ECONOMIST IMPACT

Vision 2030

Future adaptation strategies to minimise the impact of climate change on cardiovascular, renal & metabolic care

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Contents

About this report

Vision 2030: Future adaptation strategies to minimise the impact of climate change on cardiovascular, renal & metabolic care is an Economist Impact report supported by Bayer. The full editorial control of the research and outputs are the responsibility of Economist Impact. The report explores future adaptation strategies to minimise the impact of climate change on cardiovascular-renal-metabolic care. In order to do so, it maps pathways via a backcasting framework to reach a preferred Vision 2030. Grounded in a literature review, an expert advisory panel and an interview programme conducted between November 2024 and May 2025, this report outlines the key components and milestones to follow in the implementation of the vision by 2030.

Our thanks are due to the following experts, in alphabetical order, for their time and insight during their participation in a workshop that took place in February 2025:

- **Prabhakaran Dorairaj**, Vice-President, Research & Policy, Public Health Foundation of India
- **Kristie Ebi**, Professor of Global Health, University of Washington, US
- **Halshka Graczyk**, Technical Specialist on Occupational Safety and Health, International Labour Organization (ILO), Switzerland
- **Vivek Jha**, Chair of Global Kidney Health and Principal Investigator of the NIHR Global Health Research Centre on Environmental Change and NCDs, Imperial College London, UK
- **Ivo Laranjinha**, MD, Clinical nephrologist, Unidade Local de Saúde de Lisboa Ocidental, Portugal and Chair of the Sustainable Nephrology Task Force of the European Renal Association (ERA)
- **Bertalan Meskó,** Director, The Medical Futurist Institute, Hungary
- **Jason Kai Wei Lee**, Director of the Heat Resilience and Performance Centre, Yong Loo Lin School of Medicine, National University of Singapore

Our thanks are due to the following experts, in alphabetical order, who provided insights through interview and the provision of information:

- **Kristie Ebi**, Professor of Global Health, University of Washington, US
- **Jason Glaser**, CEO, La Isla Network, US
- **Renzo Guinto MD DrPH**, Associate Professor of Global and Planetary Health, SingHealth Duke-NUS Global Health Institute, Duke-NUS Medical School, National University of Singapore

- **Renee N Salas**, Founding Director, *The Cooperative* at Mass General Brigham; attending physician, Department of Emergency Medicine at Massachusetts General Hospital and Harvard Medical School, US
- **Mona Sarfaty**, Founder and Emeritus Executive Director of the Medical Society Consortium on Climate and Health, US

Economist Impact team:

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Executive summary

The big picture is growing ever sharper and more alarming. Climate change will have substantial effects on both overall disease burdens and the capacity of health systems to deal with them. This is particularly the case for cardiovascular, renal and metabolic conditions. This related group of diseases includes some of the world's biggest killers: five of the top 12 causes of death globally belong to this category of illnesses, and cardiovascular diseases (CVD) alone account for just under a third (32%) of global deaths each year.

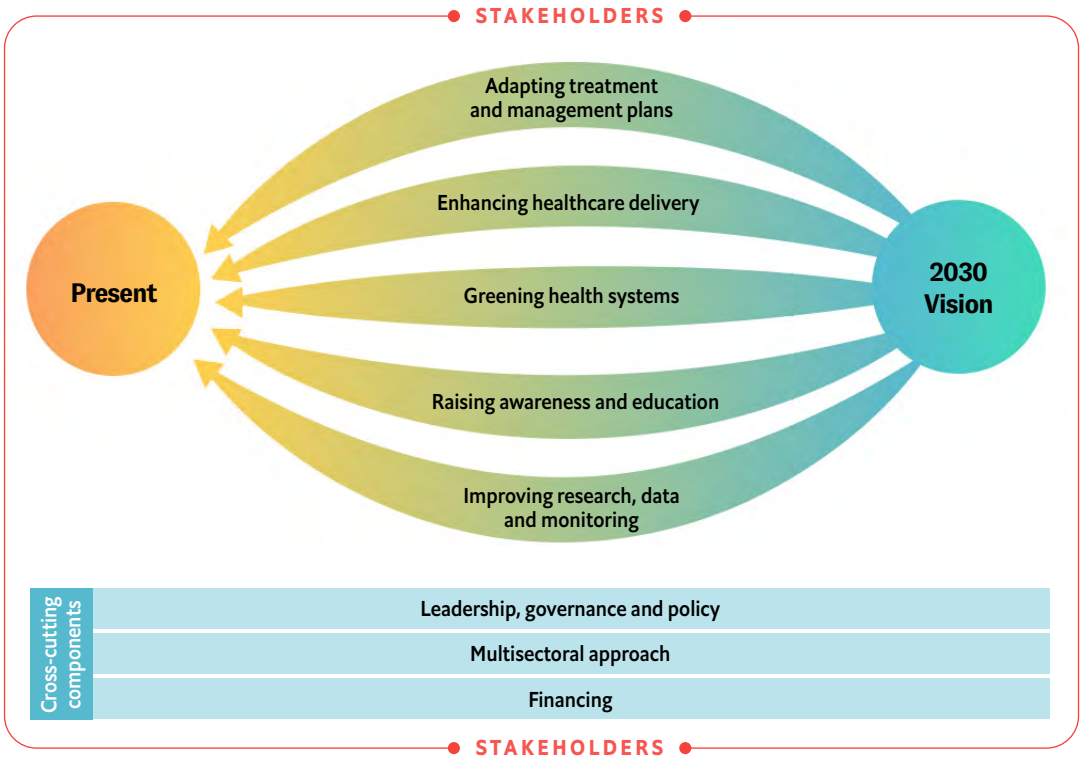
Without proper interventions now, a likely wave of increased incidence, prevalence and mortality associated with these diseases will crash into healthcare provision, with infrastructure weakened by climate-related weather effects. Heatwaves, for example, are widely expected to become more common. Without appropriate action to stay cool, they will drive higher rates of kidney disease and CVD. Similarly, disruptive weather events, such as storms and floods, also likely to rise in frequency, can have long-term effects on people living with the diseases of interest to this study: the impact of hurricanes on all-mortality death rates for those living with diabetes can last for more than a decade.

Meanwhile, care practices for cardiovascular, renal and metabolic diseases are unwittingly contributing to the problem through their own substantial carbon footprint.

The wider interaction of climate change and health is gaining increasing attention. The World Health Organisation (WHO) has published a number of guidances and white papers, the latest a Global Action Plan on Climate Change and Health, which runs until 2028, and national governments are being encouraged to do the same. Such general efforts will be crucial to prepare for the challenges ahead. However, climate change and health will also need granular solutions to adaptation needs arising from specific illnesses. That is why this study has taken a disease-specific focus, specifically adaptation for the better care and management of people living with cardiovascular, renal and metabolic diseases.

Using a backcasting approach, the aim is to present a road to a better future than the one described above. It posits a hopeful Vision 2030, in which, "by 2030, we envision a world where the effects of climate change on cardiovascular-renal-metabolic health have been minimised, fostering equitable and inclusive care". To help interested stakeholders reach this ambitious but attainable goal, we present a detailed framework with five individual components (each containing two main milestones) and three cross-cutting ones (**see Figure 1 for a summary**). Each is important on its own, but together they create a mutually supportive structure for progress.

Figure 1: Overview of the cardiovascular-renal-metabolic disease climate change adaptation framework



In summary, the components are:

Adapting treatment and management plans. In an environment reshaped by climate change, strategies for the prevention and treatment of these diseases will need to have different emphases, even while retaining much of current practice. Efforts to stop these conditions from developing will require paying even more attention to the social determinants of health. Heat stress, for example, increases levels of kidney and heart disease, raising the risks for those too poor to avoid exposure. Clinicians will also need revised clinical guidelines that advise how to treat patients in a world of more frequent weather extremes when certain interventions – such as beta blockers for CVD – can increase the risk of dehydration and heat stress. More generally, healthcare professionals are already aware that such extremes can impact the effectiveness of a range of medications for cardiovascular, renal and metabolic diseases, but need better data on which adjustments to recommend in specific situations.

Enhancing healthcare delivery. Climate change will make more pressing the importance of progress against several known health system weaknesses. One priority is to reduce inequity of outcomes for cardiovascular, renal and metabolic conditions as risks related to social determinants rise. For countries without universal health coverage, its adoption will be a minimum first step. Meanwhile, geographic over-centralisation of care for non-communicable diseases (NCDs), another long-standing health system problem,

could benefit from rethinking provision. This could include greater use of telehealth, where appropriate, and new kinds of rural facilities. Finally, climate change is expected to bring more frequent weather-related disasters. Accordingly, health systems should, in general, improve the robustness of infrastructure in the face of floods, storms and heatwaves. Relevant healthcare personnel, and patients themselves, will also have to prepare detailed plans to meet the specific challenges that disasters present for those living with the diseases of interest to this study. Japan's Diabetes Care Providers' Manual for Disaster Diabetes Care is a good example.

Greening health systems. Certain standard elements of care for cardiovascular, renal and metabolic diseases are, ultimately, environmentally unsustainable. For example, diagnostic imaging – such as CT and MRI scans – may account for 1% of all global carbon emissions. One important and immediate step is to seek ways to reduce waste, resource usage and carbon intensity within current practices. Water capture and reuse in dialysis is an important example. More root and branch rethinking of care holds out the promise of far greater environmental benefits in the near future. Among our diseases of interest, the Green Nephrology movement is the furthest advanced in thinking about such change. It is exploring better prevention, quicker intervention and earlier transplantation where appropriate as ways to scale back on the need for dialysis. Beyond treatment, health systems need to consider how to reduce their own carbon footprints and those of important stakeholders. The framework suggests working with colleagues in food production and regulation to create healthier and more sustainable diets, as well as co-operating with suppliers so the emissions related to what health facilities purchase are as low as possible.

Raising awareness and education. The links between climate change and cardiovascular, renal and metabolic diseases are poorly understood by the general public. Nor is the situation much better among healthcare professionals: in a global survey of nearly 1,000, fewer than half possessed knowledge about the impact of climate change on kidney health. Training of all healthcare professionals is therefore an essential step, but tools exist to make this easier. Medical schools of various kinds can benefit from the resources of the Global Consortium on Climate and Health Education, a pedagogical collaboration between institutions with, in aggregate, 175,000 students. For continuing professional development, the University of New Mexico's Project ECHO has a series of modules for clinicians, available in more than 190 countries, on climate change and human health. The material has been shown to significantly improve knowledge, confidence and communication skills related to this field. General awareness can benefit from traditional public health messaging, but two specific sections of the public should receive particular attention: employees and employers. Several studies and projects, including the Adelante Initiative, show that working together to reduce heat stress can prevent diseases among workers and increase overall economic productivity. Co-operation and collaboration are win-win activities and should be seen as such.

Improving research, data and monitoring. We know enough to get started in preparing healthcare for a changed environment. Nevertheless, extensive gaps exist in the knowledge needed to understand the implications of the many relationships between climate change and health. Those lacunae mentioned in earlier sections are only the beginning of what is needed. This lack of information is more than an academic problem: the speed of climate change makes the need

for progress urgent. The framework therefore recommends: development of national research agendas within the broader field of climate change and health; creation of multidisciplinary research networks and partnerships to support such research and allow data sharing; identification of specific research needs related to cardiovascular, renal and metabolic diseases; and assessment of the effectiveness of greener health practices.

A particularly pressing data-related need is for the development of weather-based early warning systems to alert the population, and health facilities, of higher incidence risks. These tools will require sometimes complex combinations of data which have rarely been put together. While work continues to understand the best constituent data sources for warning systems, jurisdictions should consider basic ones. A straightforward heatwave warning scheme in Shenzhen has already shown a capacity to reduce CVD risk.

Cross-cutting components: multisectorality, financing and leadership, governance and policy. For every component, these three attributes will be essential to success.

- **Multisectorality** is an obvious requirement in addressing the complex overlap of factors related to climate, public health and the specifics of cardiovascular, renal and metabolic diseases, to name just a few relevant areas. The framework advises multisectoral collaboration and co-ordination—including on research, policies and monitoring—between the health, environmental, labour, urban, energy, transport, agriculture, food, meteorological, municipal, healthcare industry, regulatory, research and patient sectors. Willingness by all parties is essential, but so is widespread training in how best to partner with those in other parts of healthcare or in different sectors.
- **Financing** is inevitably essential to support the changes needed to reach Vision 2030, but increasingly difficult to secure. Funding from climate adaptation funds is, in practice, limited, and governments have constrained budgets in general. The framework advises mobilising financing from diverse funding streams. The best advice from experts interviewed for this study is to look widely for initial funding for initiatives, use pilot projects to prove their worth, and secure greater financing based on evidence of likely return on investment.

- The related areas of good **leadership, governance and policy** are also fundamental prerequisites for progress. The framework emphasises the need to establish strong, effective leadership and governance at the international, national and local level, including communities, in the development of equitable policy that embeds adaptation measures for those living with cardiovascular-renal-metabolic diseases. Successful leadership requires commitment and vision, but also relies on institutional structures that allow and support action on climate change across multiple sectors. The WHO recommends specific responsibility and accountability mechanisms on climate change and health within healthcare; the embedding of climate change considerations within every main health policy or programme; and formal collaboration with relevant partners. Otherwise, matters related to cardiovascular, renal and metabolic diseases will get lost in the shuffle. Leaders also need a policy environment in which to operate. The WHO's new Global Action Plan on Climate Change and Health provides useful general ideas, which can complement the framework's focus on cardiovascular, renal and metabolic diseases.

Think globally, act locally. The framework takes a wide-angle view of the steps needed to reach Vision 2030. The best way to implement these ideas will, though, inevitably vary by geography and level of socioeconomic development. Those interested in using the framework to make progress need to see how it can best be applied to their local circumstance. Valuable steps in this direction would include: creating a detailed assessment of the specific climate-related challenges within given national or local contexts, along with any particular assets that might be available; finding and developing links with possible like-minded partners within healthcare and in other sectors; devising national or local strategies or plans that draw on the framework, as well as any other relevant document; and within that strategy remaining flexible about how different steps covered each component are carried out. Finally, as so much of this road is new and untrodden, publishing experience about what does (and does not) work would be extremely valuable to those on the same journey elsewhere.

Why a Vision 2030?

VISION STATEMENT

By 2030, we envision a world where the effects of climate change on cardiovascular-renal-metabolic health have been minimised, fostering equitable and inclusive care.

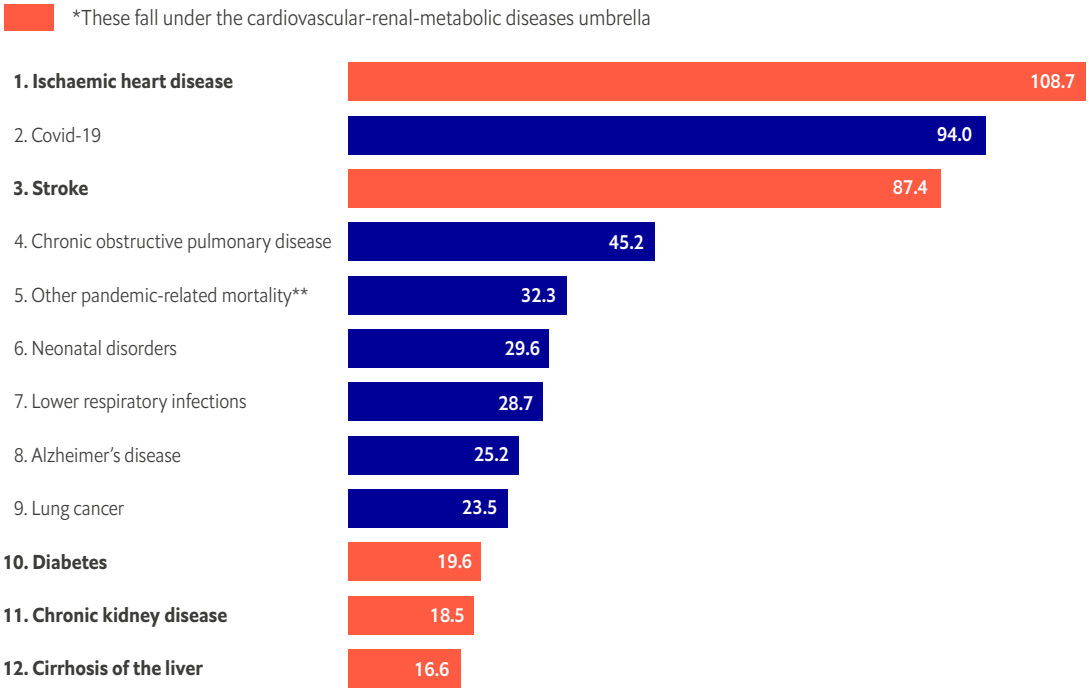
Why cardiovascular-renal-metabolic diseases?

The climate crisis will have major impacts on human health. The actions of countries are coming under scrutiny to develop health national adaptation plans,[1] but there is a need to go deeper and understand how climate affects the most burdensome diseases. These will require their own adaptations.

Cardiovascular-renal-metabolic diseases, a related group of conditions, already impose a major burden on individuals, families and societies. They make up five of the top 12 causes of death globally (**see Figure 2**). To name just a few of the illnesses included in this group: cardiovascular diseases (CVDs) affect around 640m people[2] across the world and are a major cause of mortality (some 17.9m deaths per year, or 32% of global deaths[3]); chronic kidney disease affects some 9% of the global population (around 700m cases)[4]; and around 589m people globally live with diabetes.[5] These diseases also present high costs to healthcare systems and societies.[6,7,8,9]

Cardiovascular-renal-metabolic diseases, a related group of conditions, already impose a major burden on individuals, families and societies. They make up five of the top 12 causes of death globally.

Figure 2: Leading causes of death, 2021
Age-standardised death rate (per 100,000)



**includes excess mortality associated with the pandemic.

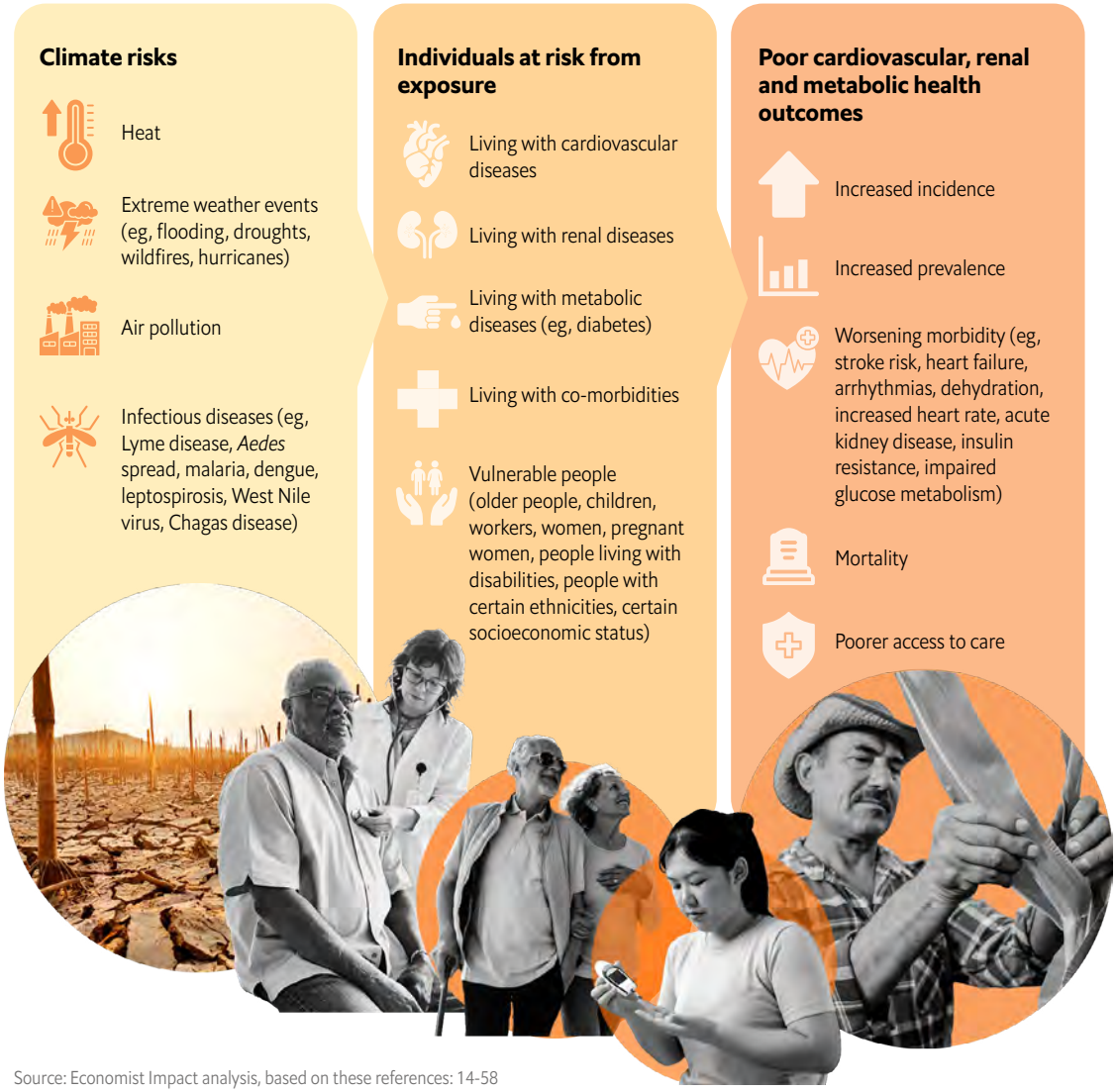
Source: IHME https://www.healthdata.org/research-analysis/library/causes-death-and-their-effects-life-expectancy

By looking at these diseases together, we can create synergies and develop comprehensive climate adaptation strategies that effectively address this group of conditions.

Meanwhile, climate change plays a major role in the growing burden of these diseases, as individuals living with these conditions are particularly vulnerable to ongoing climate impacts.[10,11,12,13] For instance, climate change affects the incidence, prevalence, morbidity and mortality and management of these diseases, based on Economist Impact analysis (**see Figure 3**).

By looking at these diseases together, we can create synergies and develop comprehensive climate adaptation strategies that effectively address this group of conditions. This strategy also allows readers to appreciate the interconnections between these diseases, such as their shared modifiable and non-modifiable risk factors, common pathophysiological mechanisms and their multi-directional interaction and interplay.

Figure 3: Climate change impacts on cardiovascular-renal-metabolic health



Source: Economist Impact analysis, based on these references: 14-58

Why the year 2030 for our Vision?

Although an adaptation backcasting framework developed to 2040 or 2050 may be seen as more flexible, a five-year pathway-to-impact framework has the following key advantages:

- **The gravity of the impacts of climate change on health are receiving greater priority worldwide.** This has been seen with the growing focus on health at top-level climate and health forums. The launch of the Alliance for Transformative Action on Climate and Health (ATACH)[59] followed COP26 (in Glasgow in 2021). Two years later, the first Health Day occurred at COP28 in Dubai, which also saw 151 countries sign the UAE Declaration on Climate and Health[60] with its strong emphasis on adaptation. Meanwhile, the World Health Organisation (WHO) has continued to emphasise the impacts of climate change on health in its work programmes.[61,62,63] Most recently, in May 2025, it adopted a Global Action Plan on Climate Change and Health, which runs from 2025 to 2028.[64]
- **The constrained time horizons of political and budgetary cycles matter.** Considering the short-term nature of political cycles and their associated funding rounds, we believe

the five-year vision to 2030 will have more resonance than a longer-term projection with policymakers, healthcare actors and stakeholders whose actions have an impact on health.

- **A nearer-term focus aligns with Sustainable Development Goal (SDG) efforts.** The SDGs[65] were set for the year 2030 and many of the goals have health, climate and wellbeing elements. Aligning our framework paths for cardiovascular-renal-metabolic diseases to 2030 made sense.
- **Healthcare bodies have been targeting 2030 to improve outcomes for these diseases.**

A leading cardiovascular professional and patient body, the World Heart Federation (WHF), has been advocating for improvements and change towards 2030. It's World Heart Vision 2030[66] is an actionable guide which aims to reduce cardiovascular mortality and incidence by at least 30%. The WHO's Global Diabetes Compact Forum[67] (2021 to 2030) is bringing a collective vision to advocacy and collaboration in diabetes; the WHO has five new targets to reach by 2030 related to that condition.[68] In the US, Healthy Planet 2030[69] has been targeting diabetes, hypertension and chronic kidney disease.[70]

WHAT DO THE EXPERTS SAY ON A VISION 2030?

"I actually like a relatively short vision. I understand visions are usually longer term but in this case if we don't approach this with urgency, people will not prioritise and bear in mind that many governments are organised relatively short term. They don't see more than 5-10 years and therefore if we are asking them to put in resources to [climate adaptation for cardiovascular-renal-metabolic diseases] we must give them a reason why they should do so now and not wait."

Jason Kai Wei Lee, Director of the Heat Resilience and Performance Centre, Yong Loo Lin School of Medicine, National University of Singapore

"Traditionally, we in global health create disease roadmaps with long time frames, say 10, 20, or 30 years. But when we have climate in mind, we don't have that luxury. I think, with the rapidly worsening climate crisis, a five-year vision for cardio-renal-metabolic diseases is appropriate. And some people might say it's even too late."

Renzo Guinto, Associate Professor of Global and Planetary Health, SingHealth Duke-NUS Global Health Institute, National University of Singapore

"It is imperative that we develop comprehensive plans for protecting patients with cardio-metabolic diseases in the near term because their health is already being harmed by climate change in direct and indirect ways. These climate-related health threats will only continue to accelerate. As climate change continues to redefine clinical care and healthcare delivery, we must adapt our approaches to meet the needs of our patients."

Renee N Salas, Founding Director, *The Cooperative* at Mass General Brigham; Attending physician, Department of Emergency Medicine at Massachusetts General Hospital and Harvard Medical School, US

"Both [a short-term and long-term vision] are clearly greatly needed. To ignore the short term would be to ignore the looming needs of people who are already suffering adverse health consequences because of climate change. In many cases we can project what will be needed by 2030. We must prepare for that as well."

Mona Sarfaty, Founder and Emeritus Executive Director of the Medical Society Consortium on Climate and Health, US

How to use the adaptation framework

This framework serves as a guide to health systems—which comprise healthcare and health-determining organisations, institutions, actors and people—in the development of climate resilience and adaptation planning for cardiovascular-renal-metabolic diseases. The ultimate aim is, of course, better outcomes. We envision a world where we strengthen prevention, early detection, leadership, multi-stakeholder awareness and progress on the impacts of climate change on cardiovascular-renal-metabolic health for equitable and inclusive care.

Our vision is aspirational, yet actionable.

It spans the next five years and recognises the diverse structures, governance and development stages of health and climate systems globally, and the inherent uncertainties from now until 2030.

We encourage countries to apply the framework flexibly, taking into account their own needs. The framework consists of eight primary components, of which five contain actionable paths (or subcomponents) designed to support health and health-adjacent systems, from initial steps to the creation of more comprehensive approaches. We also acknowledge that adaptation strategies cannot take place without mitigation efforts: the two sit side by side.

We encourage countries to apply the framework flexibly, taking into account their own needs. The framework consists of eight primary components, of which five contain actionable paths (or subcomponents) designed to support health and health-adjacent systems, from initial steps to the creation of more comprehensive approaches.

Although our components are conceptually distinct, overlaps exist. The last three components—leadership, governance and policy; multi-sectoral approach; and financing—are the clearest examples. We have therefore called them cross-cutting components, as they directly impact the ability to make progress everywhere. For this reason, they are discussed separately and collectively at the end.

Within the other five components, certain themes reappear frequently: the need for data and greater risk awareness are components in their own rights, but also essential parts of disease control and health system management. Issues are therefore noted wherever relevant but discussed where most germane.

Finally, the adaptation framework is a detailed piece of work. The following overview of its parts is too small to go into detail. Each of the first five components, for example, contains subcomponents with initial (Milestone 1) and subsequent recommendations up to the year 2030 (Milestone 2), as well as suggested stakeholders, along with footnoted explanations for this advice. To give readers an idea of this complexity, the graphic included with the discussion of the first component will go into far more detail than the others. Stakeholders interested in improving the health of people living with cardiovascular-renal-metabolic disease as impacted by climate change will benefit from the valuable insights revealed by a close reading of the framework in the appendix.

Component 1: Adapting treatment and management plans

Adaptation is the process of adjusting to climate change effects. It is important that policymakers, as well as the healthcare and health-adjacent sectors, identify and adopt adaptation strategies that will improve cardiovascular-renal-metabolic care, as so many people are affected by these conditions. A key part of this effort will be adjustment of treatment and management plans—often a first port of call for healthcare systems (**see Figure 4**).

Figure 4

COMPONENT 1

Adapting treatment and management plans

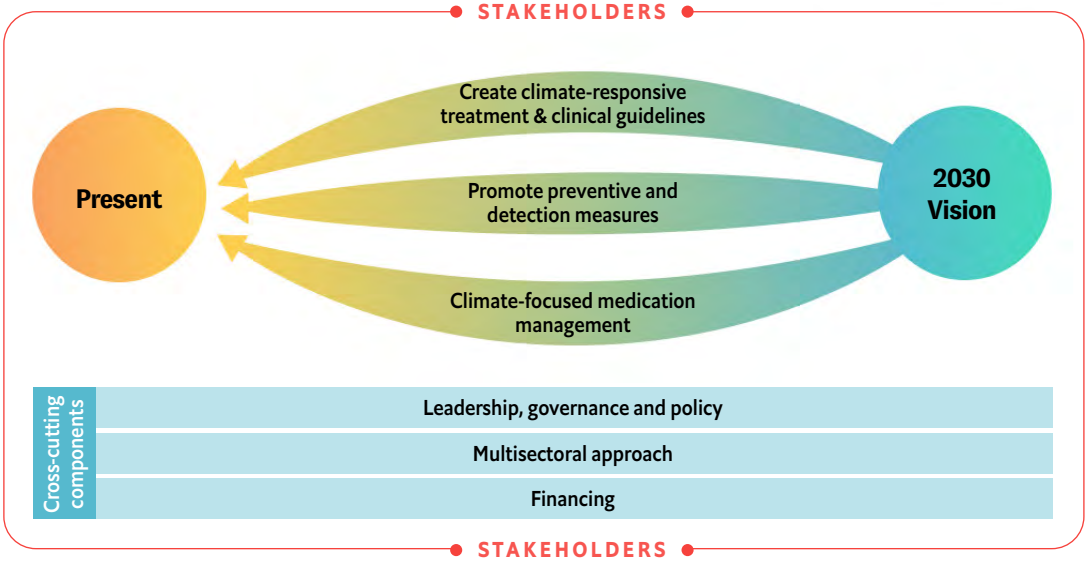
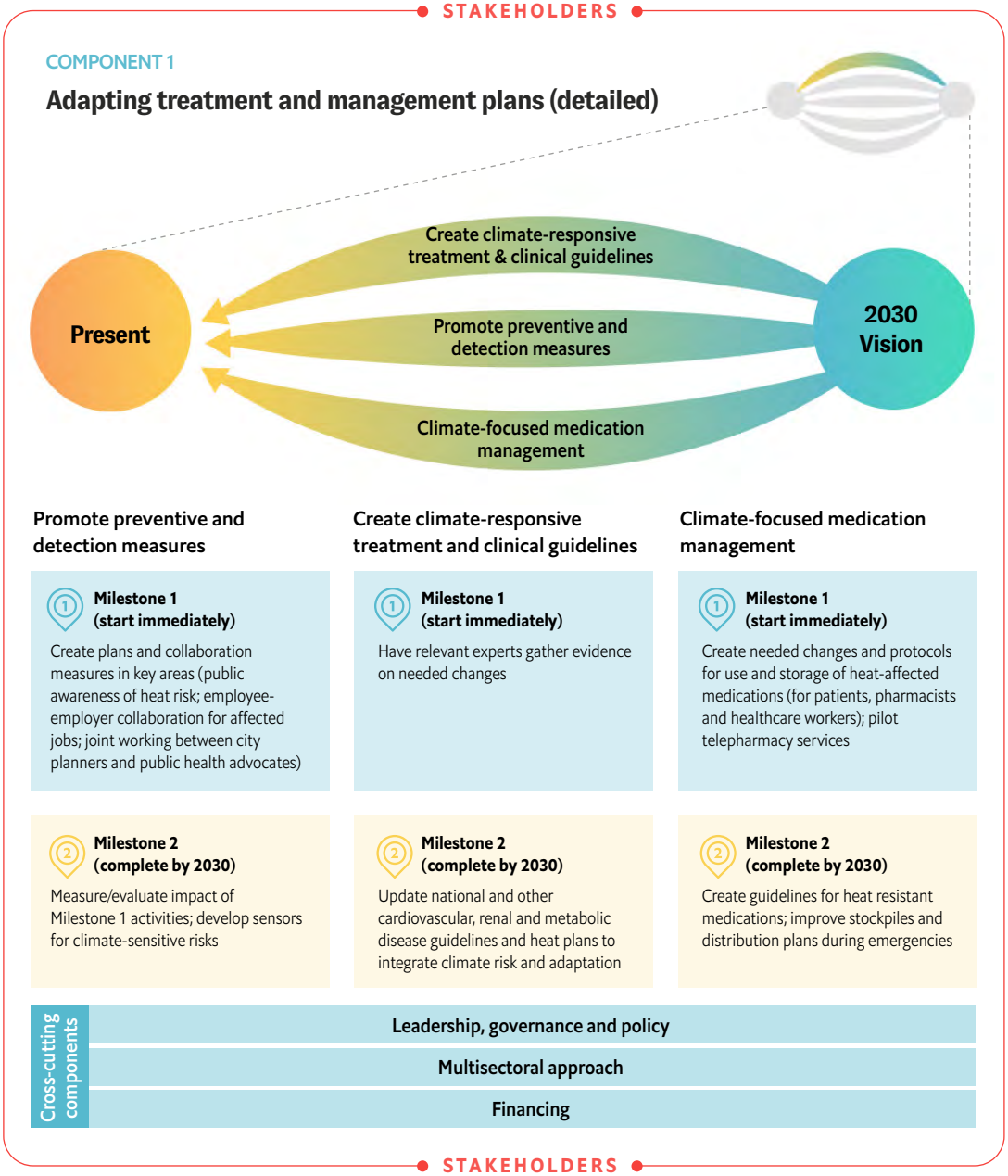


Figure 5: A detailed look at Component 1 and its milestones



The main elements of this component will be familiar to many involved in healthcare: prevention, detection, appropriate treatment and medication management. This should come as no surprise. Climate change may affect much, but it does not rewrite everything. As Renee Salas, Founding Director of *The Cooperative* at Mass General Brigham and Co-Director of the Climate Crisis and Clinical Practice Initiative with the New England Journal of Medicine Group, puts it, the best way to approach the coming challenges is to "see everything that we do in healthcare through a climate lens". This involves adjustment where needed, rather than necessarily wholesale reinvention.

i. Prevention

In addressing the burden of non-communicable diseases (NCDs), such as cardiovascular, renal and metabolic conditions, strategies for prevention and early detection are already major considerations. The biggest shift brought by climate change here is a still higher salience for the social determinants of health. Renzo Guinto, Associate Professor of Global and Planetary Health at the SingHealth Duke-NUS Global Health Institute, points out that the greatest health risks affect "those who are in the margins of society". This is largely because such individuals are much less likely to be able to take risk-mitigating steps at work, such as finding cool shelter when needed. Jason Glaser, CEO of La Isla Network, a non-governmental organisation (NGO) focused on worker safety, agrees. He notes, for example, that even in Latin American and South Asian countries with perhaps a low national prevalence of chronic kidney disease of non-traditional origin (CKDnT), 8-30% of working age male populations might have the condition. This is sometimes up to eight times what would normally be expected, says Mr Glaser. The cause is heat stress from toiling in outdoor occupations with little control over when to take rest breaks in cool locations. His response was to develop the Adelante Initiative in Nicaragua and then expand that to three Central American sugar cane operations through the Prevention Resilience Efficiency and Protection (PREP) programme – a US government scheme, now discontinued according to Mr Glaser (**see box**). The project then began a programme in Mexico. More generally, as the framework indicates, better knowledge of appropriate prevention strategies in the years ahead is essential.

"Patients with cardio-metabolic diseases are being harmed by climate change in direct and indirect ways."

Renee N Salas, Founding Director, *The Cooperative* at Mass General Brigham; attending physician, Department of Emergency Medicine at Massachusetts General Hospital and Harvard Medical School, US

ii. Treatment, guidelines and medication-related issues

Going beyond prevention and diagnosis, the treatment of patients with one of this study's conditions of interest will also need to take account of climate-modified risks. The underlying natural history of these conditions remains the same, but a modified environment can shift what constitutes optimal secondary prevention and treatment. As Dr Salas explains, "Patients with cardio-metabolic diseases are being harmed by climate change in direct and indirect ways."

While much remains uncertain, she adds, "Evidence already exists to begin to drive practice change." For example, in periods of high heat, those with CVD should be advised to: increase fluid intake; remain in a cool place; and reduce normal activity levels from those usually recommended. More active monitoring of heat stroke in such weather is also advisable.[71]

Amid the various potential changes in overall treatment best practice, climate change is likely to cause the most change in matters related to medication in particular. In some cases, such as for

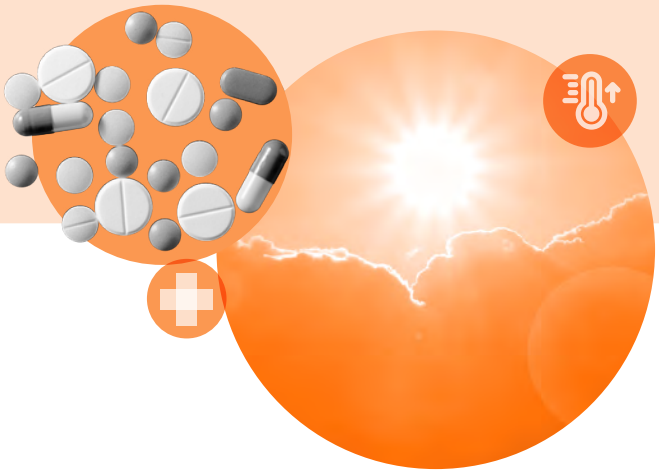
those living with diabetes, higher temperatures increase insulin resistance—a situation in which the body responds less well to such treatment. This, in turn, makes dosage adjustment necessary.[72] Meanwhile, certain drugs can exacerbate climate-related health risks. Diuretics, beta-blockers and angiotensin inhibitors, for example, all commonly used to manage CVD, also impair thermoregulation and thereby increase the risk of dehydration, heatstroke and acute kidney injury when temperatures rise.[73]

It is obvious to those closely involved in managing treatment that weather variations can require drug changes and dosage adjustments. Nevertheless, best practice remains to be worked out. Ivo Laranjinha, a clinical nephrologist in Portugal, says, "I have found it necessary in my practice to adjust hypotensive and diuretic medication during heatwaves or hotter summers, for instance. But adapting treatment is mostly based on empirical judgement without solid scientific data. This makes the development of formal guidelines a necessary first step—not only to support clinical decision-making, but also to raise awareness among clinicians about this increasingly frequent need."

Finally, the storage and transport of various medications will become much harder amid higher average temperatures. Insulin again is a clear example, with cold storage an ongoing problem in tropical countries. A world that sees more natural disasters will also require better provision for emergency supply. Already, such events in the Caribbean and the US have shown the need for new approaches.[74,75] Any lessons from specific disasters and disease should be generalised to the greatest extent possible.

"I have found it necessary in my practice to adjust hypotensive and diuretic medication during heatwaves or hotter summers, for instance. But adapting treatment is mostly based on empirical judgement without solid scientific data."

Ivo Laranjinha, MD, Clinical nephrologist, Unidade Local de Saúde de Lisboa Ocidental, Portugal and Chair of the Sustainable Nephrology Task Force of the European Renal Association (ERA)



ADELANTE INITIATIVE: PROTECTING THE KIDNEYS OF OUTDOOR WORKERS IN CENTRAL AMERICA

Since the 1970s, notes Jason Glaser, CEO of La Isla Network, research has demonstrated that heat stress can cause acute kidney injury (AKI), permanent chronic kidney disease, and even early mortality.[76] Higher temperatures arising from climate change could contribute to the problem. A recent study Mr Glaser helped conduct found that a 1°C increase in wet bulb temperature at a Nicaraguan sugar plantation increased the rate of AKI on the same day by 18%.

Why study sugar plantations? Because conditions matter as much as background temperature. Hard work and an inability to take breaks can also substantially raise internal body temperatures. As Mr Glaser puts it, cane harvesting is "one of the heaviest jobs in the world and it's a pervasive monoculture in a hot place." Accordingly, it is also where interventions can make an immediate and dramatic difference.

The Adelante Initiative brought together workers, employers, practitioners, and researchers, with the support of German government funders, to bring in a centre of excellence in Nicaragua to create safer heat conditions in cane harvesting. The immediate aim was to keep the core body temperature of workers below 38°C – the upper limit in the ISO Standard on Heat Stress.[77] The main interventions were scheduled breaks, portable shade tents, portable hydration beverages, and maintenance of good hygiene. Soon thereafter, the US government, through PREP, paid for the expansion of the programme to three further sites: one each in El Salvador, Guatemala, and Honduras.

These low-cost, low-tech measures were highly effective. The rate of heat-induced AKI among the most vulnerable workers (cane cutters) dropped dramatically from the start, with a decline of 60% in the first year and 94% within two years.[78] What Mr Glaser found to be a "very happy surprise" were the simultaneous benefits to other stakeholders. These healthier, more rested employees could harvest far more than before even taking break times into account. Overall, he says, with the initiative's programmes, "you reduce the harm in your workforce by 70-80% immediately, and you increase productivity by 9-20% in the mid- to long-term. In five years, you'll have a return on investment of 60%."[79]

As periods of high temperature become more common amid climate change, a range of affected industries will need programmes such as the Adelante Initiative to protect their most affected and vulnerable workers. While the co-benefits are huge, the interventions will also be highly profitable. The question becomes, says Mr Glaser, "why aren't you doing this for yourself, for your workers, and for your society?"

Component 2: Enhancing healthcare delivery

Adaptation strategies are essential to create healthcare systems robust enough to deliver care and services for people living with cardiovascular-renal-metabolic diseases amid climate-related weather events. Whatever happens, patients will still need care, making it urgent to ensure facilities are fit for purpose over the next five years, that appropriate warning systems exist and that we consider new models of care such as decentralised delivery, as the framework advocates (**see Figure 6**).

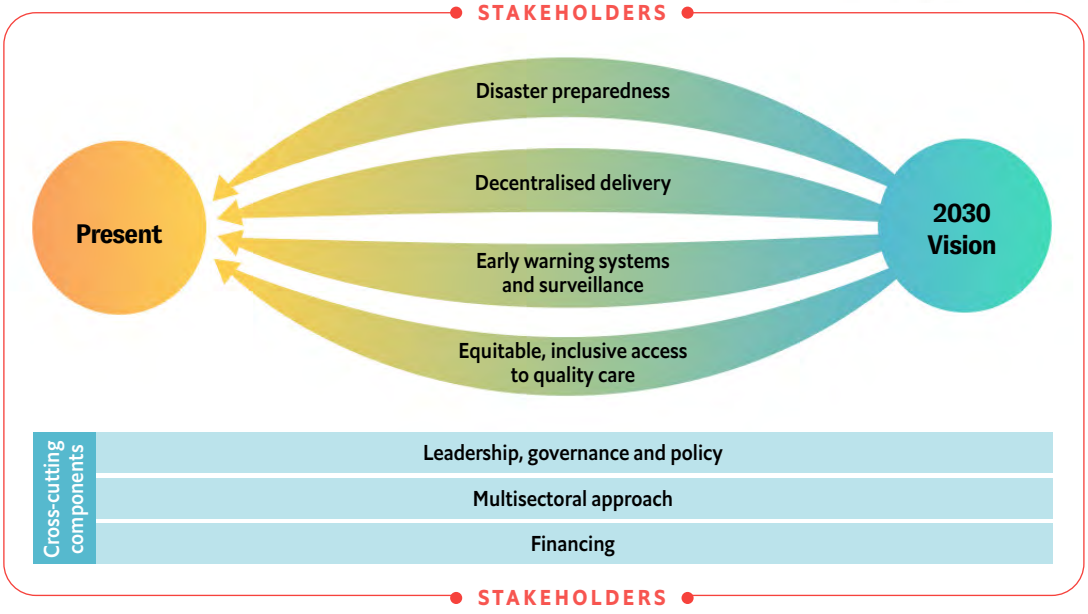
That said, wholesale system reform, however desirable, is challenging. As Dr Guinto notes, "Whether we like it or not, health systems are designed with vertical silos in public health programmes addressing specific diseases. How can we embed climate in all of them?"

The best approach over the next five years is to address current, well-known weaknesses that will be exacerbated by climate change.

Figure 6

COMPONENT 2

Enhancing healthcare delivery



i. Addressing current system weaknesses: improving equity and decentralisation

One such weakness, known for years, is the lack of outcome equity from given health systems. To cite just one of myriad possible examples, despite notionally universal health coverage in the UK, the difference in life expectancy between males living in the most and least deprived areas of the country is currently just over a decade.[80] The differences are starker at the international level: according to UN data, life expectancy at birth in 2025 in low-income countries—which often lack comprehensive healthcare—is just 65 years, compared to 82 years in their high-income counterparts.[81]

Development of "equitable, inclusive access to care" is a key subcomponent of Component 2 because climate change threatens to exacerbate such disparities markedly. People living with cardiovascular, renal and metabolic diseases will be among those affected. As noted earlier, for example, heat stress can drive higher rates of kidney disease among vulnerable workers. Similarly, a recent Israeli study found that in extreme hot or cold temperature conditions, those of lower socio-economic status are more susceptible to poor CVD health outcomes.[82] As Dr Guinto puts it, climate change's disproportionate effects on "those who have less in life makes it a health equity and justice issue." At the extreme, adds Dorairaj Prabhakaran, president-elect of the World Heart Federation, of the world's 8bn people, "the really vulnerable are the bottom billion. How do we address the challenges imposed on them by climate change?"

"The really vulnerable are the bottom billion. How do we address the challenges imposed on them by climate change?"

Prabhakaran Dorairaj, Vice-President, Research & Policy, Public Health Foundation of India

Within national health systems, strategies to address inequity will inevitably vary. At the global level, a key part of the answer, as our framework points out, will be progress on universal health coverage with an emphasis on primary care (part of the "equitable, inclusive access to care" subcomponent).[83] The resultant prevention and early diagnosis also hold out the possibility of a reduced carbon footprint, as noted elsewhere.

Another issue facing health systems, and especially their provision of NCD care, is how to decentralise delivery (another part of Component 2). A potential climate adaptation innovation here, especially given the lessons learned during covid-19, would be a greater adoption of telemedicine.

Current evidence on its effectiveness is mixed, if more positive than negative.[84] A meta-study—drawing largely on research into experience among those living with diabetes—found that clinicians and patients were mostly, if not always, satisfied with telephone-based treatment. That said, poor electronic infrastructure and unfamiliarity with the technology remain issues.[85] As Bertalan Meskó, director of The Medical Futurist Institute, explains, to deploy telemedicine fully, "you have to solve all the legal barriers, train a new generation of doctors, and even educate patients about building relationships based on trust through that technology."

"You have to solve all the legal barriers, train a new generation of doctors, and even educate patients about building relationships based on trust through that [telemedicine] technology."

Bertalan Meskó, Director, The Medical Futurist Institute, Hungary

The results will likely be worth the effort. A single-centre US study found savings of more than 19 kg of carbon dioxide (CO_2) per cardiology visit through telehealth.[86] Similarly, three telemedicine pilot nephrology projects collectively reduced CO_2 consumption by six tons, largely through reduced travel.[87]

Despite the potential role of telemedicine as an adaptation strategy, adequate health services still require bricks-and-mortar physical infrastructure. Rural areas are a particular challenge. Research on best practice in these regions points to the creation of small, modular facilities for patient consultations.[88] Looking ahead, one of the subcomponents of the framework highlights that pharmaceutical and logistics companies should also work together on drug delivery in difficult-to-reach areas.

ii. Preparing for disaster

The changes described above are important on their own. They will also be essential tools as health systems try to re-establish services following natural disasters—a growing concern amid increasingly unpredictable weather. They will not, however, be sufficient for such eventualities.

Instead, explains Dr Mona Sarfaty, Founder and Emeritus Executive Director of the Medical Society Consortium on Climate and Health, "Healthcare systems must address their resilience to climate impacts so they can continue to function regardless of local conditions... [including] storms, wildfires, weather inversions and other extreme conditions." She adds, "People can learn, and institutions can make improvements to prevent disasters. The worst damage occurs where there are no preparations."

Accordingly, infrastructure strengthening will be essential. The framework advises that these activities include working within the health system, along with external authorities and experts, on the following priorities: retrofitting hospitals and clinics to cope with extreme weather; incorporating climate resistance in any new health-related facility; and enhancing energy resilience with deployment of renewable, small-scale generation as backups. Equally important will be general disaster management plans with emergency protocols.[89]

General infrastructure preparedness is essential but is often insufficient on its own. Natural disasters multiply specific challenges for people living with CVD, kidney disease and diabetes. The problems facing those with diabetes provide a good illustration. In the aftermath of hurricanes or floods, their immediate challenges include keeping insulin at the right temperature amid power outages and obtaining emergency prescription renewals.[90,91] Meanwhile, staying healthy in such conditions and their aftermath is far from straightforward. Following floods in England in 2007, those with diabetes had higher HbA1c levels—a measure of long-term blood glucose control—12 months after the event compared to a control group.

Similarly, patients impacted by Hurricane Katrina in 2005 still showed worsened glycaemic control up to 16 months after the disaster. Shifting to the bigger picture, the all-cause mortality rate of elderly people living with diabetes in the areas hit by Hurricanes Katrina and Rita was higher than for their peers who lived in areas unaffected by these storms, even a decade later.[92]

Accordingly, health systems need disaster management plans for each of the conditions covered in this study. The accompanying box shows what this can look like for diabetes. These plans will be of limited value without health systems familiarising staff with the specific protocols they contain. Ideally, this should take place before a disaster strikes. Nevertheless, hands-on training during Hurricanes Irma and Maria enhanced provider response capabilities, ensuring more timely interventions for people living with cardiovascular, renal and metabolic diseases.[93] Aside from health systems, Dr Salas says, "Every patient with underlying medical conditions needs to have their own plan." Elements should include how they deal with the impact of normal infrastructure not working: for example, how power outages will affect their usual treatment tools, from dialysis machines to refrigerators, or how to cope with an inability to travel because of road or public transport damage creating greater difficulty in reaching care. Dr Sarfaty advises, "Overall, 'getting ready' implies a serious risk assessment and a plan to address every risk in advance to avoid the impact of climate threats in the individual's vicinity."

Finally, health systems would benefit from creating new or updating current early warning systems to predict potential disasters. Kristie Ebi, Professor of Global Health at the University of Washington, explains: "There are hundreds of heatwave early warning systems in existence. While they have many commonalities, they vary depending on the local circumstances." The issue is finding ways for healthcare to engage with them. As this is part of the broader challenge of filling the knowledge gaps that impede better climate-adapted care for the diseases of interest to this study, we discuss it in Component 5 on "data".

"Healthcare systems must address their resilience to climate impacts so they can continue to function regardless of local conditions… [including] storms, wildfires, weather inversions and other extreme conditions."

Mona Sarfaty, Founder and Emeritus Executive Director of the Medical Society Consortium on Climate and Health, US

JAPAN'S MANUAL FOR DISASTER DIABETES CARE

Individuals living with diabetes need plans in case of natural disasters. Many good templates exist.[94] Much rarer are health system-wide strategies. The world's first appeared only in 2019. Issued by the Japan Diabetes Society—a medical society for those involved in diabetes treatment—the manual is based on analysis of the country's experience of two earthquakes in the preceding decade, along with input from various stakeholders. It provides an excellent model on which other jurisdictions could draw for climate-related weather events.[95]

While too detailed to describe in depth, the manual provides several broadly applicable lessons for post-disaster care for any of this study's diseases of interest:

1. Those getting ready for a disaster need to prepare for a range of simultaneous breakdowns in the systems and infrastructure that undergird modern life. The challenges will be diverse. For example, problems with critical infrastructure, including power, water and communication after the earthquakes brought difficulties as varied as sub-optimal food preparations, even in healthcare facilities, and inability to access electronic medical records, to name just a few.

2. Fully trained, specialised teams should be ready. One novel recommendation of the manual is the creation of diabetes medical assistance teams. Mobilised at the request of local authorities, these work with other emergency teams to provide "disaster diabetes assistance… which include[s] not only ensuring insulin supplies for patients with type 1 diabetes and treating hypoglycemia/hyperglycemia…, but dealing with patients with diabetes discontinuing treatments… and providing care for diabetic complications in the subacute/chronic phase".

3. Detailed protocols and guidelines must reflect the specific conditions likely to arise post-disaster. Much of the manual provides instructions for different clinicians and their respective roles after a disaster. These are then divided by time from the disaster's occurrence, as patient needs can evolve quickly. For example, it recommends that, during the first week after the triggering event, the highest priority for physicians should be the prevention of hypoglycaemia and ketosis. In the following two months, resumption of normal patient treatment routines take priority, as well as secondary prevention of episodes requiring emergency care. After two months, longer term sugar and lipid control, as well as possibly worsening mental health, need attention.

The manual also warns of heightened risks that might be underappreciated. For example, food in Japanese refugee shelters tends to be saltier than that of normal diets, possibly leading to higher blood pressure.

4. Clinicians and health centres must be ready for higher complication incidence after a disaster than would normally occur. Risks rise for just about every complication of diabetes in such situations, from infection and CVD through retinopathy and neuropathy.

5. The specific challenges of the post-disaster environment may demand temporary adjustments to best clinical practice. Certain medical advice that would normally be very wrong may simply be necessary. The uncertain food situation in the immediate aftermath of an event, for example, means that patients should be told to aim for higher average levels of sugar than normal, rather than risk the far greater short-term danger of sugar levels falling too low.

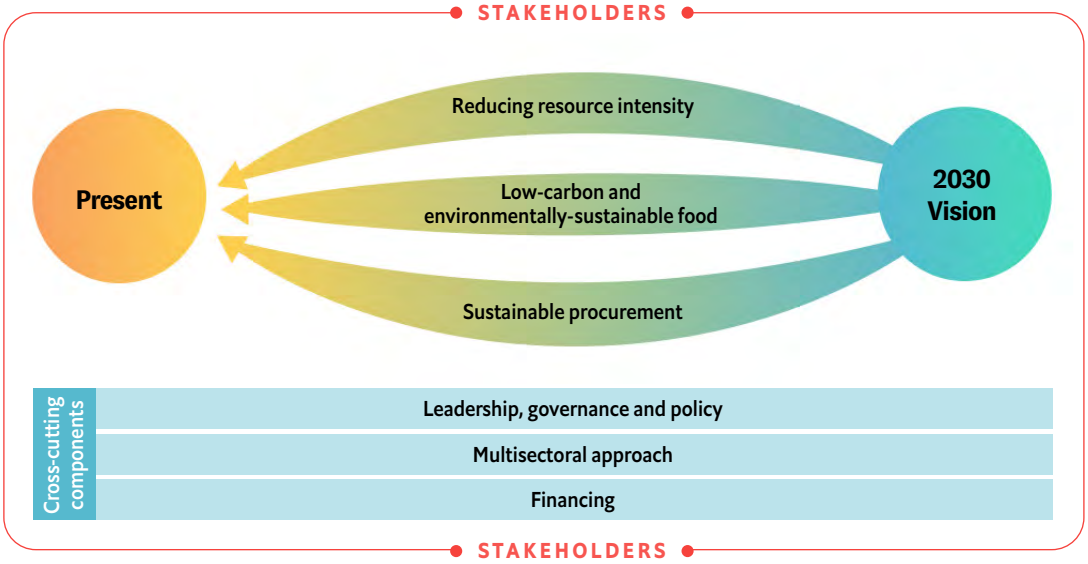
Component 3: Greening healthcare systems

The healthcare sector must address its contribution to greenhouse gases and climate change and their related public health impacts, such as adverse effects on people living with cardiovascular, renal or metabolic diseases. Our framework identifies three areas where care for such conditions, along with health systems more generally, should consider improvements in their environmental performance. It looks at: reducing disease management resource intensity; advocating diets that prevent cardiovascular-renal-metabolic diseases through promoting environmentally sustainable food; and looking at sustainable procurement across healthcare systems (**see Figure 7**).

Figure 7

COMPONENT 3

Greening health systems



"Climate change and greenhouse gases themselves can seem distant and very disconnected from the day-to-day work that we do on the frontlines to care for patients."

Renee N Salas, Founding Director, *The Cooperative* at Mass General Brigham; attending physician, Department of Emergency Medicine at Massachusetts General Hospital and Harvard Medical School, US

Dr Salas explains that, in her dealings with medical professionals, "Climate change and greenhouse gases themselves can seem distant and very disconnected from the day-to-day work that we do on the frontlines to care for patients." She adds, however, that when the downstream impact of resource consumption issues related to current medical practice is explained, clinicians "can see the vicious cycle as healthcare-related emissions harm patients and disrupt healthcare delivery, often resulting in a desire to provide better care for their patients and advocate for the upstream actions needed" to reduce environmental footprints. "Do no harm" is ancient medical advice. It is still relevant, including when care is delivered in a way that exacerbates climate change and all its attendant medical risks.

i. Reducing resource use

The greatest relevant opportunities for direct action come from the reduction of the environmental burden exacted by current disease management practices. A few examples illustrate the striking costs. One study in Germany extrapolated, from a limited survey, that the country generated around 1.2bn pieces of waste related to diabetes care per year.[96] Meanwhile, diagnostic imaging, especially CT and MRI scans, is an essential part of current CVD care but consumes substantial energy. One study estimated that their combined annual carbon footprint came to 1% of the world's emissions.[97] Meanwhile, dialysis, with its high water and energy consumption, exacts a substantial environmental toll: data from the UK shows that dialysis patients generate seven times the carbon emissions compared to an average patient.[98]

No silver bullet exists to eliminate these sorts of burdens. As our framework points out, the issue needs to be addressed at various levels, including the creation of waste and energy reduction mandates that draw on expertise from healthcare providers, the energy sector and environmental agencies. Similarly, medical device and pharmaceutical companies need to devise treatments, tools and even packaging with a lower carbon burden.

More important will be rethinking best practice with the environment in mind. Those working in cardiovascular[99] and diabetes[100] care are already wrestling with these issues, but the most advanced example of this kind of progress related to our diseases of interest is the Green Nephrology movement (**see box**).

Some easy wins are available, such as the greater use, where appropriate and beneficial, of telemedicine (as discussed in the previous section). Meanwhile, for dialysis, existing

technologies such as water capture and reuse systems, as well as recycling dialysate effluent for agriculture, can reduce waste greatly.[101,102]

Today's efforts to reconceptualise provision, though, are not simply the greening of business as usual. Instead, they often seek to improve both health outcomes and carbon footprints simultaneously. Typical, for example, is a focus within such discussions on primary and secondary prevention. Simply put, a disease avoided brings the lowest health, economic and environmental burden.

Some will nevertheless inevitably require treatment. Here, Dr Laranjinha says that advances in precision medicine—which better identifies, often through genetic testing or AI algorithms, who can benefit from which treatments—will be essential. Without such progress, "we simply will not have the resources to provide the same treatments to all the patients under the current model. The system will collapse. A shift toward more personalised care not only improves individual outcomes but also helps reduce the unnecessary use of medications and the complications associated with them, which would otherwise further increase their environmental footprint." Greener medicine needs to provide better, more advanced care, all round.

Dialysis, with its high water and energy consumption, exacts a substantial environmental toll: data from the UK shows that dialysis patients generate seven times the carbon emissions compared to an average patient.

Today's efforts to create greener care are important and valuable but ultimately still lack the broader buy-in needed to succeed. Vivek Jha, executive director at India's George Institute for Global Health and Principal Investigator of the NIHR Global Health Research Centre on Environmental Change and NCDs, notes that climate change's impact on cardio-metabolic conditions "has been embraced much more strongly by multilateral organisations and even international professional societies. The critical gap we still have is local implementation." Dr Guinto agrees: "Have these global initiatives already trickled down successfully? Not yet. It's getting there but the pace is slow."

ii. Healthy, sustainable diets and green supply chains

Another key element in greening the health system builds on the importance of prevention, but this time at the population level. The framework sets out a supporting role for the health system here, as it works with other stakeholders—the food industry, retail, agricultural producers and relevant regulators—to encourage the creation and consumption of healthy, environmentally sustainable foods and diets. This will align personal and planetary health.

Finally, actors within health systems need to pay attention to the environmental impact of their supply chains. This can happen at every level, from individual clinics working with suppliers committed to sustainability, through larger-scale public organisations developing and implementing sustainable procurement guidelines, to international bodies. For the latter, the green vaccine procurement policies of both the Pan American Health Organisation (PAHO) and UNICEF can act as a good example of what might be possible.[103]

Climate change's impact on cardio-metabolic conditions "has been embraced much more strongly by multilateral organisations and even international professional societies. The critical gap we still have is local implementation."

Vivek Jha, Chair of Global Kidney Health and Principal Investigator of the NIHR Global Health Research Centre on Environmental Change and NCDs, Imperial College London, UK

GREENING NEPHROLOGY

Although still in the early stages, concerted efforts to reduce the environmental burden of kidney care are more advanced than in other medical fields—appropriate given its substantial carbon footprint and water consumption.[104]

The most high-profile programme is the International Society of Nephrology's GREEN-K (Global Environmental Evolution in Nephrology and Kidney Care) initiative, which launched in 2023.[105] Its aim is to "promote and support environmentally sustainable and resilient kidney care globally through advocacy, education and collaboration".

Fundamentally, GREEN-K seeks to reshape kidney medicine. Indeed, its starting point is to have environmentally sustainable kidney care declared a distinct field. Key elements of this new way of thinking include an emphasis on avoiding the need for dialysis—through prevention, early diagnosis and even earlier transplantation where possible. It is also committed to researching ways to find and transition toward low carbon and zero waste dialysis therapies.

The focus so far has been on education, with a series of webinars and articles released online. In the autumn of 2024, the initiative also started to develop a model green procurement strategy for those in the sector.

As these and other efforts expand, the potential impact is large. GREEN-K consciously models its agenda on the UK Kidney Association's Sustainable Kidney Care programme.[106] The latter has reported a string of small successes capable of being scaled up. For example, in a trial project, simple process innovations had marked effects. One, involving paperless lab reporting, waste reduction at various points in care and better waste segregation, collectively saved £186,000 and 183 tons of carbon per year. As noted above, three telemedicine pilot projects led to reduced carbon emissions. Finally, a series of investments in power, water and waste management already save 12m litres of water per year and 84 tons of carbon. The necessary investment to obtain the last of these results will pay for itself in a little over two years.[107] New thinking could mean that soon nephrology will change from the carbon black sheep of medicine to a leader in green innovation.

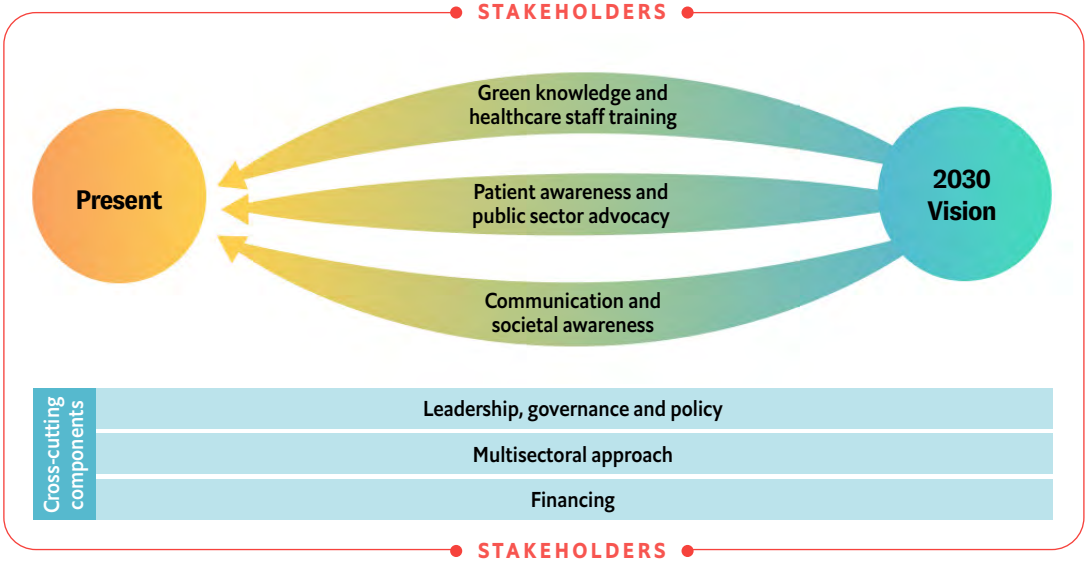
Component 4: Raising awareness and education

"Unawareness": Jason Kai Wei Lee, Director of the Heat Resilience and Performance Centre at the National University of Singapore, uses this word to sum up perhaps the most important current challenge in dealing with the effects of climate change on cardiovascular, renal and metabolic health. The way that climate change raises risk exacerbates this problem: "We as humans tend to focus on urgent things and to neglect more important things that take a few more years, sometimes decades, to manifest themselves."

Figure 8

COMPONENT 4

Raising awareness and education



"It's very rare that members of the general population understand that heat, for example, has impacts on chronic diseases."

Halshka Graczyk, Technical Specialist on Occupational Safety and Health, International Labour Organization (ILO), Switzerland

Dr Halshka Graczyk, a technical specialist in health and safety at the International Labour Organisation, describes the extent of the challenge: "It's not just about patient awareness. It's about broad awareness within different components of the population. It's very rare that members of the general population understand that heat, for example, has impacts on chronic diseases."

Academic research supports her assessment. Most patients simply do not mentally link their conditions with climate change. One US study found that only 44% of adults were aware that air pollution affects heart disease.[108] Research in England, meanwhile, showed that just 27% of adults aged over 75 altered their behaviour during heat alerts.[109]

Nor does awareness of these issues improve greatly among clinicians. To cite one example, a global survey of nearly 1,000 healthcare professionals found that fewer than half possessed knowledge about the impact of climate change on kidney health or about the environmental effect of kidney care.[110]

Clearly, as Dr Salas says, "we need to educate our patients and our clinicians first and foremost."

i. Building awareness among healthcare professionals

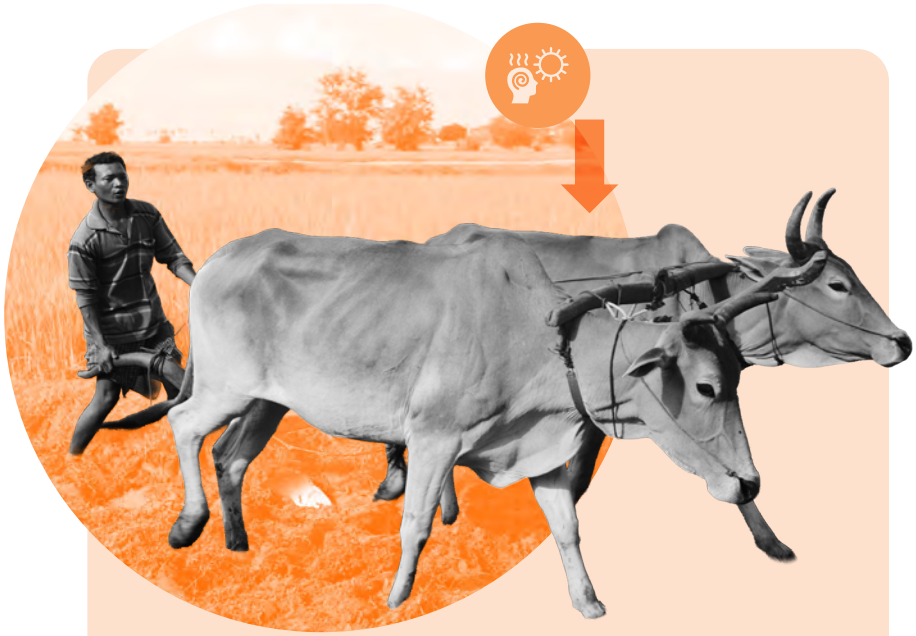
That is where this component of our framework begins (**see Figure 8 and appendix**). The principle underlying most of its detailed suggestions for medical education are simple: to integrate climate modules into every kind of teaching and training provided to healthcare students, as well as within continuing education of healthcare staff working in care related to CVD, renal disease and diabetes.

Although climate change is new within many medical curricula, organisations do not need to start from scratch. At the medical school level, the Global Consortium on Climate and Health Education helps medical, nursing, public health and similar schools to educate their students on the health effects of climate change (**see box**).[111] Meanwhile, when it comes to ongoing professional development, the University of New Mexico's Project ECHO (Extension for Community Healthcare Outcomes) now has a series of modules for clinicians, available in more than 190 countries, on climate change and human health.[112] The Project ECHO courses have been shown to significantly improve knowledge, confidence and communication skills related to climate change and health among clinicians.[113]

While such general efforts are a good start, they will need to be built upon to develop curriculums specific to given disease areas.

ii. Promoting patient and public awareness

Public health awareness programmes are less advanced in the incorporation of climate-related content than healthcare professional education. Nevertheless, the framework has numerous suggestions – drawn from detailed research – on where such efforts might begin.



"Reducing heat strain in workers will augment work productivity. Everyone wins. And so my question is, why not?"

Jason Kai Wei Lee, Director of the Heat Resilience and Performance Centre, Yong Loo Lin School of Medicine, National University of Singapore

A sensible start would be to collaborate with existing organisations involved in public health education, such as the American Heart Association including on its website guidance for individuals on how to protect their heart amid high temperatures.[114]

The framework also deals specifically with awareness among two important stakeholder groups within the general public: employers and employees. As noted elsewhere in this report, working amid high heat stress raises the risk of cardiovascular, renal and metabolic diseases. The specifics of how best to deal with this danger may vary with the sector, but Dr Lee emphasises a common, underlying philosophical basis. "Some employers," he says, still "think that this is a conversation about being altruistic—profit less and provide more welfare to the employees by implementing heat management measures. This is a myth we need to debunk. Reducing heat strain in workers will augment work productivity. Everyone wins. And so my question is, why not?"

As for raising workplace awareness, interested parties for whom heat is the issue would do well to look at the information available on the website of Dr Lee's Project HeatSafe. It hosts substantial academic research and videos aimed at employees and employers in several languages.[115]

Finally, efforts to raise awareness of the health risks of climate change should, to the extent possible, be mutually supportive rather than operate in silos. The framework recommends multisectoral co-operation on shaping messages to diverse stakeholders, as well as the creation of centralised data hubs and web pages to disseminate information on the impact of climate change on cardiovascular, renal and metabolic conditions in a general way.

THE GLOBAL CONSORTIUM ON CLIMATE AND HEALTH EDUCATION: TEACHING 175,000 STUDENTS AND GROWING

The Global Consortium on Climate and Health Education (GCCHE)[116] began as an initiative announced at the COP21 conference in 2015 by the US White House and Columbia University's Mailman School of Public Health (which remains the consortium's host).

Since it began operating in 2017, the consortium's membership has grown to more than 390 institutions, spread across 56 countries worldwide and collectively teaching 175,000 students. It also partners with a wide range of NGOs, professional groups and companies. The consortium's overarching aim is to promote health standards, knowledge and resources in order that, ultimately, "all health professionals throughout the world will be trained to prevent, mitigate, and respond to the health impacts of climate change."

The consortium pursues this end in various ways. At a basic level, to help with curriculum development, it has created a regularly-updated short list of core concepts and competencies relevant to the field. In addition, the consortium holds its own courses, both on the impacts of climate change on health as well as on the pedagogical issues related to teaching these topics. Collaborative member discussion groups also allow distribution of best practice, as does an online knowledge bank of resources. Finally, regional associations address needs in their areas.

Dr Guinto describes what regional content can look like. He helped organise an online-based course in Asia supported by the consortium, involving dozens of faculty experts from the region who understand, study, and work on various aspects of the climate-health nexus. The regional course covered a host of issues (including climate change and non-communicable diseases) and was open to students, clinicians and policy makers. Interest is growing dramatically, he reports. In 2023, around 700 students participated. The 2025 version had 1,000 participants.

Introducing climate change into healthcare professional school teaching is not always straightforward, with barriers including limited staff time, expertise, funding or space within curricula.[117] The consortium is designed to help with such issues, but ultimately the inclusion of the topic is a matter of choice as much as anything else. A recent survey of public health institutions within the consortium and in the Global Network for Academic Public Health found that, currently, 70% of respondents provide education on climate change and health. A comparative study of similar institutions that did not respond to the survey found that just 27% did so.[118] If others are interested, membership to the consortium is free.

Component 5: Improving research, data and monitoring

i. Filling the gaps

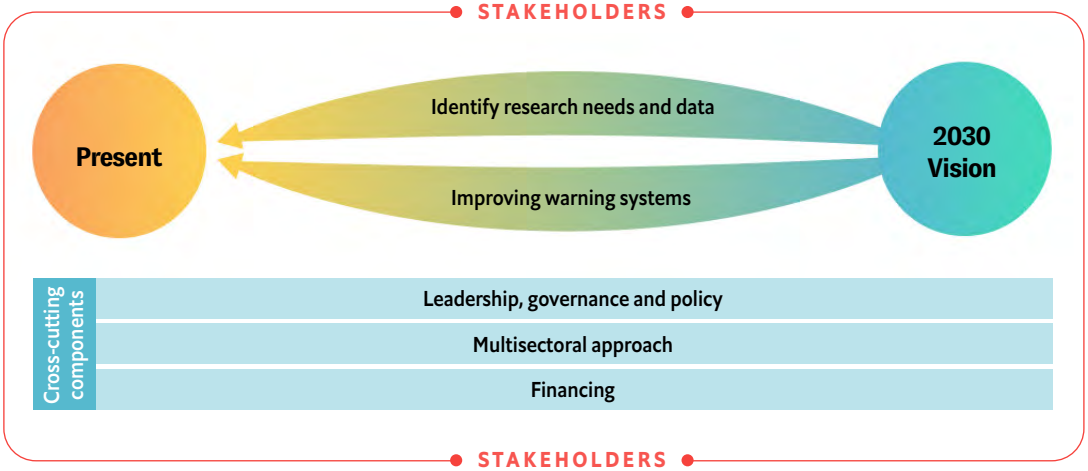
Good healthcare, including public health, must rely on evidence and science. To date, however, the intersection between climate and health remains a field rife with unknowns. In Dr Guinto's words, "the challenge and the excitement" of the topic are that it "gives birth to a million research questions." However, these are of more than intellectual interest. Dr Salas explains that, "we must drive data and evidence focused on solutions so we can make the best decisions."

The necessary research to fill today's gaps will be substantial and multifaceted. To begin with, understanding of the broad ways in which climate change will affect disease burdens and health systems remains far from complete.[119,120]

Figure 9

COMPONENT 5

Improving research, data and monitoring



Meanwhile, current understanding of climate and specific cardiovascular, renal and metabolic diseases contains wide-ranging gaps. As discussed earlier, treatment guidelines that address care for those living with such conditions in higher temperatures or amid natural disasters still require solid underpinning with data. Similarly, finding ways to reduce the resource intensity of specific treatments, such as dialysis, is a familiar challenge.

These only begin the list of issues that require attention. To cite just a few other examples: changing climates may affect the availability of medications derived from natural sources, such as heparin (an anticoagulant), requiring attention to possible alternatives;[121] the greater use of digital health technologies and remote monitoring in the management of cardiovascular, renal and metabolic diseases could reduce carbon footprints but might bring as yet unappreciated consequences or costs;[122,123,124] and more detailed work is also needed on the pathophysiological impacts of environmental stressors on vulnerable populations with these diseases, such as children, older people and those with comorbid conditions.[125,126,127]

Moreover, such research by its nature needs to be multisectoral, requiring input from different parts of medical science, as well as insights from beyond the field. Dr Salas points to "an urgent need to bridge what have been data sets existing in silos. For example, can we have an electronic medical record system connected to environmental data? There's an enormous opportunity to think about data in other sectors as well." Mr Glaser points out that one strength of his research was its integration of human resource and worker productivity statistics. Data from such a wide range of fields implies a need for a similarly diverse set of researchers. As Dr Guinto puts it, "no single person or discipline has the necessary expertise to tackle these new complex challenges."

Given today's knowledge gaps, the framework recommends initiatives at several levels: development of national research agendas within the broader field of climate change and health; creation of multidisciplinary research networks and partnerships to support such research and allow data sharing; identification of specific research needs related to cardiovascular, renal and metabolic diseases; and assessment of the effectiveness of greener health practices.

"[There is] an urgent need to bridge what have been data sets existing in silos. For example, can we have an electronic medical record system connected to environmental data? There's an enormous opportunity to think about data in other sectors as well."

Renee N Salas, Founding Director, *The Cooperative* at Mass General Brigham; attending physician, Department of Emergency Medicine at Massachusetts General Hospital and Harvard Medical School, US

"Without leadership from healthcare, early warning systems will continue to be designed without considering" CVD, renal diseases or diabetes.

Kristie Ebi, Professor of Global Health, University of Washington, US

Meanwhile, such activity should go beyond the crucial task of creating better intellectual understanding of the issues involved. Dr Lee stresses the importance of finding ways to translate findings into policy and healthcare practice, "not just producing another piece of research." Accordingly, the framework suggests toolkits based on emerging research to enhance care pathways for the diseases in this study.

Finally, one crucial difference between the envisaged research activity and typical public health programmes is pressing urgency. Dr Guinto points out that the current and likely imminent rises in average world temperature will bring "long-term, widespread and even dramatic health consequences. Traditionally, we do public health research in a manner as if there's no deadline. But there is a climate deadline. Hence, we really need to rethink health research so that it is more rapid and scaled."

ii. Early warning systems

Weather-based early warning systems have been used in healthcare since at least the 1990s. Early warning systems for malaria[128] rely on the link between temperature, precipitation and the mosquito population of a region. They are integral to the WHO's Global Technical Strategy for Malaria.[129]

Given the connection between extreme climate events and the diseases covered in this study, an important goal (and one included in the framework) is some form of early warning systems to forecast increases in incidence and hospital admissions. As Dr Ebi points out, many weather early warning systems exist worldwide. The challenge will be harnessing them to help understand the shifting burden of CVD, renal disease and diabetes in a changing climate.

This is not straightforward. Dr Ebi explains that effective early warning systems have "multiple components." These begin with integrated surveillance that includes data on both the health condition of a population and the local environment. "You need data at the scale at which it will be useful for decision-makers, focusing, of course, on the most vulnerable," she adds. "There also needs to be collaboration across sectors, particularly with the meteorological services." Ideally, this co-operation should involve formal links and information sharing. But, she warns, "without leadership from healthcare, early warning systems will continue to be designed without considering" CVD, renal diseases or diabetes.

Building up trust among patients in such initiatives is another area that Dr Ebi sees as fundamental. She adds, "I'm sure there are patient advocacy groups and others with which it would be useful to collaborate."

Another current deployment hurdle is that researchers are still looking at which factors would be useful to include in early warning systems for these diseases. Recent studies have largely examined environmental data and hospital admission or mortality retrospectively, rather than trying to look ahead. A 2024 Italian study, for example, found that atmospheric pressure, minimum temperature and carbon monoxide levels had a marked impact on emergency room admissions for CVD and respiratory disease.[130] A Chinese study from the same year similarly found that an air quality index was an effective predictor of mortality from cardiovascular conditions.[131]

While insights are growing into how best to shape an early warning system for any or all of CVD, renal diseases and diabetes, the perfect must not become the enemy of the good. According to another recent Chinese study, even a general system to alert populations about heatwaves has recently saved lives (**see box**). Such systems might be considered as work continues on more focused ones that hold out the promise of even greater value.

HEATWAVE WARNINGS IN SHENZHEN AS CARDIOVASCULAR DISEASE PREVENTION[132]

The meteorological service and public health authorities in Shenzhen, China, issue early heatwave warnings to the city's population whenever the local weather is classified as sultry and the high temperature within the next 24 hours is expected to reach 35°C or more. Local surveys indicate that 80% of respondents reduce outdoor activities or increase indoor cooling after such alerts.

A recent Lancet study tracked, from 2017 to 2023, nearly 10m residents of the metropolitan area who, at the beginning of the period, did not have CVD. It used various statistical techniques to compare levels of heat-related disease and CVD incidence, adjusted for demographic and medical history, among sub-groups within this population. It also looked at outcomes on the days before the heatwave warnings and the days of and following these interventions, to see if they had any health effect.

The analysis found a statistically significant impact from the warnings. Compared to the day before they were issued, on the day of the warning the odds of admission to hospital with a heat-related condition were roughly 10% lower. The odds of admission with likely heat-related CVD dropped by around 4%, with the biggest impact three to four days after issuance. In short, the researchers concluded, "heatwave warnings mitigated both heat-related illness and subsequent CVD risks."

Cross-cutting components: The secret sauce—multisectorality, financing, leadership and policy

Across this study's various framework components, three in particular have shown themselves to be central to the achievement of progress: a multisectoral approach, adequate financing and strong leadership, governance and policy. If present, they are essential enablers; the absence of any creates a huge barrier.

i. Multisectoral collaboration

Multisectoral collaboration on just about any matter related to the overlap of climate change and cardiovascular, renal and metabolic care is vital. Even on the very surface, this topic brings together two broad areas with different collections of experts: climatology and healthcare. This only begins the list of those whose collaboration is important for adaptation strategies to be effective. Many other sectors must be involved. Among other essential sectors, says Dr Sarfaty, are "transportation, power supply generation, the building sector (to address energy supply, insulation, energy efficiency), industry and agriculture." She could add urban government, environmental policymakers at every level, the food industry and academic researchers (**see box for summary of necessary baseline priorities to drive a multisectoral approach in the adaptation framework**). The reason is straightforward. As Dr Sarfaty puts it, "these sectors impact health. The pollution they produce has negative impacts, both directly through the effect of air pollution on human health, and indirectly because their emissions degrade our life-sustaining atmosphere. The impacts must be addressed through education, standards, zoning laws, regulations and legal requirements."

Multisectoral collaboration allows all of these sectors, in their joint and individual policies and actions, to exhibit a common aim of addressing the diverse issues surrounding cardiovascular, renal and metabolic diseases. The wide variety of potentially affected stakeholders discussed above within the framework's components only adds to the pressing need for engagement and collaboration.

Such joint work has borne important fruit. The International Alliance for Diabetes Action, for example, consists of more than 60 member organisations including UN agencies, humanitarian and health NGOs, academic institutions and private-sector bodies. It has successfully driven progress in insulin thermostability, affordability of glucose monitoring and the development of open-access resources such as e-learning platforms and crisis-specific guidelines.[133]

CROSS-CUTTING COMPONENT

MULTISECTORALITY

Baseline priorities for developing an inclusive, multisectoral approach to adaptation

1. Encourage multisectoral collaboration and co-ordination between the health, environmental, labour, urban, energy, transport, agriculture, food, meteorological, municipal, healthcare industry, regulatory, research and the community and patient sectors for the exchange of evidence-based practices, actions, roles and responsibilities to protect cardiovascular-renal-metabolic health in light of climate change.

2. Ensure there are health-promoting policies and joint monitoring in place across sectors to reduce cardiovascular-renal-metabolic health risks and improve environmentally sustainable health practices, behaviours and processes.

3. Foster partnerships between the public, private and philanthropic sectors to secure investments in innovative solutions.

Source: Economist Impact Adaptation Framework (see appendix for full details).

Such extensive collaboration is universally wished for, but nevertheless a challenge for a sector that has traditionally worked in institutional, professional and speciality-related silos. Dr Jha notes the difficulties when he says that on one hand, "the multisectoral response needs to go beyond just immediate health system actors to others. Community engagement becomes really very critical." On the other, how to achieve this is a "question, and I don't have immediate answers." Some data indicate it is worth it. The London School of Hygiene and Tropical Medicine's Climate and Health Evidence Bank finds that multisectoral efforts that involve health actors have produced moderate health benefits, which are context-specific.[134] Still, challenges exist and can be even basic; Dr Prabhakaran notes that in "many countries, the environment ministry will not speak with the health ministry, or the labour ministry will not speak to the commerce ministry". However, this should not inhibit leaders from taking on the multisectoral task, as climate change is affecting the health of many people now.

One way to help move the needle on the effective participation of people in multisectoral initiatives will be agreeing on values and building up experience. Effective programmes need to have all parties working together in order to understand the aims of every partner organisation; to agree and align on the values that undergird the effort; and to find a common understanding of what success will look like, as well as how to measure it.[135] These do not just happen but require conscious effort. As Dr Guinto puts it, "it's easier said than done to put actors in the same room and have them talk, but when it comes to decision-making, financing and accountability, that's when people start pointing fingers."

At the very least, the clear need for multisectorality in addressing climate change's challenges for the diseases covered in this study should lead to greater attention to, and teaching of, how such partnerships can best be run. Success may also require inventiveness in specific situations rather than, necessarily, reliance on existing, formal collaborative structures. Mr Glaser, for example, says that within the

"It's easier said than done to put actors in the same room and have them talk, but when it comes to decision-making, financing and accountability, that's when people start pointing fingers."

Renzo Guinto, MD DrPH, Associate Professor of Global and Planetary Health, SingHealth Duke-NUS Global Health Institute, Duke-NUS Medical School, National University of Singapore

Adelante Initiative, his small NGO has been able to bring together various stakeholders who would normally not get along, by going to them individually and explaining the advantages of participation. In other situations, Dr Prabhakaran notes, the broad international membership of bodies such as the WHF can give important convening power.

ii. Financing

Sufficient financing is also a fundamental cross-cutting component in addressing climate change-related health issues. It is unfortunate that, as Dr Ebi says, "funding is a huge challenge in this space." That is why the framework notes not only that financing should be mobilised at a national, regional and international level, but also that diverse sources may be needed (**see box for summary of necessary baseline priorities around financing**).

The WHO's general recommendation is for interested parties to focus on the strengthening of health systems as a first step to dealing with climate-related issues.[136] It advises countries, noting that those most vulnerable to climate change impacts are often least able to finance actions, that some money specifically for climate adaptation might be available from the Green Climate Fund, the Global Environmental Facility, the Special Climate Change Fund, the Least Developed Countries Fund and the Adaptation Fund.[137,138] In practice, though, little goes to healthcare. Dr Guinto notes that "the Green Climate Fund has funded only two health projects[139] until now, and it took almost a decade for them to be convinced." The Global Environmental Facility, meanwhile, is supporting one project, but most of the money for it had to come from other sources and it took five years to secure approval.[140]

Meanwhile, cash-strapped national governments are both cutting back on foreign aid and constrained in what they can spend on their own health systems. In the US, for example, Dr Sarfaty expects "significant damage to the health system caused by reductions in the system's budget and staffing levels. Biomedical research has already been cut along with the funding that supports the delivery of leading edge therapies at the National Institutes of Health. Subsidies for health insurance and Medicaid face severe reductions." Even apparent new money may not bear scrutiny. Too often, Dr Guinto says, funding ostensibly announced for climate and health simply involves the addition of a "climate layer" to existing health system commitments. With even general funding hard to get, he regrets that projects on "climate and cardio, metabolic and renal disease [will appear too] narrow and specific, attracting a much smaller pool of funders."

CROSS-CUTTING COMPONENT

FINANCE

Baseline priorities to mobilise and scale up a flexible and diverse revenue base

1. Mobilise financial resources at the national, regional and international level so that healthcare and health-determining sectors can fund adaptation measures in health national adaptation plans (HNAPs), guidelines, prevention and awareness campaigns on the impacts of climate change on cardiovascular-renal-metabolic diseases.

2. Health financing needs to be scaled up and mobilised from a diverse revenue base, considering the major challenges faced by health systems (such as climate-related hazards, ageing populations, increased chronic disease burden). This should include national health budgets (such as general taxation, payroll tax, pooled funds, local taxes, voluntary insurance), climate change funds (such as the Green Climate Fund and the Adaptation Fund), and financing from the philanthropic/charitable (such as the Gates Foundation) and non-governmental organisations (such as development banks). Some nations may consider other revenue sources such as wealth, consumption and excise taxes (such as sin taxes).

Source: Economist Impact Adaptation Framework (see appendix for full details).

Clearly, those looking to fund relevant initiatives will have to be creative in securing money wherever it can be found. In this search, our experts have one general piece of advice: focus on return on investment rather than cost. Dr Graczyk advises that, for given interventions, substantial evidence exists "not only about the human lives you can save, but also the cost savings for different stakeholder groups. It is critical to remind people that everyone can benefit from these kinds of approaches."

Dr Sarfaty thinks that such evidence may be used to build a case for funding. While initiatives will likely need to rely initially on seed funding from wherever it is available. "Once solutions have been demonstrated to be effective, the funding sources will hopefully broaden and there can be efforts to bring the solutions to scale." Dr Salas agrees, saying that, by demonstrating a return on investment "through evidence-based and data-driven pilots," it might be possible to leverage health insurers and other payers as funders.

"Once solutions have been demonstrated to be effective, the funding sources will hopefully broaden and there can be efforts to bring the solutions to scale."

Mona Sarfaty, Founder and Emeritus Executive Director of the Medical Society Consortium on Climate and Health, US

iii. Leadership, policy and governance

Finally, but importantly, as Dr Ebi notes, "without leadership and governance, nothing's going to happen. We all know of policies that sit in drawers." In fact, the WHO lists "Climate-transformative leadership and governance" as the first component in its Operational framework for building climate resilient and low carbon health systems.[141]

What such leadership needs to mean in practice will be multifaceted (**see box for summary of necessary baseline priorities around leadership and policy**). To begin with, as discussed above in the section on multisectorality, leaders and policies dealing with the issues arising from climate change and health will need to be present far beyond health systems. Moreover, leadership and relevant governance structures are required at every level: international, national and local level, including communities and patients.

Within healthcare itself, leadership must involve paying attention simultaneously to the diverse issues related to climate change—including those dealt with in the components of this framework. Thus, health system leaders will need to be aware of and understand the link to climate issues from: new challenges to healthcare, including those facing services for cardiovascular, renal and metabolic diseases; the health system's own environmental footprint; the likely increase in the number of disasters; the importance of relevant training; and the need to develop data to support decision-making. Dr Guinto adds that they will also need to work with leaders outside the health system, from other sectors, and especially at the political level, where it is relevant to health.

Although commitment will be crucial, successful leadership will require more. It will also need institutional structures that will allow and support action on climate change. The WHO recommends, for example, specific responsibility and accountability mechanisms on climate change and health within healthcare; the embedding of climate change considerations within every main health policy or programme; and formal collaboration with relevant partners.[142]

CROSS-CUTTING COMPONENT

LEADERSHIP, GOVERNANCE AND POLICY

Baseline priorities for leadership, governance and policy needed on all levels

1. Establish strong, effective leadership and governance at the international, national and local level, including communities and patients, in the development of equitable policy that embeds adaptation measures in the response to the impacts of climate change on individuals living with cardiovascular-renal-metabolic diseases.

2. Facilitate inter-ministerial co-operation between health, finance and environment sectors to comprehensively tackle climate-related health issues and translate research, data and evidence into policy action.

3. Ensure policies support vulnerable people in an equitable and non-discriminatory way, so they can have livelihoods while protecting their cardiovascular-renal-metabolic health. Patients groups and workers take on pro-active leadership roles to create awareness and co-design policy.

Source: Economist Impact Adaptation Framework (see appendix for full details).

In short, leadership will involve both having a vision and making sure that it is integrated across the numerous day-to-day activities that health systems require. Not only is this combination of the big-picture and the quotidian essential for overall success, it is also the only way that matters related to cardiovascular, renal and metabolic diseases do not get lost in the shuffle.

Finally, policy is essential to translate that vision into success. The specifics will depend on the detailed conditions in a given health system or country. A good place to begin thinking about what might work best in individual situations would be the WHO's new Global Action Plan on Climate Change and Health.[143] Approved by the World Health Assembly in May 2025, this document gives a detailed list of suggested actions for the WHO itself, national governments and other stakeholders in support of three action areas and a total of 11 specific objectives. Amid such general advice, as important as it is, the particular issues related to individual disease, including cardiovascular, renal and metabolic, require attention as well. Here is where looking at our adaptation framework will help build better health systems and healthier populations.

Conclusion: Where do we go from here?

We do not have the luxury of time to address climate change impacts. In the face of worsening weather-related events, such extravagance is simply unavailable to health systems and health professionals managing the care of people living with cardiovascular, renal and metabolic disease. This study provides a framework of components that can help these systems, and other key stakeholders within and beyond the government, to make extensive progress in five years toward a vision of equitable care that meets the health needs within a changing climate.

A single adaptation framework aimed at a global audience is inevitably general. How, then, should those wishing to apply this framework to their own national—or even sub-national—situations proceed? Each user is likely to find a slightly different answer, but a few broad comments may help those looking for a place to start.

First, understand the national or local context in which you are acting.

Scoping should include possible dangers facing the location, including, for example:

- what is the current incidence and prevalence of CVD, renal disease and diabetes;
- what non-climate risk factors are likely to affect the burden of these diseases in the future;
- what are the specific climate risks most likely to affect the country, such as higher or lower temperatures, increased or decreased rainfall, floods, heatwaves and tropical storms; not all problems will be equally likely in any given place; and
- what are the most likely challenges that the interaction of the above factors will create for effective cardiovascular, renal and metabolic care, and so which parts of the response should have the highest priority.

The scoping should also include consideration of assets, such as any effective public health programmes already in place or robust infrastructure capable of rendering service in an emergency.

Second, find and begin to build links between possible partners.

As our discussion of multisectoral collaboration notes, partnerships are essential in carrying out the tasks in every framework component, but they also will not happen spontaneously. The constellation of stakeholders that are both valuable allies and genuinely interested in collaboration will inevitably vary with geography. In some cases, relationships may already exist. In others, these will need to be created from scratch. Building appropriate national or local teams early will make every other step easier.

Third, use the framework to help devise a national, or even local, strategy or plan.

A comprehensive plan allows interested stakeholders to address every area of importance—including all of those covered in detail in the framework—and to ensure that policies and actions in every area are consistent and mutually supportive. It can also consider ways to finance a range of activities strategically, rather than actors needing to compete for limited available funding.

Fourth, be flexible about how different steps under each component are carried out.

One reason, noted near the start of this report, for a specific study on climate change and cardiovascular, renal and metabolic diseases is that these specific but high-burden conditions can be missed in general health system adaptation plans. Nevertheless, some elements of those plans will be essential to the changes encouraged in the framework. The IT systems needed to integrate telehealth further into care provision, the existence of rural health facilities and the strengthening of hospitals and clinics to cope with extreme weather are, for example, best handled as part of general adaptation. Depending on the country and its particular burden of conditions, even initiatives specific to the diseases of interest in this study may fit into a wider adaptation plan. (For example, 90% of National Cancer Control Plans worldwide contain specific goals and actions related to breast cancer screening and 81% for human papillomavirus vaccination to prevent cervical cancer.[144]) Other initiatives still will be best handled by those with a specific expertise or interest in these conditions, such as Green Nephrology or Japan's national diabetes disaster plan. The key to progress will be flexibility.

Finally, monitor and document successes (and failures).

Given the ongoing need for better data, discussed in the framework's Component 5, case studies of adaptation efforts will be highly valuable for others seeking to reach Vision 2030.

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APPENDIX

Economist Impact cardiovascular-renal-metabolic diseases and climate change adaptation framework

Vision 2030

By 2030, we envision a world where the effects of climate change on cardiovascular-renal-metabolic health have been minimised, fostering equitable and inclusive care.

Purpose of the framework:

This framework serves as a guide to health systems, which comprise healthcare and health-determining organisations, institutions, actors and people, in the development of climate resilience and adaptation preparation/ planning for cardiovascular-renal-metabolic diseases for better outcomes. We envision a world where we strengthen prevention, early detection, leadership, multistakeholder awareness and progress on the impacts of climate change on cardiovascular-renal-metabolic health for equitable and inclusive care.

Our vision is aspirational, yet actionable.

It spans the next five years and recognises the diverse structures, governance, and development stages of health and climate systems globally, and the inherent uncertainties from now until 2030.

We encourage countries to apply the framework in a flexible manner taking into account their needs.

The framework consists of eight components, made up of five components with milestones (or actionable pathways), and three cross-cutting components. This has been designed to support health systems from initial steps to the creation of more comprehensive approaches.

Summary:

Components	Sub-components
1. Adapting treatment and management plans	1. Create climate-responsive treatment and clinical guidelines 2. Promote preventive and detection measures 3. Climate-focused medication management
2. Enhancing healthcare delivery	1. Disaster preparedness 2. Decentralised delivery 3. Early warning systems and surveillance 4. Equitable, inclusive access to quality care
3. Greening health systems	1. Reducing resource intensity 2. Low-carbon and environmentally-sustainable food 3. Sustainable procurement
4. Raising awareness and education	1. Green knowledge and healthcare staff training 2. Patient awareness and public sector advocacy 3. Communications and societal awareness 4. Workplace awareness
5. Improving research, data and monitoring	1. Identify research needs and data 2. Improving warning systems
	Cross-cutting components These components are recognised as cross-cutting as they must be addressed individually and as integral elements in each of the five components outlined above. We have considered baseline priorities for these components:
6. Cross-cutting component: Leadership, governance, and policy	**Leadership, governance and policy needed on all levels** **1. Establish strong, effective leadership and governance at the international, national and local level**, including communities and patients, in the development of equitable policy that embeds adaptation measures in the response to the impacts of climate change on individuals living with cardiovascular-renal-metabolic diseases. Leadership and governance can ensure health-promoting and inclusive climate strategies and policies are integrated into Nationally Determined Contributions (NDCs), Health National Adaptation Plans (HNAPs), cardiovascular-renal-metabolic health guidelines, and heat action plans. Strong leadership can foster needed multisectoral collaboration. **2. Facilitate inter-ministerial co-operation** between health, finance and environment sectors to comprehensively tackle climate-related health issues and translate research, data and evidence into policy action. **3. Ensure policies support vulnerable people in an equitable and non-discriminatory way**, so they can have livelihoods while protecting their cardiovascular-renal-metabolic health. Patients groups and workers take on pro-active leadership roles to create awareness and co-design policy.
7. Cross-cutting component: Multisectoral Approach	**Develop an inclusive, multisectoral approach to adaptation** **1. Encourage multisectoral collaboration and co-ordination** between the health, environmental, labour, urban, energy, transport, agriculture, food, meteorological, municipal, healthcare industry (pharma, devices), regulatory, research and the community and patient sectors for the exchange of evidence-based practices, actions, roles and responsibilities to protect cardiovascular-renal-metabolic health in light of climate change. It is essential to recognise that there are multiple drivers for the incidence of cardiovascular-renal-metabolic diseases and people living with these conditions are vulnerable to the effects of climate change.

7. Cross-cutting component: Multisectoral Approach (*cont.*)	**2. Ensure there are health-promoting policies and joint monitoring in place across sectors** to reduce cardiovascular-renal-metabolic health risks and improve environmentally sustainable health practices, behaviours and processes. **3. Foster partnerships between the public, private and philanthropic sectors to secure investments in innovative solutions**. These collaborations are essential for addressing climate and cardiovascular-renal-metabolic health challenges effectively. By working together, public and private entities can leverage their combined resources and expertise to drive initiatives forward. This synergy can lead to the development and implementation of robust strategies for tackling global issues at both local and broader levels.
8. Cross-cutting component: Financing	**Mobilise and scale up a flexible and diverse revenue base** **1. Mobilise financial resources at the national, regional and international level** so that healthcare and health-determining sectors can fund adaptation measures in health national adaptation plans (HNAPs), guidelines, prevention and awareness campaigns on the impacts of climate change on cardiovascular-renal-metabolic diseases. **2. Health financing needs to be scaled up and mobilised from a diverse revenue base**, considering the major challenges faced by health systems (such as climate-related hazards, ageing populations, increased chronic disease burden). This should include national health budgets (such as general taxation, payroll tax, pooled funds, local taxes, voluntary insurance), climate change funds (such as the Green Climate Fund and the Adaptation Fund), and financing from the philanthropic/charitable (such as the Gates Foundation) and non-governmental organisations (such as development banks). Some nations may consider other revenue sources such as wealth, consumption and excise taxes (such as sin taxes).

Methodology

The design of this framework has been shaped by WHO guides addressing health and climate resilience, findings from a rapid literature review on climate adaptation for cardiovascular-renal-metabolic health, and valuable insights from an expert panel. (See the methodology page for more details.)

Key WHO documents include:

[1] WHO. Operational framework for building climate resilient and low carbon health systems. 2023; Available from: https://www.who.int/publications/i/item/9789240081888 [This contains 10 climate-resilience related components, based on the WHO's health system building blocks]

[2] WHO. Operational framework for building climate resilient health systems. 2015; Available from: https://www.who.int/publications/i/item/operational-framework-for-building-climate-resilient-health-systems.

Component 1: Adapting treatment and management plans

Sub-component	Milestone 1	Milestone 2 (by 2030)	Justification
1. Create climate-responsive treatment and clinical guidelines	**Mobilise experts from the health and health-determining sectors to set up convening committees to gather evidence**, as well as vulnerability assessments, on how climate change affects people living with cardiovascular-renal-metabolic conditions. Key stakeholders include healthcare professionals, patient groups and community leaders, civil society, academics, multidisciplinary health actors in cardiology, nephrology and metabolism, and experts from health determining sectors (eg, labour, urban, environment, communities). Discussions should be open so that other stakeholders are involved in the creation of "health in all policies" . **Stakeholders:** healthcare professionals and providers, specialists, professional bodies, clinical writing bodies, payers, multisectoral entities	**Reach consensus on updating national, regional, and international guidelines and heat action plans so that climate risk and adaptation is integrated into cardiovascular-renal-metabolic care.** Stakeholders creating climate-responsive guidelines should consider personalised health action plans, managing heat-related conditions, behavioral adaptations, and preventive approaches that offer environmental co-benefits, such as healthier diets (eg, reduced animal-based saturated fat consumption). Ensure any international guidelines are contextualised for a specific region/ country with different social and economic development.	Clinical guidelines are often seen as the gold standard for how healthcare professionals manage their patients. The inclusion of the climate impacts of these conditions would better help them identify risks and align solutions for prevention and better management of these diseases. This approach has already been applied in nephrology, where integrating environmental factors into clinical and public health practices is essential for addressing climate-related diseases such as chronic kidney disease of unknown origin (CKDu). [1-4]
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2. Promote preventive and detection measures	**Develop effective public health plans and campaigns that promote prevention, self-care and behaviour change** on healthy eating, physical activity, smoking reduction, hydration and shade, heat stress reduction, cooling strategies, and limiting air pollution exposure. As individuals living with cardiovascular-renal-metabolic diseases are more vulnerable to climate change, prevention will reduce disease burden, the use of carbon-intensive therapies, and environmental impact. **Set up effective collaboration between employers and workers particularly affected by climate-change for the inclusion of hydration stations, heat sheltering and monitoring of air pollution as preventive interventions in the workplace**. Labour agencies publish occupational guidelines and mandate best practices for preventive interventions against heat stress, dehydration and renal disease in the workplace. **Set up effective collaboration between city planners and public health advocates** to plan for green infrastructure, such as tree canopy and parks, and improved housing and shelter to reduce the impacts of heat stress and air pollution on individuals living with these conditions.	**Measure the success of public health plans and campaigns targeting preventive interventions**, particularly for people living with cardiovascular-renal-metabolic disease such as workers. Track and monitor progress of public awareness campaigns through data collection and surveys. Ensure vulnerable people have signed up to receive alerts on ambient air pollution to limit outdoor activity on high pollution days. **Introduce early detection for climate-sensitive risk factors** (such as hydration status, air pollution exposure, heatwave susceptibility) for people living with cardiovascular-renal-metabolic diseases during regular patient healthcare evaluations. **Introduce early detection for heat stress among workers** (including indoor and outdoor workers) on a regular basis to prevent chronic kidney disease of unknown origin (CKDu). **Evaluate the cost-effectiveness of wearable health technology for real-time monitoring** of hydration, glucose levels and body temperature in individuals living with cardio-renal-metabolic disease or those at high-risk of these conditions.	Studies consistently demonstrate that behavioral changes, particularly quitting smoking, increasing physical activity, and improving overall lifestyle habits, can significantly reduce the burden of cardio-renal-metabolic diseases. Implementing interventions based on behavioral change models like the transtheoretical model (TTM) could be an effective strategy for disease prevention and management. A study on chronic kidney disease (CKD) prevention utilized TTM to guide behavioral changes - participants who improved their stage of change for healthy lifestyle behaviors showed a lower risk of CKD incidence.[2] A study on chronic kidney disease (CKD) prevention utilized TTM to guide behavioral changes - participants who improved their stage of change for healthy lifestyle behaviors showed a lower risk of CKD incidence.[2] A study of 357,554 UK Biobank participants found that a healthy lifestyle had a protective effect throughout the progression of cardio-renal-metabolic multimorbidity.[3] Academic literature provides strong evidence that behavioral changes promoted through public awareness campaigns can significantly reduce the burden of cardio-renal-metabolic diseases. [4] [5]

Component 1: Adapting treatment and management plans (cont.)

Sub-component	Milestone 1	Milestone 2 (by 2030)	Justification
2. Promote preventive and detection measures (cont.)	**Secure investment from smart technology companies** for wearable devices to monitor climate-sensitive health indicators. **Stakeholders**: Local and national government, public health organisations, urban and rural community leaders, employers for indoor/outdoor workers, NGOs, media, professional societies, patients, workers, employers, workers, investors		Research indicates that smartphone air quality alerts play a crucial role in helping individuals manage their health conditions by promoting positive behavioral changes. [6] Research has revealed initial findings indicating positive health outcomes associated with the use of wearable health technology among individuals with chronic diseases. [7]
References	[1] Economist Impact expert panel; 2025 [2]Kimura H, Asahi K, Tanaka K, et al. Health-related behavioral changes and incidence of chronic kidney disease: The Japan Specific Health Checkups (J-SHC) Study. Scientific Reports. 2022 Sep 29;12(1):16319. [3] Zhang N, Liu X, Wang L, et al. Lifestyle factors and their relative contributions to longitudinal progression of cardio-renal-metabolic multimorbidity: a prospective cohort study. Cardiovascular diabetology. 2024 Jul 18;23(1):265. [4] Zhang F, Bai Y, Zhao X, et al. Therapeutic effects of exercise interventions for patients with chronic kidney disease: an umbrella review of systematic reviews and meta-analyses. BMJ open. 2022 Sep 1;12(9):e054887. [5] Ndumele CE, Rangaswami J, Chow SL, et al. Cardiovascular-kidney-metabolic health: a presidential advisory from the American Heart Association. Circulation. 2023 Nov 14;148(20):1606-35. [6] D'Antoni D, Auyeung V, Walton H, et al. The effect of evidence and theory-based health advice accompanying smartphone air quality alerts on adherence to preventative recommendations during poor air quality days: A randomised controlled trial. Environment International. 2019 Mar 1;124:216-35. [7] Mattison G, Canfell O, Forrester D, et al. The influence of wearables on health care outcomes in chronic disease: systematic review. Journal of medical Internet research. 2022 Jul 1;24(7):e36690.		
3. Climate-focused medication management	**Clinicians introduce medication adjustments for at-risk individuals**, including those living with cardiovascular-renal-metabolic diseases, as some medicines are thermoprotective while others can impair patients' thermoregulatory response in light of extreme heat. **Develop pharmacy protocols** for temperature-sensitive medication storage and distribution in high-risk areas to avoid shortages. **Pilot telepharmacy services** for people living with cardiovascular-renal-metabolic diseases to ensure medication access during extreme weather events. **Increase awareness around proper storage of medicines in appropriate containers and facilities** by the healthcare workforce and patients during climate related events such as heatwaves, using guidance from medical and pharmacy societies, and drug regulatory agencies. **Stakeholders:** government, patients, healthcare professionals, including pharmacists, community health workers, pharmaceutical industry, regulators, professional societies	**Drug regulatory agencies provide guidance** to pharmaceutical companies on researching and developing heat-and-climate-resilient medicine formulations. **Develop localized emergency stockpiles** of climate-sensitive medications to prevent shortages. **Expand climate-informed telepharmacy services** and digital prescription solutions to maintain medication access during extreme weather disruptions. **Community health workers are deployed regularly** to distribute medicines in hard to reach or rural areas in light of extreme weather disruptions.	Climate change, particularly heatwaves, significantly impacts the safety and efficacy of temperature-sensitive medications such as insulin and vaccines. Regulatory agencies must update guidelines to address these risks, including revising storage and transportation requirements for pharmaceuticals during extreme weather events. Seasonal changes, such as heatwaves, increase risks for vulnerable populations (eg, older individuals living with cardiovascular diseases). Modifications in medication regimens, such as adjusting diuretics or anticoagulants, are necessary to prevent adverse outcomes like dehydration or heat stress. [1] Extreme weather events disrupt supply chains and compromise medication storage conditions. Developing resilient protocols for temperature-sensitive medications is critical to maintaining their efficacy during transit and storage. Investments in climate-resilient infrastructure, such as temperature-controlled storage facilities and robust supply chain networks, have been recommended to mitigate these risks. [2] Telepharmacy has been shown to improve access to medications in rural or underserved areas, especially during inclement weather or extreme climate events. This model ensures continuity of care by providing remote consultations and timely medication delivery. [3]

Component 1: Adapting treatment and management plans (cont.)

Sub-component	Milestone 1	Milestone 2 (by 2030)	Justification
3. Climate-focused medication management (cont.)			The majority of Community Health Workers (CHWs) operate in rural, minority, and underserved areas, often living within the communities they assist. Trained personnel perform pharmacy-related services such as medication packaging services, health screenings, education sessions with pharmacists. This close connection enables CHWs to become trusted members of these communities, significantly enhancing the acceptance of their services among hard-to-reach populations. [4]
References	[1] Redshaw CH, Stahl-Timmins WM, Fleming LE, et al. Potential changes in disease patterns and pharmaceutical use in response to climate change. Journal of Toxicology and Environmental Health, Part B. 2013 Jul 4;16(5):285-320. [2] Evans R. The Impact of Climate Change on Drug Safety and Efficacy. Journal of Pharmacovigilance. 2024 12:491. [3] Rural Pharmacy and Prescription Drugs. Available from: https://www.ruralhealthinfo.org/topics/pharmacy-and-prescription-drugs [4] Yoon HS, Teshome BF, Eisenbeis A, Micek ST. Pharmacy technicians trained as community health workers: A prospective multicenter cohort study. Journal of the American Pharmacists Association. 2024 Jan 1;64(1):47-54.		
Cross-cutting components: **Leadership, governance, policy** **Multisectoral approach** **Financing**	**These three components are critical and cut across the subcomponents list above.**		

Component 2: Enhancing Healthcare Delivery

Sub-component	Milestone 1	Milestone 2 (by 2030)	Justification
1. Disaster Preparedness	**Plan retrofit upgrades to hospitals and clinics to cope with extreme weather events**, incorporating flood-proofing, enhanced ventilation and heat-resistant cooling systems. **Prioritise energy resiliency by integrating renewable energy backup solutions**, such as solar microgrids and battery storage systems, to ensure operational continuity. Establish clear targets for equipping hospitals, especially those in high-risk areas, with climate-resilient infrastructure. **Urban planners and environmental agencies** develop plans for climate-resilient hospitals and sustainable energy. **Insurance and finance companies** develop models for disaster-proof healthcare infrastructure. **Develop early warning systems** linked to extreme weather alerts and patient registries, ensuring patient contact information is up to date by health systems. Work with the technology sector to develop and deploy AI-driven climate risk prediction tools for individuals living with cardiovascular-renal-metabolic diseases. **Establish pre-disaster care plans** for individuals living with cardiovascular-renal-metabolic diseases that set up how access to emergency services and medication supplies will take place. **Map out needs to strengthen availability of mobile and home dialysis and cardiac care units** for flood-prone and disaster-affected areas, with assumptions of increased frequency of extreme weather events. **Major employers (especially in high-risk industries) develop disaster response plans and provide training for occupational and safety officers** on the impacts of climate-related events on the cardiovascular-renal-metabolic health of their workers. **Stakeholders:** Healthcare sector, patient groups, emergency and disaster units, government, energy sector, community leaders, technology sector, employers	**Implement upgrades to hospital and clinic infrastructure** to withstand extreme weather events, and evaluate safety of constructions. **Ensure healthcare workers and first responders have been trained** on specific climate-related disaster protocols in relation to these conditions, as well as ensuring there is continual monitoring of the effectiveness of early warning systems, and the supply of emergency medication and pre-disaster care plans. **Implement mobile and home dialysis and cardiac care units** for flood-prone and disaster-affected areas as well as develop temporary pop-up clinics in schools, community centers, and relief shelters during emergencies. **Major employers act on their emergency response planning, ensuring continued access to critical care** (eg, dialysis, insulin) for affected employees. Occupational and safety officers are skilled in identifying and supporting at-risk workers, incorporating early warning systems (such as alerts for heatwaves or air-quality indexes).	Extreme weather events—heatwaves, hurricanes, floods, and wildfires—disrupt healthcare infrastructure, medication supply chains, and emergency response capacity. People living with cardiovascular-renal-metabolic diseases face heightened risks due to dehydration, reduced access to dialysis, medication instability and cardiovascular stress during disasters.[1] In fact cardiovascular diseases linked to climate change can be influenced by adaptation strategies; however, this may lead to considerable health disparities, as individuals and communities with lower socioeconomic status have fewer options for adaptation.[2] For example, ensuring access to diagnostic, blood pressure monitoring tools and diabetes kits during climate disasters have been suggested as essential in identifying and managing cardiovascular and diabetic disease progression.[3-4] An island in the Philippines vulnerable to extreme weather events, mapped rescue routes and times to the hospital and suggested areas where point-of-care cardiac troponin testing facilities should be implemented to identify and expedite care of acute myocardial infarction for harder to reach populations.[5] Emergencies can create a variety of hazards for workers in the impacted area. Preparing before an emergency incident plays a vital role in ensuring that employers and workers have the necessary equipment, know where to go, and know how to keep themselves safe when an emergency occurs.[6] For instance, during Hurricane Ian, dialysis-dependent employees with end-stage kidney disease (ESKD) were at heightened risk when supply chain disruptions impeded access dialysis.[7] Employers play a role in employee safety and evacuation to ensure that employees are not exposed to an unreasonable risk of injury or death.[8] Innovative devices and technologies (eg, physiological status monitor (PSM) and Ultra-Wideband (UWB)) are being used to real-time location tracking and physiological status of construction workers for enhancing construction safety and productivity. A Hong Kong study has established an algorithm to develop an early-warning system against hot and humid climates, which can alert workers to occupational heat stress and provide intervention measures as well.[9]

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Component 2: Enhancing Healthcare Delivery (cont.)

Sub-component	Milestone 1	Milestone 2 (by 2030)	Justification
References (cont.)	[6] US Department of Labor. Occupational Safety and Health Administration. Emergency Preparedness and Response. Available at: https://www.osha.gov/emergency-preparedness [7] Shakour RL, Mithani Z, Kopp JB, et al. Safeguarding Patients with End-Stage Kidney Disease From Climate-driven Extreme Heat and Hurricanes. Disaster Medicine and Public Health Preparedness. 2024;18:e124. doi:10.1017/dmp.2024.97 [8] Shillingstad HA. Hurricane Ian and Preparing for Landfall: Employer Best Practices in the Face of a Natural Disaster]. Natlawreview.com. National Law Review; 2022. Available from: https://natlawreview.com/article/hurricane-ian-and-preparing-landfall-employer-best-practices-face-natural-disaster [9] Yi W, Chan APC, Wang X, Wang J. Development of an early-warning system for site work in hot and humid environments: A case study. Automation in construction. 2016. 62; 101-113. https://doi.org/10.1016/j.autcon.2015.11.003 Available at: https://www.sciencedirect.com/science/article/abs/pii/S0926580515002289		
2. Decentralised delivery	**Healthcare systems draft plans that enable telemedicine** to be activated in the delivery of care for people living with cardio-renal-metabolic diseases in the light of climate-related events, when patients can't access care. Health National Adaptation Plans are written to ensure the availability of telemedicine for these vulnerable people. **Convene committees to establish small, modular health centers** across rural and underserved communities. **Engage pharmaceutical companies and logistics companies** to ensure they have commenced contingency planning for the delivery of medications and mobile health services. **Stakeholders:** Local, national and regional government (health), policymakers, public health departments, healthcare providers, telemedicine and digital health companies, pharmaceutical and medical device manufacturers, logistics & supply chain providers, payors & insurance companies, patient advocacy groups, NGOs and community organisations	**Telemedicine has been tested and partially rolled out in the highest climate-risk areas**. Health professionals, pharmacists, nurses and community health workers have received training on how to use telemedicine platforms, how to engage patient confidence, and have received adequate legal/reimbursement support for this emerging model of care. **Patients are given time and information to adjust and gain trust in remote care, taking into account cultural differences**. Existing telemedicine services are expanded to include pharmacist-led and nurse-led clinics. **Small modular health centers are starting to be set up** in rural and underserved regions, particularly across low and middle income countries. **Pharmaceutical companies and logistics companies** ensure efficient supply chain and last mile delivery of medications and mobile health services.	Flexible telemedicine services are vital for maintaining care continuity during disasters. Familiarity with telemedicine has demonstrated better health outcomes for conditions like diabetes, hypertension, and coronary artery disease in the aftermath of events such as wildfires and floods.[1-4] Expert panellist Bertalan Meskó stressed the importance of building relationships based on trust in relation to remote care.[5] Adopting telemedicine and remote monitoring technologies can reduce the need for patient travel, thereby lowering carbon emissions associated with transportation. Remote consultations and monitoring allow for efficient care delivery while minimising environmental impact.[6-8] In nephrology, telemedicine projects piloted by the Green Nephrology Programme in the UK saved six tons of CO_2 annually during their initial phase.[7] Research identifies best practices for designing healthcare facilities in rural and remote areas that promote high-quality and sustainable services.[9] Pharmaceutical logistics ensures the health system consistently provides medicinal supplies and tools, manages waste disposal, cleaning, sterilization, and other activities that support the control process.[10]
References	[1] Hassan S, Nguyen M, Buchanan M, et al. Management of chronic noncommunicable diseases after natural disasters in the Caribbean: A scoping review. Health Affairs, 2020. 39(12): p. 2136-2143. [2] Shankar A, Kesavadev J, Krishnan G, et al. Impact of Follow-Up Interventions on Diabetes Management during Floods. Diabetes Research and Clinical Practice, 2024. Conference: IDF Virtual Congress 2023. Virtual. 209(Supplement 1) (no pagination). Available from: https://www.diabetesresearchclinicalpractice.com/article/S0168-8227(24)00186-4/abstract [3] Friedman, R.S.C., et al., Telemedicine Familiarity and Post-Disaster Utilization of Emergency and Hospital Services for Ambulatory Care Sensitive Conditions. American Journal of Preventive Medicine, 2022. 63(1): p. e1-e9. [4] Fawad M, Ullah S, Xu X. Climate-responsive telemedicine: Innovative strategy for enhancing healthcare in the face of climate change. J Glob Health. 2024 Oct 18;14:03043. [5] Economist Impact expert panel; 2025 (Bertalan Mesko). [6] Otero González A, Chronic kidney disease, dialysis and climate change. Nefrología (English Edition), 2024. 44(3): p. 331-337. Available from: https://www.revistanefrologia.com/en-chronic-kidney-disease-dialysis-climate-articulo-S2013251424001287 [7] Yau A, Agar JWM and Barraclough KA, Addressing the Environmental Impact of Kidney Care. American Journal of Kidney Diseases, 2021. 77(3): p. 406-409. [8] Rodler S, Ramacciotti LS, Maas M, et al. The Impact of Telemedicine in Reducing the Carbon Footprint in Health Care: A Systematic Review and Cumulative Analysis of 68 Million Clinical Consultations. European Urology Focus, 2023. 9(6): p. 873-887. [9] Staloch K. The Architecture of Rural Healthcare: Supporting access to health in remote and rural areas. Clemson OPEN. 2015. Available from: https://open.clemson.edu/all_theses/2151/ [10] Iliashenko O, Iliashenko V, Filippova K, Lohyeeta N. Pharmaceutical Logistics: Features and Challenges. InXIV International Scientific Conference "INTERAGROMASH 2021" Precision Agriculture and Agricultural Machinery Industry, Volume 1 2021 Oct 31; 493-501. Cham: Springer International Publishing. Available from: https://link.springer.com/chapter/10.1007/978-3-030-81619-3_56		

Component 2: Enhancing Healthcare Delivery (cont.)

Sub-component	Milestone 1	Milestone 2 (by 2030)	Justification
3. Early warning systems and surveillance	**Design warning systems so that they consider health impacts and not just climate and weather based**. Draft plans for effective early warning systems are integrated with surveillance for climate-related events (such as heatwaves). Drafts plans on how alerts are delivered to healthcare professionals and patients (texts, emails etc) and how data is collected at scale. Ensure there is wide collaboration across sectors (including urban and environmental) and patient advocacy groups so the process is inclusive of people living with cardiovascular-renal-metabolic conditions. **Healthcare providers create plans and invest in the development of electronic health records to identify people** living with cardiovascular-renal-metabolic diseases and at risk of climate-related events to aid care continuity. Introduce automated patient alerts for high-risk conditions triggered by extreme weather events. **Technology and AI companies start to develop advanced predictive analytics** for wearable devices, providing real-time climate-health risk detection and enabling immediate alerts and proactive care. **Draft plans to expand 5G coverage into rural and at risk areas**, to enable seamless telemedicine and remote patient monitoring. **Stakeholders:** Government (digital, industry, science, health), health systems, healthcare providers, public health planners, technology and AI firms, mobile network and telecom providers	**Finalise plans for early warning systems and surveillance**, as well as pragmatic delivery and communication plans. **Monitor the effectiveness of healthcare system climate-related alerts for high-risk individuals** living with these diseases. Developed countries will monitor healthcare staff awareness of the alerts, and whether they are effective and pragmatic. **Healthcare systems begin integrating electronic health records with environmental monitoring systems.** **Expand 5G connectivity into rural areas** to enable seamless telemedicine and remote monitoring. Telecoms expand coverage of 5G connectivity through new investments in connectivity infrastructure.	UN bodies such as the WHO and UN Environment advocate for early warning systems in multiple guidance documents (and this is supported by Professor Kristi Ebi in an Economist Impact interview).[1-3] Remote healthcare technologies allow people living with cardio-renal-metabolic conditions to receive real-time monitoring and support, reducing hospital visits and improving emergency response. Efficient identification, contact and monitoring of people living with cardiovascular-renal-metabolic diseases before and during climate-related events are crucial for reducing risks and ensuring care continuity.[4] Identifying at-risk populations using tools like Acute Kidney Injury warning algorithms and monitoring electrolyte imbalances can prevent related complications.[5] Among heat-stressed workers, early markers like leukocyturia and haemoglobin, measurable through point-of-care methods, have been identified as early indicators of kidney injury and rapid estimated glomerular filtration rate decline.[6] Wearable technologies can also be used by employers. Heat-related illnesses and injuries persist as an occupational health management challenge. This scoping review[7] evaluates common wearable technologies used for real-time data collection to conduct heat-related risk assessments. One of the findings of the scoping review is that fostering collaboration between researchers, industry stakeholders, and end-users is paramount to advancing the development and deployment of wearable solutions tailored to the unique demands of different work environments. Some advanced countries have already drafted plans for nationwide coverage of standalone 5G to all populated areas by 2030, with e-medicine in mind.[8,9]

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Component 2: Enhancing Healthcare Delivery (cont.)

Sub-component	Milestone 1	Milestone 2 (by 2030)	Justification
4. Equitable, inclusive access to quality care	**Build policies that expand foundational access to cardiovascular-renal-metabolic care in an equitable, inclusive way without putting individuals (and families) into financial hardship**. **Ensure socio-economically vulnerable communities** are prioritised to receive quality healthcare services as a foundation for any climate-adapted healthcare system. **Bring in campaigns that show primary healthcare and community health workers** can take on a greater role in the response to climate-related cardiovascular-renal-metabolic health threats. **Stakeholders:** Payors, government (health), healthcare providers, healthcare professionals, communities, patients, primary care providers, NGOs, private and voluntary sector, civil society	**Develop guidelines for integrating climate-sensitive risk assessments into primary care workflows**. Medical practitioners implement universal screening for high-risk individuals across high-income and LMICs. Ensure that climate-sensitive risk assessment tools are embedded into primary care. **Governments (ministry of health) mandate preventive care programs as part of universal healthcare coverage.** **Monitor the progress of nations towards universal health coverage (UHC)** as a foundation for climate adapted inclusive healthcare systems, by assessing the WHO's UHC Index. The global health community should aim to raise this index by three points by 2030. **Mobilise public-private-partnerships** that encourages equitable, inclusive access to quality care for people, including those most vulnerable to climate change such as those living with cardiovascular-renal-metabolic diseases. **Mobilise sufficient funding for primary and community care**, including that from the Health Impact Investment Platform (HIIP), which is aimed at climate-adaptive primary healthcare in the most vulnerable nations.	The WHO has been monitoring movement towards UHC and believes that, "To build back better, WHO's recommendation is to reorient health systems using a primary health care (PHC) approach. Most (90%) of essential UHC interventions can be delivered through a PHC approach, potentially saving 60 million lives and increasing average global life expectancy by 3.7 years by 2030. " EI has been pragmatic in considering three points, as the index rose by only three index points between 2015 and 2021.[1-3] The HIIP platform, which was set up in 2023, innovates multilateral solutions to increase the share of development funding going to the health sector. It aims to raise US$1.5bn for low- and middle-income country governments to build resilience against the climate crisis and pandemics.[4]
References	[1] Economist Impact expert panel; 2025 [2] WHO. What are the Overall Principles of HBP Design? Available from: https://www.who.int/teams/health-financing-and-economics/economic-analysis/health-technology-assessment-and-benefit-package-design/resource-guide-for-the-use-of-hta-and-hbp-design-processes/what-are-the-overall-principles-of-hbp-design [3] WHO. Universal health coverage (UHC). Available from: https://www.who.int/news-room/fact-sheets/detail/universal-health-coverage-(uhc) [4] WHO. New Health Investment Platform to improve primary health care convenes its first Steering Committee. Available from: https://www.who.int/news/item/18-03-2025-new-health-investment-platform-to-improve-primary-health-care-convenes-its-first-steering-committee		
Cross-cutting components: **Leadership, governance, policy** **Multisectoral approach** **Financing**	**These three components are critical and cut across the subcomponents list above.**		

Component 3: Greening health systems

Sub-component	Milestone 1	Milestone 2 (by 2030)	Justification
1. Reducing resource intensity	**Set up energy efficiency and waste reduction mandates for healthcare facilities and services, in partnership with government, healthcare providers, environmental agencies and the energy sector**. Funding and incentives are allocated for renewable energy adoption that may be used for cardiovascular-renal-metabolic services. **Healthcare providers begin upgrading dialysis centers with more efficient and environmentally-friendly machines**, such as piloting reverse osmosis (RO) systems, peritoneal dialysis and home-based dialysis. Providers begin upgrading to lower-energy imaging alternatives such as echocardiology, and where feasible and safe, encourage the use of devices (in diabetes and cardiovascular care) that use less plastic waste. **Dialogue initiated with pharmaceutical, medical device and technology companies** for the development of environmentally friendly, low-energy medical products and devices used in renal, diabetic and cardiology care. **Healthcare leaders bring in communications that frame any planned rollout of telemedicine initiatives and remote monitoring as "carbon-saving".** **Healthcare providers introduce regular training for healthcare staff** on energy-efficient processes, waste reduction, active transport, as well as educating patients on home-based dialysis and digital health solutions. **Researchers and academia gather evidence on the feasibility, effectiveness and affordability of green care model pathways for cardiovascular, renal and metabolic diseases.** **Stakeholders**: Healthcare providers, medical device and pharmaceutical industry, energy sector, waste sector, healthcare professionals, patient groups, government, sustainability accreditation & standards bodies, professional medical associations, sustainability NGOs	**Energy efficiency and waste reduction mandates are starting to be implemented across the healthcare sector**. This includes the scale up of renewable energy projects in hospitals and the use of environmentally-friendly dialysis and cardiac care services. Embedding waste policies that standardise medical waste segregation and recycling programmes across facilities, while partnering with the waste management industry to repurpose medical plastics and hazardous materials. **Ministries of Health implement incentives for hospitals achieving sustainability targets.** **Waste management companies to repurpose plastics and recycle hazardous materials.** **Medical device, pharmaceutical and technology companies** begin research into low-carbon cardiovascular, renal, diabetic products, improved packaging, circular supply chains, and power purchase agreements for green energy. They commence signing power purchase agreements (for green energy), and sourcing materials from their suppliers with green credentials. **Medical societies and patient groups use the "carbon-savings" frame** for encouraging telemedicine adoption, home-based dialysis, and remote monitoring. **Healthcare providers and medical societies monitor the uptake (and attitudes) of healthcare staff** towards energy-efficient processes, waste reduction, and patient engagement on home-based dialysis and digital health solutions. **Healthcare providers bring in aspects of green care model pathways** (based on scientific evidence), without compromising the safety, quality, effectiveness, and the availability of care for people living with cardiovascular-renal-metabolic diseases.	Healthcare services delivering care for those living with cardiovascular, renal and metabolic care diseases are resource-intensive and contribute significantly to environmental degradation. Nephrology, especially dialysis care, has a disproportionately high environmental footprint due to intensive water and energy consumption and substantial waste generation. Researchers have found that if 20 green nephrology initiatives were brought in all kidney units in England, the NHS could save £7m, as well as 470m litres of water and 11,000 tonnes of Co2equivalent.[1-4] Diabetes care contributes through the widespread use of single-use plastics in insulin pens, test strips, and continuous glucose monitoring systems, leading to substantial medical waste.[5] Cardiovascular care is inherently resource-intensive, with procedures and treatments generating substantial waste and environmental impact.[6] For instance, cardiac catheterization labs rely heavily on single-use devices, contributing significantly to medical waste. Each cardiac catheterization procedure can produce up to 1.4 kg of waste, and with over 1m procedures performed annually in the US, the cumulative environmental footprint is considerable.[7-8] Additionally, advanced cardiac imaging techniques such as CT angiography and MRI, have seen a dramatic increase in associated CO2 emissions, with a tenfold increase for CT angiography and a staggering hundredfold increase for cardiac MRI within the past decade.[9] There are examples of leveraging remote monitoring technologies for home dialysis, such as wearable sensors, which minimises in-person clinic visits and reduces logistical energy costs.[10] Further efforts to reduce the carbon footprint of dialysis care through innovations such as water recycling, energy-efficient machines, and biodegradable consumables.[11] To create a sustainable healthcare system, certain decisions should be made during the initial planning, design, and construction phases, while several can be implemented once hospitals are operational.[12] Despite advancements in healthcare waste disposal technologies, the widespread adoption of eco-friendly disposal and management methods remains limited due to challenges related to cost, accessibility, and practicality.[13] The healthcare industry can enhance its decarbonization initiatives by promoting sustainable energy training and practices among staff. This can be achieved through environmentally focused servant leadership (ESL), fostering green self-efficacy (GSE), and ensuring green perceived organizational support (GPOS).[14]

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Component 3: Greening health systems (cont.)

Sub-component	Milestone 1	Milestone 2 (by 2030)	Justification
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2. Low-carbon and environmentally-sustainable food	**Initiate multisectoral engagement between government and the healthcare, food, retail and agriculture sectors** to promote and develop low-carbon, sustainable and healthy diets that reduce the incidence of cardiovascular, renal, metabolic disease (and their environmental impact). Align this with public healthy living campaigns while strengthening investment into the root causes of these diseases (social, environmental and commercial determinants of health). **Stakeholders**: Government (education, industry, health, welfare, housing), industry (food, retail, agriculture), healthcare sector, civil society, local councils, academia and researchers, media, social impact investors	**The food, retail and agricultural sectors improve their product offerings** and operational processes to enhance alignment with healthy lifestyle practices, by creating minimally processed, environmentally sustainable foods. Gain industry-wide consensus on the principle that human health should be a leading priority and the first premise of business. **Introduce local financial incentives for grocery stores and fresh food markets to open in low-income neighbourhoods**, ensuring access to affordable, nutritious and environmentally-sustainable food.	Preventing the onset and progression of cardiovascular, renal and metabolic diseases reduces the demand for resource-intensive treatments. Public health initiatives that promote healthy lifestyles, such as balanced diets, physical activity, and smoking cessation, lower the incidence of diabetes and cardiovascular diseases.[1-2] Early identification and management of CKD can prevent progression to end-stage renal disease, reducing the need for dialysis or transplantation.[3-4] This is in line with the Planetary Health Framework for Sustainable Kidney Care by reducing demand for kidney care services.[5] Healthcare policies that facilitate prevention, early detection and proactive management of cardiovascular, renal and metabolic diseases can reduce the burden on healthcare systems and the environment.[6-7] For example, maintaining or improving glycaemic control, for example, has been shown to reduce the risk of developing diabetes-related complications but is also associated environmental benefits.[8] By emphasising primary and secondary prevention within the framework of universal health coverage and empowering patients to self-care, not only can health outcomes be improved but the environmental impact reduced.[9-11]
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Component 3: Greening health systems (cont.)

Sub-component	Milestone 1	Milestone 2 (by 2030)	Justification
3. Sustainable procurement	**Governments and regulatory agencies develop regulations, fund sustainability initiatives and set procurement standards. Public procurement organisations develop sustainable procurement guidelines for the healthcare sector**. This can include carbon footprint disclosures, lifecycle assessments, improved packaging and greener transportation, for the medical equipment and pharmaceutical suppliers. Consultations are commenced between healthcare providers, regulatory agencies, industry and government partners to set **industry-wide sustainability benchmarks**. **Hospitals and clinics improve their procurement across their supply chain by identifying and engaging low-carbon suppliers with transparent sustainability standards** for cardiovascular-renal-metabolic related healthcare products. They launch hospital and clinic wide initiatives to reduce single-use plastics in medical procedures as well as establish pilot programs for reusable and biodegradable medical devices. Develop regional recycling and material repurposing programmes in hospitals and encourage supplier commitments to sustainable packaging innovations. **Identify potential financing mechanisms that support healthcare sustainability.** Governments and public health agencies implement tax incentives for companies focusing on greening healthcare systems through new medical devices, regenerative and circular approaches, low carbon solutions; as well as providing incentives for hospitals and clinics that adopt low carbon/green practices. **Stakeholders**: Healthcare sector, medical device and pharmaceutical industry, public procurement bodies, procurement officers, finance sector and development banks	**Public procurement organisations communicate and mandate the gradual introduction of sustainable procurement guidelines across the sector.** This ensures healthcare procurement contracts mandate carbon reporting as well as supplier adherence to sustainability criteria. Some public procurement bodies may introduce incentives for manufacturers, including environmental, social and economic weightings. **Hospitals and clinics ramp up reductions in single-use plastics** across cardio-renal-metabolic healthcare delivery. They communicate with manufacturers to scale take-back programmes for medical devices, as well as standardise waste recycling initiatives in hospitals and clinics, particularly in dialysis units. **Hospitals and clinics work with procurement officers to integrate sustainability into purchasing decisions**. Industry wide initiatives to improve circularity and the greening of the supply chain—such as implementing large-scale pilot programmes for biodegradable diabetes and cardiovascular care devices—are fostered. **Healthcare procurement officers are fully trained** on effective and sustainable procurement processes and practice. **Green bonds and climate funds are mobilised to finance healthcare sustainability.**	Multilateral procurement organisations, such as UNICEF and PAHO can drive industry-wide shifts toward sustainable procurement by integrating sustainability criteria into their processes, such as prompting suppliers to report their emissions.[1] They could also integrate incentives, such as legal instruments or environmental weightings, into their contracts with suppliers.[1] Healthcare organisations can also support sustainability by partnering with suppliers who engage in environmentally-friendly practices. Dialysis organisations, for example, can prioritise suppliers that use sustainable packaging and shipping methods.[2] In diabetes and cardiovascular care, sourcing medications and devices from manufacturers committed to reducing their carbon footprint and using sustainable materials can also make a significant environmental impact.[3-4] The Green Climate Fund (GCF) was established in 2010 to help mobilize funding for low-emission and climate-resilient development. According to WHO's Operational Framework for Building Climate Resilient and Low Carbon Health Systems, the GCF is recognized as a key funding source for climate and health projects. It supports initiatives submitted to major international climate change funding mechanisms, including the GCF itself, the Global Environment Facility (GEF), the Adaptation Fund (AF), and various bilateral donors.[5]
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Cross-cutting components: **Leadership, governance, policy** **Multisectoral approach** **Financing**	**These three components are critical and cut across the subcomponents list above.**		

Component 4: Raising awareness and education

Sub-component	Milestone 1	Milestone 2 (by 2030)	Justification
1. Green knowledge and healthcare staff training	**Start to introduce climate change and health modules into the curricula** of medical, nursing, and allied health schools. **Initiate dialogue** with government (education department) and philanthropic organizations on the need to allocate **funding** to support schools integrating this curricula. **Develop postgraduate training** on climate-related-disease-specific training, including early warning measures, for healthcare workers, including cardiologists, nephrologists and endocrinologists. **Encourage professional bodies** to provide awareness, continuing education and training materials on the impacts of climate change on individuals living with cardiovascular-renal-metabolic diseases, the importance of engaging with early warning mechanisms, and the role of remote patient care. (Such bodies include the International Society of Nephrology, Kidney Associations, World Heart Federation, and the International Diabetes Federation.) **Healthcare providers receive funding to develop toolkits, education and training for healthcare workers** (including specialists and community workers), recognising heat-related illness and dehydration in people living with cardiovascular-renal-metabolic conditions, and how best to share evidence-based adaptation strategies and alerts. Train staff on how to select sustainable products and services for people living with cardiovascular-renal-metabolic diseases. **Ensure a co-designed, patient-centric approach is built into climate related modules, education and training**, so healthcare staff can adjust adaptation strategies to work with patient lifestyles and preferences. **Foster multisector collaboration** with other sectors, including the labour, urban and environmental sector, industries (such as the pharmaceutical and healthcare insurance) on the integration of climate-health awareness, sustainability strategies and education into the curricula and training of staff. **Stakeholders**: Patients, healthcare providers, healthcare professionals, government, universities, students, community health workers, labour, urban, environment sectors, professional societies, communities	**Mandate medical, nursing, pharmacy, and allied health schools to have modules on planetary-health and climate change impacts on chronic diseases**. Monitor the number of schools that have introduced modules. **Healthcare facilities (clinics, hospitals and others centres)** introduce routine healthcare staff training on the impacts of climate change on these diseases, climate resilience, disaster preparedness, and low carbon sustainability, by 2030. **Work with communities to promote healthcare facilities are protected from climate-related impacts, and ensure contingency planning** takes into account whether healthcare staff transportation is in place to react to climate events. **By 2030, annual healthcare training and advocacy efforts are targeted** to those living in the most prone areas to climate-related weather events. **Train community health workers (CHWs) to deliver climate-health literacy sessions in hard to reach places**. Focus on high-risk groups (eg, indoor and outdoor workers, older populations, those living with comorbidities). **Utilise patient surveys to capture patient experiences and preferences on adaptation strategies**, such as accessing healthy diets, alternative forms of dialysis, the use of air pollution alerts and telemedicine. Feedback the survey results to trainers and educators to improve services and care.	Some medical schools have begun embedding planetary health and environmental sustainability into their curricula, however, similar efforts are needed at the postgraduate level.[1-3] Global initiatives such as the Climate Change and Human Health series of the Extension for Community Healthcare Outcomes Project (Project ECHO), delivers virtual mentoring programme to address the climate and health educational needs of health-care and public health professionals in more than 190 countries.[4] Project ECHO, alongside organisations including the Association of Schools of Public Health in Africa (ASPHA) and CDC-Africa, is also supporting the delivery of Africa Climate and Health Responder Course which aims to equip African health professionals with essential skills to identify, communicate, respond to, and prepare for climate-related health impacts.[5] Organisations specific to cardiovascular, renal and metabolic diseases are key to building sustainability awareness within their disease specialities, with organisations such as the UK's Kidney Association and Australia New Zealand Society of Nephrology taking initial steps to promoting sustainable kidney care through the education of healthcare professionals.[6-8] Professional societies, including the American Society of Nephrology (ASN), have taken strong positions on climate advocacy, calling on kidney health professionals to take action to address the impact of climate change on the 850m people living with kidney diseases globally who are uniquely vulnerable. They have recently also joined the Medical Society Consortium on Climate and Health to amplify efforts for sustainable healthcare. [9, 10] The World Heart Federation has formed an Air Pollution Expert Group to inform policy action on air pollution for CVD health.[11] In 2012, the International Diabetes Federation already called for the scale up of development aid and technical assistance for climate change adaptation for diabetes and NCDs, and emphasising that health systems in LMICs are ill-equipped to adapt to the rising diabetes burden and climate extremes.[12] Training community health workers not only provides access to healthcare in remote areas, increases the overall quality of care and confidence in the health system, and also saves time and cost for patients in remote areas. [13]

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Component 4: Raising awareness and education (cont.)

Sub-component	Milestone 1	Milestone 2 (by 2030)	Justification
References (cont.)	[10] American Society of Nephrology, Statement on Climate Change. 2022. Available from: https://www.asn-online.org/policy/webdocs/22.4.22StatementOnClimateChange.pdf [11] Brauer M, Davaakhuu N, Escamilla Nuñez MC et al. Clean Air, Smart Cities, Healthy Hearts: Action on Air Pollution for Cardiovascular Health. Global Heart, 2021. 16(1): 61. [12] International Diabetes Federation. Diabetes and Climate Change Report. 2012. Available from: https://idf.org/media/uploads/2023/05/attachments-15.pdf [13] De Roodenbeke E, Lucas S, Rouzaut A, Bana F. Outreach services as a strategy to increase access to health workers in remote and rural areas. WHO. 2011 Jul 17.		
2. Patient awareness and public sector advocacy	**Government departments (health, environment, labour and urban), public health bodies and professional societies launch public and patient awareness campaigns on self-management (such as staying hydrated, seeking shade), emergency preparedness, and resilience in light of climate events, such as heatwaves**. Ensure campaigns prioritise vulnerable people living with cardiovascular-renal-metabolic diseases, who underestimate their risk from heat-related events. Ensure campaigns are created through multisector co-design and contain disease-specific disaster risk toolkits for people living with cardiovascular-renal-metabolic diseases, which will support better implementation. **Collaborate with media on campaigns that educate the public** on the benefits of low carbon dietary and improved lifestyle habits, and receiving air pollution or early warning alerts, which will encourage action and mutual benefit. Involve civil society, environmental and climate change groups, urban actors and healthcare professionals so they can advocate for awareness of the impact of climate change on people living with these diseases at a local, national or international level. Create local heat health networks to encourage broad stakeholder engagement. **Hospitals, clinics, health providers, insurance companies and employers should expand awareness of care continuity options** during climate disruptions, particularly for those requiring specialised services like dialysis and wound care. Enhance stakeholder ownership in this matter by establishing committees and incentivizing participation. **Stakeholders**: Government agencies (departments of health, environment, labour, urban, development, education), public health bodies, media, civil societies, NGOs, local authorities such as municipality, healthcare providers (public and private), employers, patient advocacy groups	**Monitor the effectiveness of awareness campaigns through surveys**, by asking questions about self-management, behaviour change and emergency preparedness. Check if messages have reached specific target/vulnerable patients living with cardiovascular-renal-metabolic conditions, and if disaster risk kits have been distributed in disaster prone areas. **Engage broader multisectoral stakeholders to help** expand public health campaigns for climate-resilience. **Acknowledge successes through awards and public recognition**.	Awareness campaigns should target individuals living with cardiovascular, renal and metabolic diseases, many of whom may underestimate their risk from heat-related events. Several campaigns to tackle the impact of heat stress on workers have been recently launched, including a global campaign led by the US, Brazil and International Labour Organization (ILO) and through the Partnership for Workers' Rights (PWR). A US study found that only 44% of adults were aware that air pollution affects heart disease.[1] Another US study found that having a cardiovascular condition did not have significant effects on reported intentions to seek information about ambient air quality.[2] A study in England found that only 26.8% of potentially vulnerable adults aged 18–74 and in poor health, including living with chronic diseases, altered their behaviour during heat alerts, often prioritising concerns about sun exposure over the direct health effects of heat.[3] Public health messaging must therefore emphasise the broader risks of extreme heat and the importance of protective behaviours, such as staying hydrated, seeking shade, and monitoring medications that affect thermoregulation, prioritising patients with these diseases who are most at risk.[4] The American Heart Association, for example, has provided guidance on their website for individuals on how to protect their heart in the heat.[5] Similarly to create awareness around the health impacts of air pollution, the United States Environmental Protection Agency (EPA)'s AirNow mobile app tool was developed to provide information on health risks of air pollution and live air quality information, however knowledge of this app amongst the population was found to be low.[6] Advocacy at individual, provider, and systemic levels is essential to prepare healthcare systems for the impact of climate change on cardiovascular, renal and metabolic diseases.[7] Clinicians are urged to promote community cooling centres, shaded exercise spaces, and public health campaigns to protect vulnerable populations, such as CKD and CVD patients.[8] The skill and expertise of various healthcare professionals involved in the care of these individuals, such as cardiovascular nurses, should be harnessed in order to lead change.[9] Healthcare professionals, as trusted members of society, can engage policymakers, join organisations like the "Medical Society Consortium on Climate and Health," and support climate-focused, low carbon healthcare solutions.[6, 10]

Component 4: Raising awareness and education (cont.)

Sub-component	Milestone 1	Milestone 2 (by 2030)	Justification
2. Patient awareness and public sector advocacy (cont.)			Awareness on continuity of care is paramount during climate disruptions—particularly for patients requiring specialised services such as dialysis or wound care. A case study from Hurricane Maria highlighted the insurance barriers many patients faced, underscoring that individuals with cardiovascular, renal, and metabolic conditions may be unaware of coverage options during emergencies. Empowering patients with clear guidance on their insurance benefits and eligibility can help ensure uninterrupted care when climate-related events disrupt normal healthcare access.[11]
References	[1] Dowling TC, Pennington AF, Wall HK et al. Air Quality Perceptions, Awareness, and Associated Behaviors Among U.S. Adults With and Without Heart Disease. AJPM Focus, 2024. 3(4):100249. [2] Altinay Z and Crosswell L. Public perceptions of air pollution and associated health risks in Nevada, USA: applications for health communication. Journal of Communication in Healthcare, 2024. 17(2): 205-213. [3] Erens B, Williams L, Exley J, et al. Public attitudes to, and behaviours taken during, hot weather by vulnerable groups: results from a national survey in England. BMC Public Health, 2021. 21(1):1631. [4] Gallagher A, Smyth B, Jha V. Climate Change, Heat-Related Acute Kidney Disease, and the Need for Action. American Journal of Kidney Diseases, 2023. 81(5):501-503. [5] American Heart Association. Protect Your Heart in the Heat. 2024; Available from: https://www.heart.org/en/health-topics/consumer-healthcare/what-is-cardiovascular-disease/protect-your-heart-in-the-heat. [6] Damon SA, Rupert DJ, Pryzby R. Air Aware: Improving Use of an Existing Air Quality and Health Tool. Journal of Health Communication, 2022. 27(1): 1-7. [7] Brauer M, Davaakhuu N, Escamilla Nuñez MC, et al. Clean Air, Smart Cities, Healthy Hearts: Action on Air Pollution for Cardiovascular Health. Global Heart, 2021. 16(1): 61. [8] Inglis SC, Ferguson C, Eddington R, et al. Cardiovascular Nursing and Climate Change: A Call to Action From the CSANZ Cardiovascular Nursing Council. Heart, Lung & Circulation, 2023. 32(1):16-25. [9] Khoshnaw LJ, Johnson RJ, Young SE. Ten tips on how to care for your CKD patients in episodes of extreme heat. Clinical Kidney Journal, 2024. 17(6): sfae156. [10] The Medical Society Consortium on Climate and Health. About us. 2025 Available from: https://medsocietiesforclimatehealth.org/about/ [11] Mellgard G, Abramson D, Okamura C et al. Hurricanes and healthcare: a case report on the influences of Hurricane Maria and managed Medicare in treating a Puerto Rican resident. BMC Health Services Research, 2019. 19(1): 818.		
3. Communication and societal awareness	**Multisectoral collaboration can lead to the development of clear, easy to understand and culturally sensitive messages that will form the foundation of all communication efforts on climate adaptation for improved cardiovascular-renal-metabolic health**. Adjust messages aimed at younger audiences compared to older people or certain cultural groups. Create a strong and **consistent visual identity**, including logos and color schemes, which will aid in campaign recognition across all platforms. **Create dedicated websites which will serve as a central information hub on cardiovascular-renal-metabolic health and climate change**, including evidence of effective adaptation strategies, learning activities, alerts, toolkits and resources. Drive traffic to user-friendly websites through active social media messaging. **Develop a centralised app** (eg, "ClimateHealth Hub") with real-time air quality alerts, heatwave warnings and disease-specific advice. **Stakeholders**: policymakers, government departments (such as health, environment, labour, meteorological), labour bodies, medical professional societies, app developers, communications experts, website designers	**Review and refine resources and materials** that the public and patients use (such as toolkits, websites, or social media groups or forums), to further support long-term engagement. Consider how to bridge traditional and cultural practices and beliefs that vulnerable populations, such as the elderly subscribe to which can differ to biomedicine-based approaches. **Use AI chatbots to deliver tailored advice** (eg, SMS reminders for insulin storage during floods). **Utilize data analytics** to refine messaging and channel selection **Monitor app use, website traffic and user behavior** to understand how the public and patients are interacting with the content.	Multisectoral collaboration is crucial for developing clear, culturally sensitive messages that serve as the foundation for climate adaptation communication aimed at improving cardiovascular-renal-metabolic health. Such partnerships have long been recognized for their role in addressing health inequities by fostering effective communication across diverse sectors and communities.[1] To maximize the impact of these collaborations, it's crucial to understand the unique languages and priorities of different audiences, allowing for tailored messaging that resonates with both younger individuals and specific cultural groups. As highlighted by Professor Jason Lee in the Economist Impact panel discussion, effective messaging requires tailoring strategies to engage relevant stakeholders, from government officials to healthcare providers.[2] Branding also plays a vital role in establishing a unique identity for the campaign, fostering connections based on shared values and lifestyles. The success of a health campaign relies on maintaining long-term engagement and encouraging existing participants to attract new ones.[3] A strong brand presence enhances recognition and engagement, encouraging participants to remain involved and attract new supporters. This is particularly important for health campaigns focused on climate adaptation.

Component 4: Raising awareness and education (cont.)

Sub-component	Milestone 1	Milestone 2 (by 2030)	Justification
3. Communication and societal awareness (cont.)			Organisations like the NCD Alliance and the World Heart Federation provide valuable insights into the impact of climate change on health.[4],[5] Nevertheless, there remains a significant need for improved dissemination of this information to effectively tackle the challenges posed by climate change. AI chatbots are increasingly adopted across various industries. One of the studies have shown that their use can positively influence pro-environmental attitudes.[6] By engaging users in meaningful conversations and providing relevant information, chatbots can help reinforce the importance of climate adaptation and health, thereby fostering a more informed and proactive public.
References	[1] Schiavo R. Encouraging multisectoral collaboration for health, equity, climate, and sustainability: the role of communication and advocacy. J Commun Healthc. 2024 Jul;17(2):119-122. doi: 10.1080/17538068.2024.2367366. Epub 2024 Jul 16. [2] Economist Impact expert panel; 2025 [3] Basu A, Wang J. The role of branding in public health campaigns. Journal of communication management. 2009 Feb 13;13(1):77-91. [4] Shaping a Stronger Global Plan of Action on Climate Change and Health: Key Recommendations for Impact. World Heart Federation. Available from: https://world-heart-federation.org/news/shaping-a-stronger-global-plan-of-action-on-climate-change-and-health-key-recommendations-for-impact/ [5] NCDs and climate change shared opportunities for action. NCD Alliance. Available from: https://ncdalliance.org/sites/default/files/resource_files/NCDs_%26_ClimateChange_EN.pdf [6] Chi, NTK. The Effect of AI Chatbots on Pro-environment Attitude and Willingness to Pay for Environment Protection. SAGE Open, 2024 https://doi.org/10.1177/21582440231226001		
4.Workplace awareness	**All major employers (especially high-risk industries) complete an audit to map top climate threats to workers' health (particularly those prone to cardiovascular-renal-metabolic diseases), then share findings with industry peers to spur collaboration**. Assign a chief sustainability officer to plan and oversee the climate adaptation audit and sector-wide data sharing. **Assess specific climate challenges** (eg, heat stress, air pollution, extreme weather) most relevant to their workforce (especially for those who work in physically demanding environments) and present the findings to senior management with cost/benefit metrics. **Collaborate with industry associations and multilateral organisations** (such as the International Labour Organisation) to publicise workplace awareness, research findings and best practices, so employers avoid "reinventing the wheel". **Stakeholders**: Employers, HR and occupational health and safety managers, industry/commerce associations, trade unions/ worker representatives, multilateral organisations, government (departments of labour, welfare,Health, environment), health and safety regulators, healthcare providers, community health workers.	**All major employers (especially in high-risk industries) update their occupational health guidelines** to address escalating climate threats. This milestone can be achieved by revising occupational health and safety policies, including heat-stress protocols, hydration recommendations, and work-rest cycles tailored to climate risks (such as Water, Electrolytes, Rest, Shade) —while ensuring they're adapted to local contexts. Incorporate specific cardiovascular-renal-metabolic disease scenarios—eg, dehydration risks in chronic kidney disease or insulin storage protocols for diabetes—into employer guidelines and training. **All major employers (especially in high-risk industries) to collaborate with healthcare professionals** to ensure safe medication adjustments for workers with chronic diseases during extreme temperatures or poor air quality days and coordinate with local authorities and supply chains to secure cooling stations, and safe shelter for employees with chronic diseases, especially an emergency response plan tailored to at-risk workers and vulnerable populations. Employers establish cross-sector dialogues with healthcare providers and local meteorological offices to fine-tune the occupational health guidelines based on real-time climate indicators.	Climate change significantly impacts worker health—particularly those living with cardiovascular, renal, and metabolic conditions. Extreme temperatures intensify hypertension and dehydration, which can damage the heart and kidneys.[1] Outdoor workers, such as agricultural and construction workers, are exposed to extreme weather conditions that increase the risk of heat stress and dehydration. This exposure has been linked to a higher prevalence of chronic kidney disease of non-traditional origin CKDnt among workers in hot climates.[2] Heat stress also contributes to acute kidney injury (AKI) and chronic kidney disease (CKD) due to dehydration and reduced renal perfusion. There is increasing evidence to show that occupational exposure to high temperatures are contributing to an epidemic of CKD among workers.[3],[4] Employers must therefore proactively adapt occupational health guidelines, integrating evidence-based strategies—like heat acclimatisation, work-rest cycles, fluids, including water-electrolyte-rest-shade (WERS), and improved workplace ergonomics—to mitigate heat-related kidney and heart risks.[5],[6] The Adelante Initiative in Nicaragua, for instance, demonstrated a 72% reduction in kidney injury among sugarcane workers who adopted heat-stress mitigation measures.[7] Furthermore, as noted by Professor Jason Lee at the Economist Impact expert panel, employers often view climate-health efforts as altruistic.[8] In reality, timely interventions not only protect workers but also boost productivity, creating a "win-win" rather than a zero-sum scenario. The ILO expert, Dr Halshka Graczyk, also emphasized the importance of drawing on repositories of best practices to safeguard workers.

Component 4: Raising awareness and education (cont.)

Sub-component	Milestone 1	Milestone 2 (by 2030)	Justification
4.Workplace awareness (cont.)		**Major employers (especially in high-risk industries) implement training and awareness sessions for employees,** personal protective measures, and the importance of early symptom recognition in heat-related or pollution-related illnesses and its impact on cardiovascular-renal-metabolic conditions. Offer short, interactive sessions with medical experts—eg, healthcare professionals, community health workers, specialists (cardiologists, nephrologists, occupational health workers)—to clarify how climate extremes (heatwaves, air pollution) can aggravate these conditions. Offer practical drills for heat, flood, or air-quality alerts, so employees understand early warning signs and preventive steps.	She stressed the need to act with urgency while ensuring that actions are grounded in evidence so that policies are not only timely but also represent the most effective strategies for protecting those most at-risk.
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Cross-cutting components: **Leadership, governance, policy** **Multisectoral approach** **Financing**	**These three components are critical and cut across the subcomponents list above.**		

Component 5: Improving research, data and monitoring

Sub-component	Milestone 1	Milestone 2 (by 2030)	Justification
1. Identify research needs and data	**Develop a multisectoral national research agenda on the intersection of climate change and health**. Establish a specific budget within the health system for this research, of which a portion is allocated to the impact of climate change on chronic diseases, such as cardiovascular, renal, and metabolic conditions. Establish multidisciplinary research partnerships and networks to support the development of the national research agenda, its implementation and translation into health policy. Governments and public health agencies disburse research grants and fund research to further understand the climate-health interactions on people living with cardiovascular-renal-metabolic diseases. **Identify the specific research and evidence needs on how environmental factors** affect cardiovascular, renal and metabolic diseases in diverse regions and geographies, and different demographic and ethnic groups (older adults, patients living with co-morbidities and rural communities). Collect disaggregated data to understand how climate change affects the most vulnerable people and to what extent they respond to early warnings. Trial preventive interventions such as behavior change, self-care, heat acclimation training, passive heat therapy and BP-lowering. **Expand research into the effectiveness and impact of low-carbon or greener healthcare practices**, such as greener dialysis, water recycling, limiting single use medical devices, digital and remote care, and energy efficient healthcare infrastructure. Identify areas where further data collection and research is needed into understanding how climate-friendly these practices are. **Gather data on the current level of preparedness and awareness** with the public, healthcare professionals and the health-determing sectors. Employers collect metrics on heat-related absences, near-miss incidents, and worker self-reported symptoms among staff affected by cardiovascular-renal-metabolic diseases. **Set up data-sharing agreements for research** on sustainability, new technologies, surveillance, monitoring and climate resilience. **Examine the regional legal regulations and compliance measures** aiming at protecting human health from climate change to identify current status. **Stakeholders**: Government bodies (departments of health, environment, science, and technology), National Research Councils, academic and research institutes, healthcare providers and professional organisations, multilateral organisations (eg, development banks), regulators, R&D firms	**Communicate the national research agenda widely to multisectoral stakeholders**. **Support research into the evidence between climate change and cardio-renal-metabolic conditions based on gaps identified in Milestone 1**. Based on progress made and gaps identified, expand research into how environmental factors affect cardiovascular, renal and metabolic diseases in more regions and geographies and across different demographic and ethnic groups (older adults, children, patients with co-morbidies). Collect real-world data (electronic health records, registries) to improve care pathways, identify high-risk cohorts, and enhance outcomes for these patients under climate stressors. **Based on data collected, create toolkits for local implementation of low-carbon, improved cardio-renal-metabolic care pathways**. Translate early findings into practical guidelines that healthcare facilities, employers, and local authorities can adopt to strengthen care in climate-vulnerable settings. Outline data points, resource requirements, and best practices for community-level interventions. **Ensure processes are in place for researchers to inform policymakers of research findings**, which have been published in peer-review journals.	As Dr Vivek Jha (Economist Impact expert panel) pointed out, the local implementation remains a "critical gap"—health systems need practical toolkits that address climate threats.[1] The WHO's operational framework offers a roadmap, highlighting essential components (eg, governance, service delivery, health workforce) to build climate resilience.[2] More research on the environmental sustainability of healthcare practices, particularly for resource-intensive cardiovascular, renal and metabolic disease services are needed.[3] This aligns with Milestone 1, which calls for a national research agenda that addresses environmental sustainability in dialysis and chronic disease care. Additional studies are also needed to explore the pathophysiological impacts of environmental stressors on vulnerable populations with these diseases, such as children, older people, and those living with comorbid conditions, as well as further characterise individual risk factors for climate-related events amongst individuals living with these diseases.[4, 5, 6] Further research to improve understanding of the impact of climate change, biodiversity loss and infection transmission on kidney health is also needed.[3] Likewise, bridging these research findings to actionable local solutions, such as toolkits for greener dialysis or heat-acclimation programs, underpins Milestone 2.

References

[1] Economist Impact expert panel; 2025

[2] WHO. Operational framework for building climate resilient and low carbon health systems. 2023; Available from: https://www.who.int/publications/i/item/9789240081888

[3] Meena P, Jha V. Environmental Change, Changing Biodiversity, and Infections–Lessons for Kidney Health Community. Kidney International Reports, 2023. 8(9):1714-1729.

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Component 5: Improving research, data and monitoring (cont.)

Sub-component	Milestone 1	Milestone 2 (by 2030)	Justification
2. Improving warning systems	**Investigate the effectiveness and costs of early warning systems (that utilise temperature and air pollution data)** as a mechanism to predict poor cardiovascular-renal-metabolic disease outcomes. **Collaborate with other sectors (such as environmental and meteorological agencies)** to capture real-time data at scale to develop effective early warning systems. **Undertake research on the resources needed by primary care to use health records to identify patients with cardiovascular-renal-metabolic conditions** that are at highest risk of being affected by climate related environmental hazards. **Evaluate the effectiveness of developing patient registries** for people living with cardiovascular, renal-metabolic diseases (such as diabetes and hypertension) to assist in targeted disaster response and resource allocation. **Evaluate the effectiveness of new technology (such as machine learning and AI) to predict cardio-renal-metabolic hospitalisations** during extreme weather events/heatwaves and compare the data with actual data to improve prediction capabilities of the model. **Stakeholders**: Environment, AI and data firms, academia, health sector, patient groups, meteorological services	**Link health records with environmental monitoring systems to enable real-time health risk alerts**, and understand the capacity that a healthcare system needs to absorb during climate-related natural disasters/ heatwaves. **Integrate (evidence-based) predictive machine learning models to accurately predict required hospital capacity** for cardio-renal-metabolic care during a climate emergency/extreme weather event/ heatwave. Use the data from the predictive models to support clinical management plans and strategies to protect vulnerable communities from poor cardiovascular, renal and metabolic diseases health outcomes. **Gather qualitative evidence (interviews and focus groups) and survey data from patient groups** on what works well in the uptake of early warning systems and alerts.	Early warning systems are critical for identifying climate risk thresholds, such as those for temperature and air pollution, to anticipate climate sensitive disease health outcomes including those related to cardiovascular, renal and metabolic disease.[1-2] There are several indexes and predictive models that have been evaluated in recent years. In one Korean study, it was found that wet-bulb globe temperature (WBGT) failed to predict cardiovascular hospitalisations during heatwaves.[3] Another study conducted in subtropical Hong Kong, and which used the Adjusted Wind Chill Equivalent Temperature Index (AWCET), was able to predict cardiovascular mortality.[4] Another study examining Twitter and Google search terms related to weather, medical, recreational, and adaptation as potential surveillance indicators, found inconsistent relationships between renal illness and search data, and no association between data and cardiovascular illness cases.[5] For air pollution risk thresholds, one study examining the spatiotemporal air quality health index (ST-AQHI), was able to demonstrate its potential in predicting CVD specific health outcomes.[6] Similarly, the AQHI exhibited best fit to CVD related physician visits during all wildfire seasons in the British Columbia region of Canada.[7] A study in the US which used both temperature and air quality parameters in their model was able to predict cardiovascular hospital admissions.[8] Ongoing efforts are needed to develop and locally validate early warning systems with predictive accuracy that can support evidence-based clinical management plans and strategies to protect vulnerable communities from poor cardiovascular, renal and metabolic health outcomes.
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Cross-cutting components: **Leadership, governance, policy** **Multisectoral approach** **Financing**	**These three components are critical and cut across the subcomponents list above.**		

A note on methodology

Many methods used in the field of futures studies[1] address a number of goals, such as appraising the probable, imagining the possible, and deciding on the preferable.

Economist Impact decided to focus on the "preferable" in creating our Vision 2030 for cardio-renal-metabolic diseases.

While we acknowledge that there are many challenges facing healthcare systems over the next five years, we believe a pathway to impact map for health adaptation for these conditions serves as a reminder of the gravity of the climate crisis and suggests opportunities for action. Furthermore, considering the short-term nature of political cycles and their associated funding rounds, Economist Impact believes a short five year vision to 2030 will have more resonance with policymakers, healthcare actors and stakeholders whose actions have an impact on health, as well as complementing the 2030 SDGs goals.

We started with a literature review to understand the impact of climate change on cardio-renal-metabolic diseases where we developed a draft optimised Vision and the drafted key components for consideration in a backcasting framework that mostly addressed adaptation strategies. Backcasting helps in the development of a clear future vision. Working backwards from that future vision (2030), a backcasting process can help identify key steps (subcomponents) (and stakeholders) to convert this idea into a reality. The Vision 2030 was stress-tested with experts in a workshop held in February 2025, and refined by Economist Impact researchers and insights from experts. Economist Impact acknowledges that there are many possible "paths" to an optimised Vision 2030, looking at different components, stakeholders and solutions and we understand that many context-specific issues are not fixed in time, but dynamic by nature. We hope that this Vision will stimulate thinking and inspire action before 2030. Our Vision represents an aspirational yet actionable vision over the next five years.

[1] Bibri SE. Backcasting in futures studies: a synthesized scholarly and planning approach to strategic smart sustainable city development. European Journal of Futures Research. 2018 6(1), 1-27. https://doi.org/10.1186/s40309-018-0142-z

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