workers take frequent breaks inside clean air spaces; focusing on only performing high priority tasks, with workers' protection measures in place)?	●	●	●	●	●	●
b. Equipped with a plan to identify and protect health workers at risk of smoke and ash exposure, and heat stress?	●	●	●	●	●	●
c. Prepared with clear messages on reduction measures for short- and long-term exposures to indoor and outdoor air pollution and smoke (e.g., providing cleaner air spaces; using respirator masks; reducing outdoor activities; setting air conditioners to recirculation mode where safe; avoiding the use of exhaust fans in the kitchen, bathroom, clothes dryer and other facility rooms with exhaust fans)?	●	●	●	●	●	●
d. Prepared with clear guidance on actions to reduce heat and respiratory risk factors for staff?	●	●	●	●	●	●
5. Aware of the potential risks of climate hazards on the facility and themselves (for example: risk of sea-level rise)?	●	●	●	●	●	●
6. Protected from impacts of storm surges?	●	●	●	●	●	●
7. Provided with programs for supporting staff with regards to mental health, injuries due to climate-related hazards (such as eye and skin irritation due to smoke exposure, diseases related to hot temperatures, air pollution and ash and smoke exposure, chronic respiratory and cardiovascular diseases), medical treatment, and related support measures?	●	●	●	●	●	●
8. Participating in drought, water and climate change adaptation plan and policies?	●	●	●	●	●	●
9. Equipped with an emergency plan for shift relay or replacement of health professionals to ensure that staff get adequate rest?	●	●	●	●	●	●
10. Provided with an information system to manage occupational safety and health in the facility during climate-related emergency (for example: flood/storm/heatwave/cold wave)?	●	●	●	●	●	●
11. Equipped with an emergency plan to protect health workers from multiple biological and chemical hazards?	●	●	●	●	●	●
12. Provided with safe water and food during an event?	●	●	●	●	●	●
<b>Capacity Development</b>						
13. Trained on public health and climate change hazards including health impacts related to floods/storms/drought/heatwaves/wildfires/cold waves?	●	●	●	●	●	●
14. Equipped with knowledge, experience, training, and resources to manage climate change-related hazards reduction at the facility and in the local communities?	●	●	●	●	●	●
15. Engaged in the development of plans and responses to climate change-related risks?	●	●	●	●	●	●
16. Prepared with a contingency plan for continuing to provide services at other facilities or in the local communities (health primary care), if necessary?	●	●	●	●	●	●
17. Trained to detect posttraumatic stress disorder among staff to take prompt action?	●	●	●	●	●	●

18. Trained to manage hazardous chemicals in emergency situations?	●	●	●	●	●	●
19. Trained in multi-hazard assessments?	●	●	●	●	●	●
20. Trained to maintain correct level of water safety, quality control and treatment supplies, and alternative sources and electrical power supply, in both routine and emergency/disaster situations	●	●	●	●	●	●
21. Trained on how to treat stored water for human consumption?	●	●	●	●	●	●
22. Trained or prepared to quantify drought-sensitive diseases taking into account the special drought patterns?	●	●	●	●	●	●
23. Able to convey protective strategies for public health emergencies, in case of high temperature effects, and water and food contamination to patients, staff and communities?	●	●	●	●	●	●
24. Prepared and trained on a contingency plan for climate-related health impacts (including rapid increase in health workforce respiratory and cardiovascular problems, increased temperatures and heat stress, water- and air-borne diseases, and smoke and ash exposures)?	●	●	●	●	●	●
25. Provided with a mechanism to learn about air pollution advisories and warnings, including air quality monitoring information?	●	●	●	●	●	●
26. Trained on risk factors related to heating (e.g., carbon monoxide poisoning from certain heating appliances)?	●	●	●	●	●	●
27. Trained on actions to reduce personal levels of cardiac workload risk factors for staff?	●	●	●	●	●	●
28. Able to manage peak electricity demand?	●	●	●	●	●	●
<b>Communication and Awareness Raising</b>						
29. Aware of the impacts of climate change related hazards on human health	●	●	●	●	●	●
a. Impacts of drought on human health?	●	●	●	●	●	●
b. Impacts of hot temperatures on human health via water quality and quantity (including water- and food-borne diseases) and air quality?	●	●	●	●	●	●
c. Impacts of wildfire on human health due to poor air quality?	●	●	●	●	●	●
d. The risk factors of patients and symptoms expected during a cold/heat wave?	●	●	●	●	●	●
30. Following guidance on risk assessments to assist in the identification, planning, monitoring and evaluation of risk reduction and adaptation strategies associated with direct and indirect impacts of climate change related hazards including drought and wildfires?	●	●	●	●	●	●
31. Aware of preventive measures to reduce impact during climate change related emergency:	●	●	●	●	●	●
a. Aware of the need to keep hydrated and wear appropriate clothing during heatwaves?	●	●	●	●	●	●
b. Aware that they must use cool compresses, misting, and showers during heat waves?	●	●	●	●	●	●
c. Aware of appropriate strategies to reduce smoke exposure during evacuation, when necessary, because of danger from wildfires?	●	●	●	●	●	●
d. Aware of wearing tight-fitting respirators to filter ash particles from the air to protect lungs (e.g., N95 respirator mask#), particularly for cleaners and outdoor workers during wildfires?	●	●	●	●	●	●
e. Aware of having to change shoes and clothing before leaving a clean-up site to avoid taking ash offsite during wildfires?	●	●	●	●	●	●
f. Aware of not bringing food or eating at the affected site (and keeping food in a sealed container) and washing hands well before eating during wildfires?	●	●	●	●	●	●

g. Aware of the need to wear appropriate clothing (ensuring that head, nose, mouth, neck, hands and feet are covered properly; wearing appropriate boots that keep feet warm and prevent from slipping and falling; using several layers of clothing and ensuring the top one is windproof and waterproof), specifically for outdoor activities during cold waves?	●	●	●	●	●	●
h. Aware of avoiding getting their clothes wet during cold waves?	●	●	●	●	●	●
i. Aware of keeping the facility environment cool (e.g., keep windows that are exposed to the sun closed during the day and open at night when the temperature has dropped; close curtains that receive morning or afternoon sun; turn off nonessential lights and electrical equipment that generate heat; sleeping in a cooler room or use electric fans for some relief if temperatures are below 35°C) during drought and heat wave events?						
j. Aware of the need for an alternative action plan for the health workforce with outdoor responsibilities to reduce or avoid activity during excessive cold?	●	●	●	●	●	●
k. Aware of the need to take breaks in a warm place that is sheltered from wind and snowfall, when needing to stay outdoors for long periods of time during cold waves?	●	●	●	●	●	●
l. Aware of the risk factors that can increase impacts on health (e.g., smoking and drinking alcohol may lower the body temperature leading to hypothermia; some medications can make people more sensitive to cold; certain diseases can be aggravated from cold temperatures, such as heart diseases, lung diseases, malnutrition) during cold waves?	●	●	●	●	●	●
32. Provided with a safe internal communication system, especially in emergency situations?	●	●	●	●	●	●
33. Informed on how to use and follow a surveillance system to track health outcomes?	●	●	●	●	●	●
34. Aware of contingency plans for accessing and leaving/evacuating the facility during climate change related emergencies, and health workforce transportation?	●	●	●	●	●	●
35. Regularly participating in community disaster planning committees to: improve knowledge on how to reduce risks and vulnerabilities, be prepared and respond to climate-change related emergencies, and recover better than before through adaptation measures?	●	●	●	●	●	●
36. Prepared with clear messaging about water and food safety during and after a climate change related emergency?	●	●	●	●	●	●
37. Equipped with a flood plan or program with clear instructions on how to proceed during flood emergency situations?	●	●	●	●	●	●
38. Equipped with a community health educational program to improve community health in the face of climate change related risks?	●	●	●	●	●	●
39. Informed on how to reduce risks and vulnerabilities to flood and storm surge events resulting from sea-level rise?	●	●	●	●	●	●
<b>Water, sanitation and healthcare waste</b>						
<b>Monitoring and assessment</b>						
<b>Does the health care facility</b>						
40. Assess the capacity of the existing storm water management system, to ensure adequacy for anticipated 50- or 100-year storm events today?	●	●	●	●	●	●
41. Have an evaluation system to monitor its water system and supply and reduce contaminate concentrations before, during and after a climate change related emergency (such as storm surge/ cold wave event/wildfire)?	●	●	●	●	●	●
42. Have a water quality monitoring plan for human consumption and drinking water during and after the emergency event?	●	●	●	●	●	●
43. Have information on water system installation that ensures lower risk of freezing and contamination?	●	●	●	●	●	●
44. Have an updated assessment plan to map risks to the water and sanitation infrastructure in place, and to identify where services could be disrupted from climate-change related hazards and water scarcity?	●	●	●	●	●	●

45. Verify water safety conditions, including updated risk assessments to map water resources and water supplies for the facility and ensure proper functioning of all elements of the system and monitor water drips, leaks and unnecessary flows in bathrooms, laundry facilities, kitchen, etc.; and perform prompt repairs to avoid loss?	●	●	●	●	●	●
46. Regularly assess its sanitation system for any possible damage in the event of climate change related hazards (such as flooding, storm and sever winds, sea-level rise)?	●	●	●	●	●	●
47. Monitor sewer overflows in order to fix pumps in advance of the emergency event (such as flood or storm) and after the event?	●	●	●	●	●	●
48. Conduct a waste audit to reduce waste as much as possible?	●	●	●	●	●	●
49. Regularly inspect the rainwater harvesting system for damage and contamination?	●	●	●	●	●	●
<b>Risk management</b>						
50. Have a water management plan able:	●	●	●	●	●	●
a.To identify water contamination	●	●	●	●	●	●
b. To avoid or reduce vector breeding sites	●	●	●	●	●	●
51. Have a storm water management system able:	●	●	●	●	●	●
a. To cope with storm-caused floods	●	●	●	●	●	●
b. To avoid standing water near the facility	●	●	●	●	●	●
52. Have a natural floodwater infiltration system to reduce risk of facility flooding?	●	●	●	●	●	●
53. Have a rainwater catchment system with safe water storage?	●	●	●	●	●	●
54. Have anti-mosquito breeding measures?	●	●	●	●	●	●
55. Have water storage tanks with appropriate covers that is protected from direct sunlight and excessive heat and that prevents access or contamination, damage and saline water intrusion and safety located for an emergency event?	●	●	●	●	●	●
56. Have chemicals stored away from excessive heat/cold waves or wildfires?	●	●	●	●	●	●
57. Provide sufficient drinking water to staff, patients, and visitors?	●	●	●	●	●	●
58. Have a schedule for emptying latrines in advance of the flood season/storm events to avoid overflows?	●	●	●	●	●	●
59. Have onsite water treatment and water purification equipment to provide sufficient quantity of safe drinking water?	●	●	●	●	●	●
60. Have non-return valves installed on water supply pipes to prevent backflows?	●	●	●	●	●	●
61. Have a surveillance system for diseases related to water quality and sanitation?	●	●	●	●	●	●
62. Have a mechanism to protect freshwater sources around the facility from all types of contamination, including saline intrusion?	●	●	●	●	●	●
63. Have a safe water and wastewater management system for sea-level rise impacts, including standing water near the facility?	●	●	●	●	●	●
64. Have direct communication with water providers to ensure that water supply is safe to drink?	●	●	●	●	●	●
65. Have a safe health care waste management system in place before, during and after climate change related event including:	●	●	●	●	●	●
a. Have a safe storage place, away from excessive heat in cool and covered spaces?	●	●	●	●	●	●
b. Have a safe waste disposal system?	●	●	●	●	●	●
c. Have an established safe management approach to health care waste transport (including hazardous waste)?	●	●	●	●	●	●

d. Have chemical, radioactive and biological hazardous waste stored in a safe place and on a level above the ground floor?	●	●	●	●	●	●
e. Have waste pits able to withstand flood events?	●	●	●	●	●	●
f. Have waste storage tanks supported and anchored to resist strong winds and rainfall?	●	●	●	●	●	●
g. Keep waste sealed in rubbish bins to avoid rodents?	●	●	●	●	●	●
h. Have safe waste disposal of debris after a high tide event?	●	●	●	●	●	●
<b>Health and safety regulation</b>						
66. Have an emergency water supply plan (alternative water source) and a long-term drought management plan?	●	●	●	●	●	●
67. Have a water safety plan in place, in case:	●	●	●	●	●	●
a. Water contamination	●	●	●	●	●	●
b. Freezing waters?	●	●	●	●	●	●
68. Have a mechanism or regulation to carry out sanitary inspections of water supply and alternative sources (e.g., wells, dams, cisterns, fountains and water trucks), and when necessary, establish a temporary ban on use, until improvements are made?	●	●	●	●	●	●
69. Have a contingency plan to ensure effective and timely delivery of safe water during extreme temperatures, floods, droughts, cold waves, and other climate change related emergencies over the short, medium, and long-term?	●	●	●	●	●	●
70. Have a plan to provide and maintain adequate cleaning and disinfection supplies (such as chlorine, filters or other water treatment technology, rapid water testing kit) for water safety?	●	●	●	●	●	●
71. Have an emergency plan for maintenance and restoration of waste management systems?	●	●	●	●	●	●
72. Work with water utility agencies to prevent suspension of services.	●	●	●	●	●	●
73. Have a coordinated cross-sectoral water management plan to protect local or alternative water sources?	●	●	●	●	●	●
74. Have a plan to conserve and manage water to reduce water usage, specifically in case of prolonged drought?	●	●	●	●	●	●
75. Have additional water treatment and storage capacity to account for interruption, quality and quantity?	●	●	●	●	●	●
<b>Energy</b>						
<b>Monitoring and assessment</b>						
<b>Does the health care facility</b>						
76. Regularly assess its energy system to ensure that it can cope with climate change related events and minimize their impacts?	●	●	●	●	●	●
77. 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 an emergency event?	●	●	●	●	●	●
78. Periodically check emergency backup generators (including fuel, where relevant)?	●	●	●	●	●	●
79. Assess whether renewable energy (if available, such as solar) is sufficient to power critical equipment?	●	●	●	●	●	●
80. Assess regularly and monitor the heating, ventilation, and air conditioning systems to control the functioning of all critical medical equipment?	●	●	●	●	●	●
81. Regularly assess whether the heating system can cope with unexpected cold temperatures?	●	●	●	●	●	●
82. Monitor building humidity and if needed adjust the cooling system to control the humidity in operating room areas?	●	●	●	●	●	●
83. Identify priority areas within the facility which would require emergency power during and after an emergency event?	●	●	●	●	●	●

Risk management						
84. Have a secure place to protect the backup generator (e.g. an elevated place; including fuel or battery storage, where relevant) from flood waters or damage during an emergency event?	●	●	●	●	●	●
85. Have adequate daylight to ensure proper visibility during a power outage?	●	●	●	●	●	●
86. Have power-operated doors that can easily be opened manually to permit exit in case of power failure?	●	●	●	●	●	●
87. Have appliance thermometers in the refrigerator and freezer to determine if food, vaccines, and other essential refrigeration-dependent medical supplies are safe?	●	●	●	●	●	●
88. 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, do not use electrical equipment that has been exposed to heat from a fire until checked by an electrician; use extreme caution when equipment is moved near overhead power lines; do not stand or work in areas with thick smoke (smoke hides electrical lines and equipment))?	●	●	●	●	●	●
89. Have a clear guidance on heat/cold-risk management for the maintenance of critical infrastructure (e.g. air-conditioning, heating systems medical devices, computers, diagnostic equipment, boiling water)?	●	●	●	●	●	●
Health and safety regulation						
90. Have an emergency plan for power outages in the short- and long-term before, during and after an emergency event?	●	●	●	●	●	●
91. Work with energy utility agencies to prevent suspension of electricity services?	●	●	●	●	●	●
92. Have a management plan for intermittent energy supplies or system failure?	●	●	●	●	●	●
93. Have a generator backup or renewable energy sources (e.g. solar, wind power, small-scale hydroelectric power plants) that can be used for water pumping?	●	●	●	●	●	●
94. Have a plan or regulation to determine ways to reduce overall energy use?	●	●	●	●	●	●
95. Have an emergency plan to ensure availability of adequate lighting, communication and information systems, and refrigeration and sterilization equipment during an emergency event?	●	●	●	●	●	●
96. Have a plan to evacuate patients to a cooling/heating stations if the facility has lost power and has no other source of energy?	●	●	●	●	●	●
Infrastructure, technologies, products and processes						
Adaptation of current systems and infrastructures						
Does the health care facility						
97. Have necessary training and preparedness to minimize the impacts of cold waves including:	●	●	●	●	●	●
a. Have preparedness and training for periods of extreme cold exposure?	●	●	●	●	●	●
b. Perform necessary and appropriate maintenance work to prepare the facility for winter or severe cold temperatures?	●	●	●	●	●	●
c. Ensure that the rooms are well ventilated, when using an auxiliary heating system, such as oil-burning furnaces, wood-burning fireplaces, wood-burning stoves, propane heaters generators?	●	●	●	●	●	●
d. Have caulked windows and doors to prevent cold air from coming in?	●	●	●	●	●	●
e. Provide sufficient and necessary materials to supporting staff in outdoor activities, when necessary (e.g., in the case of vehicle breakdown having bottled water, food, blankets, cell phone and charger, shovel, snow brush, traction aids and medication)?	●	●	●	●	●	●

98. Have necessary training and preparedness to minimize the impacts of wildfires including:	●	●	●	●	●	●
a. Have an indoor air quality contingency plan in place for hazard-reduction burning, before the start of the fire season, as well as during and after a wildfire to assist in planning and decision-making?	●	●	●	●	●	●
b. Regularly monitor air quality (temperature and humidity), especially during and after wildfire exposures?	●	●	●	●	●	●
c. Have available appropriate air filters in indoor working areas to reduce overall smoke and dust exposure?	●	●	●	●	●	●
d. Assess if the filters of the heating, ventilating and air conditioning systems are not dirty, damaged, dislodged or leaking around the edges, before the wildfire season and during smoke events to ensure necessary repairs and appropriate maintenance?	●	●	●	●	●	●
e. Have appropriate portable air cleaners to reduce indoor particle levels?	●	●	●	●	●	●
f. Have appropriate ceiling fans or portable fans for room cooling?	●	●	●	●	●	●
g. Have a management plan for the use of personal protective equipment for wildfires in the medical stockpile?	●	●	●	●	●	●
h. Maintain partnerships with key partners and stakeholders (e.g. air quality agencies, local health providers, health departments, fire department, land management agencies, and others) for effective wildfire response and recovery?	●	●	●	●	●	●
99. Have necessary training and preparedness to minimize the impacts of floods including:	●	●	●	●	●	●
a. Have a safe location for critical services and equipment in a flood emergency situation?	●	●	●	●	●	●
b. Have a safety plan to prevent medical and laboratorial equipment and supplies, and food packages to be exposed to flood waters?	●	●	●	●	●	●
c. 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?	●	●	●	●	●	●
d. Have evacuation routes above flood elevation?	●	●	●	●	●	●
e. Have water-resistant interior construction?	●	●	●	●	●	●
f. Have walls protected and insulated against moisture and mold?	●	●	●	●	●	●
g. Have roof drainage systems for rainfall?	●	●	●	●	●	●
h. Have rooftop structures and equipment revised for anticipated increased rainfall?	●	●	●	●	●	●
i. Have roofs that are leak-proof and insulated?	●	●	●	●	●	●
j. Ensure removal of equipment and power supplies from basements and ground floor level to avoid damage from flooding?	●	●	●	●	●	●
100. Have necessary training and preparedness to minimize the impacts of heat waves including:	●	●	●	●	●	●
a. Assess the capacity of heating, ventilation and air-conditioning systems to deal with increasing heat and humidity?	●	●	●	●	●	●
b. Have exterior shading devices, trees or other architectural features that mitigate heat and dryness?	●	●	●	●	●	●
c. Have openable windows to provide for ventilation and to maintain habitable conditions?	●	●	●	●	●	●
d. Install reflective white roofs to reduce heat impacts?	●	●	●	●	●	●
e. Install green roofs to mitigate heat impacts?	●	●	●	●	●	●
f. Have pavements and roofs designed to withstand extreme temperatures or solar radiation?	●	●	●	●	●	●
g. Have light colored paving on parking areas and walkways around the facility?	●	●	●	●	●	●
h. Provide an extra medical supply in case of increased demand for treatment of heat stress/cold effects?	●	●	●	●	●	●
i. Have insulated loft and cavity walls?	●	●	●	●	●	●

101. Have necessary training and preparedness to minimize the impacts of drought including:	●	●	●	●	●	●
a. Have a mechanism to filter indoor and ambient air pollutants?	●	●	●	●	●	●
b. Have a system for cooling the environment?	●	●	●	●	●	●
c. Stimulate increase of water intake by staff and patients?	●	●	●	●	●	●
d. Conduct ongoing and post-drought evaluations to identify success and weakness to improve preventive measures?	●	●	●	●	●	●
e. Perform assessments of drought conditions – current, past trends and future changes – to implement preventive actions?	●	●	●	●	●	●
102. Have necessary training and preparedness to minimize the impacts of storms including:	●	●	●	●	●	●
a. Have safe roofing designed to withstand wind velocity of 175–250 kph (e.g. in a high intensity tropical storm)?	●	●	●	●	●	●
b. Have rooftop structures and equipment which have been reviewed for anticipated storm and high wind speeds?	●	●	●	●	●	●
c. Have machine rooms that are resistant to flooding or rooftop damage?	●	●	●	●	●	●
d. Have stairwell construction fortified against high-wind events?	●	●	●	●	●	●
e. Have glass walls, doors and windows able to resist basic wind speeds up to 200–250 kph?	●	●	●	●	●	●
f. Have laminated or protected glass windows to prevent risk of shattering during a storm?	●	●	●	●	●	●
g. Have leak proof windows and doors with wind protection devices?	●	●	●	●	●	●
103. Have knowledge, experience (considering previous damages) and resources (including human, material, financial, supplies chain and logistics) to manage and reduce risk of climate change related emergency?	●	●	●	●	●	●
104. Provide greater advocacy on health workforce education to cover climate change risks and responses?	●	●	●	●	●	●
105. Work with the local government to support vulnerable local populations to actively participate in risk reduction management, policy making, planning and implementation?	●	●	●	●	●	●
106. Conduct climate risk and vulnerability assessments for all facility sectors to identify risk scenarios, vulnerabilities, and the facility's response capacity?	●	●	●	●	●	●
107. Utilize the assessed information as a basis to plan and prioritize measures to reduce risk impact?	●	●	●	●	●	●
108. In their annual planning consider how climate risks may change in the future?	●	●	●	●	●	●
109. Map the facility's location relative to sea-level rise hazards and wildfire hazards?	●	●	●	●	●	●
110. Have resources available to adopt risk reduction measures on the building and its infrastructure, technologies, products, and processes?	●	●	●	●	●	●
111. Regularly update these assessments, considering emerging scientific information?	●	●	●	●	●	●
112. Have a schedule to inspect the facility regularly, both internally and externally, for signs of deterioration (e.g., cracks or sinking structural elements, broken plaster, cracks or sinking structural elements) to avoid or reduce impacts of climate change related events?	●	●	●	●	●	●
113. Evaluate the condition and safety of structural and nonstructural elements impacted by previous exposure to climate change related events?	●	●	●	●	●	●
114. Explore the relationship between social learning and adaptation measures in the face of climate change related threats to identify and implement the best behavioral responses from successful health facilities?	●	●	●	●	●	●
115. Have a plan for assessing vulnerable public infrastructure along the coastal area of the health facility (e.g. transit systems and roads, water and sewage systems, energy infrastructure, alternative route for other health care facilities, logistics and supply chain for medical and laboratorial supplies, drinking water, food and other supplies) during sea-level rise event?	●	●	●	●	●	●

116. Have a plan to respond during a climate change related emergency, including:	●	●	●	●	●	●
a. 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?	●	●	●	●	●	●
b. Have a contingency plan in place for safe and efficient personnel evacuation (including health staff and patients) before, during and following an emergency event?	●	●	●	●	●	●
c. Have a plan to transfer critical equipment and medical supplies to another health care facility or to a secure storage?	●	●	●	●	●	●
d. Have a mechanism for providing prompt maintenance and repair of equipment required for essential services?	●	●	●	●	●	●
e. Have a mechanism to rapidly supply or restore water services to the facility?	●	●	●	●	●	●
f. Have an effective emergency risk communication plan to reduce risks and impacts for health workers and patients?	●	●	●	●	●	●
g. Have a plan for arranging for extra staffing for emergency support services?	●	●	●	●	●	●
h. Have a coordinated mechanism across the health sector in different levels of government, to manage the response and risks resulting from public health emergencies and disasters (including sharing of resources and supplies, transferring of patients, and health workforce support)?	●	●	●	●	●	●
i. Have health care agreements with other health care providers for additional health services and clinical resources?	●	●	●	●	●	●
j. Have established procedures for procuring, and safely transporting and storing medical devices, pharmaceuticals, vaccines, laboratorial supplies, parenteral nutrition and blood supplies, and other essential medical supplies?	●	●	●	●	●	●
k. Have established procedures or plans for procuring, transporting, and storing bottled water and food supplies during an emergency?	●	●	●	●	●	●
l. 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?	●	●	●	●	●	●
m. Have a plan to house staff at the health care facility if shelter is required (sleeping areas, food, water)?	●	●	●	●	●	●
n. Have an established post-emergency recovery plan of all infrastructure facilities (structural and nonstructural elements)?	●	●	●	●	●	●
o. Have a plan on continuity of operational processes during an emergency and for building back better through training and workshops?	●	●	●	●	●	●
117. Conduct site and building maintenance procedures that include specifications on how the weather may affect the safety and continued functioning of the facility?	●	●	●	●	●	●
118. Calculate possible losses and implement measures to reduce impacts?	●	●	●	●	●	●
119. Gave a monitoring and early warning system to manage and reduce the risks of climate change related hazards health effects?	●	●	●	●	●	●
<b>Promotion of new systems and technologies</b>						
120. Have an information system between the health sector and meteorological services to communicate about climate hazards (such as storm surge hazards, risk of wildfires, hazards-reduction burning, expected number of hot and smoky days or the likelihood of forthcoming extreme cold weather conditions)?	●	●	●	●	●	●
121. Monitor information alerts from local announcements, air quality forecasts, and changing smoke conditions?	●	●	●	●	●	●
122. Have emergency plan and procedures in place related to wildfire effects (such as hot temperature, air pollution, smoke, ash) on the facility?	●	●	●	●	●	●
123. Have a calibrated carbon monoxide alarm with a digital display and battery backup function to identify air contamination?	●	●	●	●	●	●
124. Have a syndromic surveillance system for drought-, heat- and cold-related illnesses?	●	●	●	●	●	●

125. Have an updated training program for the health workforce to detect and track climate change-related human heat stress?	●	●	●	●	●	●
126. Have an assessment plan for identifying vulnerability conditions considering the degree or extent of potential damage or loss in the event of a drought?	●	●	●	●	●	●
127. Have identified capacities, resources and needs to better cope and manage climate change related emergency event?	●	●	●	●	●	●
128. Have an established set of procedures to continually evaluate and implement risk management plans to stay responsive to the needs of the facility in climate change related emergency events?	●	●	●	●	●	●
129. Have an established plan to review, evaluate and catalogue climate risks for the health care facility's location and supply chain?	●	●	●	●	●	●
130. Have electronic patient health records to make available to other receiving health care facilities, in case of evacuation?	●	●	●	●	●	●
131. Have information and communication systems safely secured with backup arrangements (via cloud, satellite) to satisfy the facility's demand?	●	●	●	●	●	●
132. Ensure information and communication flow between the health workforce and policy makers, particularly during high-stress situations and demands created by emergencies?	●	●	●	●	●	●
133. Have an established, clear and consistent knowledge transfer procedure for a public health emergency?	●	●	●	●	●	●
134. Perform site and building maintenance procedures that include specifications on how the weather may affect the safety and continued functioning of the facility?	●	●	●	●	●	●
135. Have an information system for tracking and monitoring diseases following climate change related events (such as flood, drought, heatwave, cold wave events)?	●	●	●	●	●	●
136. Have measures that improve health performance, based on a history of climate variability in the region or locality?	●	●	●	●	●	●
137. Have more than one access route, especially if the facility is critical to higher demand following a storm event?	●	●	●	●	●	●
138. Have mitigation measures in place to respond to climate change scenarios and threats identified, including engineering, planning, as well as preparedness solutions for the facility and community surroundings (e.g. storm water pump stations, floodplain mapping, assessing future climate change impacts)?	●	●	●	●	●	●
139. Have trees and plants which are resilient to drought surrounding the facility?	●	●	●	●	●	●
140. Have a long-term strategy for reducing heat and cold effects, such as through building insulation?	●	●	●	●	●	●
141. Perform risk assessments to assist with adaptation measures for heatwaves/cold waves?	●	●	●	●	●	●
142. Perform evaluations to predict heatwave conditions 1–5 days in advance?	●	●	●	●	●	●
143. Coordinate public broadcasts of information about the anticipated timing, severity and duration of heatwave/cold wave conditions in its surrounding communities?	●	●	●	●	●	●
<b>Sustainability of health care facility operations</b>						
144. Offer a pleasant cool and protected environment that can avoid any kind of stress from high temperatures and smoke?	●	●	●	●	●	●
145. Have adaptive governance capacity regarding evaluation and measures for risk identification, risk reduction and response?	●	●	●	●	●	●
146. Have partnerships established between the facility, community, and local authorities to reduce vulnerabilities in the surrounding areas?	●	●	●	●	●	●
147. Have a secure storage for hazardous chemicals to avoid their damage or release during an emergency event?	●	●	●	●	●	●
148. Have a safe location for fuel storage systems (e.g., gas, gasoline, and diesel) or other protection measures in place?	●	●	●	●	●	●
149. Have a defined and sustained budget as part of core budgeting for emergency preparedness and response during climate change related emergency event?	●	●	●	●	●	●

150. Have an access route for public transportation which is likely to remain operational during or immediately following an event?	●	●	●	●	●	●
151. Review building code design baselines against rainfall volumes, storm, wind speeds, extreme heat, cold temperatures, wildfires and map each risk?	●	●	●	●	●	●
152. Have trees planted in a secure place that will not block access to the facility or fall on the building during an event?	●	●	●	●	●	●
153. Have trees and leafy plants near windows to provide natural cooling?	●	●	●	●	●	●
154. Have salt-resistant trees and plants?	●	●	●	●	●	●
155. Have a plan to conserve and manage water to reduce water usage, specifically in case of prolonged drought?	●	●	●	●	●	●
156. Have established requirements or provide incentives to encourage water conservation in the facility and in the communities?	●	●	●	●	●	●
157. Have estimates of the consumption (such as amount used per week) of essential medical, pharmaceutical, nutritional and laboratorial supplies, personal protective equipment, food, etc., using the most likely climate change emergency scenario?	●	●	●	●	●	●
158. Undertake risk assessments of the supply chain for essential medical and nonmedical products?	●	●	●	●	●	●
159. Have a secure plan to ensure continuity of the facility's supply and delivery chain?	●	●	●	●	●	●
160. 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?	●	●	●	●	●	●
161. Have secure access to essential backup food sources via multiple agreements with different vendors, and through cooperative agreements with other facilities to maintain functioning of critical services?	●	●	●	●	●	●
162. Have health care coalitions and partnerships with local health care providers for strategic decision-making on health services and clinical resources?	●	●	●	●	●	●
163. Have a coordinated plan with municipal health department heads to ensure appropriate preparations for climate change emergencies (such as ongoing sea-level rise and heatwave/cold-wave conditions)?	●	●	●	●	●	●
164. Have a plan to consider relocating the facility?	●	●	●	●	●	●
165. Assess the length of time people can remain in a place before it gets overheated, requiring evacuation to another facility?	●	●	●	●	●	●
166. Have a thermal stress device to assess temperature and identify heat warning environment?	●	●	●	●	●	●
167. Have arrangements to transfer patients to temporary safe shelters?	●	●	●	●	●	●
168. Have a clean-up plan with appropriate measures to avoid contamination and stir up ash in the air (e.g., store in plastic bags or other containers to prevent stirring up; avoid washing ash into storm drains; use a high-efficiency particulate air vacuum to clean dusty surfaces; avoid stirring up or sifting through ash) during wildfire event?	●	●	●	●	●	●
169. Have a trained and prepared team or a dedicated person for occupational health and safety, to manage hazards (e.g., providing respirator masks that are appropriate for the hazard and work situation; medical evaluation for safe respirator use; fit testing for tight-fitting respirators; training on topics such as how to use and maintain respirator masks; and program evaluation) during climate change related emergency such as wildfire event?	●	●	●	●	●	●

- High risk as the entity is not met
- Medium risk as the entity is partially met
- Low risk as the entity is addressed

## Appendix 3: Concept notes to increase resilience in Health Care Facilities

### Concept Note 1: Primary Health Care Centers Emergency Preparedness: WASH and Health Care Waste Management

#### Background

Lebanon has an active network of 212 Primary Health Care Centers (PHCCs). The latest PHCC network assessment conducted in 2020 showed that Mount Lebanon includes the largest number of PHCCs (n = 55, 25.9%) while the lowest is in Beirut (n = 14, 6.6%). In addition, more than 50% of the PHCCs are located in rural areas (n = 125, 59.0%). Currently, 77.8% PHCCs provide the following health services (1) family medicine / general consultation services; (2) dental services; (3) pediatric services; (4) reproductive, maternal, and newborn health services; (5) non-communicable disease management; (6) mental health services; (7) diagnostic imaging services; (8) basic laboratory services; and (9) pharmaceutical services. However, their readiness for the delivery of these services was considered low; only seventeen (8.0%) of the PHCCs have been accredited by the national PHC Accreditation Program (Hamadeh et.al., 2020). In addition, PHCCs play a crucial role in health emergencies preparedness as they are associated with the following services: (Bou-Karroum et al., 2020; WHO, 2018):

- (a) Delivery of primary prevention interventions (e.g., WASH services, vaccination programs and surveillance systems for the rapid detection of disease outbreak following a disaster),
- (b) Identification of vulnerable groups in disaster-affected communities,
- (c) Alleviation of the burden on overloaded hospitals through acting as a community-level triage system (patients with minor illnesses treated onsite, and those with serious injuries are referred to hospitals),
- (d) Management of health-related emergency diseases (e.g., mental health, chronic disease interventions, food- and water-borne disease),
- (e) Promotion of community engagement (effectively communicating risks and sharing timely information), and
- (f) Provision of outreach amenities and mobile clinic services (e.g. non-communicable disease interventions, mental health services and other primary health care services) to vulnerable and disadvantaged populations.

Among the services provided by PHCCs, WASH and Health Care Waste Management has been identified as a key area that significantly impacts the health facilities and communities' vulnerability to climate change crisis. Accordingly, monitoring and assessment as it relates to water, sanitation, chemical use, and health care waste is crucial. Hence the need to strengthen the capacity of PHCCs to achieve sustainable management of water and sanitation services, chemical use and health care waste; this entails the assessments of climate-resilience and environmental sustainability in responding to hazards and identifying and reducing exposures and vulnerabilities (WHO, 2020, WHO, 2021). Further, as Lebanon continues to be challenged by the provision of safe drinking water, improved sanitation, and management of health care waste which have been further aggravated by the influx of Syrian Refugees (892,310 registered as of 31 May 2020), a significant role can be played by PHCCs to overcome these challenges (UNHCR, 2020).

Therefore, PHCCs should be able to manage water and sanitation service, chemicals use and health care waste onsite to reduce associated risks to workers and patients and serve communities by overseeing water quality monitoring and management, as well as overall WASH services, under normal circumstances, during emergencies and through recovery phases.

#### Project Goals and Objectives

The ultimate goal of the project is to empower Primary Health Care Centers in emergency preparedness to climate change crises. This would be achieved by reducing the vulnerability and enhancing the preparedness of health care facilities, including e.g., Primary Health Care Centers, by appropriate and sustainable management of the following four key vulnerability areas (1) health workforce, (2) WASH and health care waste, (3) energy, and (4) infrastructure, technologies, products and processes.

The preliminary phase of the project address WASH and Health Care Waste Management with the following objectives:

1. Provision of onsite sustainable basic WASH services and health care waste management in primary health care centers (PHCCs) to improve health outcomes at the level of the workers, patients, and community.
2. Empower PHCCs to oversee water quality monitoring and management, and overall WASH services under normal circumstances, and during emergencies and recovery phases.

## Methodology

The Initial Phase of the project would include PHCCs that are accredited by MoPH to ensure better compliance and continuity. Moreover, the sample size should cover all regions of the Country (urban and rural). Additionally, once resources become available, all PHCCs should be covered by sustainable basic WASH services and sustainable health care waste management and should be leading on objective two as part of the package of health services provided.

The project has two components, one onsite, within the healthcare center, and the other component as community outreach. For objective one that is mostly onsite, the following activities are detailed:

- 1.1. Assess onsite WASH services and health care waste management in a representative sample of small, medium, and large-scale service providers (community served).
- 1.2. Determine needs to provide basic WASH and sustainable health care waste management, onsite, at PHCCs.
- 1.3. Coordinate with concerned Ministries (MoPH and MoE and DRM unit) on ensuring sustainable financial resources.
- 1.4. Upgrade facilities and services needed to sustainably provide appropriate and sustainable onsite WASH services and health care waste management
- 1.5. Conduct training and capacity building to ensure sustainability of human resources.
- 1.6. Develop key performance indicators, to be monitored and continuously evaluated.

For objective two, which includes the community outreach component of the project:

- 1.1. Provide basic technical infrastructure (basic field units) to conduct water quality monitoring.
- 1.2. Train technical staff to conduct routine water quality monitoring of domestic water supplies serving homes, schools, and all other health care facilities, specifically in and post emergencies (in collaboration with MoEW, Regional Water Establishments, and MoPH).
- 1.3. Train technical staff to evaluate, on continuous basis, changes in water safety plans by water establishments.
- 1.4. Train technical staff on regular assessment of sanitation systems for possible damage relating to climate change hazards and crisis.
- 1.5. Train technical staff on basic and emergency hygiene measures and procedures.
- 1.6. Develop operational procedures and quality control procedures.
- 1.7. Develop clear risk communication forms and channels to activate interventions at the governmental and community levels.

## Significance and Scientific Novelty

The outputs of the project will improve the environmental sustainability of PHCCs and will empower their role in service provision and climate change preparedness. Moreover, it will expand on the scope of services that can be provided throughout the country and can, as such, reach the more vulnerable and disadvantaged communities. It will strengthen the PHCCs Network and its resilience and response to climate change shocks and emergency disasters.

## Expected Results

The expected outcomes include the following:

- Better health preparedness
- More equity in provision of basic environmental health services that define vulnerability to climate change crisis.
- More community outreach resulting in better risk communication for directed management.

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## Concept Note 2: Achieving Environmentally Sustainable Health Care Facilities

### Background

Health systems are fundamental to improve and conserve public health and wellbeing, particularly during public health emergencies and crises, including climate change related events (WHO Regional Office for Europe, 2015). Still, health care facilities have direct and indirect environmental impacts, as they are major consumers of water and energy resources. Moreover, they generate significant amounts of solid waste and wastewater, and produce air emissions contributing to climate change (WHO, 2017). Healthcare facilities are among the highest waste generating sectors; although the majority of the waste generated is municipal solid waste, the remaining is hazardous healthcare waste that have negative impacts on the environment if not properly treated and disposed of (AMA, 2019; Chartier et al., 2014). Additionally, healthcare facilities generate wastewater that contains hazardous toxic substances that harm environmental ecosystems such as pharmaceutical products, heavy metals, detergents and other chemicals of concern (WHO, 2017). Moreover, they are major consumers of toxic chemicals, such as mercury, polyvinyl chloride, flame-retardants, and volatile organic chemicals, which significantly affect the natural environment and human health (WHO, 2017).

Accordingly, environmentally sustainable health systems, as defined by the World Health Organization, are systems that improve, maintain, or restores health while minimizing negative impacts on the environment and leveraging opportunities to restore and improve it, to the benefit of the health and well-being of current and future generations (WHO, 2017). Moreover, achieving environmental sustainability of health care systems, also referred to as greening, is aligned with the sustainable development 2030 goals and targets through addressing upstream determinants of health, providing benefits for patients and contributing to healthier communities. It also provides benefits to the health system's core functions by decreasing associated environmental health risks (WHO, 2017; AMA, 2019; Health Research & Educational Trust, 2014). For example, studies have shown that selected electronic health (e-health) interventions (such as telemedicine) can improve health outcomes and access to care, reduce pollution and reduce out-of-pocket expenses by limiting the need for travel, and save costs through reduced need for care (WHO, 2017; Health Research & Educational Trust, 2014). Mainstreaming environmental sustainability can also reduce operational costs of the health system (Health Research & Educational Trust, 2014). A study of 5 hospitals in the United States implementing environmental sustainability interventions reported financial savings exceeding \$5.4 billion over five years and \$15 billion over 10 years (WHO, 2017). Most importantly, such interventions can decrease the vulnerabilities of hospitals and increase resilience of health systems. Moreover, greening of health care facilities has been identified by the Arab Health and Environmental Strategy 2017-2030 as a strategic response to sustainable development and health (WHOEMRO/Arab League/UNEP, 2016). The National Health and Environment Strategic Framework 2021-26 recommends the development of a sustainable system for financing greening imitative of the health care sector, setting national environmental resource utilization targets, and increasing the efficiency of resources use.

As such, adopting a national Environmental Sustainability Policy Framework and Strategic Action in Lebanon is fundamental in achieving environmental sustainability of the health care system; still, limited work has been conducted to evaluate the environmental sustainability of hospitals in Lebanon.

### Project Goal and Objectives

The ultimate objective of this project to achieve environmental sustainability of the health care facilities (Primary Health Care Centers) by developing a roadmap including a national policy framework and strategic action plan through consultation with healthcare providers and concerned stakeholders.

Phase one objectives of the project are to:

1. Assess the environmental footprint of health facilities (hospitals) in Lebanon and evaluate their environmental sustainability.

2. Develop and implement greening projects in health care facilities (hospitals) relating to conservation and maintenance of safe water supplies and management of wastewater and solid waste.

3. Propose a roadmap for achieving environmental sustainability of the Lebanese health care system, which includes necessary policy framework, strategic action plans and interventions to be implemented at health care facilities to achieve the latter and overcome the barriers for the successful implementation. The framework will include principles, commitments, and priorities of the organization with respect to the environment, while the action plan includes measurable performance objectives and clear roles and responsibilities to ensure transparency, accountability, and effective partnerships.

## Methodology

The following project activities are proposed:

- Conduct desk review and stakeholder consultation meetings to collect data on the current environmental impacts of the health system and best approaches to achieving environmental sustainability in the health system, as well as opportunities and barriers to implementation. Concerned stakeholders may include e.g. Ministry of Public Health, Ministry of Environment, Syndicate of Hospitals, and Hospitals (Governmental and Public).
- Carry out a national survey to assess environmental sustainability of hospitals in Lebanon.
- Identify greening projects that can be implemented in hospitals to conserve and maintain safe water supplies.
- Identify greening projects that can be implemented in hospitals to manage the facilities' wastewater.
- Identify greening projects that can be implemented in hospitals to manage the facilities' hazardous solid waste.
- Develop and implement a sample of greening projects in hospitals to conserve and maintain safe water supplies, and manage facilities' wastewater and hazardous solid waste.
- Develop performance indicators to monitor implementation and ensure sustainability.

## Significance and Scientific Novelty

The outputs of the project will serve to improve environmental sustainability of hospitals in Lebanon, thus reducing the environmental impacts of health care facilities on climate change and reduce the risk of climate change hazards. In addition, improving the sustainability of operations of hospitals and primary healthcare centers in Lebanon will enhance their resilience to climate change shocks and emergency disasters.

## Expected Results

The expected outcomes include the following:

- Identify the environmental footprint of the main health facilities in Lebanon.
- Propose interventions to enhance and achieve environmental sustainability of hospitals (such as efficient management of resources, minimizing waste generation and management of healthcare waste, sustainable procurements, etc.)
- Propose a roadmap, including national policy framework and strategic action plan to achieve environmental sustainability of the health care facilities, to be disseminated amongst stakeholders.

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