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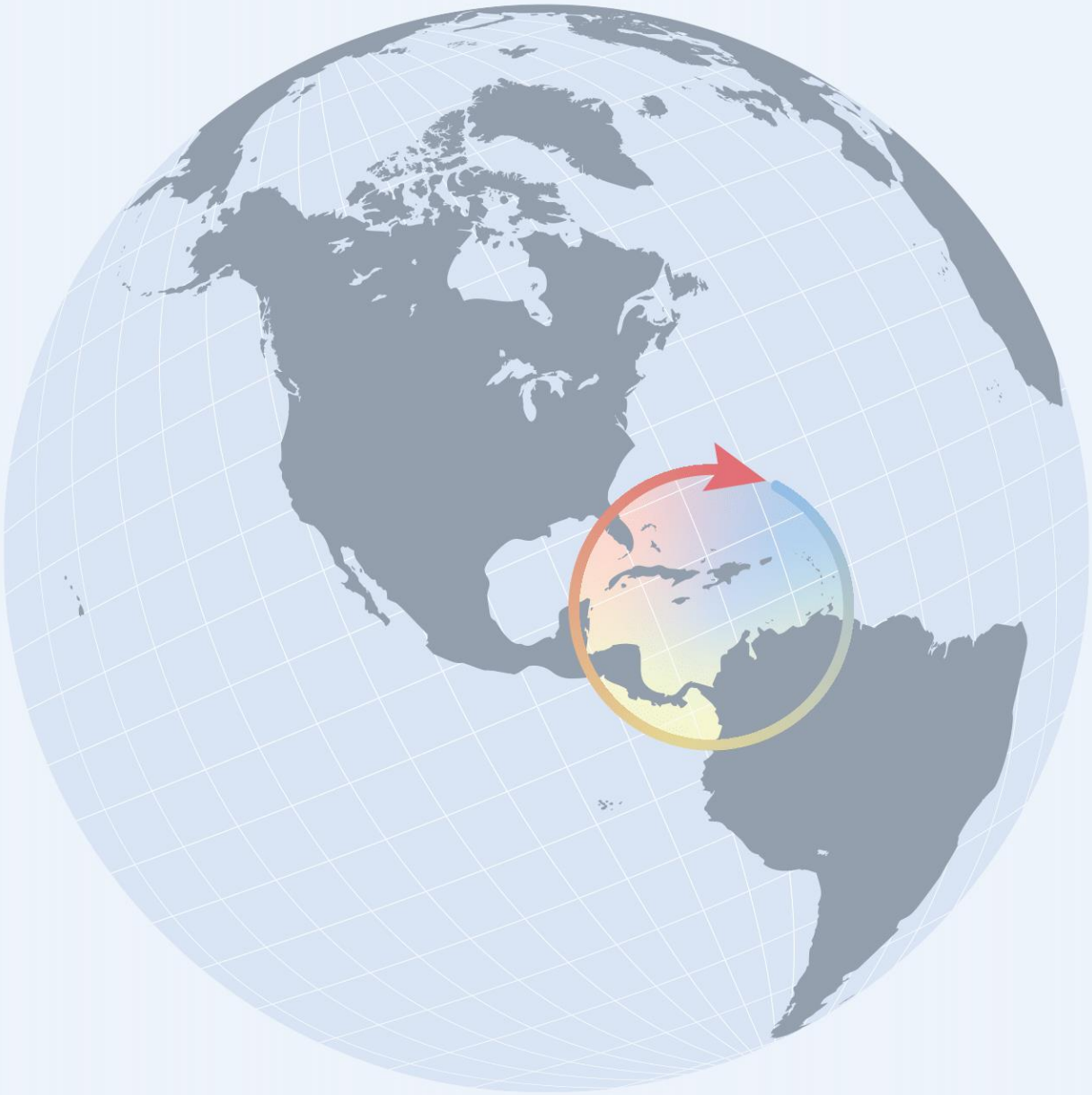
A BACKGROUND PAPER >> HEALTH SYSTEMS

360° Resilience

A Guide to Prepare the Caribbean for a New Generation of Shocks



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Health Systems Resilience in the Caribbean

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Abbreviations

AIDS	Acquired immunodeficiency syndrome
CARPHA	Caribbean Public Health Agency
CARICOM	Caribbean Community
CCRIF SPC	Caribbean Catastrophe Risk Insurance Facility Segregated Portfolio Company
CDB	Caribbean Development Bank
CDEMA	Caribbean Disaster Emergency Management Agency
COVID-19	Coronavirus Disease 2019
GDP	Gross domestic product
GHSI	Global Health Security Index
HIV	Human immunodeficiency virus
HSR	Health system resilience
HSS	Health system strengthening
IHR	International Health Regulations
IMF	International Monetary Fund
IFRC	International Federation of Red Cross and Red Crescent Societies
LAC	Latin America and the Caribbean
MOH	Ministry of Health
NCDs	Noncommunicable diseases
OECS	Organisation of Eastern Caribbean States
OOP	Out-of-pocket payment

PAHO	Pan American Health Organization
PHEIC	Public Health Emergency of International Concern
PPE	Personal protective equipment
SIDS	Small Island Developing States
TB	Tuberculosis
UHC	Universal Health Coverage
UNDP	United Nations Development Programme
UNICEF	United Nations Children's Fund
WASH	Water, sanitation, and hygiene
WBG	World Bank Group
WHO	World Health Organization

1.0 Introduction

Caribbean islands are vulnerable to external shocks such as natural disasters, disease outbreaks, and economic decline due to their geographic location, geologies, and economic structures. Most Caribbean countries have small-scale economies that are highly dependent on climate-related activities such as tourism and agriculture. Shocks can therefore have devastating impacts on individuals and communities, and stymie development efforts.

Health system resilience (HSR) refers to the capacity of a health system to prepare for and effectively respond to shocks, such as natural disasters and disease outbreaks. While there are important differences between the risks posed by natural disasters and disease outbreaks, both types of hazards have the potential to cripple multiple facets of the health sector at a time of increased demand for health services. As a result, population health outcomes may be adversely affected. Thus, increasing the resilience capacity of a health system ultimately reduces the negative impacts of shocks on population health. For example, a highly resilient health system is better able to continue delivering health services following a natural disaster, which mitigates the impact of the disaster on population health. The importance of resilient health systems has recently been emphasized in a report highlighting principles and priority areas for action to strengthen the resilience of health systems to shocks and pressures.[1]

Overall, this paper aims to analyze HSR capacities in the Caribbean and suggests priority actions for strengthening. As there has been limited guidance to date on assessing HSR in the Caribbean, the specific objectives for this paper are to develop and apply a conceptual framework for HSR and to categorize HSR capacities in the region. The proposed conceptual framework, which aims to align the WHO's six building blocks of a health system to previously identified HSR capacities (i.e. absorptive, adaptive, and transformative capacities) was applied to analyze selected historical health system responses to shocks in the region. Additionally, the conceptual framework was used to develop a traffic light system for classifying national HSR capacity. This analysis should provide guidance to policymakers and other health sector stakeholders on assessing national HSR capacities, as well as provide targets for strengthening HSR capacities in the Caribbean.

The following provides an overview of the structure and scope of the paper. It should be noted that the countries that are typically considered part of the Caribbean vary based on geographic boundaries, historical backgrounds, and cultural similarities. This paper will focus mainly on 13 Caribbean countries*, which were selected based on the ease of information availability and accessibility. Section 2 provides a contextual background for subsequent

[1] *Rentschler, Jun; Klaiber, Christoph; Tariverdi, Mersedeh; Desjonqueres, Chloe; Mercadante, Jared. 2021. Frontline : Preparing Healthcare Systems for Shocks from Disasters to Pandemics. World Bank, Washington, DC. © World Bank. https://openknowledge.worldbank.org/handle/10986/35429 License: CC BY 3.0 IGO.*

* The thirteen countries selected countries are: Antigua and Barbuda, Belize, Dominica, Dominican Republic, Grenada, Guyana, Haiti, Jamaica, St. Kitts and the Nevis, St. Lucia, St Vincent and the Grenadines, Suriname, and Trinidad and Tobago.

sections by describing the population health and health systems in Caribbean islands. Section 2 also presents a justification for the paper's focus on resilience by highlighting the islands' vulnerabilities to shocks. Section 3 briefly discusses the concept of HSR and proposes a conceptual framework to guide the analysis of HSR in the Caribbean. Section 4 reviews historical shocks in the Caribbean and examines the effects on and responses of the health systems. Following this overview of HSR in the Caribbean, Section 5 assesses HSR capacities in Caribbean islands, while Section 6 categorizes these capacities into a traffic light system that can be used to guide policy makers on assessing the current status of national HSR capacity, while providing targets for improvement.

2.0 Health Outcomes, Health Systems & Vulnerability to Shocks

This chapter discusses the vulnerability of the health sector in the Caribbean to external shocks, with an emphasis on natural disasters. Given the frequency and intensity of disease outbreaks in the region, they will also be covered briefly though they are not the primary focus of this paper. While both natural disasters and disease outbreaks can impact various aspects of the health sector, there are important differences between the two types of hazards. First, some natural hazards can be predicted and they often have a finite timeline. With adequate preparation, these hazards may not translate to a disaster. These qualities make it possible to plan and prepare in advance, as well as to anticipate needs during the acute emergency and recovery phases. Natural disasters typically have a limited geographic scope, which also allow required resources to be diverted from other countries to the affected area. In contrast, disease outbreaks are often challenging to predict, and the duration of an outbreak is uncertain. Often, disease outbreaks transmit from one country to the next, which makes it challenging to obtain the resources needed to respond. The demand on health systems also vary, with an increase in demand for treatment of trauma patients following a disaster, and an increase in demand for treating infectious diseases during an outbreak. This chapter begins with an overview of the health status of the Caribbean population and a general description of health systems in the region. Against this background, the vulnerabilities of health systems and the associated effects of shocks on population health are discussed.

2.1 Situational Analysis of Health Systems and Population Health in the Caribbean

While the health situation and health system in each Caribbean island is unique (as a result of differing histories and economies),[2] common trends can be discerned. Table 1 highlights several key indicators related to health systems and health outcomes across thirteen Caribbean islands. Box 1 examines Jamaica's health system more closely to provide a more detailed overview of a health system in the region.

National health ministries provide oversight to health systems in Caribbean countries and are responsible for health policy development and implementation. In some countries, health services are delivered by one or several national health authorities. A noteworthy feature of the region is the strong presence of regional organizations, such as the Caribbean Community (CARICOM), Caribbean Public Health Agency (CARPHA), and Organisation of Eastern Caribbean States (OECS), that play varying roles to support the functioning of their member states' health systems. Health financing systems vary between

[2] Elizabeth A. Talbot and Laura E. Shevy, 'The Caribbean', in *Infectious Diseases* (John Wiley & Sons, Ltd, 2017), 302–16, https://doi.org/10.1002/9781119085751.ch21.

countries, with some countries relying more on public systems funded through government revenue (e.g. Guyana, Jamaica, and Trinidad and Tobago) and other countries relying more on social or mandatory insurance schemes with public or private administrators (e.g. Suriname and Dominican Republic).[3] Turning to service delivery, primary health care services are provided by public facilities in the region, but private practices and hospital outpatient units also provide these services in many countries (e.g. Dominica, Jamaica, and Trinidad and Tobago).[4] Acute care is typically provided by a combination of for-profit and public hospitals (e.g. Guyana, Jamaica, and Trinidad and Tobago), with some countries also having acute care provision by non-profit hospitals (e.g. Dominican Republic). Most countries have policies or programs in place to ensure health care access to low-income and high-risk groups (e.g. Suriname, Guyana, and the Dominican Republic), while some countries only have specific programs for high-risk groups (e.g. Jamaica and Trinidad and Tobago, Antigua & Barbuda (Medical Benefits Scheme)).[5] Coverage of essential health services in the region ranges from 47 percent in Haiti to 77 percent in Barbados, with the majority of CARICOM states having approximately 70 percent coverage.[6] For all islands, patients' out-of-pocket payments (OOP) at the point of care remain relatively high, which contributes to inequities in health care access based on income.[7]

Table 1. Key Health System and Outcome Indicators in 13 Caribbean Countries

Country	Selected Health Systems and Health Outcomes Indicators									
	Population (millions), 2019	Income Level	GNI per capita, PPP (Int$), 2019	Domestic general government health expenditure per capita, PPP (Int$), 2017	Out-of-pocket expenditure per capita, PPP (Int$), 2017	Hospital beds (per 1,000 people), 2014*	Physicians (per 1000 people), 2017*	Nurses & Midwives (per 1000 people), 2018*	Life expectancy at birth, 2018	U5MR** (per 1,000 live births), 2018
Antigua and Barbuda	0.10	High income	21,500	503.64	374.61	3.8	3.0	4.5	77	6
Belize	0.39	Upper middle income	6,630	326.99	116.19	1.3	1.1	2.3	74	13
Dominica	0.07	Upper middle income	12,460	426.59	203.27	3.8 (2012)	1.1	6.4	NA	36
Dominican Republic	10.74	Upper middle income	18,280	453.46	441.00	1.6	1.6	1.4	74	29
Grenada	0.11	Upper middle income	16,250	307.88	377.95	3.7	1.4	6.3	72	15

[3] Luca Lorenzoni et al., 'Health Systems Characteristics: A Survey of 21 Latin American and Caribbean Countries', 19 June 2019, https://doi.org/10.1787/0e8da4bd-en.
[4] Lorenzoni et al.
[5] Lorenzoni et al.
[6] 'Pooling Resources for Universal Health Coverage', *Bulletin of the World Health Organization* 98, no. 2 (1 February 2020): 83–84, https://doi.org/10.2471/BLT.20.020220.
[7] 'Pooling Resources for Universal Health Coverage'.

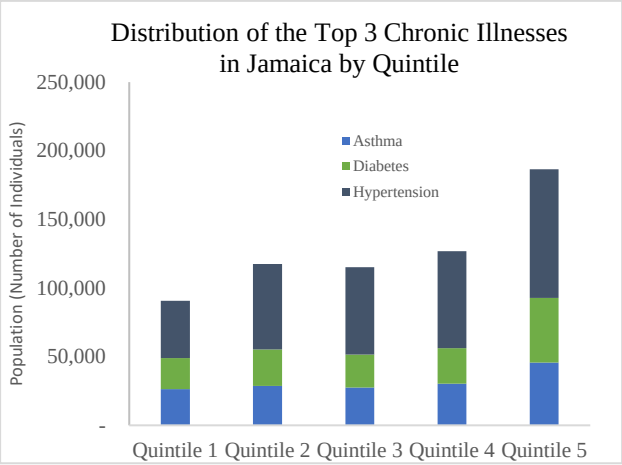
Country	Selected Health Systems and Health Outcomes Indicators									
	Population (millions), 2019	Income Level	GNI per capita, PPP (Int$), 2019	Domestic general government health expenditure per capita, PPP (Int$), 2017	Out-of-pocket expenditure per capita, PPP (Int$), 2017	Hospital beds (per 1,000 people), 2014*	Physicians (per 1000 people), 2017*	Nurses & Midwives (per 1000 people), 2018*	Life expectancy at birth, 2018	U5MR** (per 1,000 live births), 2018
Guyana	0.78	Upper middle income	9,900	242.59	131.53	1.6	0.8 (2018)	1.0	70	30
Haiti	11.26	Low income	1,790	17.33	58.79	0.7 (2013)	0.2 (2018)	0.7	64	65
Jamaica	2.95	Upper middle income	9,770	351.24	93.54	1.7 (2013)	1.3	0.8	74	14
St Kitts and Nevis	0.05	High income	25,920	672.06	688.91	2.3 (2012)	2.7 (2015)	4.2 (2015)	NA	12
St Lucia	0.18	Upper middle income	15,140	324.21	296.41	1.3 (2013)	0.6	3.2 (2017)	76	17
St Vincent and the Grenadines	0.11	Upper middle income	12,880	339.76	164.69	2.6	0.7 (2010)	7.0	72	16
Suriname	0.58	Upper middle income	15,200	554.20	249.65	3.1 (2010)	1.2	2.8	72	19
Trinidad and Tobago	1.39	High income	26,950	1,173.48	877.41	3.0	4.2	4.1	73	18

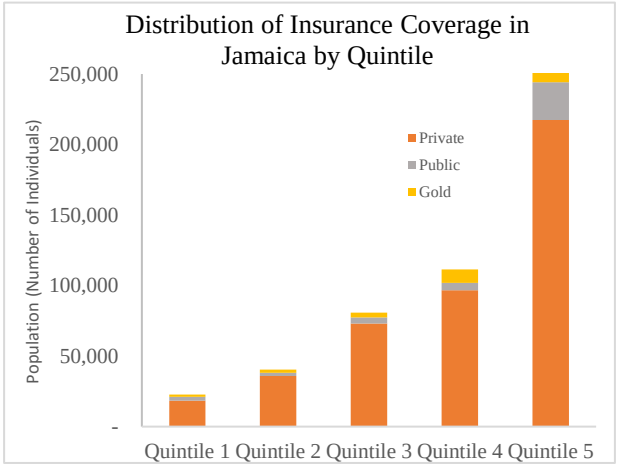
Source: https://data.worldbank.org/
https://data.worldbank.org/indicator/SP.POP.TOTL?name_desc=false

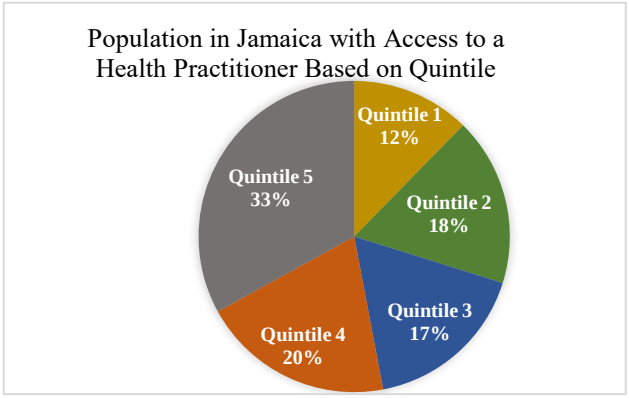
*unless stated otherwise
**U5MR=Under 5 Mortality Rate

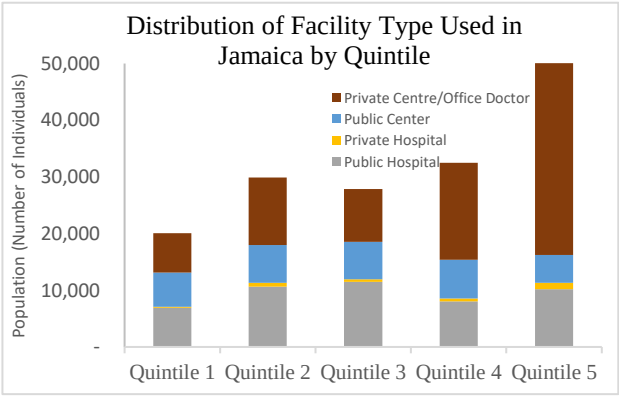
Box 1. An Overview of Jamaica's Health System

Primary, secondary, and tertiary health services in Jamaica are provided through the public and private sectors. The health services network includes over 330 health centers, 24 public hospitals, the University Hospital of the West Indies, 10 private hospitals and over 495 pharmacies. The public health sector provides approximately 5,000 hospital beds, while the private sector provides approximately 200 beds. The Ministry of Health and Wellness maintains oversight of population health and health services in the country, with its mission "to ensure the provision of accessible quality health services and to promote healthy lifestyles". In accordance with the National Health Services Act of 1997, the public health services are administered through four Regional Health Authorities that serve the 14 parishes of Jamaica. Despite improvement in the overall availability of medical doctors, nurses and midwives in recent years, Jamaica continues to struggle with limited and unevenly distributed key health providers as well as with issues of retention. Health financing is derived mainly from government taxes, followed by out-of-pocket expenditures, pre-paid plans/health insurance, and external aid/support. High OOPs and low insurance coverage contribute to inequitable access to healthcare. According to the 2015 Jamaica Survey of Living Conditions, approximately 19 percent of the population have private health insurance, with the largest proportion in the richest quintile and the lowest in the poorest quintile. While noncommunicable disease (NCDs) prevalence in the poorest and richest quintiles were similar, only 3.7% of the poorest quintile had any kind of health insurance compared with 40.3% of the richest quintile.









Sources:
http://www.commonwealthhealth.org/americas/jamaica/
https://www.moh.gov.jm/wp-content/uploads/2019/05/MOHW-Vision-for-Health-2030-Final.pdf
Figures based on analysis of data from the Jamaica Survey of Living Conditions

Mirroring global trends, the elderly population is growing faster than the general population in the Latin America and Caribbean (LAC) region, with 11.2 percent of the LAC population aged 60 and older.[8] However, this demographic shift is most pronounced within the Caribbean sub-region (compared to South American and Central America), with 13.2 percent of the Caribbean population aged 60 or older.[9] Similarly, within the LAC region, NCD mortality and morbidity are highest in the Caribbean. In 2016, almost 80 percent of all deaths in the Caribbean were due to NCDs, with cardiovascular diseases, cancer and diabetes representing the leading causes of death.[10] NCDs are the main culprit for all premature deaths in the Caribbean among persons aged 30-69 years old (more so than for any other sub-region of the Americas).[11] As a result of the toll exerted by NCDs, life expectancy at birth is now lower in the countries of the CARICOM[12] than the rest of Latin America, a stark reversal of a situation that existed 30 to 40 years ago.[13] Research has approximated that diabetes and hypertension impact 5-8 percent of GDP in the region.[14] In nearly all Caribbean countries, the major burden of disease stems from the rising prevalence of NCDs, while certain endemic and emerging communicable diseases still remain detrimental, leading to the double-burden of disease.[15]

While there have been important advancements in addressing communicable diseases, including the elimination of vaccine-preventable diseases such as polio, measles, and rubella,[16] but challenges related to the spread of viruses persist.[17] The Caribbean region is the second most affected region for HIV/AIDS, following sub-Saharan Africa. There has been an overall decrease in deaths due to AIDS in the region, but figures

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[8] Steering Committee for the Workshop on Strengthening the Scientific Foundation for Policymaking to Meet the Challenges of Aging in Latin America and the Caribbean et al., *Aging in Latin America and the Caribbean in Global Perspective*, *Strengthening the Scientific Foundation for Policymaking to Meet the Challenges of Aging in Latin America and the Caribbean: Summary of a Workshop* (National Academies Press (US), 2015), https://www.ncbi.nlm.nih.gov/books/NBK322002/.

[9] Steering Committee for the Workshop on Strengthening the Scientific Foundation for Policymaking to Meet the Challenges of Aging in Latin America and the Caribbean et al.

[10] Noncommunicable Disease Mortality and Risk Factor Prevalence in the Americas. PAHO. 2019

[11] Forum of Key Stakeholders on NCD in Caribbean - Fact Sheet. PAHO. 2015

[12] CARICOM countries include Antigua and Barbuda, Bahamas, Barbados, Belize, Dominica, Grenada, Guyana, Haiti, Jamaica, Montserrat, Saint Kitts and Nevis, Saint Lucia, Saint Vincent and the Grenadines, Suriname, and Trinidad and Tobago.

[13] NCDs in the Caribbean. Healthy Caribbean Coalition. 2017

[14] Vijay Kumar Chattu and Andy W Knight, 'Port of Spain Summit Declaration as a Successful Outcome of Global Health Diplomacy in the Caribbean Region: A Systematic Review', *Health Promotion Perspectives* 9, no. 3 (6 August 2019): 174–80, https://doi.org/10.15171/hpp.2019.25.

[15] Caribbean Public Health Agency, 'Pathway to 2025: Strategic Plan 2018-2020.', March 2018, https://www.carpha.org/Portals/0/Documents/CARPHA-Strategic-Plan-2018-2020.pdf.

[16] Caribbean Public Health Agency.

[17] Chattu and Knight, 'Port of Spain Summit Declaration as a Successful Outcome of Global Health Diplomacy in the Caribbean Region'.

remain concerning in some countries.[18] For example, Jamaica and Haiti are estimated to have 0.36 and 0.24 AIDS-related deaths per 1000 population, respectively, which are notably higher than the Caribbean regional average of 0.17 AIDS-related deaths per 1000 population.[19] The emergence and re-emergence of TB infections also threaten health security throughout the region. While some countries have sustained significant progress towards eliminating TB (e.g. Antigua and Barbuda, Dominica, and St Kitts and Nevis), countries such as Haiti and the Dominican Republic have high overall TB incidence rates, as well as high rates of HIV co-infection and drug-resistant TB.[20] Drug-resistant TB is considered a public health crisis as it has less successful treatment outcomes, with a global treatment success rate of 56 percent.[21]

Mosquito-borne viral disease outbreaks are common, as reflected by a history of frequent dengue outbreaks[22] and recent widespread regional outbreaks with the introduction of Chikungunya in 2013 and Zika in 2015.[23] These arboviruses are transmitted by the *Aedes* mosquito and therefore, diseases outbreaks have been associated with the onset of suitable climate conditions (warm temperatures and rainfall) for vector proliferation.[24] Similarly, leptospirosis is an endemic zoonotic disease in the region, with increased likelihood of outbreaks after flooding (as flood waters bring bacteria into closer contact with humans through their animal hosts).[25] There have been multiple documented outbreaks of leptospirosis following extreme weather events in countries around the world, including countries in the Caribbean region.[26] A recent review of leptospirosis in the Caribbean highlighted that most cases have a positive correlation with floods, with the highest incidence rates of human leptospirosis recorded in the region occurring in Barbados,

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[18] Tahvi D. Frank et al., 'Global, Regional, and National Incidence, Prevalence, and Mortality of HIV, 1980–2017, and Forecasts to 2030, for 195 Countries and Territories: A Systematic Analysis for the Global Burden of Diseases, Injuries, and Risk Factors Study 2017', *The Lancet HIV* 6, no. 12 (1 December 2019): e831–59, https://doi.org/10.1016/S2352-3018(19)30196-1.

[19] UNAIDS. "AIDSinfo | AIDS Mortality per 1000 Population." Accessed February 16, 2021. http://aidsinfo.unaids.org/.

[20] WHO, 'WHO | Global Tuberculosis Report 2019' (World Health Organization, 2019), http://www.who.int/tb/publications/global_report/en/.

[21] WHO.

[22] Olivia Brathwaite Dick et al., 'The History of Dengue Outbreaks in the Americas', *The American Journal of Tropical Medicine and Hygiene* 87, no. 4 (3 October 2012): 584–93, https://doi.org/10.4269/ajtmh.2012.11-0770.

[23] Caribbean Public Health Agency, 'Pathway to 2025: Strategic Plan 2018-2020.'

[24] Rachel Lowe et al., 'Nonlinear and Delayed Impacts of Climate on Dengue Risk in Barbados: A Modelling Study', *PLOS Medicine* 15, no. 7 (17 July 2018): e1002613, https://doi.org/10.1371/journal.pmed.1002613.

[25] Talbot and Shevy, 'The Caribbean'.

[26] Colleen L. Lau et al., 'Climate Change, Flooding, Urbanisation and Leptospirosis: Fuelling the Fire?', *Transactions of the Royal Society of Tropical Medicine and Hygiene* 104, no. 10 (October 2010): 631–38, https://doi.org/10.1016/j.trstmh.2010.07.002.

Trinidad and Tobago, and Jamaica.[27] Most recently, the region has also been affected by the COVID-19 pandemic, which spreads via human-to-human transmission; this is described in greater detail in Section 4.

Haiti is an exception to the Caribbean's general burden of disease trend, with a higher burden of communicable diseases than NCDs and low vaccine coverage. Almost 50% of mortality in Haiti is due to AIDS, diarrheal diseases, respiratory infections, and meningitis.[28] Poor health outcomes in Haiti are related to high levels of national poverty, low access to basic healthcare, and political unrest.[29] Additionally, the cholera and diphtheria outbreaks in Haiti have been linked to the 2010 earthquake that caused widespread devastation to the country.

2.2 Vulnerability of the Caribbean Health Systems to Shocks

According to the Emergency Events Database (EM-DAT) data from the last two decades, the most common hazards experienced in the Caribbean are storms, followed by floods, epidemics, and droughts. The majority of Caribbean countries are classified as SIDS, which have been identified as among the most vulnerable to the effects of climate change.[30] Climate change events, such as rising sea levels, longer droughts, and higher-intensity rain events, have been heavily documented in the region and are predicted to worsen.[31] The region is highly vulnerable to the effects of natural disasters (which are compounded by climate change) because of their small-scale economies and weak institutional frameworks. Given that most of Caribbean islands' economies are largely dependent on tourism, agriculture, and fisheries, the increasing frequency and severity of natural disasters can have devasting economic impacts.[32] Natural disasters cost the Caribbean over $22 billion (in constant 2009 dollars) between 1950 and 2016 and for some countries, the damage of a single disaster has exceeded the size of the countries' economies (e.g. Hurricane Maria cost

[27] Abena Peters et al., 'Leptospirosis in the Caribbean: A Literature Review', *Revista Panamericana de Salud Pública* 41 (19 December 2017), https://doi.org/10.26633/RPSP.2017.166.
[28] Talbot and Shevy, 'The Caribbean'.
[29] Talbot and Shevy.
[30] 'Small States' Resilience to Natural Disasters and Climate Change - Role for the IMF', IMF, accessed 27 July 2020, https://www.imf.org/en/Publications/Policy-Papers/Issues/2016/12/31/Small-States-Resilience-to-Natural-Disasters-and-Climate-Change-Role-for-the-IMF-PP5079; Stacy-ann Robinson, 'Adapting to Climate Change at the National Level in Caribbean Small Island Developing State', *Island Studies Journal* 13, no. 1 (May 2018): 79–100, https://doi.org/10.24043/isj.59.
[31] Roxann K. Stennett-Brown, Tannecia S. Stephenson, and Michael A. Taylor, 'Caribbean Climate Change Vulnerability: Lessons from an Aggregate Index Approach', *PLOS ONE* 14, no. 7 (10 July 2019): e0219250, https://doi.org/10.1371/journal.pone.0219250.
[32] Caribbean Public Health Agency, 'Pathway to 2025: Strategic Plan 2018-2020.'

Dominica approximately 225 percent of its GDP).[33] The IMF (2016) approximated that nearly one in every ten hazards can cause damages equivalent to 30 percent (or greater) of the GDP of SIDS, compared to less than 1 percent of the GDP of larger states.[34] Research has also predicted that future effects of climate change in some Caribbean SIDS will amount to at least 75 percent of their countries' GDP by 2100.[35]

The World Health Organization (WHO) Health System Building Blocks Framework, which identifies six components of a health system, is used as a starting point to understanding the resilience of health systems toward shocks in the region (Table 2). In addition to the direct economic impact of shocks, specific aspects of financing, service delivery, health workforce, and the supply chain in current Caribbean health systems may increase the systems' vulnerability to shocks. In the context of health financing, for example, it is challenging to redirect external funds earmarked for specific purposes (e.g. tobacco control) to respond to short-term increases in demand for health services (such as trauma treatment). As a result of limited resources, existing health systems may be stressed when faced with additional demand for services. Essential health care services coverage in CARICOM countries are estimated at 70 percent,[36] making it likely that a strain on resources will deepen the existing access inequalities. Access to care can be further constrained by poor distribution of health workers as well as shortages in the health workforce. Standard population ratios for health workers are not suited for countries with small populations, which results in a lack of guidance and may hamper planning efforts. Turning to the supply chain, countries' reliance on imports from outside the region for many health products contributes to their vulnerability. Supply importation can be impeded by a shock that affects transportation services/infrastructure and ultimately, result in treatment deficiencies. Despite regional attempts to circumvent such national supply chain issues (such as the establishment of the Organization of Eastern Caribbean States Pharmaceutical Procurement Service[37]), a shock that affects multiple countries simultaneously can still overwhelm regional mechanisms. In light of vulnerabilities such as those described here, the effects of a shock

[33] Inci Ötker and Krishna Srinivasan, 'Building Resilience in the Caribbean to Climate Change and Natural Disasters', *IMF Finance and Development Vol. 55, No. 1*, March 2018, https://www-imf-org.proxygw.wrlc.org/external/pubs/ft/fandd/2018/03/otker.htm.
[34] 'Small States' Resilience to Natural Disasters and Climate Change - Role for the IMF'.
[35] Michelle A. Mycoo, 'Beyond 1.5 °C: Vulnerabilities and Adaptation Strategies for Caribbean Small Island Developing States', *Regional Environmental Change* 18, no. 8 (1 December 2018): 2341–53, https://doi.org/10.1007/s10113-017-1248-8.
[36] 'Pooling Resources for Universal Health Coverage'.
[37] The Organization of Eastern Caribbean States (OECS) Pharmaceutical Procurement Service is a program that procures medicines and health equipment on behalf of member states of the OECS, which is an inter-governmental organisation dedicated to regional integration in the Eastern Caribbean.

on a health system as outlined in Table 2, are exacerbated and can contribute to poor health outcomes for Caribbean populations.

Table 2. High-level Effects of a Shock on the Building Blocks of a Health System

HEALTH SYSTEM	POTENTIAL EFFECTS OF SHOCK
Leadership & Governance	Existing leadership capacity exceeded (due to increased demands across health systems)
	Increased need for collaboration
Financing	Decline in available financing due to economic impact of shock
	Increased demand for financing to support emergency needs across health system
Service Delivery	Reduced capacity for service delivery (due to damage to infrastructure/equipment and/or reduced workforce)
	Increased demand for specific services (due to disease outbreak, injuries from disaster or subsequent increase in health issues)
	Reduced access to services due to inability to reach facility, damaged facility or financial constraints of patients
Health Workforce	Reduced workforce (due to illness/injury/deaths from diseases or hazards)
Information	Increased demand for timely information
	Reduced capacity to deliver information (due to damages to infrastructure)
Medical Products, Vaccines & Technologies	Increased demand for specific medical products, vaccines and technologies
	Reduced supply chain capacity

2.3 Effects of Shocks on Population Health

While there are direct health consequences of shocks such as injuries (natural hazards) and infections (disease outbreaks), the diversion of health systems to address these direct health consequences may impact routine health services (e.g. immunizations and cancer screenings) and negatively impact health outcomes in the short and/or long term. Research examining health impacts following climate-related shocks in the Caribbean is limited.

However, one review that examined the health impacts of the 2017 Atlantic basin hurricane season on SIDS (not only in the Caribbean region) noted significant disruptions of health services related to damaged facilities, power outages, and fuel shortages.[38] This exacerbated chronic health problems, as populations experienced unrelieved heat exposure, inability to refrigerate medications, and a reduction in availability of kidney dialysis and cancer therapies. The review also found that psychological distress was experienced by almost all of SIDS populations who were exposed to hurricanes in 2017 and predicted an increase in the onset of post-traumatic stress disorder and depression.[39] Further, after the 2017 hurricanes, some water treatment and sewage systems on SIDS were disabled due to damages to infrastructure or power outages, resulting in cross-contamination of the water supply with wastewater and other pollutants. Climate-related shocks can also have longer-term health impacts through water-, food- and vector-borne diseases. A systematic review of human health following disasters occurring globally between 1985 and 2014 found that gastrointestinal illness and leptospirosis generally increased following flooding and storms.[40]

A shock can have also indirect impacts on health by exacerbating existing poverty. Despite the majority of Caribbean islands being classified as upper-middle income, there are relatively high income inequalities throughout the region.[41] These inequalities are due to factors such as gender disparities, levels of education, occupation and quality of employment, household size, and quality of housing. A notable proportion of the Caribbean population experiences high levels of poverty, with one in five individuals living below the poverty line, [42] Those in poverty are known to suffer disproportionately from natural disasters due to overexposure, higher vulnerability, less ability to cope and recover, and impacts on education and health.[43] Increased poverty can lead to worse health outcomes through various mechanisms, including reduced access to healthcare services, malnutrition, chronic stress, and unsafe housing conditions.

[38] James Shultz et al., 'Risks, Health Consequences, and Response Challenges for Small-Island-Based Populations: Observations From the 2017 Atlantic Hurricane Season', *Disaster Medicine and Public Health Preparedness* 13 (6 April 2018): 1–13, https://doi.org/10.1017/dmp.2018.28.
[39] Shultz et al.
[40] Dell D. Saulnier, Kim Brolin Ribacke, and Johan von Schreeb, 'No Calm After the Storm: A Systematic Review of Human Health Following Flood and Storm Disasters', *Prehospital and Disaster Medicine* 32, no. 5 (October 2017): 568–79, https://doi.org/10.1017/S1049023X17006574.
[41] 'Latin American Economic Outlook 2019: Development in Transition | En | OECD', accessed 28 July 2020, https://www.oecd.org/publications/latin-american-economic-outlook-20725140.htm.
[42] 'Latin American Economic Outlook 2019'.
[43] Stephane Hallegatte et al., *Unbreakable : Building the Resilience of the Poor in the Face of Natural Disasters*, Climate Change and Development (Washington, DC: World Bank., 2017), https://openknowledge.worldbank.org/handle/10986/25335.

3.0 Health System Resilience Conceptual Framework

Over the past decade, resilience has increasingly been used to describe an ideal response or outcome for health systems facing a shock. The concept of HSR has been applied in situations of acute shocks (such as infectious disease outbreaks, natural disasters, or armed conflict), as well as in situations of more chronic stresses (such as drug or personnel shortages).[44] The varying definitions of HSR offered in recent literature reflect ambiguities surrounding the concept.[45] Three scoping reviews, which aimed to explore the meaning of HSR, have noted that there is no academic consensus on the definition of HSR.[46] However, the definition by Kruk et al (2015) has emerged as one of the more widely-used and robust definitions and thus, was used for this paper.[47] According to Kruk et al (2015), **HSR is defined as "the capacity of health actors, institutions, and populations to prepare for and effectively respond to crises; maintain core functions when a crisis hits; and, informed by lessons learned during the crisis, reorganise if conditions require it."**

In addition to the differing definitions of HSR, researchers have proposed several conceptual frameworks for HSR.[48] These frameworks suggest relationships and/or directionality among elements of resilience from the health system perspective. Kruk et al (2015) characterized resilient health systems based on five elements (aware, diverse, self-regulating, integrated,

[44] Margaret E Kruk et al., 'Building Resilient Health Systems: A Proposal for a Resilience Index', *BMJ*, 23 May 2017, j2323, https://doi.org/10.1136/bmj.j2323.
[45] Charlotte Pailliard Turenne et al., 'Conceptual Analysis of Health Systems Resilience: A Scoping Review', *Social Science & Medicine* 232 (1 July 2019): 168–80, https://doi.org/10.1016/j.socscimed.2019.04.020.
[46] My Fridell et al., 'Health System Resilience: What Are We Talking About? A Scoping Review Mapping Characteristics and Keywords', *International Journal of Health Policy and Management* 9, no. 1 (01 2020): 6–16, https://doi.org/10.15171/ijhpm.2019.71; Turenne et al., 'Conceptual Analysis of Health Systems Resilience'; Jennifer B. Nuzzo et al., 'What Makes Health Systems Resilient against Infectious Disease Outbreaks and Natural Hazards? Results from a Scoping Review', *BMC Public Health* 19, no. 1 (17 October 2019): 1310, https://doi.org/10.1186/s12889-019-7707-z.
[47] Margaret E Kruk et al., 'What Is a Resilient Health System? Lessons from Ebola', *The Lancet* 385, no. 9980 (May 2015): 1910–12, https://doi.org/10.1016/S0140-6736(15)60755-3.
[48] Kruk et al.; Olushayo Olu, 'Resilient Health System As Conceptual Framework for Strengthening Public Health Disaster Risk Management: An African Viewpoint', *Frontiers in Public Health* 5 (2017), https://doi.org/10.3389/fpubh.2017.00263; Karl Blanchet et al., 'Governance and Capacity to Manage Resilience of Health Systems: Towards a New Conceptual Framework', *International Journal of Health Policy and Management* 6, no. 8 (01 2017): 431–35, https://doi.org/10.15171/ijhpm.2017.36; 'WHO | Operational Framework for Building Climate Resilient Health Systems', WHO (World Health Organization), accessed 15 July 2020, http://www.who.int/globalchange/publications/building-climate-resilient-health-systems/en/; Caroline Chamberland-Rowe, François Chiocchio, and Ivy Lynn Bourgeault, 'Harnessing Instability as an Opportunity for Health System Strengthening: A Review of Health System Resilience', *Healthcare Management Forum* 32, no. 3 (1 May 2019): 128–35, https://doi.org/10.1177/0840470419830105.

and adaptive)[49] However, one drawback to the Kruk et al (2015) framework is that the suggested elements are not well-known or utilized in the health field,[50] which may pose challenges for adoption. In 2015, the WHO proposed a conceptual framework for health system resilience, specifically in response to climate change threats, which described resilience as a combination of decreased vulnerability and increased adaptive capacity.[51] Blanchet et al (2017) produced a conceptual framework describing the governance of three resilience capacities (absorptive, adaptive, and transformative capacities) through four interlinked dimensions (knowledge, uncertainties, interdependence, and legitimacy).[52] Other researchers similarly described HSR through absorptive, adaptive, and transformative capacities,[53] but Ziglio et al (2017) further identified anticipatory capacity as a fourth resilience capacity.[54] Another popular approach to conceptualizing and analyzing HSR has been through the lens of the WHO building blocks.[55]

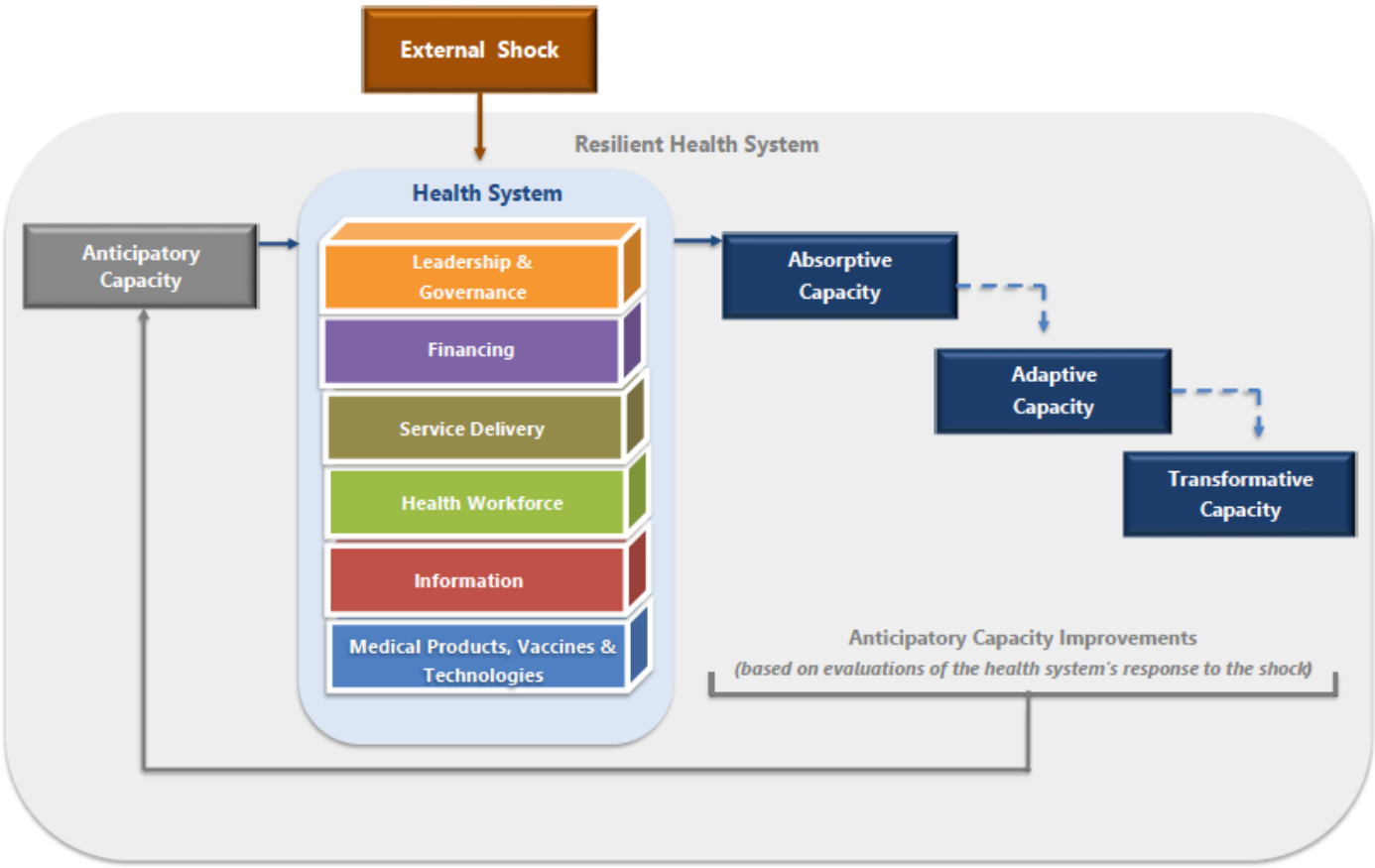
3.1 Proposed HSR Conceptual Framework

Based on existing frameworks and previous conceptualizations of HSR, a conceptual framework (shown in Figure 1) for HSR was developed for this paper to guide the analysis of HSR in the Caribbean. Recognizing the differences between national health systems, as well as their varying contexts, this framework remains broad and flexible. While previous literature acknowledges that health systems need to be resilient to routine stresses (commonly termed "everyday resilience"),[56] this framework focuses on HSR in response to significant external shocks (such as natural disasters or disease outbreaks) as these are the most crucial contexts for HSR in the Caribbean region. The proposed framework describes the existing health system using the six WHO building blocks.[57] Given the ubiquity of these building blocks for describing health systems, aligning the four types of resilience capacities to these building blocks will enhance applicability of the framework (especially to the diverse

[49] Kruk et al., 'What Is a Resilient Health System?'
[50] Turenne et al., 'Conceptual Analysis of Health Systems Resilience'.
[51] World Health Organization, ed., *Operational Framework for Building Climate Resilient Health Systems* (Geneva, Switzerland: World Health Organization, 2015).
[52] Blanchet et al., 'Governance and Capacity to Manage Resilience of Health Systems'.
[53] Chamberland-Rowe, Chiocchio, and Bourgeault, 'Harnessing Instability as an Opportunity for Health System Strengthening'; Erio Ziglio, Natasha Azzopardi-Muscat, and Lino Briguglio, 'Resilience and 21st Century Public Health', *European Journal of Public Health* 27, no. 5 (01 2017): 789–90, https://doi.org/10.1093/eurpub/ckx116.
[54] Ziglio, Azzopardi-Muscat, and Briguglio, 'Resilience and 21st Century Public Health'.
[55] Fridell et al., 'Health System Resilience'; Olu, 'Resilient Health System As Conceptual Framework for Strengthening Public Health Disaster Risk Management'.
[56] Lucy Gilson et al., 'Everyday Resilience in District Health Systems: Emerging Insights from the Front Lines in Kenya and South Africa', *BMJ Global Health* 2, no. 2 (1 July 2017): e000224, https://doi.org/10.1136/bmjgh-2016-000224.
[57] World Health Organization, *Monitoring the Building Blocks of Health Systems: A Handbook of Indicators and Their Measurement Strategies* (Geneva: World Health Organization, 2010).

Caribbean context) and improve comprehensiveness of subsequent analyses that apply the framework. In addition, this approach recognizes the commonalities between natural hazards and disease outbreaks, for example, in disaster risk management planning and pandemic preparedness.

Figure 1. Health System Resilience Conceptual Framework



From a national perspective, anticipatory capacity refers to a government's ability to minimize vulnerability through proactive actions aimed at predicting and reducing disturbances and risks.[58] As shown in Figure 1, anticipatory capacities should be continuously developed across the health system (not in response to any shock). These anticipatory capacities should facilitate the expected shock responses as outlined below. Following a lower-intensity shock (such as a low-magnitude, localized earthquake), absorptive capacity, which refers to a health system's ability to continue to deliver the same level of services and protection to the population using the same level of resources and capacities, is activated. However, if absorptive capacity is exceeded, then adaptive capacity is triggered. Adaptive capacity refers to the capacity of a health system's actors to deliver the same level of

[58] Ziglio, Azzopardi-Muscat, and Briguglio, 'Resilience and 21st Century Public Health'.

healthcare services with fewer and/or different resources through incremental adjustments.[59] If the adaptive capacity of the system is overwhelmed, then transformational capacity must drive transformational changes to the system's structures or functions. Following a shock, there should be improvements to the anticipatory capacities based on lessons learned, which reflects the iterative nature of HSR.

3.2 HSR Assessment Tool

There is currently no established tool for assessing health system resilience. Several researchers have attempted to develop measures of resilience.[60] Kruk and colleagues (2017) have suggested a "resilience index" to measure resilience capacity, with 25 measures aligned to the five previously-proposed characteristics of a resilient health system.[61] In a different approach, Thomas and colleagues suggested indicators under three elements of resilience (financial resilience, adaptive resilience, and transformative resilience).[62] However, it can be argued that both tools do not comprehensively capture elements of resilience across the entire health system since some key components (such as the medical product supply chain) may be overlooked.

This paper develops and applies a tool to assess HSR capacity in the Caribbean with the aim of stimulating more in-depth assessments at the national level, which will ultimately inform action plans to improve HSR capacity. This tool is meant to complement (and not replace) other specific tools such as the JEE and GHSI, which have a different area of focus as described in Section 5.

Considering the proposed conceptual framework and the high-level effects of a shock on the building blocks of a health system (as outlined in Table 1), key components of each type of resilience capacity were identified and stratified by building block. Appropriate resiliency capacity measures were then developed and aligned with each component to create a guide for assessing HSR capacity.

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[59] Blanchet et al., 'Governance and Capacity to Manage Resilience of Health Systems'; Christophe Béné et al., 'Resilience: New Utopia or New Tyranny? Reflection about the Potentials and Limits of the Concept of Resilience in Relation to Vulnerability Reduction Programmes', *IDS Working Papers* 2012, no. 405 (2012): 1–61, https://doi.org/10.1111/j.2040-0209.2012.00405.x.

[60] Kruk et al., 'Building Resilient Health Systems'; Steve Thomas et al., 'A Framework for Assessing Health System Resilience in an Economic Crisis: Ireland as a Test Case', *BMC Health Services Research* 13, no. 1 (30 October 2013): 450, https://doi.org/10.1186/1472-6963-13-450.

[61] Kruk et al., 'Building Resilient Health Systems'.

[62] Thomas et al., 'A Framework for Assessing Health System Resilience in an Economic Crisis'.

Table 3. HSR Assessment Tool

Health System	Key Components of Resilience Capacities				Examples of Measures of Resilience Capacities
	Anticipatory Capacity	**Absorptive Capacity**	**Adaptive Capacity**	**Transformative Capacity**	
1. Leadership & Governance	Legal framework(s) to allow appropriate authorities to take necessary actions in emergencies, including activation of Emergency Operations Center Established collaboration mechanisms (with public and private sector, community organizations, regional and international actors and other relevant bodies) Policies and plans for regular risk assessments (including hazard vulnerability analysis) Evidence-based multisectoral policies and plans for emergency responses Political prioritization of emergency preparedness, HSS and building HSR	Coordinated and efficient mobilization of existing resources Monitoring and evaluation of the implementation of emergency plans across the health sector	Coordinated and efficient mobilization of additional or reduced resources Coordination of multi-sectoral response to support health priorities Rapid and efficient engagement of external organizations (including local, regional, and international bodies) for productive collaborations Decentralized decision-making to allow rapid response to changing demands	Established research capacities to generate the evidence base to inform decision-making Effective planning processes, coordination and change management	□ Emergency Operations Center or Unit for health sector □ Emergency management laws and regulations related to the health sector □ Emergency Response Plan for Health Sector (reviewed & updated annually) □ National Multisectoral Emergency Response Plan, which specifies roles of other sectors (such as transportation and defense) in supporting the health sector response (reviewed & updated annually) □ Membership in local, regional, and international organizations, as well as signatory to agreements, which provide support to health sector in emergencies □ IHR Core Capacity Index

					□ Enforced plan for regular emergency preparedness activities, including simulations and drills, across the health sector
2. Financing	Estimated costs of future potential shocks to HS Contingent finance and reserve funds Adequate investment in HSS (including building HSR) Nationally funded health system with low OOPs	Adequate funding for continuation of health services in primary, secondary and tertiary health facilities (especially for vulnerable populations) and development of surge capacity	Rapid access to additional financing (from internal and external sources) for continuation of health services in primary, secondary and tertiary health facilities (especially for vulnerable populations) and development of surge capacity	Significant, longer-term financing for large structural or functional changes	□ Contingent financing (and mechanism for rapid access) identified in national budget □ Costed and financed HSS plans □ Emergency health sector funding arrangements through national, regional and international organizations
3. Service Delivery	Maintenance of health facilities' infrastructure, as well as other critical infrastructure including water, transportation, electricity and telecommunication Healthcare Facilities Emergency Response Plans Public health programs (e.g. vector control and health education) are prioritized nationally to	Sustained levels of routine healthcare delivery (including vaccine delivery/ immunization) and availability of emergency response services Functioning critical infrastructure including water, transportation, electricity, and telecommunicati on	Restructured and flexible service delivery based on priority needs, available infrastructure, and current workforce Increased emergency response services, including higher levels of trauma management, case management of novel diseases, and management of	"Building Back Better": new or improved infrastructure for health facilities and other critical infrastructure	□ The Hospital Safety Index (provides a snapshot of the probability that a hospital or health facility will continue to function in emergency situations, based on structural, nonstructural and functional factors) □ UHC Service Coverage Index (the average coverage of essential health services among the general and the

	support everyday health system resilience		highly infectious diseases, based on increased needs introduced by the emergency		most disadvantaged population) □ Hospital beds per 10 000 population (pre-shock) □ Immediate Bed Availability (post-shock) □ National population health measures (maternal mortality rate, infant mortality rate, and NCD prevalence)
4. Health Workforce	Sufficient emergency preparedness and response education that aligns with national risk profile Scale-up community-based health workforce	Reorganization of workforce to match service needs Efficient management capacity of district or local health teams Healthy, motivated, flexible, and protected (e.g. PPE, isolation capacity) workforce	Expanded public health and clinical workforce (surge capacity) Maintenance of a healthy, motivated, flexible, and protected (e.g. PPE, isolation capacity) workforce	Adequate workforce numbers and skills to plan, implement, and sustain long-term structural or functional changes	□ Emergency preparedness and response included in curricula for public health workers and clinicians □ Number of HCP receiving emergency preparedness and response trainings annually □ Surge capacity capability (including established surge activation criteria and access to adequate supplies, including PPE)
5. Information	Integrated risk monitoring, routine surveillance, and established early warning system	Situation-specific technical guidance developed and disseminated Early, effective,	Situation-specific technical guidance updated and disseminated	Development of a robust evidence base to inform large-scale changes	□ National Risk Communication Plan (reviewed and updated regularly) □ International Health Regulations

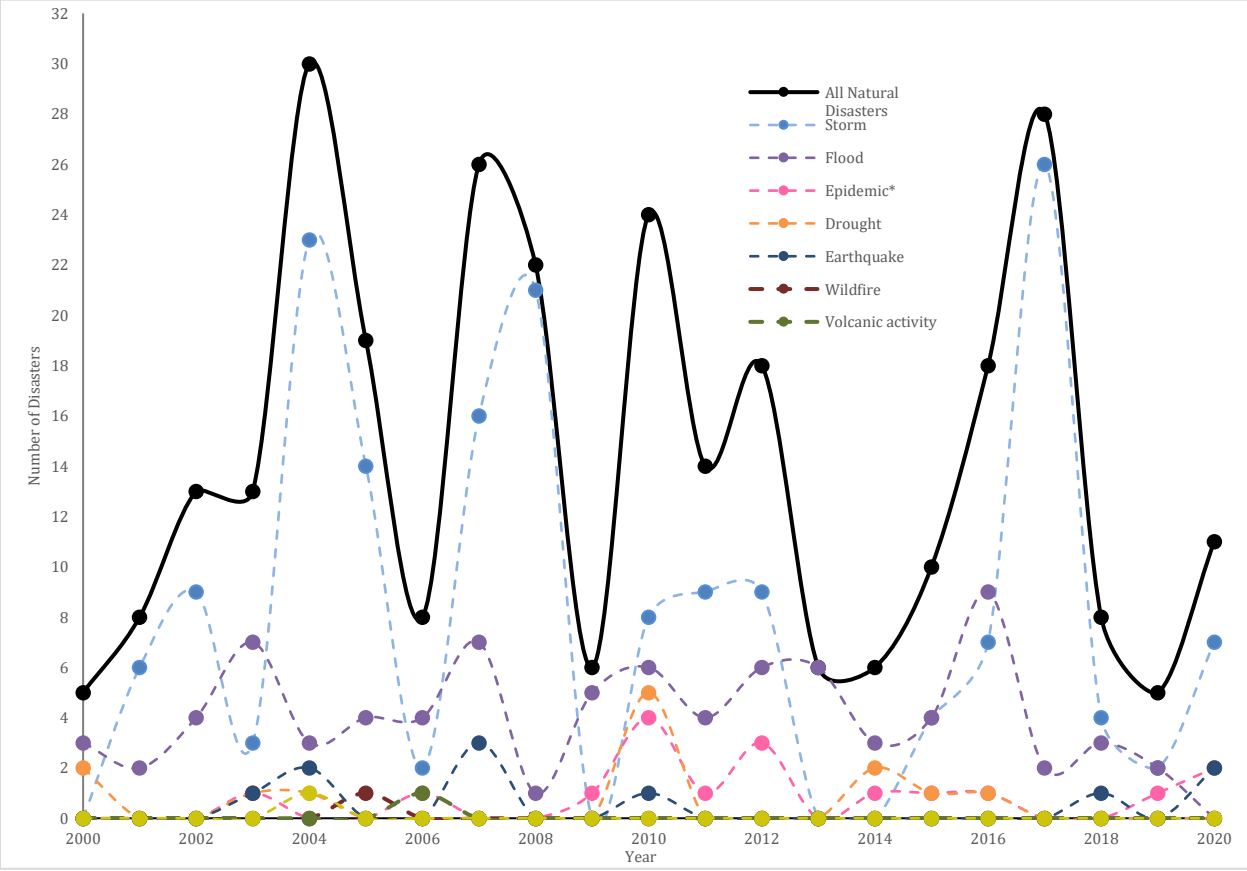
	Functioning civil registration and vital statistics system National Risk Communication Plan (for effective communication to health and other sectors, government, the media, and the public)	two-way communication with the public	Strong public health surveillance system to capture changing health needs of the population Regular, effective, two-way communication with the public		(2005) Core Capacity Index for Risk Communication (annual national score assessing mechanisms for effective risk communication during a public health emergency) □ Active health sector surveillance system. □ Active mortality surveillance from vital registration systems, civil registries, sentinel health facilities, and/or community-based reporting □ Integrated Health Information System □ Dedicated research capacity at the executive level of the health sector
6. Medical Products, Vaccines & Technologies	Establishment of a stockpile of essential medicines, medical supplies (including PPE) and lab supplies Redundant supply chains Accessible new technology adopted to reduce	Awareness of current status of supplies and equipment	Rapid and frequent needs assessment for all healthcare supplies Effective emergency supply chain	Robust partnerships established to support long-term needs for specific medical products, vaccines or technologies	□ Local or regional stockpile of medicines, medical supplies (including PPE) and lab supplies □ Established mechanism(s) for efficient mobilization of medicines, medical supplies (including PPE) and lab

	risks (e.g. low environmental impact technologies) and enhance service delivery				supplies

4.0 HSR Experiences in the Caribbean

The health systems across the Caribbean are challenged by a variety of shocks on a frequent but erratic basis, as demonstrated in Figure 2. This chapter will apply the proposed HSR conceptual framework to examine how Caribbean health systems have historically prepared and responded to the specific shocks of recent natural disasters and disease outbreaks. Each subsection will describe the impacts of a specific shock, as well as how responses to the shock exemplify anticipatory, absorptive, adaptive and/or transformative capacities. For each shock, there will be an in-depth exploration of the experiences of at least one Caribbean country (which was selected based on availability of relevant information).

Figure 2. Graph Showing the Annual Frequency of Selected Shocks in the Caribbean from January 2000 to December 2020**



Source: https://public.emdat.be/data

*Epidemics include cholera, dengue, typhoid fever, and chikungunya. The COVID-19 pandemic is not included for 2020 in the data source, and was not added as the pandemic is still ongoing.

**Caribbean countries included are: Anguilla, Antigua and Barbuda, Bahamas, Barbados, Cayman Islands, Cuba, Dominica, Dominican Republic, Grenada, Guadeloupe, Haiti, Jamaica, Martinique, Montserrat, Puerto Rico, Saint Barthélemy, Saint Kitts and Nevis, Saint Lucia, Saint Martin (French Part), Sint Maarten (Dutch part), Saint Vincent and the Grenadines, Trinidad and Tobago, Turks and Caicos Islands, Virgin Island (British), Virgin Island (U.S.)

4.1 Natural Disasters

Natural disasters have become more frequent and damaging in the Caribbean over the past two decades.[63] This increased frequency and intensity of disasters is predicted to worsen due to climate change.[64] As shown in Figure 2, a strikingly high frequency of natural disasters occurred in 2017, which included two category 5 hurricanes that caused devastation throughout the Caribbean. The severity and timing of these hurricanes, which occurred consecutively within one month, greatly tested the HSR capacity of many Caribbean countries. Given that climate change is likely to increase the frequency of similarly severe weather events, this section focuses on countries' preparation and response to these two hurricanes, through a health systems perspective. Table 4 outlines Emergency Events Database (EM-DAT) data for the natural disasters occurring in 2017 in the Caribbean and some of their high-level impacts. While the variance in the impacts of hurricanes partially reflect variance in the hurricanes' intensity over time, it also reflects variance in countries' resilience capacities.

Table 4. Snapshot of Natural Disasters & their Effects in the Caribbean for 2017

Disaster Type	Event Name	Country	Total Deaths	Total Affected	Total Damages (million US$)
Storm	Hurricane Irma	Cuba	10	10,000,000	540
		Dominican Republic		6,300	
		Anguilla	4	15,000	200
		Antigua and Barbuda	1	1,800	250
		Bahamas			2
		Barbados	1		
		Haiti	1	40,092	
		Puerto Rico	2		
		Turks and Caicos Islands			500
		Saint Kitts and Nevis		500	20
		Virgin Island (U.S.)	4		
		Saint Barthélemy	4		
		Virgin Island (British)	9		3,000

[63] Sònia Muñoz and İnci Ötker, 'Building Resilience to Natural Disasters in the Caribbean Requires Greater Preparedness', IMF, accessed 27 July 2020, https://www.imf.org/en/News/Articles/2018/12/07/NA120718-Building-Resilience-to-Natural-Disasters-in-Caribbean-Requires-Greater-Preparedness.
[64] Muñoz and Ötker.

Disaster Type	Event Name	Country	Total Deaths	Total Affected	Total Damages (million US$)
		Saint Martin (French Part)	7		4,100
		Sint Maarten (Dutch part)	4	11,400	2,500
	Hurricane Maria	Dominica	64	71,393	1,456
		Dominican Republic	5	26,000	63
		Puerto Rico	64	750,000	68,000
		Haiti	3		
		Martinique		2	44
		Guadeloupe	4	80,002	120
		Virgin Island (U.S.)	3		
		Virgin Island (British)			
		Dominican Republic		10,287	
		Haiti			
		Jamaica		5,000	
Flood		Haiti	5	50,000	
		Haiti	26	342	

Source: https://public.emdat.be/data

4.1.1 Hurricane Irma (2017)

Hurricane Irma moved through the Caribbean region affecting many islands, as outlined in Table 4, from September 5 to September 7, 2017.[65]

Barbuda was one of the most critically affected islands, with total losses to Antigua and Barbuda approximating US$18.9 million.[66] All of the island's critical infrastructure was damaged, including the water system, the electricity generation and distribution network, roadways, the main cargo and ferry pier, and the airport, rendering the island uninhabitable.[67] The loss of critical infrastructure, which occurred during the disaster and remained for weeks following the disaster, reflects low resilience capacity.

[65] 'CDEMA Situation Report #9 - Hurricane Irma - as of 9:00pm on September 18th, 2017 - CDEMA', accessed 2 August 2020, https://www.cdema.org/news-centre/situation-reports/1740-cdema-situation-report-9-hurricane-irma-as-of-9-00pm-on-september-18th-2017.

[66] 'Hurricane Irma and Maria Recovery Needs Assessment for Antigua and Barbuda | GFDRR', ACP-EU Natural Disaster Risk Reduction Program, accessed 29 October 2020, https://www.gfdrr.org/en/publication/hurricane-irma-and-maria-recovery-needs-assessment-antigua-and-barbuda.

[67] 'Hurricane Irma and Maria Recovery Needs Assessment for Antigua and Barbuda | GFDRR'.

Recommendations for "building back better" included an underground electricity distribution system and a renewable energy component.[68] A government-commissioned Pan American Health Organization (PAHO) Assessment Report on the island's only hospital, the Hanna Thomas Hospital and Health Center, noted that 85 percent of the roof was damaged with obstructed road access and inoperable utility services, but otherwise, the building was structurally sound.[69] The presence of stagnant water and dead animals represented environmental health risks due to the increase in vectors such as mosquitos and rodents. With 95% of housing damaged and no local access to clean water, electricity or health services, a mandatory evacuation of Barbuda's population to shelters in Antigua was issued.

Routine health services continued to be provided at the public hospital and 25 health centers in Antigua, indicating that some degree of absorptive capacity was present on that island. Adaptive capacity was demonstrated as five health centers in Antigua were designated to serve the population that was evacuated from Barbuda.[70] Further adaptive capacity was shown when the undamaged part of the Hanna Thomas Hospital was designated as a medical post following the lifting of the evacuation order three weeks after the hurricane .[71] Through a $1.55 million donation from the Government of India, the United Nations Development Programme (UNDP) (as implementing partner) carried out a project beginning in 2018 to rehabilitate and equip the damaged Hanna Thomas Hospital using the "build back better" approach. By ensuring the hospital was rebuilt with greater structural resilience, transformative capacity was demonstrated.

Both regional and international organizations and other governments stepped up to lend technical and financial support to the Government of Antigua and Barbuda in other disaster response and recovery efforts. Suriname supported the provision of relief supplies while PAHO deployed a regional response team to Antigua and Barbuda and other affected countries. The International Federation of Red Cross and Red Crescent Societies (IFRC) also assisted with relief and recovery efforts through the provision of cash, hygiene kits, shelter kits, mosquito nets, livelihood support for fishermen in Barbuda, and hospital equipment donation.[72] PAHO played a role in coordinating international organization responses and obtaining necessary medical supplies and equipment from other countries in the region.

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[68] 'Hurricane Irma and Maria Recovery Needs Assessment for Antigua and Barbuda | GFDRR'.
[69] PAHO/WHO, 'Hanna Thomas Hospital and Health Centre Assessment Report', September 2017, https://rosanjose.iom.int/site/sites/default/files/caribe/Hannah%20Thomas%20Hospital%20and%20Health%20Centre.pdf.
[70] PAHO/WHO, 'Hurricane Irma Situation Report No. 4, September 13 2017 – 20:00 EST - British Virgin Islands', ReliefWeb, 13 September 2017, https://reliefweb.int/report/british-virgin-islands/hurricane-irma-situation-report-no-4-hurricane-irma-situation-report.
[71] '3 Weeks After Irma Wrecked Barbuda, Island Lifts Mandatory Evacuation Order', NPR.org, accessed 2 August 2020, https://www.npr.org/sections/thetwo-way/2017/09/29/554540066/3-weeks-after-irma-wrecked-barbuda-island-lifts-mandatory-evacuation-order.
[72] Gavin White, 'Final Evaluation: IFRC Hurricane Irma Response Operation (Antigua & Barbuda and St Kitts & Nevis) - Antigua and Barbuda', ReliefWeb, 4 March 2019, https://reliefweb.int/report/antigua-and-barbuda/final-evaluation-ifrc-hurricane-irma-response-operation-antigua-barbuda.

CDEMA facilitated distribution of relief supply and supported operational logistics of the regional response.[73] The leverage of international and regional partnerships to obtain medical supplies to meet health needs following the disaster demonstrate adaptive capacities.

4.1.1 Hurricane Maria

In the wake of the damage left by Hurricane Irma, Hurricane Maria became a category 5 hurricane on September 18, 2017, causing severe damages when it made landfall in Dominica and continuing to wreak havoc on several countries in the region until September 20, 2017.[74] CDEMA's Regional Response Mechanism was convened on September 19, 2017, to plan a coordinated regional response for affected member states.[75] CDEMA's established Regional Response Mechanism represents anticipatory capacity for participating member states. Table 4 highlights the range of effects of Hurricane Maria on islands throughout the Caribbean.

In Dominica, a hurricane warning was issued by their national Office of Disaster Management (ODM) on the morning of September 17, 2017.[76] The ODM functions as the Secretariat of National Emergency Planning Organisation, which operates the National Emergency Operations Centre as one of its key functions.[77] The prescribed functions of the ODM reflects some anticipatory capacity in Dominica. Despite such anticipatory capacities, Hurricane Maria had devastating impacts in Dominica. A post-disaster assessment in Dominica conducted by the World Bank in conjunction with the UN, ECCB, the CDB, and the EU, estimated the damage and losses from Hurricane Maria to be approximately US$931 million and US$382 million, respectively, which cumulatively represents 226 percent of Dominica's 2016 GDP.[78] Recognizing the economic impact of Hurricane Maria, the government of Dominica passed the Climate Resilience Act in 2018, which established the Climate Resilience Execution Agency of Dominica to ensure all efforts to build back were in line with climate resilient standards.[79] This legislation represents a new anticipatory capacity for Dominica under the governance building block of a health system.

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[73] 'CDEMA Situation Report #9 - Hurricane Irma - as of 9:00pm on September 18th, 2017 - CDEMA'.
[74] 'CDEMA Situation Report #9 - Hurricane Maria - October 6th, 2017 - CDEMA', accessed 2 August 2020, https://www.cdema.org/news-centre/situation-reports/1752-cdema-situation-report-9-hurricane-maria-october-6th-2017.
[75] 'CDEMA Situation Report #9 - Hurricane Maria - October 6th, 2017 - CDEMA'.
[76] 'ODM Advises Residents to Prepare for Hurricane Maria', Dominica News Online, 17 September 2017, https://dominicanewsonline.com/news/homepage/news/odm-advises-residents-to-prepare-for-hurricane-maria/.
[77] Government of the Commonwealth of Dominica, 'Office of Disaster Management: About Us', 2020, http://odm.gov.dm/about-us.
[78] Government of the Commonwealth of Dominica, 'Post-Disaster Needs Assessment: Hurricane Maria September 18, 2017. A Report by the Government of the Commonwealth of Dominica', 15 November 2017, https://reliefweb.int/sites/reliefweb.int/files/resources/dominica-pdna-maria.pdf.
[79] Sarah Gibbens, 'Dominica Is Working to Become World's First Hurricane-Proof Country', 19 November 2019, https://www.nationalgeographic.com/science/2019/11/dominica-on-track-to-be-worlds-first-climate-resilient-nation/#close.

Heavy infrastructure damage left thousands of Dominicans homeless and requiring daily water and food assistance.[80] Telecommunications services (except for amateur radio) were inoperable for the first three days following the disaster.[81] Water supply and sanitation infrastructure were damaged, such that one city's population was exposed to raw sewage which posed several health risks. Further, 40-45 percent of the population did not have access to clean water one month after the hurricane.[82] This sustained infrastructure damage impedes health system functioning and reflects low resilience capacity.

There were also extreme damages and losses to the health sector in Dominica. The only referral hospital in Dominica's health care system, the Princess Margaret Hospital, was severely damaged with an estimated 53 percent ability to function. The majority of medical supplies, with the exception of medicines, were lost as a result of water damage.[83] Medical equipment, including the portable x-ray machine and all blood bank equipment, were also lost.[84] Overall, access to health care was reduced because all health centers around the island were impacted, with some health clinics sustaining severe damage, and blocked road access.[85] This reduction in health care services is indicative of a lack of absorptive capacity. However, primary health services continued to be provided either in buildings that had emergency repairs or in alternate locations,[86] reflecting the triggering of some adaptive capacities. Another example of adaptive capacity was the repurposing of the Newtown Primary School as a central medical store (that also served as a collection point for donations of medical supplies), which supported by PAHO.[87] Long term structural fixes to Dominica's health facilities, in line with the building back better approach, occurred in 2018. Through funding from the Government of the People's Republic of China, UNDP spearheaded a project to provide sturdier roofing to the Princess Margaret Hospital and a health center.[88]

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[80] United Nations, 'Dominica: Hurricane Maria Situation Report No. 4 (as of 7 October, 2017) - Dominica', ReliefWeb, 7 October 2017, https://reliefweb.int/report/dominica/dominica-hurricane-maria-situation-report-no-4-7-october-2017.

[81] Government of the Commonwealth of Dominica, 'Post-Disaster Needs Assessment: Hurricane Maria September 18, 2017. A Report by the Government of the Commonwealth of Dominica'.

[82] International Medical Corps, 'IMC 2017 Dominica MHPSS Assessment.Pdf', accessed 2 August 2020, https://www.mhinnovation.net/sites/default/files/downloads/innovation/reports/IMC%202017%20Dominica%20MHPSS%20Assessment.pdf.

[83] Government of the Commonwealth of Dominica, 'Post-Disaster Needs Assessment: Hurricane Maria September 18, 2017. A Report by the Government of the Commonwealth of Dominica'.

[84] Government of the Commonwealth of Dominica.

[85] Government of the Commonwealth of Dominica.

[86] Government of the Commonwealth of Dominica.

[87] United Nations, 'Dominica: Hurricane Maria - Overview of the Humanitarian Response in 2017 (September-December 2017), 8 February 2018 - Dominica', ReliefWeb, 8 February 2018, https://reliefweb.int/report/dominica/dominica-hurricane-maria-overview-humanitarian-response-2017-september-december-2017.

[88] UNDP, 'Officials from Dominica, China and UNDP Assess Recovery Efforts', UNDP in Barbados & the OECS, 9 March 2018, https://www.bb.undp.org/content/barbados/en/home/presscenter/articles/2018/03/09/officials-from-dominica-china-and-undp-assess-recovery-efforts.html.

Many other regional and international bodies also supported Dominica's emergency and recovery response. For example, the Jamaica Defence Force and the Trinidad and Tobago Defence Force deployed personnel to assist with recovery (including security efforts and hospital repairs).[89] The International Medical Corps deployed medical volunteer teams to Dominica immediately after the disaster, and in early 2018 at the request of Dominica's Ministry of Health.[90] These volunteer medical professionals carried out over 2000 patient consultations[91] and were part of the adaptive health system response. A Trinidad and Tobago NGO set-up and staffed a medical clinic in Dominica, while IFRC supported health care facility and water, sanitation and hygiene (WASH) assessments. PAHO supported the Ministry of Health (MOH) with the coordination of international assistance in health, as well as played a leading role in WASH recovery efforts with support from the Caribbean Public Health Agency (CARPHA).[92] The Organization of Eastern Caribbean States (OECS) also supported resource mobilization efforts by coordinating the rental of a boat and the purchase of oxygen supplies to facilitate the creation of a self-sufficient clinic managed by health professionals from the Dominican diaspora.[93] By February 2018, total funding support from various sources amounted to US$28.5 million.[94]

4.2 Disease Outbreaks

The Caribbean region has a long and substantial history of battling infectious diseases. The dengue virus transmitted by mosquito vectors was first isolated in the Caribbean region in the 1940s and has since been responsible for many dengue fever outbreaks on Caribbean islands --- including more severe outbreaks in recent years, namely in Dominica, Saint Vincent and the Grenadines, and Jamaica. Other diseases such as AIDS, cholera, and TB also persist. In the past decade, multiple viruses were introduced in the region for the first time (e.g. Chikungunya, Zika), contributing to increased disease burdens. The recent introduction of these novel viruses across many Caribbean demonstrates the critical regionality not just of resiliency but of risk. Outbreaks of new diseases cannot be planned for and managed in the same manner as discrete weather events or outbreaks of persisting diseases, which presents additional challenges for building HSR. Considering that new pathogens are more likely to necessitate higher HSR capacities, this section will examine how the region has responded to some of these novel virus outbreaks over the past two decades.

4.1.2 2013-2014 Chikungunya Virus Caribbean Outbreak

[89] 'CDEMA Situation Report #9 - Hurricane Maria - October 6th, 2017 - CDEMA'.
[90] International Medical Corps, 'Dominica', International Medical Corps, 14 May 2018, https://internationalmedicalcorps.org/country/dominica/.
[91] International Medical Corps.
[92] 'CDEMA Situation Report #9 - Hurricane Maria - October 6th, 2017 - CDEMA'.
[93] OECS, 'OECS Commission Relief Operations after Hurricane Irma and Maria - Update October 3 2017', 4 October 2017, https://pressroom.oecs.org/oecs-commission-relief-operations-after-hurricane-irma-and-maria-update-october-3-2017.
[94] United Nations, 'Dominica', 8 February 2018.

Given that the Caribbean population had not been previously exposed to the chikungunya virus, coupled with the broad presence of competent vectors (especially the *Aedes aegypti* mosquito), health experts made early predictions that large outbreaks were possible in the region. In 2012 PAHO subsequently hosted a workshop for Caribbean countries which produced a "*Preparedness and Response Plan for Chikungunya Virus Introduction in the Caribbean Sub-Region*" that focused on clinical management, epidemiological surveillance, laboratory, and vector control.[95] This plan reflected a degree of anticipatory capacity for 21 Caribbean member states who received training on the guidelines.

The first laboratory-confirmed autochthonous cases of chikungunya occurred in December 2013 on the French part of the Caribbean island of St. Martin.[96] This was followed by a rapid spread of the virus throughout the Caribbean, rising to a total of 103,018 suspected and 4,406 laboratory-confirmed chikungunya cases by the end of May 2014.[97] At that time, the highest number of cases were reported from the Dominican Republic, Martinique, Guadeloupe, Haiti, and Saint Martin, respectively. While the mortality rate associated with chikungunya virus is low at 4 percent, the large percentage of symptomatic infections resulted in strained healthcare resources, especially since there was no specific treatment (beyond symptomatic relief) or vaccine for the virus.[98] The CARPHA laboratory in Trinidad conducted testing for many countries using a real-time polymerase chain reaction (PCR) method developed by CDC.[99] However, these laboratory services were quickly overwhelmed as the number of cases grew, indicating low absorptive capacity of the laboratory component of the health systems. Countries instead relied mainly on the WHO clinical case definition of chikungunya to identify cases. National public health responses to local outbreaks focused mainly on vector control efforts and encouraging personal protection efforts to reduce mosquito-to-human contact.[100] Regional organizations, such as CARPHA and PAHO, as well as international universities (e.g. Yale University, USA), assisted with vector control and personal protection efforts.[101]

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[95] PAHO/WHO, 'Preparedness and Response Plan for Chikungunya Virus Introduction in the Caribbean Sub-Region; 2013 - PAHO/WHO | Pan American Health Organization', 2012, https://www.paho.org/en/documents/preparedness-and-response-plan-chikungunya-virus-introduction-caribbean-sub-region-2013.

[96] W Van Bortel et al., 'Chikungunya Outbreak in the Caribbean Region, December 2013 to March 2014, and the Significance for Europe', *Eurosurveillance* 19, no. 13 (3 April 2014): 20759, https://doi.org/10.2807/1560-7917.ES2014.19.13.20759.

[97] Marc Fischer and J. Erin Staples, 'Chikungunya Virus Spreads in the Americas — Caribbean and South America, 2013–2014', *MMWR. Morbidity and Mortality Weekly Report* 63, no. 22 (6 June 2014): 500–501.

[98] Enrique Gutierrez-Saravia and Camilo E. Gutierrez, 'Chikungunya Virus in the Caribbean: A Threat for All of the Americas', *Journal of the Pediatric Infectious Diseases Society* 4, no. 1 (1 March 2015): 1–3, https://doi.org/10.1093/jpids/piv002.

[99] Shalauddin Ahmed et al., 'Chikungunya Virus Outbreak, Dominica, 2014 - Volume 21, Number 5—May 2015 - Emerging Infectious Diseases Journal - CDC', accessed 30 July 2020, https://doi.org/10.3201/eid2105.141813.

[100] Gutierrez-Saravia and Gutierrez, 'Chikungunya Virus in the Caribbean'.

[101] Ahmed et al., 'Chikungunya Virus Outbreak, Dominica, 2014 - Volume 21, Number 5—May 2015 - Emerging Infectious Diseases Journal - CDC'.

Limited literature analyzing Caribbean countries' responses to the chikungunya outbreak was found and this lack of research can impede the improvement of anticipatory capacities for similar novel virus outbreaks. However, it was found that several researchers studied the situation in Jamaica so this county's outbreak will be examined further. In 2014, Jamaica's first autochthonous case was reported in early August and by the end of the year, the MOH had been notified of 4,447 chikungunya infections.[102] The MOH categorized the chikungunya virus as a Class I notifiable disease, which meant that a suspected case had to be reported to the MOH by public and private health facilities within twenty-four hours. However, one study suggested that officially reported cases are likely only a small portion of actual cases, noting that 87 percent of families in Jamaica reported having household members affected by the chikungunya virus.[103] Another study further suggested that chikungunya-related deaths were likely under-reported. The study noted that while Jamaica reported no chikungunya-associated deaths, there was an excess mortality of 2,499 deaths in 2014 against expected mortality of 15,147 deaths (calculated using average age-specific mortality rates from 2012–2013) for that period.[104] This potential underreporting of chikungunya cases and related mortality could be indicative of low resilience capacities in Jamaica's health surveillance system. While Jamaica has a National Public Health Laboratory that supports public health services and many private facilities that also provide diagnostic services, Jamaica initially relied on the regional reference lab, CARPHA, for PCR testing (the gold standard for the chikungunya lab test). In 2014, PCR testing was done for only 137 suspected cases and at the peak of the epidemic in October 2014, the local and regional labs were quickly overwhelmed by the number of cases in the country and regionally, respectively.[105] The peak of the outbreak also placed a significant strain on hospital resources, as reflected by a fivefold increase in emergency room visits for children at two public hospitals compared to a similar time period in 2013.[106] In an effort to increase available beds, the Jamaican Military built a field hospital at the Bustamante Hospital for Children,[107] reflecting a degree of adaptive capacity. Towards the end of October, the Prime Minister declared a national emergency, which activated the National Emergency Response Team to support vector control and public education campaigns.[108] This established mechanism for activating a formal, dedicated emergency team demonstrates anticipatory capacity. Widespread

[102] Celia Christie et al., 'Chikungunya in Jamaica – Public Health Effects and Clinical Features in Children', *West Indian Medical Journal* 65 (10 November 2016), https://doi.org/10.7727/wimj.2016.529; Jacqueline Duncan et al., 'Chikungunya: Important Lessons from the Jamaican Experience', *Revista Panamericana de Salud Pública* 41 (3 July 2017): 1, https://doi.org/10.26633/RPSP.2017.60.
[103] Christie et al., 'Chikungunya in Jamaica – Public Health Effects and Clinical Features in Children'.
[104] 'Excess Deaths Associated with the 2014 Chikungunya Epidemic in Jamaica: Pathogens and Global Health: Vol 113, No 1', accessed 31 July 2020, https://www.tandfonline.com/doi/full/10.1080/20477724.2019.1574111.
[105] Duncan et al., 'Chikungunya'.
[106] Christie et al., 'Chikungunya in Jamaica – Public Health Effects and Clinical Features in Children'.
[107] Christie et al.
[108] Christie et al.; Phuong N Pham et al., 'Epidemiology of Chikungunya Fever Outbreak in Western Jamaica during July–December 2014', *Research and Reports in Tropical Medicine* 8 (25 January 2017): 7–16, https://doi.org/10.2147/RRTM.S122032.

absenteeism as a result of the outbreak was observed in the labor force, with estimated losses amounting to 13 million man-hours and six billion dollars in revenue.[109]

4.2.1 2015-2016 Zika Virus Outbreak

In May 2015, an outbreak of the Zika virus in Brazil prompted enhanced surveillance for the virus in the Caribbean, reflecting some regional anticipatory capacity.[110] Regional health authorities recognized the significant threat given that the population had not been previously exposed to the virus (and hence, had no acquired immunity), the vector was ubiquitous throughout the region, and no vaccine or treatment was available.

By November 2015 the first autochthonous transmission in the Caribbean, was confirmed by the CARPHA laboratory in Trinidad.[111] Zika quickly spread throughout the region and with peak cases reported in August 2016, after the start of the rainy season. Over 16,000 locally transmitted suspected cases and over 4,000 confirmed cases were reported among non-Latin Caribbean countries[112] by December 2016 (with the highest number of confirmed cases in US Virgin Islands, Curacao, Suriname, and Trinidad and Tobago, respectively).[113] By the beginning of 2016, Zika virus was suspected as a causal factor in an increase in microcephaly and other neurological disorder cases in Brazil, which led the WHO to declare a Public Health Emergency of International Concern (PHEIC) from February 2016 until November 2016.[114] Within the same month of the declaration of the PHEIC, PAHO released a "*Regional Response Strategy to Combat Zika Virus*" focused on detecting and monitoring the virus, reducing vector presence, and supporting the management of the response to the virus.[115] In line with this strategy, PAHO created a LAC regional stockpile of immunoglobulin (used in the management of patients with Guillain-Barré Syndrome related to Zika virus infection) that was strategically located in Panama and Barbados for ease of distribution. PAHO also mediated agreements between neighboring countries as needed to address treatment gaps. Additionally, PAHO provided training to Caribbean health professionals on the clinical management of neurological complications related to Zika and thereby, increased the

[109] Christie et al., 'Chikungunya in Jamaica – Public Health Effects and Clinical Features in Children'.
[110] Lorraine Francis et al., 'Zika Virus Outbreak in 19 English- and Dutch-Speaking Caribbean Countries and Territories, 2015–2016', *Revista Panamericana de Salud Pública* 42 (17 September 2018): e120, https://doi.org/10.26633/rpsp.2018.120.
[111] Francis et al.
[112] Non-Latin Caribbean countries include: Anguilla, Antigua and Barbuda, Aruba, Bahamas, Barbados, Bonaire, St Eustatius and Saba, Cayman Islands, Curacao, Dominica, Grenada, Guyana, Jamaica, Montserrat, Saint Kitts and Nevis, Saint Lucia, Saint Vincent and the Grenadines, Sint Maarten (Dutch part), Suriname, Trinidad and Tobago, Turks and Caicos Islands, Virgin Islands (UK), and Virgin Islands (US).
[113] Pan American Health Organization / World Health Organization, 'Zika Suspected and Confirmed Cases Reported by Countries and Territories in the Americas Cumulative Cases, 2015-2016. Updated as of 29 December 2016.', 2016, https://www.paho.org/hq/dmdocuments/2016/2016-dec-29-phe-ZIKV-cases.pdf.
[114] Vivian I. Avelino-Silva et al., 'Study Protocol for the Multicentre Cohorts of Zika Virus Infection in Pregnant Women, Infants, and Acute Clinical Cases in Latin America and the Caribbean: The ZIKAlliance Consortium', *BMC Infectious Diseases* 19, no. 1 (26 December 2019): 1081, https://doi.org/10.1186/s12879-019-4685-9.
[115] PAHO/WHO, 'Pan American Health Organization Response to the Epidemic of Zika Virus in the Americas December 2015-2016', 2016, https://www.paho.org/sites/default/files/2019-04/Zika-Annual-Report-Dec-2015-2016.pdf.

anticipatory capacity of countries who had not experienced such cases prior to the training.[116] Due to limited testing capacity, countries relied on PAHO's clinical guidelines to identify suspected cases.[117] While CARPHA was initially designated as the Zika testing lab for the region at the beginning of the outbreak, several other labs in the region developed testing capacity over the epidemic period. In April 2016, the Government of Jamaica invested over US$80,000 to upgrade the University Hospital of the West Indies Virology lab, such that it was validated by the WHO to test for the disease locally.[118] Similarly, in September 2016, PCR testing using the CDC Trioplex assay was established at the national reference laboratory of the Ministry of Health of Barbados.[119] These countries' ability to establish local testing for Zika during the PHEIC illustrates a degree of transformative capacity.

The Caribbean was deeply affected by the Zika outbreak, yet limited research has examined the impact of Zika specifically within the Caribbean. One study projected that the Caribbean was the most economically affected sub-region for the period 2015 to 2017, with a negative macroeconomic impact five times greater than that of South America.[120] The study also estimated that the total short-term cost of Zika to the Caribbean region between 2015 to 2017 ranged from 1.8 billion USD to 3.4 billion USD, with the majority of this cost due to lost revenue from tourism.[121] While the direct medical costs for treating symptoms of Zika patients are low since hospitalizations are rare, the indirect lifetime costs of treating associated congenital and neurological conditions are high.

Suriname was one of the Caribbean countries with a high number of cases (791 molecularly confirmed Zika cases from October 2015 to August 2016) with projected costs estimated to be between $10–22 million.[122] In Suriname, the first two locally-acquired cases were confirmed on November 2, 2015.[123] Based on previous experiences with chikungunya, Suriname quickly implemented laboratory-based surveillance system for Zika infections.[124]

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116 PAHO/WHO, 'PAHO/WHO | Timeline of Emergence of Zika Virus in the Americas', Pan American Health Organization / World Health Organization, 29 April 2016, https://www.paho.org/hq/index.php?option=com_content&view=article&id=11959:timeline-of-emergence-of-zika-virus-in-the-americas&Itemid=41711&lang=en.

117 Sadie J. Ryan et al., 'Zika Virus Outbreak, Barbados, 2015–2016', *The American Journal of Tropical Medicine and Hygiene* 98, no. 6 (6 June 2018): 1857–59, https://doi.org/10.4269/ajtmh.17-0978.

118 CARICOM, 'Jamaica Lab Approved as WHO Zika Testing Facility', *CARICOM* (blog), 4 April 2016, https://caricom.org/jamaica-lab-approved-as-who-zika-testing-facility/.

119 Ryan et al., 'Zika Virus Outbreak, Barbados, 2015–2016'.

120 UNDP, 'A Socio-Economic Impact Assessment of the Zika Virus in Latin America and the Caribbean', UNDP, April 2017, https://www.undp.org/content/undp/en/home/librarypage/hiv-aids/a-socio-economic-impact-assessment-of-the-zika-virus-in-latin-am.html.

121 UNDP.

122 UNDP; John Codrington et al., 'Zika Virus Outbreak in Suriname, a Report Based on Laboratory Surveillance Data', *PLoS Currents* 10 (10 May 2018), https://doi.org/10.1371/currents.outbreaks.ff0f6190d5431c2a2e824255eaeaf339.

123 PAHO/WHO, 'PAHO/WHO | Timeline of Emergence of Zika Virus in the Americas'.

124 John Codrington et al., 'Zika Virus Outbreak in Suriname, a Report Based on Laboratory Surveillance Data', *PLoS Currents* 10 (10 May 2018), https://doi.org/10.1371/currents.outbreaks.ff0f6190d5431c2a2e824255eaeaf339.

This could reflect that Suriname had stronger anticipatory capacities following a previous shock, which allowed them to adapt more quickly to a new but similar threat. Blood samples were taken by general practitioners or at public health centers from suspected cases and sent to the local Academic Hospital of Paramaribo for molecular diagnosis of Zika using real-time reverse transcription polymerase chain reaction (RT-PCR) testing. The quick development of national testing capabilities for Zika reflects adaptive capacities. The Pasteur Institute in Cayenne in the neighboring country of French Guiana, which confirmed the first five indigenous cases of infection by the Zika virus in Suriname,[125] also offered yet another alternate source of testing for Zika for some other suspected cases in Suriname.[126] As of February 2017, Suriname MOH had reported 16 cases of Guillain-Barré syndrome (GBS), four of which have been laboratory-confirmed for Zika virus infection and four deaths among confirmed Zika cases.[127]

4.2.2 COVID-19 Pandemic

An outbreak of COVID-19 caused by the 2019 novel coronavirus has been spreading rapidly across the world since December 2019**,** with the WHO declaring a pandemic on March 11, 2020. On March 1, the first case of COVID-19 in the Caribbean was confirmed in the Dominican Republic.[128] On this same date, CARICOM held an emergency meeting to plan a regional response to potential local outbreaks, which was necessary as several member states had inadequate laboratory testing capabilities and insufficient healthcare facilities to address a surge of COVID-19 cases.[129] This established regional emergency mechanism indicated a degree of anticipatory capacity for member states. On March 11, 2020, the World Health Organization declared a global pandemic, which resulted in widespread travel restrictions. Many Caribbean countries had already implemented national measures to restrict movement into, as well as within, countries. A review of Caribbean responses found that national measures to restrict travel into countries were implemented up to 27 days before the first confirmed case,[130] reflecting anticipatory capacities. More specifically, most Caribbean countries had closed national borders, established quarantine and social distancing protocols, and supported the coordination of regional policies.[131] However by mid-July 2020, several Caribbean countries (including Antigua and Barbuda, St. Lucia, Jamaica, Bahamas, Cuba, Dominican Republic, St. Vincent and the Grenadine, Barbados,

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[125] {Citation}
[126] PAHO/WHO, 'Zika-Epidemiological Report Suriname', 27 February 2017, https://www.paho.org/hq/index.php?option=com_docman&view=download&category_slug=march-2017-9645&alias=43832-zika-epidemiological-report-suriname-832&Itemid=270&lang=en.No Reference
[127] PAHO/WHO.
[128] Madhuvanti M Murphy et al., 'COVID-19 Containment in the Caribbean: The Experience of Small Island Developing States', preprint (Public and Global Health, 2 June 2020), https://doi.org/10.1101/2020.05.27.20114538.
[129] Ian R Hambleton, Selvi M Jeyaseelan, and Madhuvanti M Murphy, 'COVID-19 in the Caribbean Small Island Developing States: Lessons Learnt from Extreme Weather Events', *The Lancet. Global Health*, 2 July 2020, https://doi.org/10.1016/S2214-109X(20)30291-6.
[130] Hambleton, Jeyaseelan, and Murphy.
[131] Scott B. MacDonald, 'COVID-19, the Caribbean and What Comes Next', *Global Americans* (blog), 2 July 2020, https://theglobalamericans.org/2020/07/covid-19-the-caribbean-and-what-comes-next/.

Dominica, Grenada) reopened their borders (partially or fully) for tourism, with each country implementing different COVID-19 containment protocols.[132] Following re-opening for tourism, some countries, such as the Bahamas, had to revise travel protocols due to a surge in COVID-19 cases.[133] In mid-October 2020 (over seven months after the first Caribbean case of COVID-19), PAHO reported that within the region of the Americas, the highest increase in cases was observed in the Caribbean and the Atlantic Ocean Islands subregion[134], with a 20 percent increase in cases and an 18 percent increase in deaths.[135] Table 5 provides COVID-19 related data provided by countries' respective governments on national testing, confirmed cases, and deaths. As seen in Table 5, countries in the region have fared differently, and that some countries, such as Saint Lucia, were faced with concurrent outbreaks of dengue, which have impacted their ability to respond.

Table 5. COVID-19 Testing, Cases, and Deaths in the Caribbean as of February 18, 2021*

Countries	Number of Persons Tested	Number of Samples Tested	Total Number of Confirmed Cases	Total Number of Confirmed Cases per 100,000 population**	Total Number of Deaths
Antigua and Barbuda	11,510	12,762	598	616	11
Belize	70,813	79,268	12,207	3,127	314
Dominica [a]	10,917		134	187	0
Dominican Republic		1,165,107	233,598	2,175	3,024
Grenada [b]		20,288	148	132	1
Guyana	56,902		8,338	1,065	189
Haiti [c]			12,274	109	247
Jamaica		191,272	20,581	6,981	391
St Kitts and Nevis [c]	8,625		41	78	0
St Lucia [d]		29,696	3,078	1,684	31

[132] Mulder, Nanno. "The Impact of the COVID-19 Pandemic on the Tourism Sector in Latin America and the Caribbean, and Options for a Sustainable and Resilient Recovery." International Trade Series, No. 157. Santiago: Economic Commission for Latin America and the Caribbean (ECLAC), 2020.

[133] Office of the Prime Minister of the Bahamas. "National Address - July 19, 2020 - Office of the Prime Minister," July 19, 2020. https://opm.gov.bs/national-address/.

[134] Anguilla, Antigua and Barbuda, Aruba, the Bahamas, Barbados, Bermuda, Bonaire, Sint Eustatius and Saba, the British Virgin Islands, the Cayman Islands, Cuba, Curacao, Dominica, the Dominican Republic, the Falkland Islands, French Guiana, Grenada, Guadeloupe, Guyana, Haiti, Jamaica, Martinique, Montserrat, Puerto Rico, Saint Barthélemy, Saint Kitts and Nevis, Saint Lucia, Saint Martin, Saint Pierre and Miquelon, Saint Vincent and the Grenadines, Sint Maarten, Suriname, Trinidad and Tobago, Turks and Caicos, and the U.S. Virgin Islands

[135] PAHO/WHO, 'Epidemiological Update: Coronavirus Disease (COVID-19) - 15 October 2020 - PAHO/WHO | Pan American Health Organization', 15 October 2020, https://www.paho.org/en/documents/epidemiological-update-coronavirus-disease-covid-19-15-october-2020.

St Vincent and the Grenadines		34,526	1,494	1,351	6
Trinidad and Tobago	93,153		7,666	550	138

*Unless stated otherwise
**Based on 2019 population statistics from the World Bank DataBank
[a]**Data as of February 14, 2021**
[b]**Data as of February 3, 2021**
[c]**Data as of February 17, 2021**
[d]**Data as of February 20, 2021**
Sources: Compiled by authors using figures from Ministries of Health and the CARPHA COVID-19 situation report.[136]

Strong national leadership responses, as well as regional and international bodies have played integral roles in supporting the Caribbean's responses to the pandemic thus far. The majority of medical products for treating COVID-19 are imported from outside the region so with travel restrictions and global shortages, the region's supply was likely to be adversely affected.[137] In light of this challenge, CARICOM coordinated the procurement of some necessary equipment, such as the provision of PPE from the People's Republic of China and Taiwan. CDEMA and CARPHA have also supported outbreak response logistics and the strengthening of regional testing capacity.[138] For example, CDEMA operates the distribution center for CARICOM-procured relief supplies for COVID-19,[139] while CARPHA has been disseminated guidelines and situation reports to member states.[140] Similarly, the OECS has scaled up these activities under their Pharmaceutical Procurement Service (PPS) model to swiftly purchase and distribute critical medical supplies across the region.[141] The leveraging and expanding of this existing mechanism represents absorptive and adaptive capacities for OECS member countries, respectively. The OECS has also engaged in a private sector partnership with several regional entities (such as Massy Stores) to raise funds to support their response to COVID-19. Another example of private sector support was demonstrated

[136] https://www.facebook.com/investingforwellness/, https://www.facebook.com/Belizehealth, https://www.facebook.com/MinistryOfHealthDominica, http://digepisalud.gob.do/, https://www.facebook.com/HealthGrenada, https://health.gov.gy/, https://www.mspp.gouv.ht/wp-content/uploads/Sitrep-COVID-19_17-02-2021.pdf, https://www.moh.gov.jm/covid-19-clinical-management-summary-for-thursday-february-18-2021/, https://www.facebook.com/StKittsHPU/, https://www.covid19response.lc/; https://www.facebook.com/SVGHEALTH/, https://health.gov.tt/covid-19-update-thursday-18th-february-2021-0
[137] United Nations, 'POLICY BRIEF: THE IMPACT OF COVID-19 ON LATIN AMERICA AND THE CARIBBEAN', July 2020, https://www.un.org/sites/un2.un.org/files/sg_policy_brief_covid_lac.pdf.
[138] Hambleton, Jeyaseelan, and Murphy, 'COVID-19 in the Caribbean Small Island Developing States'.
[139] CARPHA, 'CARPHA SITUATION REPORT NO. 76', 29 July 2020, https://carpha.org/Portals/0/Documents/COVID%20Situation%20Reports/Situation%20Report%2076%20-%20July%2029,%202020.pdf.
[140] CARPHA, 'COVID-19 Background', 2020, https://www.carpha.org/What-We-Do/Public-Health/Novel-Coronavirus/COVID-19-Background.
[141] Josimar Scott, 'OECS Raises EC$1.2M for COVID-19; Channels Resources through PPS System | CBR', *Caribbean Business Report* (blog), 13 April 2020, https://caribbeanbusinessreport.com/news/oecs-raises-ec1-2m-for-covid-19-channels-resources-through-pps-system/.

by Digicel, a telecommunications provider in Trinidad and Tobago, which has been allowing free calls to local health centers and free access to health information websites for their consumers.[142] This coordination between the health sector and a private company during the pandemic demonstrates adaptive leadership capacity. PAHO has also worked to increase testing capacity and surveillance within the region, by providing equipment (such as the donation of Android tablets with contact tracing software to Jamaica[143]), reagents, and training. Other UN agencies have also supported the COVID-19 response in the region. For example, the United Nations Office for Project Services (UNOPS) has procured and distributed PPE and medical equipment for the treatment of COVID-19 to Haiti,[144] while the United Nations Children's Fund (UNICEF) has supported the development of an online portal to deliver virtual mental health and psychosocial services to frontline workers and caregivers in the Eastern Caribbean.[145] International and regional banks have provided financial support to countries, including the Caribbean Development Bank (CDB), which made emergency loans available to Antigua and Barbuda, Belize, Dominica, Grenada, St. Lucia, St. Vincent and the Grenadines, and Suriname.[146] The World Bank has also provided fast-tracked financial and knowledge assistance to countries related to the procurement of essential supplies, strengthening of health systems, and expansion of social protection.[147] Emergency financing of millions of USD has been provided to certain countries by the IMF, through their Rapid Credit Facility and Rapid Financing Instrument.[148]

In general, the early response of the Caribbean countries to the COVID-19 pandemic had garnered global praise, with some noting that most Caribbean islands experienced a less steep outbreak growth in earlier months compared to their Central and South American counterparts.[149] However, as shown in Table 5, the spread of the virus, testing, and testing capacities within the region has varied greatly. Some countries, such as Dominica, Grenada,

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142 United Nations Office for Disaster Risk Reduction, 'Disaster Risk Reduction and the Caribbean Private Sector: The Role of the Telecommunications Sector in the Context of COVID-19', accessed 29 January 2021, https://www.undrr.org/publication/disaster-risk-reduction-and-caribbean-private-sector-role-telecommunications-sector.

143 'Building COVID-19 Testing and Surveillance across Jamaica - PAHO/WHO | Pan American Health Organization', accessed 2 August 2020, http://www.paho.org/en/stories/building-covid-19-testing-and-surveillance-across-jamaica.

144 UNOPS, 'COVID-19: Stay up-to-Date with the Latest on UNOPS Support to Response Efforts', UNOPS, 26 March 2020, https://www.unops.org/news-and-stories/news/covid-19-stay-up-to-date-with-the-latest-on-unops-support-to-response-efforts.

145 UNICEF Eastern Caribbean, 'Virtual Mental Health and Psychosocial Sessions Offering Support across the Eastern Caribbean', accessed 21 September 2020, https://www.unicef.org/easterncaribbean/stories/virtual-mental-health-and-psychosocial-sessions-offering-support-across-eastern-caribbean.

146 MacDonald, 'COVID-19, the Caribbean and What Comes Next'.

147 'World Bank Response to Covid-19 (Coronavirus) in the Caribbean', Text/HTML, World Bank, accessed 2 August 2020, https://www.worldbank.org/en/news/factsheet/2020/06/11/world-bank-response-to-covid-19-coronavirus-in-the-caribbean.

148 IMFBlog, 'COVID-19 Pandemic and the Caribbean: Navigating Uncharted Waters', *IMF Blog* (blog), accessed 2 August 2020, https://blogs.imf.org/2020/04/29/covid-19-pandemic-and-the-caribbean-navigating-uncharted-waters/.

149 Hambleton, Jeyaseelan, and Murphy, 'COVID-19 in the Caribbean Small Island Developing States'.

Saint Lucia, and Saint Vincent and the Grenadines, have developed in-country testing capacity for COVID-19, reflecting adaptive capacity. The Dominican Republic has a relatively high number of cases, despite taking early measures (such a national lockdown at a time of twenty-one cases and one death).[150] In the Dominican Republic, there have been reports of inadequate PPE in hospital settings, including designated COVID-19 response sites, due to market shortages and increased costs. Additionally, the country has struggled with health communication, with media misinformation leading to national shortages of drugs such as hydroxychloroquine (which prevented some patients from accessing necessary treatments) and grocery shortages.[151]

Reports have highlighted that significant economic impacts from the pandemic are expected in the region. While the impact on national economies will differ based on their economic structure, most Caribbean countries depend on tourism and/or commodities export, which have both been interrupted due to the closure of borders and the reduction in international trade.[152] Given these predicted losses in key sectors, one researcher noted that in 2020, the region will experience the largest economic contraction since 1930.[153] Guyana is expected to be an exception because of recently discovered large reserves of oil and natural gas.

[150] Leandro Tapia, 'Novel Coronavirus Disease (COVID-19) and Fake News in the Dominican Republic', *The American Journal of Tropical Medicine and Hygiene*, 29 April 2020, https://doi.org/10.4269/ajtmh.20-0234.
[151] Tapia.
[152] 'Caribbean Economies in the Time of the Coronavirus | Publications', accessed 1 August 2020, https://flagships.iadb.org/en/caribbean-region-quarterly-bulletin-2020-q1/caribbean-economies.
[153] Kirk Meighoo, 'The Caribbean and Covid-19: Not a Health Crisis, but a Looming Economic One', *The Round Table* 109, no. 3 (3 May 2020): 340–41, https://doi.org/10.1080/00358533.2020.1769917.

5.0 Assessing HSR in the Caribbean

Based on the analysis of countries' recent preparedness and response to shocks in Chapter 4, it is evident that HSR capacities vary significantly across countries in the region. Chapter 4 also demonstrates that the HSR capacities of Caribbean countries have improved to some extent over time (as exemplified by the re-building of improved infrastructure following hurricanes and increased national laboratory testing capacity following novel viruses). The subsequent health system improvements after each shock effectively represent existing transformative capacities within the health systems. However, notwithstanding these improvements, there is still a great need to further strengthen resilience capacities, especially given the increasing severity of threats due to climate change. Using six selected measures from the HSR Assessment Tool that was outlined in Table 3, this section will analyze the HSR capacities in the Caribbean. These measures, which are shown in Table 6, were selected based on data availability. Given this limitation, this is not a comprehensive analysis of HSR in the Caribbean but is intended to be a basis for necessary further exploration of HSR at the regional and national levels. For example, a useful measure such as the HSI (which provides a snapshot of the probability that a health facility will function in emergency situations based on structural, nonstructural and functional factors) is not publicly available but may be available to national authorities in countries where evaluations have been implemented. Thus, national collection and analysis of HSI scores can assist countries with assessing their HSR and formulating plans for strengthening HSR.

Table 6. Selected Measures of HSR in Caribbean

Country	Selected Measures of HSR in Caribbean												
	Membership in Inter-Governmental Organizations								State Party to IHR	IHR Average Core Capacity Score (2019)[a]	GHSI [b]	UHC Service Coverage Index (2017) [c]	Number of CR- FELTP trained workers [d]
	CARPHA	CARICOM	CDEMA	CDB	CCRIF SPC	PAHO/ WHO	WBG	IADB					
Antigua and Barbuda	✓	✓	✓	✓	✓	✓	✓	✗	✓	No data	29.0	73	0
Belize	✓	✓	✓	✓	✓	✓	✓	✓	✓	No data	31.8	64	0
Dominica	✓	✓	✓	✓	✓	✓	✓	✗	✓	71	24.0	No data	0
Dominican Republic	✗	✗	✗	✗	✗	✓	✓	✓	✓	55	38.3	74	0
Grenada	✓	✓	✓	✓	✓	✓	✓	✗	✓	No data	27.5	72	3
Guyana	✓	✓	✓	✓	✗	✓	✓	✓	✓	88	31.7	72	0
Haiti	✓	✓	✓	✓	✓	✓	✓	✓	✓	No data	31.5	49	0
Jamaica	✓	✓	✓	✓	✓	✓	✓	✓	✓	84	29.0	65	0
St Kitts and Nevis	✓	✓	✓	✓	✓	✓	✓	✗	✓	51	26.2	No data	0

St Lucia	✓	✓	✓	✓	✓	✓	✓	✗	✓	69	35.3	68	1
St Vincent and the Grenadines	✓	✓	✓	✓	✓	✓	✓	✗	✓	49	33.0	71	2
Suriname	✓	✓	✓	✓	✗	✓	✓	✓	✓	57	36.5	71	2
Trinidad and Tobago	✓	✓	✓	✓	✓	✓	✓	✓	✓	53	36.6	74	0

[a] https://extranet.who.int/e-spar#capacity-score

[b] https://www.ghsindex.org/

[c] https://data.worldbank.org/indicator/SH.UHC.SRVS.CV.XD

[d] Data received from CARPHA and represents the number of graduates from at least the Intermediate-level Caribbean Regional Field Epidemiology and Laboratory Training Programme (CR-FELTP) as of October 2020.

The Caribbean has developed a history of regional cooperation prompted by countries' recognition of the unique vulnerabilities as small states to natural disasters and disease outbreaks in the region.[154] There are several organizations, with varying country memberships, that support the health sectors' preparation and responses to shocks. Additionally, specific frameworks can guide Caribbean countries during health emergencies. Table 7 lists some of these organizations and frameworks (including those in Table 6) and outlines their role in HSR. It should be noted that Table 7 does not provide a complete list of organizations or frameworks involved in HSR for Caribbean countries, but it is meant to showcase the diversity of organizations and documents that are involved in leading, coordinating, supporting, collaborating on, guiding, and/or financing different aspects of HSR in the region.

Table 7. Organizations and Frameworks Involved in HSR

Level of Operation	Organization	General Role in HSR
Global	World Health Organization (WHO)	Works on emergency preparedness, response, and recovery, from conceptual to country level development.[a]
	United Nations Children's Fund (UNICEF)	Works with Governments, UN agencies, and other partners to help countries prepare for and respond to public health emergencies.[b]
	Global Health Security Agenda (GHSA)	Supports improvement of country capacity and leadership in the prevention and early detection of, and effective response to, infectious disease threats (in line with the IHR). [c]
	World Bank Group (WBG)	Assists governments in strengthening health systems, disease surveillance, and public health interventions, and works with the private sector to reduce the impact on economies. [d]
	International Medical Corps (IMC)	Provides emergency medical and related services to those affected by conflict, disaster and disease, as well as training to develop local first responder capacity. [e]

[154] Hambleton, Jeyaseelan, and Murphy, 'COVID-19 in the Caribbean Small Island Developing States'.

	Cooperative for Assistance and Relief Everywhere (CARE International)	Works with local partners and governments to deliver health interventions in the event of an emergency and to strengthen the existing health systems. [f]
Regional	Caribbean Community (CARICOM)	Develops and manages regional policy, as well as facilitates capacity development and resource mobilization. [g]
	Caribbean Public Health Agency (CARPHA)	Builds regional capacity, as well as capacity of individual Member States, in the preparedness, monitoring of potential threats, and responding to any emergency or disaster when the need arises. [h]
	Caribbean Disaster Emergency Management Agency (CDEMA)	Mobilizes and coordinates regional disaster response and strengthens disaster response capacity of member countries. [i]
	Caribbean Catastrophe Risk Insurance Facility (CCRIF)	Limits the financial impact of catastrophic hurricanes, earthquakes and excess rainfall events to Caribbean by quickly providing short-term liquidity when a parametric insurance policy is triggered. [j]
	Caribbean Development Bank (CDB)	Supports disaster risk reduction activities; invests in early warning systems; and promotes emergency contingency planning. [k]
	Inter-American Development Bank (IDB)	Supports the countries of the region to strengthen their health systems (including their emergency response capacity), to implement climate change policies and financing, and to develop integrated disaster risk management. [l]
	Pan American Health Organization (PAHO)	Provides technical and financial cooperation in emergency health response, as well as health system strengthening, risk reduction efforts, HSR research, and developing reserve capacity. [m]
	Organisation of Eastern Caribbean States (OECS)	Works on increasing disaster resilience and developing policy solutions to health challenges. [n]
	OECS Pharmaceutical Procurement Service (OECS PPS)	Procures medicines and allied health equipment on behalf of Member States. [o]
	University of the West Indies (UWI)	Conducts research related to sustainability, resilience, and disaster risk reduction. [p]
National	Ministry of Health	Leads national preparedness, response, and recovery efforts for public health emergencies.
	National Disaster Organization	Ensures the efficient functioning of preparedness, prevention, mitigation and response actions against natural and man-made disasters. [q]
	National Vector Control Body	Protect of the public from vector borne diseases through the application of all appropriate and sustainable vector control measures. [s]
	National Public Health Laboratory	Provide clinical and public health diagnostic, reference and referral laboratory services to facilitate disease prevention and control. [t]

Level of Operation	**Framework/Plan/Policy**	**Role in HSR**
Global	IHR (2005) treaty	A legal framework that defines countries' rights and obligations in handling public health events and emergencies that have the potential to cross borders. [u]
	IHR (2005) Monitoring and Evaluation Framework	A framework by which States Parties can monitor and evaluate the implementation of IHR capacities in accordance with the requirements of the IHR. [v]
	WHO Strategic Framework for Emergency Preparedness	A framework which identifies the principles and elements of effective country health emergency preparedness [w]
	WHO's An R&D Blueprint for Action to Prevent Epidemics	A global strategy and preparedness plan to ensure that targeted research and development will strengthen the emergency response by bringing medical technologies to populations and patients during epidemics. [x]

	The Paris Agreement	An international Agreement to strengthen the global response to climate change by aiming to limit global temperature increase to well below 2 degrees Celsius. [y]
	SIDS Accelerated Modalities of Action (S.A.M.O.A) Pathway	An international framework that identified SIDS priorities that needed to be considered in the formulation of the 2030 sustainable development agenda. [z]
Regional	Caribbean Cooperation in Health (Phase IV)	Framework for CARICOM Member States to address common health and development challenges through functional cooperation and joint action, with building "safe, resilient, healthy environments" as a strategic priority area. [aa]
	PAHO Health Sector Multi-Hazard Response Framework	An operational model for implementing health emergency response functions.[bb]
National	Health Sector Emergency Plan	National emergency preparedness and response plans specifying the role of the health sector, which are linked to the equivalent national and sub-national plans.

[a] https://www.who.int/about/what-we-do; [b]https://www.unicef.org/health/emergencies; [c] https://ghsagenda.org/; [d]https://www.worldbank.org/en/topic/health/overview; [e]https://internationalmedicalcorps.org/what-we-do/; [f]https://www.careinternational.org.uk/emergencies/how-we-work-emergencies; [g] https://caricom.org/our-work/; [h]https://carpha.org/What-We-Do/Emergency-Response; [i] https://caricom.org/institutions/caribbean-disaster-emergency-management-agency-cdema/; [j] https://www.ccrif.org/; [k] https://www.caribank.org/our-work/sectors/disaster-prevention-and-preparedness; [l]https://www.iadb.org/en/sector/climate-change/overview; [m]https://www.paho.org/disasters/index.php?option=com_content&view=article&id=699:about-us&Itemid=918&lang=en; [n]https://www.oecs.org/climate-&-disaster-resilience/; [o] https://www.oecs.org/our-work/human-and-social/pharmaceuticals; [p]https://www.uwi.edu/isd/; [q]http://www.health.gov.tt/sitepages/default.aspx?id=45; [r] http://nemo.gov.lc/About-Us/NEMO/Mission-Statement; [s]http://www.health.gov.tt/sitepages/default.aspx?id=45; [t] http://moh.gov.jm/wp-content/uploads/2015/07/Ministry-of-Healths-Strategic-Business-Plan-2015-2018.pdf; [u]https://www.who.int/ihr/publications/9789241580496/en/; [v]https://apps.who.int/iris/bitstream/handle/10665/276651/WHO-WHE-CPI-2018.51-eng.pdf?sequence=1; [w]https://www.who.int/ihr/publications/9789241511827/en/; [x]https://www.who.int/publications/m/item/an-r-d-blueprint-for-action-to-prevent-epidemics; [y] https://unfccc.int/process-and-meetings/the-paris-agreement/the-paris-agreement; [z]http://www.2030caribbean.org/content/unct/caribbean/en/home/sustainable-development-goals/samoa-pathway.html; [aa]https://www.paho.org/en/documents/caribbean-cooperation-health-phase-iv-cch-iv-0; [bb]https://iris.paho.org/handle/10665.2/51497

As outlined in Chapter 4 and Table 7, it is evident that several organizations play critical roles in countries' preparation and response to health emergencies. For example, CARPHA provides key testing capacities and health guidelines in the event of an outbreak. Therefore, countries' membership in these organizations (which have formal mechanisms for emergency responses and preparation that can benefit the health system) could be viewed as an indicator of HSR capacity. As shown in Table 6, all thirteen countries are members of PAHO/WHO and the World Bank Group, both of which can provide technical and financial support in a health emergency. Further, all countries, with the exception of the Dominican Republic, are members of CARPHA, CARICOM, and CDEMA. These organizations provide leadership, coordination, and support for Caribbean health systems' preparations and responses to a shock. These organizations facilitate access to a larger pool of regional resources, which is crucial as some shocks can quickly overwhelm local resources. The high rate of membership in these organizations generally reflect some existing anticipatory, absorptive, and adaptive resilience capacities. However, it should be noted that shocks which affect multiple countries simultaneously (e.g. a global pandemic or hurricane affecting

several islands) can also strain regional or international capacities to provide local support. An example of this is demonstrated by PAHO's public appeal for US$95 million to support the organization's responses to the COVID-19 pandemic in LAC.[155]

Being a signatory to the International Health Regulations (IHR 2005) could also be viewed as another indicator of HSR capacity, given that it legally binds countries to establish and maintain core capacities for surveillance and response to public health events. All thirteen countries are state parties to the IHR, which reflects some anticipatory capacity along the governance building block. As a signatory to the IHR, the countries demonstrate political prioritization and intention to enhance HSR. The IHR core capacities, which member states are required to implement, traverse several health system building blocks, including governance, financing, communication, and health workforce. Since the WHO monitors progress to attaining the IHR core capacities through scores from an annual country reporting tool, this score could also serve as a more revealing indicator of HSR capacity. Table 6 demonstrates that 4 countries (Antigua and Barbuda, Belize, Grenada, and Haiti) have not reported on their IHR core capacities, even though they legally agreed to report via the IHR 2005. This may limit the use of this score to inform HSR in some countries. The average IHR core capacity score for the world is 64, while the average score for WHO's region of the Americas (AMRO) is 71. As shown in Table 6, only four countries (Dominica, Guyana, Jamaica, and St. Lucia) have a score higher than the global average, while only two countries (Guyana and Jamaica) have a score higher than the regional average. Out of the 13 core capacities, the four lowest scores based on an average across the 13 Caribbean countries were related to radiation emergencies, followed by chemical events, health service provision, and human resources. This reflects insufficient resilience capacity related to specific shocks (involving chemicals and radiation), as well as general system inadequacies in service provision and health workforce across the region. It is noteworthy that several countries' responses to the ongoing COVID-19 pandemic are likely to include strengthening IHR capacities, but these changes continue to be taking place as the pandemic unfolds.

A related index is the Global Health Security Index (GHSI) which assesses health security and related capabilities across 195 countries that make up the States Parties of the IHR 2005. The index is a score normalized to a scale of 0 to 100, where 100 represents best health security conditions. It measures a country's capability to prevent and mitigate epidemics and pandemics across six categories (prevention, detection and reporting, rapid response, health

[155] PAHO/WHO, 'PAHO Launches New Site for Donations to Its COVID-19 Response Fund - PAHO/WHO | Pan American Health Organization', 1 July 2020, http://www.paho.org/en/news/1-7-2020-paho-launches-new-site-donations-its-covid-19-response-fund.

system, compliance with international norms, and risk environment). Unlike the IHR core capacities score (which relies on country responses), the GHSI relies on publicly available data on different measures. While there are some domain similarities across the measurements for the IHR core capacities score and the GHSI, there are notable differences which are reflected in Table 6. For example, Dominica has a relatively high average IHR core capacity score (71), but the lowest GHSI (24). The global average GHSI is 40.2, while the average among high-income nations of 51.9. Table 6 shows that all countries have GHSI scores lower than the global average, indicating that significant health security improvements are needed in the region.

A main component of HSR is the ability to continue to provide essential services in the event of a shock, which depends on the health system having strong established mechanisms for providing essential health services in normal circumstances. Thus, a measure of universal health coverage (UHC), such as the UHC service coverage index (defined as the average coverage of essential services based on tracer interventions that include reproductive, maternal, newborn and child health, infectious diseases, non-communicable diseases and service capacity and access, among the general and the most disadvantaged population) provides an indirect measure of HSR. With reference to Table 6, only 3 countries (Belize, Haiti, and Jamaica) are below the UHC coverage index world average of 65.69, but all countries are below the average across high income countries of 82.14. This shows that there are significant gaps in essential service coverage throughout the region, which are likely widened in the event of a shock.

A resilient health system must also include public health professionals and clinicians who can develop and implement policies and action plans for the health sector at all stages of an emergency. According to the WHO, the recommended density of doctors, nurses and midwives per 1000 population for operational routine services is 4.45 plus 30 percent surge capacity.[156] While it has been noted that standard population ratios for health workers are not well-suited for countries with small populations, this typically results in a higher-than expected ratio of health workers. Yet, with reference to the most recently available data presented in Table 1, only six of the 13 selected countries (Antigua and Barbuda, Dominica, Grenada, St. Kitts and Nevis, St. Vincent and the Grenadines, and Trinidad and Tobago) met the recommended density of doctors, nurses and midwives per 1000 population for operational routine services. Considering the lack of health professionals to provide routine services in non-emergency situations in the remaining 7 countries (Belize, Dominican

[156] World Health Organization, 'WHO Benchmarks for International Health Regulations (IHR) Capacities', WHO (World Health Organization, 2019), http://www.who.int/ihr/publications/9789241515429/en/.

Republic, Guyana, Haiti, Jamaica, St. Lucia, and Suriname), it can be inferred that these countries do not have sufficient health professionals to response to increased health needs in emergency situations. The WHO also recommends at least one trained (field) epidemiologist (or equivalent) per 200 000 population for surveillance and at least one trained epidemiologist per rapid response team.[157] In emergencies, adequately trained professionals in epidemiology would detect outbreaks of diseases, monitor the effectiveness of outbreak responses, and generate data to guide evidence-informed decision-making. These professionals are therefore essential to anticipatory, absorptive, adaptive and transformative capacities. Epidemiological capacity can be gained through graduates of public health degrees, but countries do not currently monitor the number of trained epidemiologists and thus, this data could not be included in the analysis. An alternative measure related to the national prevalence of such professionals is the number of graduates from the Caribbean Regional Field Epidemiology and Laboratory Training Programme (CR-FELTP) per country. The CR-FELTP aims to develop professionals who can address public health issues in the Caribbean through surveillance, outbreak investigation, and operational research and analysis using classroom learning and field training.[158] The CR-FELTP's curriculum has three tiers and has been coordinated by CARPHA. Only CR-FELTP intermediate or advanced training levels are considered comparable to formal epidemiological training. As shown in Table 6, intermediate-level FELTP has been implemented in limited number of Caribbean countries for only a few individuals thus far.

[157] World Health Organization.
[158] CARPHA, 'What Is FELTP?', 2020, https://carpha.org/What-We-Do/FELTP/Introduction.

6.0 Categorizing National HSR Capacity: The Traffic Light System and Priority Recommendations

Based on analyses in Chapter 4 and Chapter 5, this section proposes a traffic light system for categorizing national HSR capacity that aligns with the conceptual framework for HSR in Figure 1. This traffic light system will then be applied to two Caribbean countries to demonstrate its utility in assessing national HSR capacity.

6.1 Proposed Traffic Light System

The three proposed categories for national HSR capacity are defined as follows:

1. **Nascent HSR Capacity**: The national health system is likely unable to effectively prepare for, respond to, and recover from a shock, resulting in significantly poorer health outcomes in the short and long term after the shock. Urgent and extensive action is needed by the government to prioritize, plan, and implement building health system resilience capacities.

2. **Emerging HSR Capacity**: The national health system is likely able to effectively prepare for, respond to, and recover from mild shocks. However, the health system is likely to cease functioning effectively in the event of a moderate to severe shock and may take a long time to recover. Population health indicators are likely to decline after the shock, especially in vulnerable groups. Targeted actions needed to prioritize, plan, and implement building health system resilience capacities, where needed.

3. **Established HSR Capacity**: The national health system is likely to effectively prepare for, respond to, and recover from a shock. Health service coverage is either uninterrupted by the shock, or only interrupted for a brief period. Health outcomes (not directly related to the shock) are likely to remain the same as prior to the shock. Continuous improvement of HSR capacities based on the results of frequent evaluations (especially following a shock), along with maintenance of existing capacities, is required.

This system can be a guide to policy makers in assessing their current status of HSR, as well as support policy makers in creating goals for improving HSR. Based on these uses, it is assumed that the traffic light system will be applied in non-emergency settings. Thus, the proposed measures in Figure 3 represent anticipatory capacities. However, when shocks to the health system do occur, countries should document their absorptive, adaptive and transformative capacities as outlined in Table 3, since this information will support a more

comprehensive understanding of national HSR. With reference to the HSR conceptual framework in Figure 1, it is expected that shocks will contribute to improvements in anticipatory capacities and therefore, by applying the traffic light system over time, countries can monitor progress in building HSR. It should be noted that this traffic light system should be viewed as a general guide, which will need to be tailored to each unique national health system and context. Additionally, for the proposed system, it is possible for a country to have established capacity in some domains and nascent or emerging capacities in others.

Figure 3. Proposed Traffic Light System for Categorizing National HSR Capacity

	Nascent HSR Capacity	Emerging HSR Capacity	Established HSR Capacity
Leadership & Governance	• No existence of all legal and regulatory requirements to coordinate and response to emergencies • National Health Sector Emergency Response Plan does not exist. • National Multisectoral Emergency Response Plan does not exist • No Emergency Operations Center or Unit for health sector • Membership in a few relevant local, regional, and/or international organizations, as well as signatory to few or no agreements, which can provide technical and financial support/guidance to the national health sector in emergencies. • Centralized decision-making • No plan for regular emergency preparedness activities across the health sector exists.	• Existence but limited enforcement of all legal and regulatory requirements to coordinate and response to emergencies • National Health Sector Emergency Response Plan exists but is outdated. • National Multisectoral Emergency Response Plan exists, but is outdated and/or does not include other sectors' roles in supporting the national health system in emergencies. • Emergency Operations Center or Unit for health sector exists, but has never been tested or implemented. • Membership in some relevant local, regional, and international organizations, as well as signatory to some agreements, which can provide technical and financial support/guidance to the national health sector in emergencies.	• Existence and enforcement of all legal and regulatory requirements to coordinate and response to emergencies • National Health Sector Emergency Response Plan exists and is updated. • National Multisectoral Emergency Response Plan exists and is updated. • Emergency Operations Center or Unit for health sector exists and has history of successful implementation • Membership in all relevant local, regional, and international organizations, as well as signatory to all agreements, which can provide technical and financial support/guidance to the national health sector in emergencies. • Appropriately decentralized decision-

		• Limited decentralized decision-making • Plan for regular emergency preparedness activities across the health sector exists, but is not enforced.	making to allow rapid responses. • Enforced plan for regular emergency preparedness activities, including simulations and drills, across the health sector.
Financing	• No source of domestic contingent financing and/or mechanism for rapid access for health sector emergencies is established. • No HSS plan exist. • Emergency health sector funding arrangements with national, regional and/or international organizations are ad-hoc.	• Contingent domestic financing and mechanism(s) for rapid access for health sector emergencies are identified but has no history of successful implementation. • HSS plan exists but has not been costed or funded. • Emergency health sector funding arrangements are established with only some relevant national, regional and/or international organizations.	• Contingent domestic financing and mechanism(s) for rapid access for health sector emergencies are established and has a history of successful implementation. • Costed and funded HSS plans • Emergency health sector funding arrangements with all relevant national, regional and international organizations are formally established and updated regularly.
Service Delivery	• The majority of hospitals and health facilities have an HSI score that places them in Category C (which refers to facilities where the lives and safety of occupants are deemed at risk during disasters). • Weak critical infrastructure (e.g. inadequate road network, deteriorated water distribution system and no emergency energy	• The majority of hospitals and health facilities have an HSI score that places them in Category B (which refers to facilities that can resist a disaster but in which equipment and critical services are at risk). • Some sustainable and resilient infrastructure (e.g. underground electricity distribution network and/or alternative water sources) exists to support health services,	• The majority of hospitals and health facilities have an HSI score that places them in Category A (which refers to facilities deemed able to protect the life of their occupants and likely to continue functioning in disaster situations). • Sustainable and resilient infrastructure exists to support health services (including renewable energy system component and

	generators) exists to support health services. Mild shocks are likely to disrupt access to services.	but some weak infrastructure also exists (e.g. poor road network maintenance). Moderate shocks are likely to disrupt access to services.	reliable internet for tele-health when in-person services are not possible). Mild and moderate shocks will not disrupt access to services.
Health Workforce	• Relevant emergency education is not a component of the academic curricula for clinical and public health professionals. • Insufficient clinical and public health professionals exist to provide any surge capacity.	• Relevant emergency education is a component of the academic curricula for clinical and public health professionals, but it is not required as continuing education. • There is some surge capacity among clinical and public health professionals, but gaps in key specialties remain.	• Relevant emergency education is a component of the academic curricula and required continuing education for clinical and public health professionals. • Adequate clinical and public health exist to provide surge capacity in all specialties.
Information	• No health surveillance system exists. • No research capacity at the executive level of the health sector. • National Risk Communication Plan does not exist. • Sharing of critical information with the public is done through ad hoc mechanisms. • No National Health Information System exists.	• Existing but inadequate or inactive health surveillance system. • Existing but inadequate research capacity at the executive level of the health sector. • National Risk Communication Plan exists and but is outdated. • Information sharing mechanisms exist (but are not regularly evaluated and updated) to share critical information with the public. • National Health Information System implemented in some health facilities.	• Dedicated and active health sector surveillance system. • Dedicated and active research capacity at the executive level of the health sector • National Risk Communication Plan exists and is updated. • Established information sharing mechanisms exist (and are regularly evaluated and updated) to share critical information with the public. • National Health Information System integrated in all health facilities and used in surveillance, monitoring and evaluation, and

			tracking of medical supplies.
Medical Products, Vaccines & Technologies	• No MOH emergency procurement plan exists. • No existing stockpile of medical supplies (including PPE), medicines, and lab supplies. • Protocol(s) for mobilization of medicines (including vaccines), medical supplies (including PPE) and lab supplies developed on ad hoc basis	• An MOH emergency procurement plan exists but it is not updated. • A stockpile of medical supplies (including PPE), medicines, and lab supplies exists within the region. • Protocols(s) for mobilization of medicines (including vaccines), medical supplies (including PPE) and lab supplies has been documented but may be outdated and/or has not been shared with relevant authorities.	• An updated and tested MOH emergency procurement plan exists. • A regularly maintained stockpile of medical supplies (including PPE), medicines, and lab supplies exists within the country and the region. • Protocols(s) for efficient mobilization of medicines (including vaccines), medical supplies (including PPE) and lab supplies in various emergency situations are established, reviewed regularly, and shared with relevant authorities.

6.2 Applying the Traffic Light System to Select Countries

To demonstrate how the proposed traffic light system can be used by countries, it will be applied to Jamaica and St. Lucia. It is necessary to note that for each measure, the traffic light status is assigned based on limited, publicly available information. Measures without publicly available information were marked to indicate that the relevant information was not found. Thus, the assigned statuses are not comprehensive and are not necessarily accurate or reflective of the true HSR of these countries. As previously mentioned, each country should tailor this traffic light system, such that measures are changed, added, deleted and/or defined in more detail to match the local context. Despite these important caveats to the following country-specific applications, it is believed that these examples will help national health officials better understand how the traffic light system can be used.

6.2.1 Jamaica

Table 8. Application of Proposed Traffic Light System to Jamaica

Health System Building Block	National HSR Measure	Traffic Light Status
Leadership & Governance	Legislation	
	Health Sector Emergency Response Plan	
	Emergency Operations Center or Unit for health sector	
	Multisectoral Emergency Response Plan	
	Decentralized decision-making	
	Membership in relevant organizations	
	Signatory to agreements	
	Plan for emergency preparedness activities	
Financing	Contingent domestic financing	
	Costed and funded HSS plans	
	Emergency funding arrangements with external bodies	
Service Delivery	HSI Scores	
	UHC Service Coverage Index	
	Critical Infrastructure	***
Health Workforce	Emergency Education & Trainings	***
	Ratio of doctors, nurses and midwives per 1000 population	
	CR-FELTP trained workers	
Information	IHR Core Capacity for Risk Communication	
	Health Information System	
	Information sharing mechanisms	***
	Research capacity	
	Health sector surveillance system	
Medical Products, Vaccines & Technologies	MOH emergency procurement plan	
	Stockpile of medical supplies, medicines, and lab supplies.	
	Mobilization protocols	***

*** Information not found

Leadership & Governance

In Jamaica, there are several local laws and regulations that guide national responses to ensure the health of citizens during emergencies. Such laws allow appropriate authorities to take necessary precautions for and responses to emergencies. Relevant legislation in Jamaica for public health emergencies include: the Disaster Risk Management Act (2015), Emergency Powers Act (1969), and the Quarantine Act (1991). While legislation exists, the extent of Jamaica's enforcement of compliance is unknown**.** Jamaica has a National Emergency Operations Centre (NEOC) and the Ministry of Health and Wellness also has sector-specific National Emergency Operations Centre (MOH NEOC). Jamaica has a de-centralized health system, with 4 Regional Health Authorities, which allows for decentralized decision-making. While a National Disaster Action Plan exists, there is no emergency plan

specific to the health sector. Relatedly, there is no health sector plan for emergency preparedness activities (such as simulations or drills in health facilities). Jamaica is a member of many regional and international organizations (including CARPHA, CARICOM, CDEMA, CCRIF SPC, PAHO/WHO, WBG, IADB, Association of Caribbean States, and the U.S-Caribbean Resilience Partnership) that have established agreements to assist with building resilience capacity in the health sector and to lend assistance in emergencies. Jamaica is also a signatory to IHR (2005) and is in agreement with the United Nations Sustainable Development Goals.

Financing

Jamaica has National Disaster Fund, established under the DRM Act of 2015. A Policy on National Disaster Risk Financing was also recently approved by the government but has not yet been implemented. Jamaica has a health system strengthening programme, which is financed through a loan from the IDB.[159] As a member of the CCRIF SPC, Jamaica has an established emergency funding arrangement with an external body.

Service Delivery

The baseline HSI ranking for 148 health care facilities assessed in Jamaica were 65% Category B and 35% Category C.[160] Plans are underway to strengthen several health care facilities under the SMART project, but updated health facility rankings are not available. The UHC Service Coverage Index (which ranges from 0 to 100) for Jamaica was 65 as of 2017, indicating that a notable proportion of Jamaica's population lacked coverage of essential health services. This contributes to poor baseline population health and it is likely that in the event of a disaster, an even greater proportion of the population may lose access to essential services in the event of a shock.

Health Workforce

Based on most recently available data, Jamaica has a ratio of 2.1 doctors, nurses, and midwives per 1000 population, which is less than half of the WHO recommended density for operational routine services. The WHO also recommends at least one trained (field) epidemiologist (or equivalent) per 200 000 population for surveillance and at least one trained epidemiologist per rapid response team. While Jamaica has some frontline and basic CR-FELTP trained workers, there are no workers trained at the intermediate (the minimum equivalent to a trained field epidemiologist) or advanced training level. However, the existence of the Ministry of Health and Wellness' National Epidemiology Team suggests that some field epidemiology capacity may exist locally. Considering available data, it appears that Jamaica has insufficient clinical and public health professionals to provide surge capacity in emergencies. No information could be found on the health emergency education or training requirements for clinical and public health workers.

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[159] Ministry of Health & Wellness, Government of Jamaica. "Project Overview – Health Systems Strengthening Programme." Accessed February 21, 2021. https://hssp.moh.gov.jm/project-overview/.

[160] Department for International Development, UK AID. "Annual Review (5) 203272: Strengthening Health Facilities in the Caribbean (SMART Hospitals)," September 2020. https://iati.fcdo.gov.uk/iati_documents/57165528.odt.

Information

Jamaica's IHR Core Capacity score for Risk Communication (based on the indicator that mechanisms, including a National Risk Communication Plan, for effective risk communication during a public health emergency are established and functioning) was 100 as of 2019. Based on this self-reported data, Jamaica has strong capacities for risk communication. Jamaica does not have a national health information system. However, the country is currently conducting an E-Health Pilot Project to implement a national electronic Patient Administration System (ePAS), which will serve as a step towards a national health information system.[161] Jamaica's Essential National Health Research Committee serves as the governing body for the coordination of research for health and actively holds an annual national health research conference. The existence and functioning of the National Surveillance Unit, National Epidemiology Team, the Registrar General's Department (Jamaica's civil registration system), and National Public Health Laboratory are critical components of the health sector surveillance system. However, historic underreporting of cases in disease outbreaks reflect shortfalls in the existing surveillance system.

Medical Products, Vaccines & Technologies

General emergency procurement procedures are outlined in the Government of Jamaica's Handbook of Public Sector Procurement Procedures (revised 2014), but they are not specific to health sector. No information was found on the existence of a local stockpile of medical supplies, medicines, and lab supplies, but Jamaica has historically had access to regional stockpiles through its membership in CARPHA and PAHO.

6.2.2 St. Lucia

Table 9. Application of Proposed Traffic Light System to St. Lucia

Health System Building Block	National HSR Measure	Traffic Light Status
Leadership & Governance	Legislation	
	Health Sector Emergency Response Plan	
	Emergency Operations Center or Unit for health sector	
	Multisectoral Emergency Response Plan	
	Decentralized decision-making	***
	Membership in relevant organizations	
	Signatory to relevant agreements	
	Health sector plan for emergency preparedness activities	
Financing	Contingent domestic financing	

[161] Ministry of Health & Wellness, Jamaica. "Health Informatics." Accessed February 21, 2021. https://www.moh.gov.jm/divisions-agencies/divisions/technical-services-division/health-informatics/.

	Costed and funded HSS plans	
	Emergency funding arrangements with external bodies	
Service Delivery	HSI Scores	
	UHC Service Coverage Index	
	Critical Infrastructure	***
Health Workforce	Emergency Education & Trainings	***
	Ratio of doctors, nurses and midwives per 1000 population	
	CR-FELTP trained workers	
Information	IHR Core Capacity for Risk Communication	
	Health Information System	
	Information sharing mechanisms	***
	Research capacity	***
	Health sector surveillance system	
Medical Products, Vaccines & Technologies	MOH emergency procurement plan	
	Stockpile of medical supplies, medicines, and lab supplies.	
	Mobilization protocols	***

*** Information not found

Leadership & Governance

In St. Lucia, relevant legislation related to public health emergencies include: the Emergency powers (disasters) act (1995), Disaster Management Act, 2006, the Public Health Act, Chapter 11.01, Quarantine Act, Chapter 11.16 Act 13 of 1945 revised 31 December, 2001, Health Practitioners Act - 16.11 of the Revised Laws of Saint Lucia, Water & Sewage Act No. 14 of 2005, Police Act 2004 Chapter 14.01, Education Act No. 41 of 1999, Employees [Occupational Health and Safety] Act No. 10 of 1985, and the Industrial and Commercial Buildings [Fire Safety] Act No. 14 of 1972.[162] However, it is reported that there is insufficient monitoring of compliance with existing legal instruments.[163] In one instance, there were anecdotal reports of struggles to enforce the Quarantine Act during the COVID-19 pandemic.[164] Under the Disaster Management Act, 2006, the National Emergency Management Organisation (NEMO) and National Emergency Management Advisory Committee (NEMAC) were established and actively function in St. Lucia. The NEMO secretariat activates the National Emergency Operations Centre (NEOC) in the event of a qualifying emergency.[165] However, there is no EOC for health sector as recommended in the National Emergency Management Plan.[166] The latest version of the National Emergency Management Plan was developed in 2010,

[162] Saint Lucia NEMO. "General Information on the National Emergency Management Plan," 2021. http://www.nemo.gov.lc/Disaster-Management/National-Emergency-Management-Plan/General-Info.

[163] Thomas-Louisy, M. Luvette. "Saint Lucia: Country Document for Disaster Risk Reduction, 2014," November 2014. http://www.nemo.gov.lc/Portals/0/Documents/Final%20Saint%20Lucia%20Country%20Document%20for%20web.pdf?ver=2017-09-15-161110-000.

[164] Loop St. Lucia. "Home Quarantine Breaches May Result in Arrests in St Lucia." Accessed February 21, 2021. http://www.loopslu.com/content/home-quarantine-breaches-may-result-arrests-st-lucia.

[165] Saint Lucia NEMO. "The National Emergency Management Organisation." Accessed February 21, 2021. http://www.nemo.gov.lc/About-Us/NEMO/Organisation.

[166] Government of Saint Lucia. "National Emergency Management System," June 29, 2011. http://www.nemo.gov.lc/Portals/0/Documents/National_Plan/NEMP-Executive.pdf?ver=2017-09-15-161124-000.

which suggests that the Plan may be outdated. Under the Disaster Management Act, 2006, the NEMAC is tasked with the annual review and amendment (if necessary and approved by the Minister) of the National Emergency and Disaster Response Plan. While the National Emergency Management Plan exists, there is no emergency plan specific to the health sector. Relatedly, there is no health sector plan for emergency preparedness activities (such as simulations or drills in health facilities), although some preparedness activities occur ad hoc through partnerships with CARPHA. St. Lucia is a member of many regional and international organizations (including CARPHA, OECS, CARICOM, CDEMA, CCRIF SPC, PAHO/WHO, WBG, Association of Caribbean States and U.S-Caribbean Resilience Partnership) that have established agreements to assist with building resilience capacity in the health sector and lend assistance in emergencies. St. Lucia is also a signatory to IHR (2005) and the Revised Treaty of Basseterre Establishing the Organisation of Eastern Caribbean States Economic Union, and is in agreement with the United Nations Sustainable Development Goals.

Financing

St. Lucia does not have a costed and funded HSS plan. According to Saint Lucia's DRM Policy Framework, the government is supposed to maintain an Emergency Disaster Fund to provide relief after the impact of a disaster, but this has not been operationalized.[167] Further, the Ministry of Finance manages a contingency fund, but it has insufficient and has not been used for disaster response. St Lucia is party to the CCRIF SPC.

Service Delivery

There is very limited available information related the current state of infrastructure that supports service delivery. Under the SMART project, 15 health care facilities were strengthened to reduce the risks caused natural hazards. With these completed upgrades, Hospital Safety Index (HSI) rankings were significantly improved, with one facility now receiving an 'A' rating.[168] The baseline HSI ranking for 34 health care facilities assessed in St. Lucia were 62% Category B and 38% Category C.[169] The UHC Service Coverage Index (which ranges from 0 to 100) for St. Lucia was 68 as of 2017, indicating that a notable proportion of St. Lucia's population lacked coverage of essential health services. This contributes to poor baseline population health and it is likely that in the event of a disaster, an even greater proportion of the population may lose access to essential services in the event of a shock.

Health Workforce

Based on most recently available data, St. Lucia has a ratio of 3.8 doctors, nurses, and midwives per 1000 population, which is less than the WHO recommended density for operational routine services. St. Lucia has one individual who is trained at the intermediate (the minimum equivalent to a trained field epidemiologist) level of CR-FELTP. Considering

[167] World Bank Group. "Advancing Disaster Risk Finance in Saint Lucia," September 2018. https://openknowledge.worldbank.org/handle/10986/2185.

[168] Department for International Development, UK AID. "Annual Review (5) 203272: Strengthening Health Facilities in the Caribbean (SMART Hospitals)," September 2020. https://iati.fcdo.gov.uk/iati_documents/57165528.odt.

[169] Department for International Development, UK AID

available data, it appears that St. Lucia has insufficient clinical and public health professionals to provide surge capacity in emergencies. No information could be found on the health emergency education or training requirements for clinical and public health workers.

Information

St. Lucia's IHR Core Capacity score for Risk Communication (based on the indicator that mechanisms, including a National Risk Communication Plan, for effective risk communication during a public health emergency are established and functioning) was 60 as of 2019. This reflects a need for great improvement to the existing risk communication mechanisms. An epidemiology unit exists in St. Lucia's Ministry of Health and Wellness and the Central Statistical Office is active. The existence of these organizations supports infrastructure for the national surveillance system. St. Lucia launched a health information system in 2011 and it is currently available at almost all facilities. However, the health information system requires improvements in order to usefully inform decision-making in real time.

Medical Products, Vaccines & Technologies

There is no emergency procurement plan for the health sector. Additionally, the country has limited stockpile, but access to medical supplies is bolstered through OECS PPS and CARPHA.

Conclusion and Priority Actions

The Caribbean region has a significant history of experiencing and responding to a variety of natural disasters and infectious disease outbreaks, especially within the last two decades. Shocks of differing natures and severities test the resilience of national health systems in the region annually; thereby, contributing to iterative improvements in HSR over time. In response to the unique vulnerabilities of Caribbean islands to shocks, some uncommon HSR capacities have developed, such as multiple regional networks and mechanisms to facilitate resource sharing across islands as needed. While it is evident that health system responses to shocks have improved over time in the Caribbean, HSR capacity still remains weak across several domains for many islands. This is especially apparent with the ongoing COVID-19 pandemic, which is burdening many health systems in the region.

The effects of climate change are increasing the islands' risks for shocks and consequently, increasing the need for strong HSR. Further, with the high prevalence of NCDs in the region, countries need to provide adequate and accessible routine health services, which continue to be maintained even in the event of a shock. Thus, it is critical for Caribbean countries to assess and strengthen their HSR capacity. Established HSR capacities will not only circumvent significant increases in morbidity and mortality, but they will also reduce the negative social and financial impacts of shocks through the maintenance of good population health and productivity. Based on the limited analysis of this paper (which consisted of a general examination of countries' HSR experiences with recent shocks in Section 4 and a more focused application of the HSR assessment tool in Section 5), the following are identified as priority actions for strengthening HSR capacity in the region:

- **Strengthen national health surveillance systems**
  Disease reporting during shocks in Caribbean countries has often not been timely or complete, reflecting gaps in national health surveillance systems. A strong surveillance system is vital during a disease outbreak or disaster as it produces timely death, injury, and illness data, which should be used to guide immediate and long-term actions, including the allocation of limited public health resources. A well-functioning surveillance system has many components including clinician reporting, laboratory diagnostics, information technologies, epidemiological capacities, and information dissemination mechanisms.[170] While maintaining existing surveillance capacities, countries should monitor and regularly evaluate their surveillance system to inform plans to strengthen the system. One potential avenue for improving human resource surveillance capacity regionally is the training of more professionals through a scale-up of the existing CR-FELTP program. Surveillance systems could also benefit from the setting of selected thresholds for reporting and

[170] Samuel L. Groseclose and David L. Buckeridge, 'Public Health Surveillance Systems: Recent Advances in Their Use and Evaluation', *Annual Review of Public Health* 38, no. 1 (2017): 57–79, https://doi.org/10.1146/annurev-publhealth-031816-044348.

response; these could be applied not just to disease outbreaks, but also in the context of natural disasters.

- **Improve health research capacity**
  There is a dearth of research available on the historical responses of Caribbean health systems to shocks (and relatedly, the impacts of shocks on population health), which limits the ability to analyze national health system resilience capacities. Such research can not only inform improvements to anticipatory capacities, but it also generates an evidence base for MOHs to advocate for national funding to strengthen HSR. Further, in the event of outbreaks of novel diseases, locally established research capacity can facilitate tailored adaptive responses and reduce countries' sole reliance on foreign recommendations (that do not consider the Caribbean context or situation). Governments should ensure that there are well-trained, dedicated health research staff, as well as a sustainable source of funding for the team. In addition to adequately trained staff and sustainable funding for health research, there is need to prioritize the collection and analysis of information that can guide plans to build HSR on the national research agenda. This involves routine disease surveillance, regular resource mapping, data analysis, and information-sharing nationally and regionally. Health sectors should maximize opportunities to collaborate with local and regional academic institutions on HSR research.

- **Establish adequate contingent financing that are rapidly available and accessible to the health sector in the event of a shock**
  This analysis revealed that Caribbean countries rely heavily on external donations during shocks to adapt and transform health service delivery. Such voluntary donations are not guaranteed and thus, countries should establish contingent financing arrangements for the health sector prior to shocks. In order to ensure that sufficient sector-specific contingent financing exists, it is vital for health sectors to produce accurate estimates of financial needs in the event of shocks. This should be based on evaluation of health system needs during previous shocks and regular risk assessments.

- **Improve infrastructure of health care facilities and other critical infrastructure**
  Following disasters, many countries experience a disruption in health services due to damaged infrastructure, which includes building damages and loss of electricity and water services. While there have been "building back better" efforts following disasters, governments should also focus on improving existing infrastructure prior to a disaster. PAHO's SMART Hospital initiative and WHO's recently published

Guidance for Climate Resilient and Environmentally Sustainable Health Care Facilities[171] can be used to guide and support national infrastructure improvements.

- **Strengthen national laboratory capacities and establish a strong regional laboratory network**
  In response to shocks, Caribbean countries have been improving national laboratory capacities. However, there have still been shortfalls in testing capacities even in the most recent COVID-19 pandemic. Thus, HSR capacity building should continue to prioritize laboratory capacity development. Laboratory-confirmed cases are vital to appropriately respond to emergencies, especially for novel disease outbreaks. As national laboratory capacity develops, it is also important to ensure that they are linked to a strong regional network and that regional laboratory capacity continues to expand since this can serve as a fixed mechanism for problem-solving and resource-sharing.

- **Establish national mechanisms for procuring necessary medical supplies (including PPE), medicines, and lab supplies during a shock**
  Some emergency supply needs are dependent on the shock (e.g. disease-specific medicines during an outbreak), while other emergency supply needs are more predictable (e.g. PPE). However, even for supplies with greater demand predictability in emergencies, the mechanism for procuring some of these supplies seems to be on an ad hoc basis, with many Caribbean countries relying on donations of medical equipment and pharmaceuticals in the event of shocks. Creating a national emergency procurement plan for the health sector, with established mechanisms for procuring supplies, will decrease reliability on post-disaster external donations. Similarly, mechanisms such as prepositioned contracts can help ensure the availability of supplies outside the demands of an emergency.

- **Develop adaptive human resource mechanisms**
  The unpredictable nature of shocks, especially the introduction of novel diseases, presents many challenges for health professionals. In responding to emergencies, clinicians and public health workers may have to perform different roles, adjust work schedules, rapidly learn new information and/or procedures, work outside typical settings, compromise routine service provision, and make rapid policy decisions. It is critical for health professionals to adapt to rapidly evolving situations. More broadly, it is necessary to have national mechanisms for adapting human resources to meet situation-specific health needs. An example of such a mechanism is a country participation's in a regional agreement to access health professionals (surge capacity) from other countries following a disaster; similarly, this may require a country to

[171] WHO, 'WHO Guidance for Climate Resilient and Environmentally Sustainable Health Care Facilities', 12 October 2020, https://www.who.int/publications-detail-redirect/climate-resilient-and-environmentally-sustainable-health-care-facilities.

provide health workers to other countries in the aftermath of a disaster in the other countries.

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