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Health and Climate Change: How do we protect people's health in the climate crisis?

Social Protection and Health Division

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HEALTH AND CLIMATE CHANGE

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Health and Climate Change:

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Climate change is among the biggest health threats the world will face this century. Changing weather patterns directly and indirectly impact the well-being, health, and lives of millions of people. In 2020, the average temperature in Latin America and the Caribbean (LAC) was as much as 1°C above the 1981–2010 average. Similarly, the number of extreme climate events rose fivefold from 1970 to 2019, killing thousands of people and costing the region $100 billion in economic losses (WMO, 2021a). These events included droughts, cyclones, heavy precipitation, floods, and heat waves, which exacerbated forest fires in the Amazon (WMO, 2021b). These disasters resulted in water and energy shortages; air, soil and water pollution; and infrastructure damage, consequences that in turn made it difficult for people to access food and continue to make a living, among other problems.

Climate change is jeopardizing people's health and well-being, and the threat is especially severe among the most vulnerable groups. Climate change has direct impacts on people's health, such as the issues caused by extreme temperatures. But it also has indirect health effects, like air pollution from wildfires. These effects exacerbate inequalities that underlie social determinants of health[1] (PAHO, 2020). They disproportionately harm rural and indigenous communities, children, women, ethnic minorities, people with disabilities, and other vulnerable groups (Romanello et al., 2022; Yglesias-González et al., 2022), who have fewer strategies and resources for adaptation and who live in regions that are more exposed to the negative consequences of climate change.

The greenhouse gases (GHG) released by burning fossil fuels are the main driver of climate change. The air pollution from burning these fuels harms people's health directly, but these emissions also indirectly harm the population's health through their effect on climate change.

1. The World Health Organization (WHO) defines social determinants of health as "the conditions in which people are born, grow, work, live, and age, and the wider set of forces and systems shaping the conditions of daily life."

Without immediate action, climate change is expected to intensify in the coming decades, and its effects will be increasingly severe. In this publication, the Inter-American Development Bank (IDB) aims to further the dialogue on climate change and health among the countries in the region in order to: (i) understand health systems' main challenges in the face of climate change (Section 1); (ii) identify opportunities to address climate change (Section 2); and (iii) propose concrete adaptation actions[2] —such as preparing systems for extreme weather—and steps for mitigating the carbon footprint of health systems[3] (Section 3).

2. Climate change adaptation includes measures to limit impacts, reduce vulnerabilities, and make structures more resilient, which means ensuring they can continue to operate under harsh conditions.

3. Climate change mitigation includes actions to reduce greenhouse gas emissions.

1 THE CHALLENGE: HOW CLIMATE CHANGE EFFECTS THE HEALTHCARE SECTOR

The healthcare sector has the responsibility of protecting people's lives in the face of climate change. Sustainable Development Goal 3.8 is to "Achieve universal health coverage, including financial risk protection, access to quality essential health-care services and access to safe, effective, quality and affordable essential medicines and vaccines for all." The path to achieving this goal is to provide universal health coverage (UHC),[4] and part of that coverage is responding to the health impacts of climate change. However, climate change adds new challenges to the process of achieving UHC (Kammila, 2022), generating higher demand for health care (due to its direct and indirect effects on population health) and threatening the continuity of health services (by damage infrastructure and rendering it inoperable). Latin America and the Caribbean, a region where over half the countries are highly vulnerable to climate change, does not have climate-resilient healthcare systems (see Annex 1), and its climate investment in the healthcare sector falls short of what is needed. These weaknesses undermine a regional response to climate change, but they also reflect the systems' limited ability to guarantee UHC. Climate action and the UHC strategy overlap, since both require expanding service coverage and the health sector workforce, improving infrastructure and supplies, and remedying shortcomings in how healthcare systems and services are managed.

Climate change poses a three main challenges for the healthcare system. The first is responding to how it affects the population's health; the second is keeping health services operational despite damaged facilities, utility outages, blocked access, and logistical disruptions; and the third is reducing the carbon footprint of the healthcare sector itself.

Forty percent of countries in the region have no specific plan for responding to climate change and health (WHO, 2021a). While approximately 80 percent of countries in the region have designated someone to manage health and climate change affairs within their Ministries of Health, two-fifths of those countries still have no national strategy for health

4. The IDB's Health Sector Framework Document details the main obstacles to providing UHC in Latin America and the Caribbean, foremost among which is the fragmented nature of the current system. The framework document outlines how integrated health networks would lead to higher-quality, swifter, and more efficient health services with better outcomes. Read the full document here.

risks related to climate change and for adapting the healthcare system to climate change (WHO, 2021a). They are therefore unable to develop progress indicators (to assess the health system's vulnerability and capacity to respond and adapt), allocate funding, and take effective action. Twelve percent of countries[5] in LAC do have a national health and climate change plan, including Brazil.[6] However, these plans are only implemented to a moderate or low extent, and the main obstacles are financial and human resources. Meanwhile, over half of countries in the region have no task force or committee to bring together all stakeholders (from within and outside of the healthcare sector) and engage them in climate action.

TABLE 1 DOMAINS AND INDICATORS FOR ASSESSING COUNTRIES' CLIMATE CHANGE RESPONSE IN THE AREA OF HEALTH

DOMAIN	INDICATOR
Evidence for decision-making	Country has conducted a climate change and health vulnerability and adaptation assessment.
Leadership and governance	Country has a national health and climate change plan or strategy in place.
	Country has identified financial barriers to implementing the climate change and health plan or strategy.
	The Ministry of Health has a climate change and health focal point.
	The Ministry of Health has established a multi-stakeholder mechanism on health and climate change that is currently operational.
	The Ministry of Health has conducted public health campaigns to raise awareness on health and climate change.
Implementation	Country has assessed the climate resilience of at least one health care facility.
	Country has assessed the environmental sustainability of at least one health care facility.
Finance	Ministries of Health (in low-and-lower-middle-income countries) are currently receiving international funds for health and climate change work.
Promoting the health co-benefits of climate change mitigation	Country has conducted an assessment(s) of the health benefits of its national climate mitigation policies.

Source: WHO (2021a).

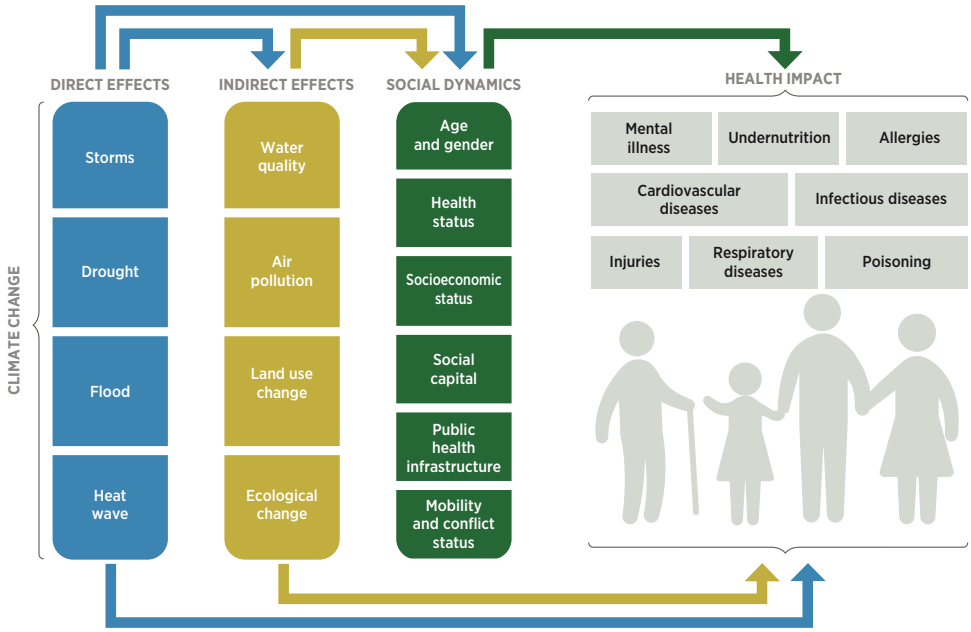
5. Other countries are included in the bibliography section: Government of Colombia (2017); Government of Mexico (2013); Government of Peru (2021); and MINSA (2021).

6. Federative Republic of Brazil (2013).

How climate change affects population health

Climate change drives storms, droughts, floods, and heat waves that directly harm people's health by causing injuries, respiratory diseases, vector-borne diseases, deterioration of chronic conditions (like cardiovascular diseases), and mental health problems, among other issues. Natural disasters can be caused by geological forces (for example, earthquakes and volcanic eruptions) or climactic ones (like heat waves and droughts). Of all events recorded in Latin America and the Caribbean from 1998 to 2017, 93 percent were climate-related (UNDRR, 2021). In the Caribbean and Central America, storms (including tropical cyclones and hurricanes) are the predominant climate risk, while heavy precipitation and drought are the greatest risks in South America (CAF, 2014). From 2000 to 2019, there were 200,055 excess deaths in the region related to extreme heat (20%) and cold (80%) (Zhao et al., 2021). In the last 50 years, these phenomena have affected over 260 million people and caused more than 90,000 recorded deaths in Latin America and the Caribbean (UNDRR, 2021)

FIGURE 1 CONCEPTUAL FRAMEWORK FOR THE DIRECT AND INDIRECT EFFECTS OF CLIMATE CHANGE



Source: Extracted and translated from The Lancet Commission on Climate Change and Health (Watts et al., 2015).

Exposure to extreme weather events puts people's health at risk (Figures 1 and 2). Based on a middle-of-the-road scenario for emissions increases and the effects of climate change, scientists estimate that the climate crisis may cause 250,000 additional deaths each year worldwide between 2030 and 2050. The main causes would be child undernutrition (38%), malaria (24%), diarrhea (19%), and heat stress (15%) (WHO, 2018). Similarly, the future costs associated with health damage are estimated at two to four billion dollars per year (WHO, 2021b).

Climate change also speeds up the transmission of infectious diseases (Mohammed-Roberts and Boukerche, 2020), of which three-quarters (75%) are spread by animals (UN, 2020; IPCC, 2022; Romanello et al., 2022). Infectious diseases spread by animals are grouped into two categories: vector-borne diseases (those transmitted by invertebrates, primarily insects like mosquitoes and fleas), and zoonoses (from vertebrates like bats, birds, pigs, and dogs). For the first group, rising temperatures favor the propagation and spread of insects and mosquitoes, which are the primary vectors of dengue fever, zika, and malaria, among other diseases. Thus, in the last four decades, the number of dengue cases in the region has increased from 1.5 to 16.2 million (PAHO, 2020). Meanwhile, zoonoses are also on the rise (Colón-González et al., 2018) as natural habitats are modified by deforestation, mass urbanization, and climate change, which generates more contact between animals and humans (Watson et al., 2022).

The WHO has estimated the impact of climate change on population health in various regions of the world using the 1961–1990 climate as a counterfactual. Using this period as a baseline, it calculated the difference in number of deaths or people exposed under different climate scenarios for the years 2030 and 2050. The study had three key findings: (i) each consequence of climate change would affect the various health problems differently, and heatwaves would be the most serious problem; (ii) the impact on the Americas region is different from the impact on the rest of the world (for example, the impact on mortality in children under age 15 would be lower than in the rest of the world); and (iii) projections for 2030 to 2050 vary by health threat (deaths due to heat waves would increase, but deaths of children under age 5 due to undernutrition would decline). Table 2 summarizes these estimates, which are presented in more detail in Annex 4.

TABLE 2 IMPACT OF CLIMATE CHANGE ON ADDITIONAL DEATHS OR PEOPLE AT RISK FOR SELECTED HEALTH PROBLEMS, MINIMUMS AND MAXIMUMS, GLOBALLY AND IN THE AMERICAS REGION

		2030		2050	
PROBLEM	REGION	Min.	Max.	Min.	Max.
Annual number of deaths in people over 65 due to heat waves	World	64,458	121,464	191,816	364,002
	Americas	9,012	17,101	26,361	50,384
Annual number of deaths in people under 15	World	21,097	67,702	15,000	49,151
	Americas	1,315	1,566	27	92
Number of people at risk of contracting malaria	World	696,480,000	1,229,490,000	798,950,000	1,144,560,000
	Americas	39,960,000	72,280,000	48,600,000	64,220,000
Number of people at risk of contracting dengue fever	World	4,291,880,000	4,418,340,000	4,506,270,000	4,640,620,000
	Americas	461,920,000	482,440,000	458,740,000	481,300,000
Number of deaths in children under age 5 from undernutrition	World	−3586	193,937	29,815	139,576
	Caribbean and Central America	−837	2,554	100	1,311
	Latin America - middle	−327	1,218	−6	665
	Latin America - south	−49	76	−27	49

Source: WHO (2014).

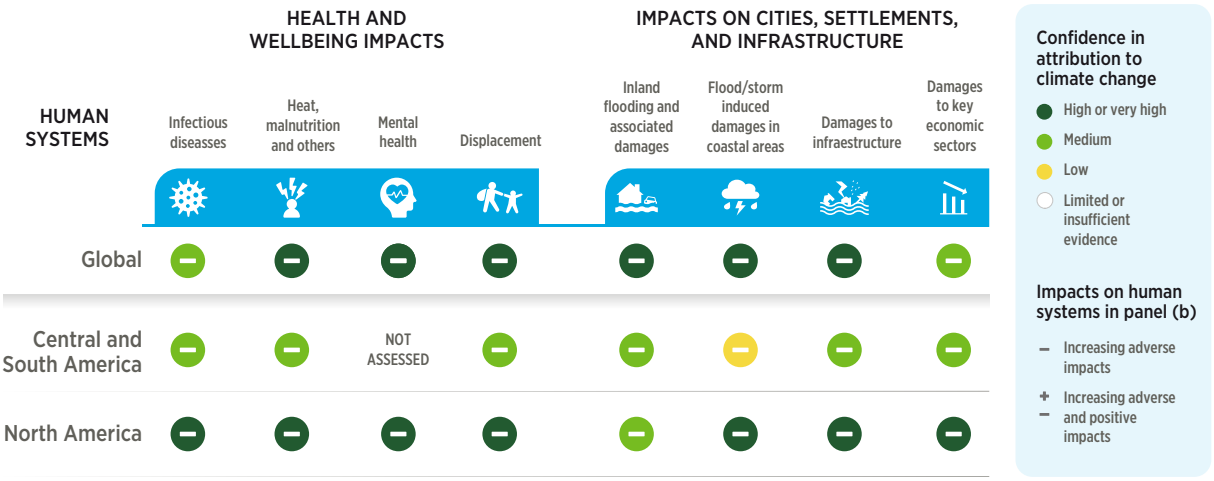
Climate change is affecting mental health. Several reports concur that the climate crisis is taking a toll on the population's mental health (Sanchez, 2019; IPCC, 2022). For example, researchers have found correlations between higher temperatures and increases in medical appointments for mood disorders, anxiety, stress, and schizophrenia (Nori-Sarma et al., 2022), with the strongest effects in women and low-income populations (Obradovich et al., 2018). Some experts even project that high temperatures could trigger an additional 9,000 to 40,000 suicides by 2050 in the United States and Mexico alone (Burke et al., 2018). Additionally, a recent study concluded that those affected by Hurricane Katrina are 4% more likely to develop mental illnesses than those not affected, in addition to suffering post-traumatic stress and anxiety due to the loss of family members or property (Obradovich et al., 2018). Climate change is also affecting mental health through a new syndrome

that the American Psychological Association (APA) defines as "ecoanxiety"[7] which includes fear, sadness, or anger in response to the long-term effects of climate change (APA et al., 2017). Likewise, there is a growing body of research on the effects of climate anxiety on people's mood and daily functioning (Fawbert, 2019; Hickman et al., 2021). These trends are made even more alarming by the fact that mental illnesses (like depression and anxiety, regardless of their causes) currently account for 34% of years lost due to a disability (YLD), more than years lost from communicable diseases; maternal, child, and nutritional disorders; and injuries, which together make up 12% (PAHO, 2018b).

Climate change is also indirectly harming people's health through its effect on water, air, and soil quality, as well as on the ecosystem. For example, floods damage crops and can pollute the environment by carrying wastewater, chemicals, or decomposing organic matter (Carrillo and Guadalupe, 2001). This can affect food production, creating food insecurity and nutritional problems for the population. Additionally, the burning of fossil fuels and the effects of climate change (droughts, fires) increase the levels of particulate matter in the atmosphere (Watts et al., 2015). Worldwide, air pollution leads to over 3 million premature deaths each year. In Latin America, around 138,000 people die from polluted air every year (CODS, 2019). In 2020, Brazil and Mexico saw their highest number of premature deaths attributable to fine particulate air pollution in the region, with 19,300 and 13,200 deaths, respectively (Romanello et al., 2022). This problem also led to an increase in cardiovascular diseases (80%), respiratory system diseases (14%) and lung cancer (6%).

7. Defined by the APA as "the chronic fear of environmental cataclysm that comes from observing the seemingly irrevocable impact of climate change and the associated concern for one's future and that of next generations."

FIGURE 2 ADVERSE HEALTH AND WELFARE IMPACTS ATTRIBUTED TO CLIMATE CHANGE[8]

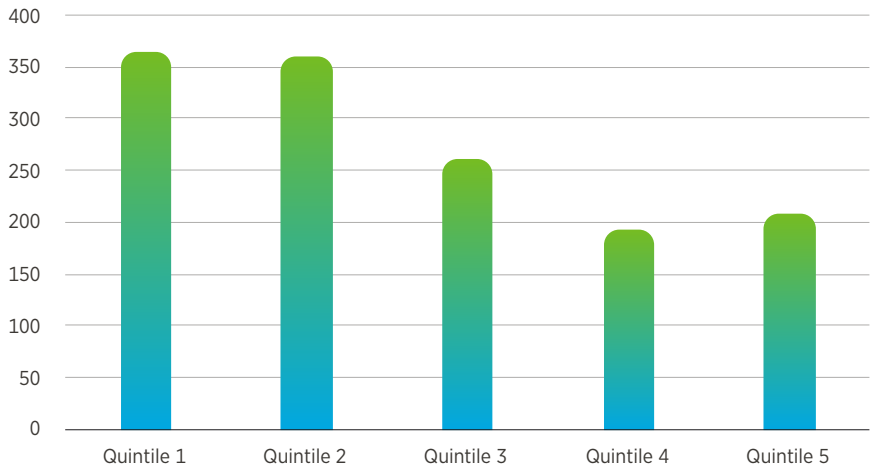


Source: Adapted from Figure SPM2 in the full report (IPCC, 2022).

The impact of climate change on population health is mediated by the way society is organized and functions, which can amplify or help reduce its impact. These societal factors include demographics, socioeconomic status, health status, geography, and migration—all of which help determine vulnerability—as well as how the public health system is structured and operates, among others. Evidence shows that mortality from avoidable causes is almost twice as high among lower-income groups than among higher-income groups (Graph 1).

8. In both Latin America and the Caribbean and North America, the negative impacts of climate change on human health and welfare systems, and on cities, settlements, and infrastructure are on the rise. However, the level of confidence in attributing these impacts to climate change varies: confidence is high in North America (which includes the United States, Canada, and Mexico) but medium in Latin America and the Caribbean. This is due to the limited number of studies in the region.

GRAPH 1 AVOIDABLE MORTALITY RATE BY INCOME QUINTILE IN THE AMERICAS, 2019 (RATE PER 100,000 POPULATION)



Source: Adapted from PAHO.

Climate change affects vulnerable populations and groups the most, impacting their health and well-being. The most vulnerable demographics are older people, children, and women. The most vulnerable socioeconomic groups are people living in poverty and extreme poverty (Wellenstein et al., 2022), and those most exposed to climate change by health status are pregnant women and patients with chronic diseases or disabilities. In Brazil, for example, researchers have found a correlation between low rainfall and shorter pregnancies, lower birth weight, and higher infant mortality. Water scarcity is also tied to increased hygiene problems and higher risks that diseases will spread (Rocha and Soares, 2015). Meanwhile, droughts, floods, and heat waves— along with water, soil, and air pollution —directly impact agriculture, which employs about 70% of adults in extreme poverty in Latin America and the Caribbean (Castañeda et al., 2018), threatening their economic livelihood and well-being (including their health). The Food and Agriculture Organization of the United Nations (FAO) estimates that, globally, climate change could push more than 122 million people, mainly farmers, into extreme poverty by 2030 (FAO, 2019).

BOX 1 HOW CLIMATE CHANGE AFFECTS GENDER DIFFERENCES

Climate shocks deepen the vulnerability women experience due to pre-existing social, economic, and cultural inequalities (IPCC, 2021). A London School of Economics study (Neuman and Plumper, 2007) found that natural disasters will lead to the deaths of more women than men, whether directly or indirectly, through post-disaster events, or will cause more women to die at a younger age than men. This gender gap is thought to be the result of discrimination against women, especially women living in poverty, since these disasters' adverse effects tends to disappear in high-income groups. UNDP data provides evidence of this gap: as of 2019, 60% of those who died from natural shocks in the previous 20 years were women (Noel Vaeza, 2021).

Climate change is pushing people to migrate in search of better living conditions (Watkins and García S., 2020). In 2019, there were 23.9 million displacements by climate change-related catastrophes. Approximately 6% of these displacements took place in the Americas (IDMC, 2020), mostly in the form of internal migration. The countries with the highest displacement rates in the region were Brazil and Bolivia. These displacements were mainly due to floods and storms that caused thousands of people to lose property, family members, and crops, as well as infrastructure damage that shut down basic services (water, sanitation, and health). These displacements jeopardize people's physical and mental health, and indigenous and low-income communities face the greatest risk. When these people become migrants or refugees, their situation deteriorates further, as they face limited access to medical care, housing, work, and education, in addition to discrimination. By 2050, an estimated 216 million people worldwide will be forced to move as a result of climate change (World Bank, 2021a).

How climate change affects healthcare services

Climate change is affecting the supply side of healthcare services as a result of damage to facilities and service disruptions. From 2007 to 2017, around 24 million people in the region went without medical care for months and years due to these extreme events (ECLAC, 2020; ECLAC, 2021). Care was interrupted by damage to facilities; power, water and communications outages; difficulty in accessing facilities for staff and patients; or supply chain disruptions, among other reasons.

Health services are highly vulnerable to climate change. Studies by the Pan American Health Organization (PAHO) estimate that 67% of health facilities are at risk (PAHO, 2006; PAHO, 2018a). Five countries have over 80% of their facilities located in at-risk areas, six have between 51 and 80%, and the remaining countries have less than 50% located in hazardous zones. These studies also find that countries have not assessed facilities' vulnerability and capacity to adapt to climate hazards (PAHO, 2018a).

The response to climate change is limited by the structural weaknesses in the resources, organization, and management of health services. On average, public spending on health in the Americas is about 4% of the Gross Domestic Product (GDP). PAHO argues that this percentage should be increased to approximately 6% to make health resources more available. It also estimates that the region has a deficit of 600,000 professionals, which affects access to care, especially for people in rural and underserved areas. In terms of assets (infrastructure and equipment), the region needs an estimated $153 billion in investments to restore deteriorated health care assets and close the new investment gap (IDB 2021b). In addition to the resource gap, there is also a management gap. If Latin America managed its health services more efficiently, Latin Americans could live nearly four years longer. And in countries like Bolivia, Guyana, Trinidad and Tobago, or Suriname, they could live as much as seven years longer, with a life expectancy of nearly 80 years (IDB, 2021b).

The healthcare sector's carbon footprint

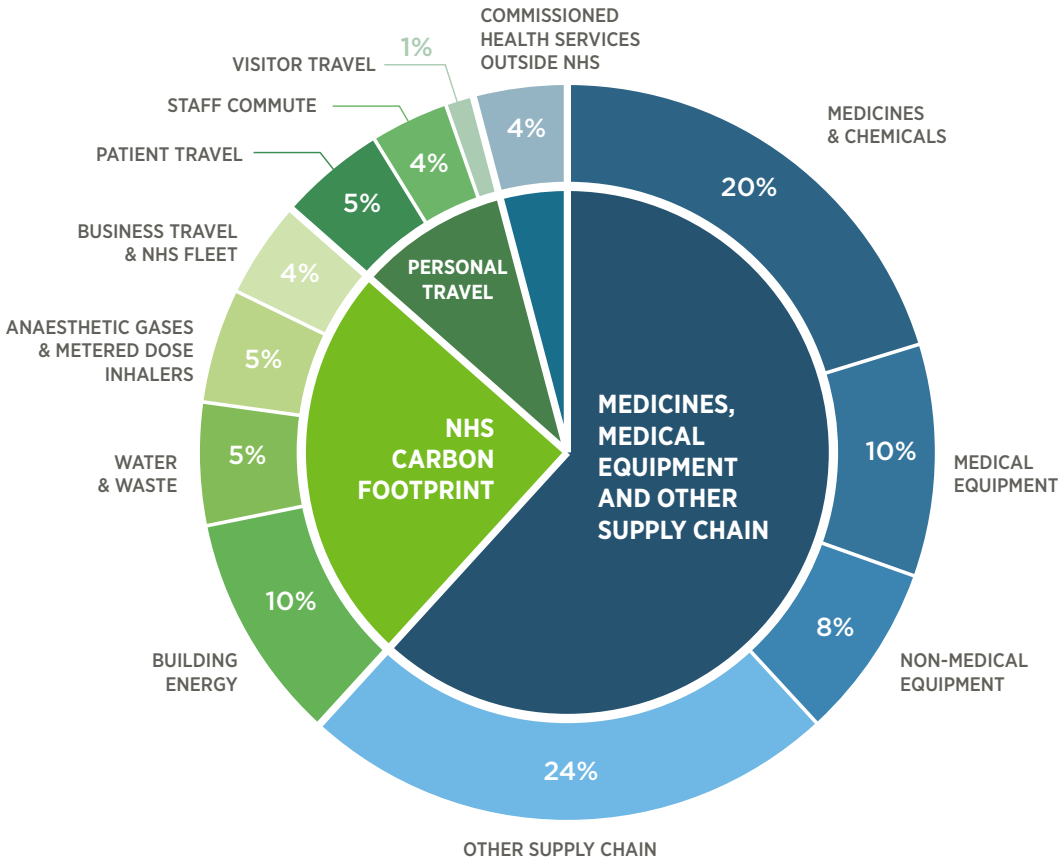
The healthcare sector[9] also contributes to climate change.[10] According to a recent study by Health Care Without Harm (2021), the sector was responsible for 4.4% of global greenhouse gas (GHG) emissions, and these emissions are among the fastest growing of any sector, with a 5% increase from 2019 to 2020 (Romanello et al., 2022). This is equivalent to 2.7 billion metric tons of CO_2, and Latin America and the Caribbean contributes 6% of the health sector's global carbon footprint. If the health sector were a country, it would have the fifth highest emissions in the world.

The supply chain providing pharmaceutical products, food, clothing, and other items is the main source of GHG emissions from the health system (80%), mostly from the energy it uses. The next largest source is emissions from the health sector itself (13%) and from transporting patients and staff (7%) (Health Care Without Harm, 2021). Emissions profiles varied by region and country based on level of health expenditure. As shown in Graph 2, England's National Health Service provides a detailed analysis of its sources of emissions (Tennison et al., 2021; NHS England, 2020). Together, medicines, medical and non-medical equipment, and other supply chain aspects are the main source. The second largest source of emissions is all the services directly related to delivering health care (24%). These emissions are primarily from buildings and everything they need to operate, like electricity and water. The remaining emissions are split between transportation of staff and patients (10%) and private-sector health services (4%). Global estimates are similar: 29% of emissions are from direct health service operations, while 71% are indirect emissions from pharmaceutical products, food, services, and other factors (Health Care Without Harm, 2021).

9. The health sector includes service providers; health officials; suppliers of equipment, products, and consumables; and the logistics needed to mobilize those services and supplies.

10. The main sectors driving climate change are energy and heat production (25%); agroforestry (24%); industry (21%); and transportation (10%). Compared to these sectors, the health sector's share is low and can be reduced, although the response to climate change is crosscutting and requires an inter-sector response.

GRAPH 2 CARBON FOOTPRINT OF ENGLAND'S HEALTHCARE SECTOR, BY SOURCE OF EMISSIONS



Source: NHS England (2020).

Within healthcare service delivery, hospitals consume most resources. Each hospital bed generates an estimated 0.5 tons to 1 ton of solid waste per year, consumes between 75 and 340 m^3 of water, and emits 133 to 528 kg of CO_2 (Minoglou et al., 2017; IDB, 2020a). In Latin America and the Caribbean, the public sector alone has over 1.1 million beds, which generate approximately 500 million to 1.1 billion tons of waste (Tello et al., 2021), consume between 82.5 and 476 million cubic meters of water, and generate from 150,000 to 600,000 tons of CO_2, which is equivalent to the average amount of CO_2 contained in 2 million trees.

2 THE OPPORTUNITY: HEALTH IN THE CLIMATE CHANGE AGENDA

The Paris Agreement lays out the framework for a comprehensive, timely, and coordinated response to climate change. The 2015 agreement was signed and ratified by 33 Latin American and Caribbean countries. The three objectives of the Paris Agreement are to keep a global temperature rise this century well below 2 degrees Celsius above pre-industrial levels, pursue efforts to limit temperature increase even further to 1.5 degrees Celsius, and achieve **climate neutrality by 2050**. Climate neutrality means that the level of CO_2 (the main gas causing global warming) released into the atmosphere by human activity is equivalent to the amount absorbed by natural sinks, like forests.

To this end, countries need to take urgent and effective measures to improve climate resilience and cut GHG emissions by 45% by 2030. To communicate its commitments and actions, each signatory country agreed to present its nationally determined contributions (NDC) every five years. These commitments are the core of the Paris Agreement, since they translate the objectives into concrete adaptation and mitigation actions in different sectors (health is a priority sector) and allow for long-term progress evaluations. Each country is responsible for defining its NDC based on its circumstances, capacities, and ambitions. It is also responsible for integrating them into its national policies.

By including health considerations in climate-related policies, policymakers can maximize social, environmental, and economic benefits. The healthcare sector is a central pillar of the response to climate change, and other sectors also mention public health when addressing the issue (WHO, 2020a). Linking NDCs for health with other sectors like infrastructure, water, and agriculture, is key to achieving additional health-related climate co-benefits. These synergies have made it so the NDC can be used to both analyze measures to address climate change and assess whether the actions also protect the population's health.[11] The Global Climate and Health Alliance (GCHA, 2021) assessed whether the proposed nationally determined contributions effectively curb temperature rise, while at

11. Many of these co-benefits are from interventions related to determinants of health (e.g., water sanitation).

the same time protecting the population's health.[12] Of 120 countries, Costa Rica is the only one in the region that is ranked in the top five and that has NDCs that are aligned with the Paris Agreement, which means that its climate ambitions are in line with not crossing the 2°C threshold. Other countries, like Colombia, Panama, and Argentina are ranked in the top 15, but their climate goals are aligned with a scenario where temperatures would rise by more than 2°C. Countries like Peru and Brazil are at the bottom of the ranking (see Annex 2).

BOX 2 HEALTH IN THE REGION'S NATIONALLY DETERMINED CONTRIBUTIONS

Approximately 80% of NDCs in Latin America and the Caribbean, including those of Chile, Panama, Peru, and Uruguay, contain adaptation measures for the health sector. The main adaptation measures include:

i. Increasing the population's climate resilience.
ii. Addressing problems related to heat waves (extreme temperatures).
iii. Health risk reduction strategies.
iv. Adapting health systems to epidemic vector patterns.
v. Adapting to pests, respiratory diseases, and diseases that have climate-correlated transmission patterns.

Meanwhile, other sectors also directly or indirectly mention public health in their approaches. For example, in Costa Rica, the infrastructure sector's NDCs include health centers, as they are considered vital public facilities. Brazil's agricultural sector highlights the importance of guaranteeing food security and nutrition, which affects people's health. El Salvador also considers potable water to be key in safeguarding the well-being of its population.

Source: European Commission (2019) and Samaniego et al. (2019).

12. GCHA used the following five assessment criteria: (i) health impacts, (ii) health adaptation, (iii) health co-benefits, (iv) economics and finance, and (v) additional "bonus" aspects for NDCs that include references or additional information relevant to health and its links to climate action (Annex 2).

Health NDC should be built on solid plans, policies, and strategies. The government plays a central role in leading the process and ensuring good coordination between actions to adapt to and mitigate climate change within the health sector (for example including emergency health plans for climate change within a multi-hazard response framework),[13] as well as with other sectors (through measures like using up-to-date risk maps to identify facility locations). The experience of multiple countries suggests that in order to implement these policies, it is best to have a regulatory framework (laws and regulations) and administrative framework (resolutions) that establishes penalties and incentives for meeting the policies' objectives (Reyes, 2017). Adaptation and mitigation efforts should also be consistent with achieving UHC and attaining the SDG (for example, health actions should contribute to adaptation rather than just reducing GHG emissions). One of the Paris Agreement's major opportunities is that it provides a cross-sector framework that identifies co-benefits that can be generated by various sectors (e.g., interventions in education, water, and sanitation improve determinants of health to protect the most vulnerable populations).

International coordination and cooperation can help improve the health sector's response to climate change (Close and Caballero, 2015). Participation in global events on climate change like the Conference of Parties (COP) can help countries in the region join forces and take bolder action. At COP26, 10 countries from Latin America and the Caribbean committed to developing low-carbon and resilient health systems: Argentina, Bahamas, Belize, Chile, Colombia, Costa Rica, the Dominican Republic, Jamaica, Panama, Peru, and Panama. Forums, seminars, or workshops for analyzing countries' adaptation and mitigation measures in the health sector also offer highly valuable spaces where countries can cooperate and accelerate uptake of new practices.

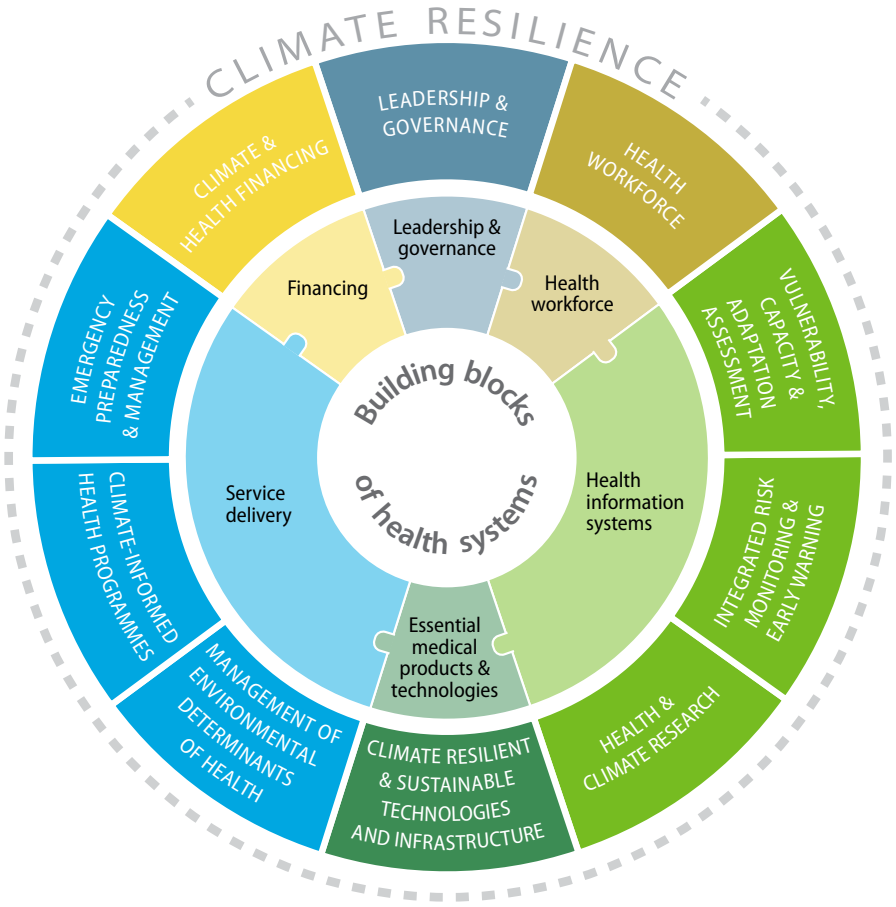
13. A multi-hazard response framework for the health sector is designed to enhance a country's operational response capacity in the event of different emergencies and catastrophes (PAHO, 2019).

Adapting the healthcare system

Adaptation measures should be designed to protect people's health and make healthcare services more resilient. On one hand, it is important to identify the direct and indirect effects of climate change, as well as the social dynamics that affect the population's health. On the other hand, countries need to build more resilient healthcare systems and services that can continue to function under unfavorable circumstances. These responses should be part of a multi-sector and cross-ministry framework that leads to climate co-benefits for the sector and country.

To ensure resilient healthcare services, countries need to reinforce the basic building blocks of the health system, so that the response to climate change strengthens the existing organization. To guide the adaptation process and ensure a good response, the World Health Organization (WHO) created the *Operational Framework for Building Climate-Resilient Health Systems* (WHO, 2017), which is aligned with the strategy for achieving UHC. The guide covers processes, resources, and governance. The processes include: (i) health information systems, encompassing vulnerability, capacity, and adaptation assessments; integrated risk monitoring and early warning systems; and health and climate research; (ii) service delivery, including emergency preparedness and management, climate-affected health programs, and managing environmental determinants of health. The resources include (iii) medical products and technologies, (iv) health workforce and (v) financing. Finally, (vi) leadership and governance are key for coordinating and managing processes and resources. Figure 3 describes these building blocks and their components.

FIGURE 3 OPERATIONAL FRAMEWORK FOR BUILDING CLIMATE-RESILIENT HEALTH SYSTEMS



Source: WHO, 2017.

While this framework can provide a starting point, there are also other models that can guide the adaptation processes (see Annex 3). The following paragraphs describe opportunities in each area of the WHO operational framework: key processes (health intelligence and response capacity), followed by resources (human resources, equipment, infrastructure, and financial resources), and leadership and governance.

I) Health information systems that bolster health intelligence in order understand the effects of climate change on health, conduct long-term research and provide early warnings. Countries need to set ambitious goals for these systems (Bofill, 2022), in order to: (i) assess the vulnerability and adaptive capacity of health systems, using tools like the *Checklists to Assess Vulnerabilities in Health Care Facilities in the Context of Climate Change* developed

by the WHO (WHO, 2021c); (ii) continue to research the relationship between climate and health to add to the growing body of literature on the subject and understand how this dynamic evolves; and (iii) set up an early risk surveillance and monitoring system to collect and analyze climate and health data in order to establish early warnings for healthcare systems or general emergency responses

Countries in Latin America and the Caribbean have recently begun to implement these types of measures. Argentina, Brazil, and Cuba have already launched surveillance and early warning systems that include climate-related diseases, like injuries and deaths due to extreme weather phenomena and high temperatures. In fact, these three countries have added climate information to these systems (WHO, 2021a). Other countries are still developing these measures. For example, *Argentina's National Health and Climate Change Action Plan* will strengthen the services responsible for monitoring and responding to climate change, such as the National Meteorological Service, the National Water Institute, the Watershed Committees, the Health Governance Secretariat, and the National System for Integrated Risk Management.

II) Service delivery with increased capacity to routinely respond to the direct and indirect effects of climate change. This opportunity involves improving readiness for, and capacity to respond to, emergencies like storms and heat waves through systems that can respond to multiple hazards that may occur more frequently (Poorolajal, 2021) (whether climate-related, pandemics, or other types of disasters). It also involves increasing actions for a sustained healthcare response through programs to control dengue vectors or eliminate malaria, or by strengthening key services and programs to prevent undernutrition, monitor noncommunicable chronic diseases, or provide mental health care and ensuring that these programs can continue even under adverse conditions. As part of the response to these threats, countries need to strengthen the routine organization and operation of healthcare services through networks that bring together all levels of care, from primary to hospitals. An example is *Chile's Climate Change Adaptation Plan for Health*, which aims to enhance the healthcare sector's ability to respond to climate change. This plan contains measures to ensure that healthcare services and networks run smoothly (Government of Chile, 2016), which include: (i) reevaluating regional risk matrices to include health risks associated with climate change; (ii) assessing regional health centers infrastructure and its capacity to withstand extreme events; and (iii) taking stock of current human resource needs for healthcare services to meet possible new demands as climate change drives changes in morbidity and mortality.

III) Essential medical products and technologies that make buildings and equipment more resilient,[14] ensuring that they can continue to operate in extreme weather and guaranteeing continuous energy and water supply and communications services. This area of work also includes using appropriate medical products and equipment and supplies with effective medical technologies that keep medical care from being interrupted. Examples include equipment that continues to function despite power outages or water supply interruptions. It is also crucial to ensure accessibility for personnel, patients, and supplies.

IV) A more climate-resilient healthcare workforce. COVID-19 made it clear that health personnel are the backbone of the system, but also that they are vulnerable to threats from the disease itself and to sustained overwork (which led to many of these professionals to have physical and mental health problems). To deal with climate change, health personnel needed to be educated on climate change's impact on population health and healthcare services, among other topics. The content of this education should be tailored to their specific role in the health system. Countries should also draw up plans for supporting frontline emergency responders to prevent stress and fatigue. Some national plans include: (i) national-level training on climate change; (ii) regional-level training on climate change; and (iii) opportunities to exchange experiences with other countries (Government of Chile, 2016).

V) More funding to meet the additional demands of climate change. Countries should quantify the investments and operational resources required to reinforce information systems and healthcare services, make assets more resilient, and support personnel. With this economic overview, they can then form a plan to redirect or expand funding. In addition to creating items in their own budgets to fund programs for climate change and health, countries should also consider securing funds from financial market instruments and local, national, or international funding mechanisms (IDB, 2020), whether private, public, or a mixture of both (World Bank, 2021c). Additionally, the national institutional framework should be adapted to include regulations and incentives for mobilizing climate finance (European Commission, 2019).

VI) Strengthen leadership and governance in the climate change response, so that health leaders support planning and action to address climate change, considering local priorities and reporting progress towards the system's mitigation and adaptation goals, while at the same time ensuring health outcomes and service quality and efficiency.

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14. Proposed improvements can be based on response capacity assessments like the one developed by the WHO (2021a), on selecting appropriate plots of land (Dalaison, 2018), on codes and guides for building safely to withstand the effects climate change, and on periodically inspecting facilities.

Recent experiences with COVID-19 have yielded lessons that can be applied to the climate response, since both are on a global and massive scale. The public health responses to both crises have many elements in common that can be useful for tackling health system weakness in areas like coordination, infrastructure, equipment, supply chains, and technologies in many countries in the region. The aim of these responses is to respond to the emergency and also keep essential health services running (WHO, 2020b). However, COVID-19 also showed how well governments can respond when committed and willing. The following table summarizes examples identified by the World Bank.

TABLE 2 MENU OF SMART HEALTH INTERVENTIONS TO RESPOND TO CLIMATE CHANGE AND COVID-19

KEY RESPONSE AREAS	CLIMATE ADAPTATION AND RESILIENCE	CLIMATE MITIGATION
Public health surveillance and risk assessment	Surveillance of climate-sensitive health diseases (for example, dengue or malaria), heat-related illnesses, air pollution-related diseases, and nutritional deficiencies).	Energy use audits to inform energy-efficiency measures and the availability of alternative renewable sources.
Emergency preparedness and management	Adopting a multi-hazard approach to emergency planning that covers pandemics, climate-related disasters, and other external shocks.	Establish low-carbon backup options for electricity (for example, solar photovoltaic PV), clean water, adequate food supply, and transport.
Continuity of essential health services	Strengthen public health programs, including those for diseases that are not climate sensitive, to ensure they continue uninterrupted.	Improve the efficiency of care pathways to ensure health provision, reduce emissions, and save costs.

Source: Adapted from World Bank (2021b).

Carbon footprint mitigation

Healthcare sectors can take a wide range of actions to decarbonize their facilities and operations. The Health Care Without Harm report lays out a mitigation roadmap (see Annex 3) with seven areas of action for reducing emissions, based on a comprehensive view of the carbon footprint that covers everything from input production to service delivery. The areas of action are: (A1) renewable energy; (A2) zero-emission buildings; (A3) zero-emission transportation; (A4) sustainable food; (A5) low-carbon pharmaceuticals (including reduced consumption through rational use of medicines and reducing the carbon footprint from manufacturing them); (A6) circular health (which encompasses sharing, reusing, repairing, refurbishing and recycling existing materials and products as often as possible, thereby reducing waste); and (A7) effective systems (making health systems more efficient reduces their carbon footprint). The final area includes macro-interventions like optimizing the network of facilities or changing clinical and operational practices to avoid redundant testing or eliminate procedures or drugs that have no evidence of clinical utility. These interventions can also raise the quality of care and improve health outcomes (Health Care Without Harm, 2021).

Mitigation can be approached from three angles. The first focuses on health facilities and their operations and services. The second broadens the focus to include the health system's entire supply chain. This is the part of the health sector that generates the most GHG admissions, but implementing supply chain mitigation measures can be complex since so many different industries, stakeholders, processes, resources, and even countries are involved. The third angle includes external industries that provide services to the health sector, like agriculture and textiles.

Green building techniques can help reduce GHG emissions and improve the health system's financial sustainability. Green building (Minoja et al., 2018) encompasses a range of measures, including: (i) active measures like LED lighting and occupancy sensors; (ii) passive measures like building orientation and exposure to sunlight; (iii) generating photovoltaic energy; and (iv) using rainwater harvesting systems and faucet aerators. An IDB-led study estimated that this type of measures can reduce consumption by a net 20 to 40 percent and can also decrease GHG emissions (IDB, 2020a). New building projects or remodels of existing buildings can follow different methods, one of which is EDGE (Excellence in Design for Greater Efficiencies).[15] Multilateral banks are promoting use of this certification. The IDB study estimated an additional cost for these measures of no more than $20 per

15. Eco-sustainable building certifications are increasingly relevant in the construction sector. EDGE and LEED are among the leading certifying entities.

square meter for new hospitals and $49 per square meter for existing ones, or 1.5% and 3.5% of the total investment. These investments are self-sustaining due to water and energy savings, which pay back the additional cost in a period ranging from under a year to six years (depending on the type of project, location, and utility costs).

Health systems can reduce their energy consumption by using efficient medical equipment. Energy efficiency certifications have been gradually incorporated into medical equipment, and these certifications should be an important consideration when procuring equipment, Indeed, the procurement process should include an asset life cycle analysis to determine all costs associated with equipment: investment, operation, training, maintenance, and final disposal or recycling. Health systems can lower their carbon footprint by choosing energy-efficient, low-maintenance, and long-lasting options.

Telehealth helps reduce the sector's emissions. The COVID-19 pandemic has accelerated the use of digital tools for service delivery, allowing healthcare services to operate more efficiently (area A7 of the mitigation roadmap). In Argentina, online care increased by 233% in 2020 (Busso et al., 2021), reducing in-person appointments and paper consumption. Telehealth has spurred changes and led to benefits in care for patients and in how medical and non-medical processes operate. Additionally, it offers new channels for coordination, exchanging information, training, and communication. It has also brought environmental benefits. For example, inter-operable information systems use resources more efficiently. According to a study prior to the pandemic, telehealth reduces redundant CAT scans, ultrasounds, and x-rays by over 40 percent (Lammers et al., 2014). Furthermore, telehealth cuts down on transportation of patients and health personnel (Purohit et al., 2021; Bagolle et al., 2022), among other benefits. Meanwhile, artificial intelligence and big data can be used to compile, complete, and integrate large and complex data sets and harness this data to improve how the health system operates and in turn reduce GHG emissions (for example, by optimizing routes for transporting patients and personnel, logistics, or managing patients on wait lists) (Batra et al., 2022; Wolf et al., 2022).

Organizing and managing healthcare services in integrated networks also offers major potential to reduce their carbon footprint. When services follow a networked organization and management model, they can take advantage of complementarity between facilities, create economies of scale, and improve the quality of services. This approach can be applied to different areas of service delivery: For example: (i) A stronger primary health care (PHC) network can reduce hospital demand and use less resources. The network can, for example, prevent emergency room visits and hospitalization by properly monitoring diabetic patients at a health center. (ii) When hospitals and health centers work together in a network, they need fewer investments and operational resources. For example, PHC facilities can reduce their need to operate maternity units 24/7 by sending births to an acces-

sible hospital with service capacity. (iii) Organizing support services for the entire network brings down the investment and operational burden for each facility through economies of scale that also reduce emissions. Examples include regionalizing routine lab tests at primary care facilities, blood banks, [16] and pathology services.

BOX 3 KEY REFERENCE MATERIALS ON HEALTH AND CLIMATE CHANGE

- The Intergovernmental Panel on Climate Change – IPCC
  Climate Change 2021: The Physical Science Basis
  Climate Change 2022: Impacts, Adaptation and Vulnerability

- The Lancet Countdown on Health and Climate Change
  The 2020 report: responding to converging crises
  The 2021 report: code red for a healthy future
  The 2022 report: health at the mercy of fossil fuels

- 2021 WHO Health and Climate Change Survey Report

- Publications specific to Latin America and the Caribbean are available from Health Care Without Harm y CEPAL

16. A PAHO publication (2002) estimates that for the same output, it costs $49 million to build and operate four blood centers and $104 million for 40 small centers.

3 RECOMENDATIONS: OPTIONS FOR HEALTH INTERVENTIONS

Climate change requires specific interventions, many of which overlap with the objective of achieving universal health coverage and addressing social determinants that increase people's vulnerability to climate change's risks and impacts.

One important recommendation is to create or update the national climate policy (NCP) for healthcare. Countries that do not have an NCP in the area of health should create one, because the health sector has the responsibility of contributing specific interventions to adapt to and mitigate climate change. Countries that do have this policy in place should evaluate it and update it, because scientists are finding that the effects of climate change are materializing at a faster rate than expected a few years ago. These interventions should form part of a national, multi-sector policy that is periodically monitored and adjusted as goals are met. For the health sector, a good policy should combine the building blocks of the WHO operational framework for adapting to climate change with the high-impact mitigation actions proposed by Health Care Without Harm **in an approach that includes the following stages:**

1. Measuring a baseline for vulnerability, adaptation capacity, and the health sector's contribution to climate change (carbon footprint), including a stakeholder mapping and an assessment of the extent to which policies are being implemented.
2. Establishing relevant measures according to the level of development at the national, subnational and local levels.
3. Designing mechanisms for monitoring these measures and evaluating whether they are actually being implemented.
4. Creating plans to adjust or modify goals based on progress towards meeting them.

Adaptation

The healthcare sector plays a key role in protecting the population, especially those who are most vulnerable, so it needs to take a range of actions to adapt to the direct and indirect effects of climate change, as well as its impact on the social dynamics that modulate the response to climate change. The following recommendations are primarily based on the dimensions of the WHO Operational Framework (Section II.A).

BUILDING BLOCK	INTERVENTION OPTIONS
Health information system	• Strengthen early warning systems that monitor climate factors that could pose a hazard to people's health. • Strengthen sectoral and inter-sectoral emergency response systems. • Strengthen epidemiological surveillance systems to monitor the incidence and prevalence of climate-related health conditions and help identify the population's most vulnerable groups. • Promote research on climate change and health to improve the evidence on how they are linked and thus improve intervention strategies.
Service delivery	• Strengthen the emergency system to coordinate the health system's response to severe cases, including communications, transport, and intra- and inter-institutional coordination, at minimum. This system should ideally incorporate the entire network of service providers, from primary care to hospitals, depending on the level of complexity of the health problem. • Set up emergency support systems for displaced groups, and coordinate them with the emergency system. For this system, primary care could serve as the main point of contact with the community or with other entities, according to on-the-ground capacity. • Ensure the continuity of essential health services through PHC, so that climatic events or population displacement do not pose additional health risks. • Strengthen digital health to guarantee service delivery during situations that could limit the movement of patients and resources. • Establish plans for a rapid, coordinated, and cross-sector response to various scenarios for the most vulnerable groups, areas, and communities, in addition to climate risk communication plans for each territory. • Optimize the use of integrated healthcare service networks (IDB, 2021a) for planning and implementing care delivery (providing services as close to the population as possible and transporting patients in more complex cases), ensuring the continuity of care in emergencies, guaranteeing support services (like medications), and defining the governance structure for response measures. • Design plans and programs that help reduce the incidence and prevalence of health problems that are exacerbated by climate change. For example, one of the risks of climate change is an increased population of malaria-carrying mosquitoes, and there are programs to stop its spread in humans (like the Regional Malaria Elimination Initiative) and reduce or eliminate this problem even in an unfavorable climate scenario.

BUILDING BLOCK	INTERVENTION OPTIONS
Essential medical products and technologies, infrastructure	• Make healthcare facilities more climate-resilient so they can continue functioning even under harsh climate conditions. This requires evaluating their vulnerability, land, buildings, and utilities (energy, water, communications), in order to: (i) select safe plots of land for new buildings; and (ii) take measures to make existing buildings less vulnerable and incorporate them into the design of new facilities. • For new projects, select only locations with low or no vulnerability. • Relocate existing health facilities that are built on high-risk sites. • For existing buildings on sites with manageable risk, reinforce and adapt structures and nonstructural elements like roofing and windows, as well as backup systems to ensure connectivity and an uninterrupted supply of water and energy. For example, move an electrical generator installed in the basement of a health center located in a flood risk area. • For new projects, incorporate structural, nonstructural, and utility availability measures into the design to ensure the facility can continue operating even during a climate emergency. • Implement digital health technologies that provide access to information on medical history, tests, or imaging studies, and other data that could be hard to access in physical format during climate emergencies. For example, if a chronic patient's condition deteriorates while they are at a temporary shelter, storing their information in the cloud can help facilitate the continuity of their treatment.
Health workforce	• Set up a training program for health personnel (medical, non-medical, and administrative) to prepare them for the potential demands caused by climate change—so they can actively participate in adaptation measures (e.g., emergency responses or health care in temporary housing)—and include them as allies in actions to reduce the carbon footprint. • Add courses on climate change and health to medical training programs. • Provide technical assistance and psychological support to health personnel (especially front-line staff) to respond effectively to crisis situations. • Train the health management team on good leadership and governance when creating and implementing climate change adaptation and mitigation plans.
Financing	• Identify a budget item with resources for carrying out mitigation and adaptation plans. • Develop projects and programs related to climate change and health to submit to the main international funds for combating the climate crisis. • Establish transparency and accountability mechanisms for funding for mitigation and adaptation activities.

BUILDING BLOCK	INTERVENTION OPTIONS
Leadership and governance	• Strengthen the health sector's governance so each of the areas described above have local, regional, and national teams in charge of implementing the response measures. There should also be a hierarchical structure for implementation and the necessary levels of coordination. This governance scheme should lay out how the sector will coordinate its response to climate change between institutions and with the community. Countries should differentiate governance schemes for emergency response—through participation in a national or regional Emergency Operations Center for example—from responses to reduce the population's risk. • Include public health measures in NDC, along with a system for monitoring and evaluating progress. • Develop continuity plans to ensure the sustainability of healthcare services in the event of supply chain disruptions that affect operations. • Implement disaster risk management to identify and evaluate the probabilities and impacts of different events and design action plans.

Mitigation

These recommendations are based on the dimensions and certain criteria of the Health Care Without Harm roadmap to decarbonizing the healthcare sector (Section II.B) and adapted to the regional context.

ACTION	INTERVENTION OPTIONS
Green buildings	• Generate renewable energy for new or existing buildings using photovoltaic panels, wind turbines, or other means. Install efficient lighting systems (LED) or systems that adjust consumption to actual use of facilities (by using sensors, for example). • For new projects, invest in sustainable and energy-efficient buildings based on the international EDGE or LEED standards. Optimize design based on climate, latitude, and exposure to sunlight, taking advantage of natural lighting, protecting facades from excessive exposure to sunlight, and including green spaces, among other measures. • For existing buildings, apply EDGE or LEED standards to optimize energy and water use by adding window protections to reduce roof solar radiation, implementing mechanisms to re-use graywater, and installing light and water sensors.
Efficient medical equipment	• When procuring equipment, include criteria like efficient use of energy, water, and consumables, as well as low maintenance levels and long useful life, so assets will operate for as long as possible and have the smallest carbon footprint from final disposal. • When purchasing vehicles, consider fuel economy or vehicles with hybrid or electric motors, when available and serviceable on the domestic market. • Promote preventative and corrective maintenance programs for medical equipment to extend its useful life and keep it from having to be replaced ahead of schedule. • Foster discussion about including reverse logistics criteria for handling out-of-service equipment (circular economy).
Optimizing operations	• Develop systems for managing logistics and mobilizing patients and personnel that optimize routes and trip times to reduce fuel and energy consumption and limit wear and tear on vehicles. • Consider replacing liquid oxygen with on-site oxygen generation plants so oxygen no longer needs to be delivered by truck. • Optimize waste management, including waste production, sorting, storage, processing, and final disposal. For example, design and monitor systems to reduce food waste at all stages at health facilities. • Optimize the logistics of medications and medical supplies in order to manage stocks as efficiently as possible and reduce the risk of losses due to depletions or obsolescence. • Arrange reverse logistics initiatives with suppliers to optimize the waste transportation process or return products that have reached the end of their useful life for recycling or repair.

ACTION	INTERVENTION OPTIONS
Clinical management and clinical support management	• Promote evidence-based clinical management models that optimize resource use based on the patient's clinical condition. This involves establishing protocols for diagnosing and treating patients, as well as assessing clinical outcomes. • Cultivate an environment that favors innovative clinical management solutions that improve patients' condition and well-being by making good use of healthcare strategies like home hospitalization and major outpatient surgery. • Optimize the length of time patients use and are exposed to anesthesia with nitrous oxide (N2O), which contributes to global warming. Likewise, consider replacing inhalers that use propellants containing GHG with non-GHG options.
Effectiveness of healthcare systems	• Comprehensively expand and strengthen digital health in an effort that encompasses clinical, clinical support, and non-clinical processes, as well as administrative and financial processes. A successful digital transformation requires promoting the use of digital technologies, making sure information systems are interoperable, leveraging artificial intelligence and big data, and guaranteeing the security of systems and data confidentiality. • In a clinical setting, services may include virtual appointments, advice, support, monitoring, and prescriptions, replacing face-to-face appointments and even potentially hospitalization. • Software systems can automate and digitalize strategic, operational, and support processes and provide better projections and estimates (for refilling stocks, for example). They can also minimize the use of paper, x-rays, and other supplies. • At the strategic level, implementing networks of complementary establishments (composed of primary care centers and hospitals) can optimize built space and eliminate redundant services. Additionally, networked clinical and non-clinical support services (like blood banks, routine labs, food supply, laundry services, and sterilization) can reduce the investment, operating costs, and carbon footprint of atomized models for each facility by providing one product center for various facilities.

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ANNEXES

Annex 1: Vulnerability of Latin American and Caribbean countries to climate change

The Climate Change Vulnerability Index (CCVI) assesses a country's risk of exposure to climate-related shifts and events. It consists of three criteria: (i) the population's exposure to extreme events like droughts and floods; (ii) human sensitivity to this exposure, with poverty and inequality being the most significant factors; and (iii) the country's capacity to adapt to climate change, which includes governance, availability of natural resources, and resilient infrastructure. The index has a scale of 1 to 10, with zero being the highest risk and 10 the lowest.

TABLE 3 CLIMATE CHANGE VULNERABILITY AND ADAPTATION INDEX FOR LATIN AMERICA AND THE CARIBBEAN

COUNTRY	RANK	SCORE	RISK CATEGORY
Haiti	1	0.58	extreme
Guatemala	2	0.75	extreme
El Salvador	3	0.79	extreme
Honduras	4	0.92	extreme
Dominican Republic	5	1.01	extreme
Nicaragua	6	1.19	extreme
Jamaica	7	1.50	extreme
Paraguay	8	1.58	extreme
Belize	9	2.25	extreme
Bolivia	10	2.48	extreme
Venezuela	11	3.64	high
Ecuador	12	3.76	high
Dominica	13	3.85	high
Cuba	14	3.90	high
Guyana	15	4.23	high
Colombia	16	4.30	high
Mexico	17	4.47	high
Peru	18	4.98	high
Panama	19	5.57	medium
Antigua and Barbuda	20	5.64	medium
Brazil	21	5.77	medium
Suriname	22	5.85	medium
Saint Kitts and Nevis	23	6.24	medium
Argentina	24	6.66	medium
Trinidad and Tobago	25	7.22	medium
Costa Rica	26	7.70	low
Saint Lucia	27	8.25	low
Uruguay	28	8.33	low
Bahamas	29	8.68	low
Chile	30	9.54	low
Granada	31	9.58	low
Saint Vincent and the Grenadines	32	9.63	low
Barbados	33	9.77	low

Source: CAF (2014).

Annex 2: Criteria for estimating nationally determined contributions (NDC) to combat climate change

The Global Climate & Health Alliance (GCHA) assessed whether national contributions are sufficient to protect the population's health. The assessment was based on five criteria, each of which was scored from 1 to 3, where 1 is the lowest score and 3 is the highest. The overall maximum score for the assessment was 15. The assessment criteria were:

1. **Health impacts:** recognition of the health impacts of climate change, monitoring or quantification of health impacts, inclusion of a specific health-related target.

2. **Adaptation in the area of health:** recognition of the need to include health in adaptation actions, commitments to assess health-related vulnerabilities, inclusion of some detailed health adaptation actions.

3. **Health co-benefits:** achieving clearly detailed health benefits from mitigation measures in other sectors, like energy, food, or transport, or measures that lead to better nutrition or air quality.

4. **Economics and finance:** mention, qua ntification of, or allusion to the economic cost of health impacts, savings, or returns on investment due to interventions.

5. **Additional aspects:** NDC that include additional relevant information on or references to health and its ties to climate action are considered a "bonus."

The assessment also analyzed whether NDC were aligned with the Paris Agreement, meaning whether the country's climate ambitions were in line with limiting warming to under the 2°C threshold, or rather used 3°C or 4°C as the upper limit.

Only four Latin American and Caribbean countries scored in the top third (with over 10 points): Costa Rica (13), Colombia (12), Panama (12), and Argentina (11). Only Costa Rica was aligned with the Paris Agreement. Other countries, like Peru (2) and Brazil (0), ranked close to last, and their climate goals are not aligned with the Paris Agreement.

Annex 3: Models and guidelines for climate change adaptation and mitigation

N	FRAMEWORK/ GUIDE	FOCUS	DESCRIPTION	REFERENCES
1	Operational framework for building climate-resilient health systems	Adaptation	The framework covers six elements: (i) leadership and governance, (ii) health workforce, (iii) health information systems, (iv) medical products and technologies, (v) service delivery, and (vi) financing. The 10 components of Figure 3 stem from these six elements. In 2020, WHO presented an abbreviated version focused solely on health facilities. It had four elements: (i) health personnel, (ii) energy, (iii) infrastructure, technology and products, and (iv) water, sanitation, hygiene, and managing biomedical waste.	WHO (2017). WHO (2020c).
2	Components of a comprehensive vulnerability and adaptation assessment for climate change and health	Adaptation	This guide outlines six steps for an accurate and full assessment of the healthcare system's vulnerability and adaptation: (i) planning the assessment, (ii) assessing vulnerability to climate change, (iii) assessing health system capacity; (iv) assessing future risks; (v) assessing adaptation: policies, programs, and actions to address risks; and (vi) consolidating and using the assessment as input for health and climate change policies, plans, and mechanisms.	WHO (2021b).
3	Menu of Interventions for Climate-Smart Health Care Actions	Adaptation and mitigation	This menu covers nine areas of the health sector's response to COVID-19 that can also be applied to address climate change. The areas are: (i) public health surveillance and risk assessment; (ii) emergency preparedness, planning, and rehabilitation; (iii) capacity for testing, isolation, and treatment; (iv) supply of essential medical commodities; (v) health services for non-COVID conditions; (vi) non-pharmaceutical interventions; (vii) public health risk communication; (viii) vaccine readiness, procurement, and distribution; and (ix) building back better.	World Bank (2021b).
4	Mitigation roadmap	Mitigation	This roadmap is based on seven areas of action: (i) renewable energy, (ii) zero-emission buildings, (iii) zero-emission transportation, (iv) sustainable food, (v) low-carbon pharmaceuticals, (vi) circular health, and (vii) effective systems (Health Care Without Harm, 2021). The roadmap recommends applying these actions from three angles: The first only focuses on health facilities and their operations and services. The second encompasses the sector's entire supply chain. The third angle includes external sectors that provide services to the health sector.	Health Care Without Harm (2021).

Annex 4: Summary of the quantitative risk assessment of the effects of climate change on selected causes of death

The WHO (2014) estimated cause-specific mortality and morbidity rates for 2030 and 2050 based on various scenarios:

- Without climate change, applying a regression model and base case, high growth and no growth scenarios.
- It developed models for climate change and health for a wide range of outcomes known to be climate-sensitive, such as heat-related mortality in elderly people, mortality linked to diarrheal diseases in children under age 15, and mortality tied to malaria, dengue fever, and child undernutrition.
- The study estimated future climate change using a medium-high emissions scenario (A1b) run through three climate models.
- The counterfactual was a future world with population growth and economic development, but with a climate identical to that of the 1961–1990 period.
- The burden of disease due to climate change was estimated for the various world regions.
- The estimates show both positive and negative impacts for most problems.
- Model uncertainty was assessed for each outcome, as far as technically possible.

The following table was prepared to reflect the additional number of cases attributable to climate change considering possible minimum and maximum ranges.

PROBLEM	REGION	2030		2050		REMARKS
		Min.	Max.	Min.	Max.	
Annual additional heat-related deaths mortality in people over age 65 due to heat waves	**Global (total)**	**64,458**	**121,464**	**191,816**	**364,002**	
	Americas (total)	**9,012**	**17,101**	**26,361**	**50,384**	
	Caribbean	193	431	550	1,314	
	Andean Region	332	753	1,689	3,100	
	Central America	1,481	2,989	6,138	11,251	
	South America – non-tropical	690	1,612	1,769	3,386	
	South America - tropical	1,330	2,707	3,727	10,181	
	North America	4,986	8,609	12,488	21,152	
Annual additional heat-related deaths mortality due to diarrhea in children under age 15	**Global (total)**	**21,097**	**67,702**	**15,000**	**49,151**	Under all climate change scenarios, the number of deaths decreases from 2030 to 2050 as the baseline burden of disease decreases, irrespective of the temperature increase due to climate change.
	Americas (total)	**109**	**360**	**27**	**92**	
	Caribbean	31	104	8	26	
	Andean Region	21	69	5	17	
	Central America	48	156	12	40	
	South America – non-tropical	0	2	0	0	
	South America - tropical	9	27	2	7	
	North America	0	2	0	2	
Exceso de personas en riesgo de contraer malaria	**Global (total)**	**696,480,000**	**1,229,490,000**	**798,950,000**	**1,144,560,000**	Baseline is calculated using data from 1961–1990
	Americas (total)	**39,960,000**	**72,280,000**	**48,600,000**	**64,220,000**	
	Caribbean	2,490,000	10,170,000	4,830,000	5,420,000	
	Andean Region	2,740,000	7,430,000	5,030,000	6,980,000	
	Central America	32,380,000	51,110,000	35,850,000	47,290,000	
	South America – non-tropical	0	0	0	0	
	South America - tropical	2,230,000	3,390,000	2,770,000	4,350,000	
	North America	120,000	180,000	120,000	180,000	

PROBLEM	REGION	2030		2050		REMARKS
		Min.	Max.	Min.	Max.	
People at risk of contracting dengue fever	**Global (total)**	**4,291,880,000**	**4,418,340,000**	**4,506,270,000**	**4,640,620,000**	The model takes socioeconomic changes into account, in addition to climate change.
	Americas (total)	**461,920,000**	**482,440,000**	**458,740,000**	**481,300,000**	
	Caribbean	41,540,000	41,540,000	40,150,000	40,830,000	
	Andean Region	15,940,000	18,790,000	13,920,000	20,270,000	
	Central America	17,321,000	18,582,000	18,950,000	18,945,000	
	South America – non-tropical	4,300,000	4,360,000	2,810,000	3,340,000	
	South America - tropical	22,690,000	23,190,000	22,089,000	22,739,000	
	North America	30,000	30,000	20,000	20,000	
Percentage of children under age 5 who will experience undernutrition and stunting	Caribbean and Central America	1,2	1,8	2,0	2,5	These figures reflect moderate cases plus severe cases, assuming base case economic growth.
	Latin America - middle	0,9	1,3	1,4	1,7	
	Latin America - south	0,2	0,5	0,3	0,5	
Additional deaths of children under age 5 due to undernutrition	**Global (total)**	**−3,586**	**193,937**	**29,815**	**139,576**	Assuming base case economic growth.
	Caribbean and Central America	−837	2,554	1,000	1,311	
	Latin America - middle	−327	1,218	−6	665	
	Latin America - south	−49	76	−27	49	


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