ESTIMATING THE IMPACT OF CLIMATE CHANGE ON EUROPEAN HEALTHCARE

European Investment Bank

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SUMMARY

Context: The climate crisis poses a significant risk to human health. It increases the need for healthcare services and exacerbates health problems. The World Health Organization (WHO) estimates that climate change will cause 250 000 deaths annually between 2030 and 2050.[1] Despite this urgent problem, the health sector receives less than 1% of adaptation finance,[2] and there is an $8 billion to $17 billion global funding shortage for health-related adaptation.[3,4]

Approach: To help tackle this funding shortage, we have developed a tool that quantifies how climate change increases healthcare demand. The tool calculates how specific challenges – such as heatwaves or floods – increase the need for healthcare services. To our knowledge, this is the first tool to directly quantify the link between climate change and healthcare. The tool will help us to prioritise climate adaptation investments in the health sector.

The tool is a proprietary Excel-based application that integrates client details, project costs and healthcare benefits during loan appraisals at the European Investment Bank (EIB). For example, it can estimate the number of additional patients who go to a hospital because of climate change. While the tool is not included in this report, we provide the framework, key methodologies and application examples.

Developing the tool involved two key steps: 1. collecting evidence on the links between climate change and healthcare needs, and 2. creating a model that quantifies these links by analysing climate risks, population vulnerabilities and types of healthcare services.

The tool focuses on Europe and uses the Copernicus dataset to make projections for climate hazards up to 2050. This dataset provides science-based information about past, current and future states of the climate in Europe. We analysed data on climate change's effects on health by looking at hazards such as heatwaves, wildfires and flooding, as well as impacts on air quality, water quality and food safety. Geographical changes are accounted for using the NUTS2[5] system, which categorises European countries into three levels. NUTS refers to the "nomenclature of territorial units for statistics," and the NUTS2 level refers to basic regional parts of countries.

Results: The tool projects that climate change will considerably increase healthcare demand by an average of 0.5%.

Our findings represent a conservative estimate of climate change's impact on healthcare. They only consider a subset of potential effects, and assess impacts only on the average need for care, rather than on any shifts in the volatility of need. This is an initial presentation for further study. There are significant variations in different parts of Europe and in different areas of healthcare. For example, parts of Spain, Bulgaria and Romania could see a 2% to 3% rise in demand for cardiovascular and respiratory care.

The tool is in line with the multilateral development bank methodology for tracking adaptation finance around the globe. This methodology is a set of international guidelines to calculate the share of an investment in healthcare that addresses physical climate risks. Combined with information on resilience measures, such as flood warning systems, our tool and the development banks' methodology offer a clearer view of the adaptation

1 World Health Organization (2023). Fact Sheet. Available at: https://www.who.int/news-room/fact-sheets/detail/climate-change-and-health

2 Alcayna, T., O'Donnell, D., & Chandaria, S. (2023). How much bilateral and multilateral climate adaptation finance is targeting the health sector? A scoping review of official development assistance data between 2009-2019. *PLOS Global Public Health,* 3(6). https://doi.org/10.1371/journal.pgph.0001493

3 United Nations Environment Programme (2022). Adaptation Gap Report. Available at:https://www.unep.org/resources/adaptation-gap-report-2022

4 United Nations Environment Programme (2023). Adaptation Gap Report. Available at: https://www.unep.org/resources/adaptation-gap-report-2023

5 Copernicus (2024). Climate Data Store. Available at: https://cds.climate.copernicus.eu/

investments needed to prepare healthcare systems for climate change. These extra investments are often referred to as the “adaptation share” of financing.

Conclusions: This work will help the health sector better understand and prepare for the increasing healthcare demands caused by climate change. It also supports efforts to increase adaptation finance in the health sector. Other development banks looking to expand their activities in climate health adaptation can use our approach to develop similar tools for other regions around the world.

CONTEXT

Climate change is directly harming humans:

- Heatwaves could lead to a 5% to 13% increase in hospital admissions for respiratory problems among the elderly.
- Wildfires could cause about a 70% increase in emergency department visits by children.[6,7]
- We are seeing more health problems related to diseases spread by mosquitos and infected water.
- Climate-related hazards could cause 250 000 deaths a year globally by 2030.[8]

Health sectors around the world need to adapt to the rise in demand for healthcare services. We need to make more investments in healthcare capacity, technology, staffing and research.[9] We need more tools to help the health sector understand these challenges and put in place the right plans and make the right investments.

Many development banks and other financial institutions have ambitious climate adaptation targets. To meet these targets, they need to know how climate change is harming people's health and increasing the need for healthcare services.[10] Since this evidence is usually not sufficiently available, the health sector receives less than 1% of adaptation finance.[11] There is a global funding shortage of $8 billion - $17 billion for health adaptation.[12, 13]

Our work was conducted in two stages. First, we collected and structured evidence on the relationship between climate risks and healthcare demand. Second, using data that is publicly available, we developed a tool that calculates the significance of climate adaptation in healthcare investments in the European Union. The tool can be developed and adapted by refining its analytics, updating the evidence and changing the geography and themes.

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6 Michelozzi, P., Accetta, G., De Sario, M., D'Ippoliti, D., Marino, C., Baccini, M., Biggeri, A., Ross Anderson, H., Katsouyanni, K., Ballester, F., Bisanti, L., Cadum, E., Forsberg, B., Forastiere, F., Goodman, P.G., Hojs, A., Kirchmayer, U., Medina, S., Paldy, A., Schindler, C., Sunyer, J., & Perucci, C.A. (2009). High Temperature and Hospitalisations for Cardiovascular and Respiratory Causes in 12 European Cities. *American Journal of Respiratory and Critical Care Medicine,* 179(5), 383-389. https://doi.org/10.1164/rccm.200802-217OC

7 Hutchinson, J.A., Vargo, J., Milet, M., French, N.H.F., Billmire, M., Johnson, J., & Hoshiko, S. (2018). The San Diego 2007 wildfires and Medi-Cal emergency department presentations, inpatient hospitalisations, and outpatient visits: An observational study of smoke exposure periods and a bidirectional case-crossover analysis. *PLOS Medicine,* 15(7). https://doi.org/10.1371/journal.pmed.1002601

8 World Health Organization (2018). Climate Change and Health 2018. Available at: https://www.who.int/news-room/fact-sheets/detail/climate-change-and-health

9 Multilateral Development Banks (2023). COP28 Multilateral Development Banks Joint Statement. Available at: https://www.eib.org/attachments/press/cop28-joint-mdb-statement.pdf

10 Multilateral Development Banks (2022). MDB Joint Methodology for Tracking Climate Change Adaptation Finance. Available at: https://www.eib.org/attachments/lucalli/20220242_mdbs_joint_methodology_climate_finance_en.pdf

11 Alcayna, T., O'Donnell, D., & Chandaria, S. (2023). How much bilateral and multilateral climate adaptation finance is targeting the health sector? A scoping review of official development assistance data between 2009–2019. *PLOS Global Public Health,* 3(6). https://doi.org/10.1371/journal.pgph.0001493

12 United Nations Environment Programme (2022). Adaptation Gap Report. Available at: https://www.unep.org/resources/adaptation-gap-report-2022

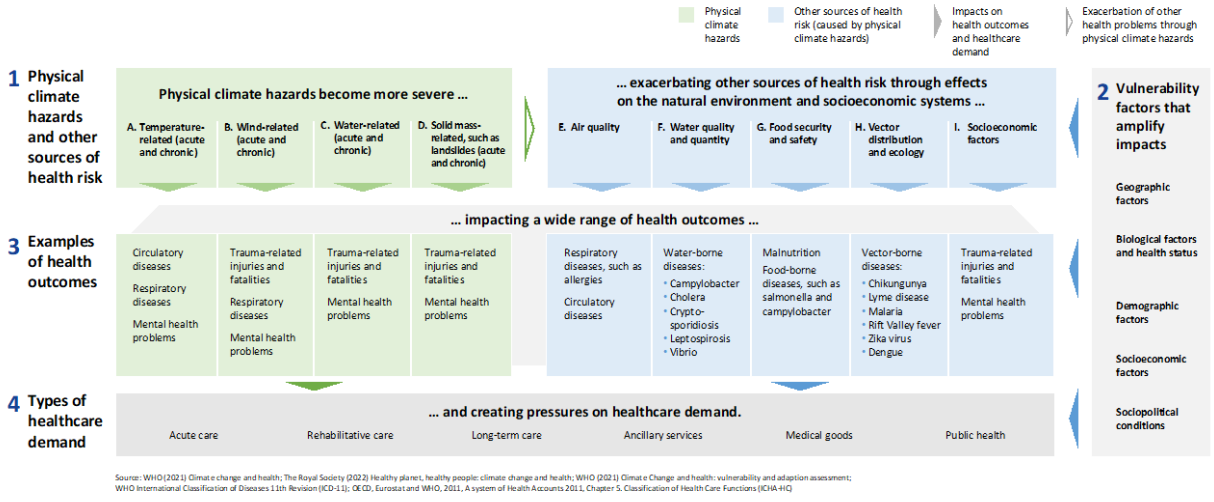
13 United Nations Environment Programme (2023). Adaptation Gap Report. Available at: https://www.unep.org/resources/adaptation-gap-report-2023

APPROACH

The evidence and the tool

Figure 1 outlines the tool that we have created. We gathered evidence on the links between physical climate risk and healthcare demand following the four steps detailed below. The evidence came from material published by leading organisations, such as the World Health Organization (WHO), The Royal Society and the European Union technical expert group on sustainable finance. This evidence included academic, peer-reviewed articles as well as information and analyses issued by international organisations such as the Organisation for Economic Cooperation and Development (OECD) and the European Centre for Disease Control (ECDC).

Figure 1. A framework of our tool that analyses how climate change increases demand for healthcare services.



Source: WHO (2021) Climate change and health; The Royal Society (2022) Healthy planet, healthy people: climate change and health; WHO (2021) Climate Change and health: vulnerability and adaption assessment; WHO International Classification of Diseases 11th Revision (ICD-11); OECD, Eurostat and WHO, 2011, A system of Health Accounts 2011, Chapter 5. Classification of Health Care Functions (ICHA-HC)

Four steps

1. **Climate risk sources.** The rise in healthcare demand comes partly from climate hazards that can directly harm humans. The rise also comes from the effect of these hazards on natural or socioeconomic systems that are critical for human health. Following the approach of the European Union's technical working group on sustainable finance taxonomy,[14] we grouped the climate hazards into temperature, wind, water and solid mass categories. The solid mass category risks resulting from the impacts of climate hazards on other systems are grouped following the approach of the Royal Society[15] and WHO,[16] to cover air quality, impacts on water and food systems, the transmission of diseases from insects to humans,[17] and impacts on economies and societies.

   There is evidence that all these climate risk sources can cause more health problems and create more demand for healthcare services. We reviewed evidence on projected populations in Europe up to 2050 and the likelihood and severity of impacts on people's health. This review focused on

[14] EU technical expert group on sustainable finance (2019). Taxonomy Technical Report. Available at: https://finance.ec.europa.eu/system/files/2019-06/190618-sustainable-finance-teg-report-taxonomy_en.pdf

[15] Royal Society (2022). Healthy planet, healthy people: climate change and health. Available at: https://royalsociety.org/-/media/policy/projects/climate-change-science-solutions/climate-science-solutions-health.pdf

[16] World Health Organization (2023). Climate change and health. Available at: Climate change

[17] Adjusted from the Intergovernmental Panel on Climate Change (IPCC) Glossary.

eight risks related to climate change: heatwaves, wildfires, flooding, indoor and outdoor air quality, water quality, food safety and geographic spread of diseases transmitted by insects.

2. **Vulnerability factors.** The project identified a number of variables that determine people's sensitivity to climate change and their ability to adapt to climate change impacts on their health. This is based on a framework developed by the WHO.[18] Our framework includes geographic factors that determine risks (local hazards, food and water problems), biological and demographic factors (malnourishment, number of pregnant or breastfeeding women, age and sex) and social factors (access to healthcare, education or housing, conflict risk or levels of discrimination).
   For our modelling, five vulnerability factors were prioritised based on their relevance to the eight main risks in Europe. These are: age, poverty, reduced access to healthcare (physical and affordability), pregnant and breastfeeding women, and populations with high levels of chronic diseases.
3. **Health results.** The diseases caused by climate change are categorised using the 24 groups in the International Classification of Diseases ICD-11 framework.[19] The medical literature outlines the impact of climate change on most of these groups, such as neoplasms and skin diseases. Our analysis focused on seven disease groups: infectious diseases, endocrine, nutritional or metabolic diseases, mental health and behavioural problems, diseases of the circulatory system, diseases of the respiratory system, and trauma-related injuries.
4. **Healthcare services.** An increase in health problems can increase the need for all key healthcare services, including acute care, rehabilitative care, long-term care, ancillary services and public health in general. Our analysis focused on acute care, including inpatient, emergency and outpatient.

The evidence

The framework uses evidence from literature to estimate the impact of climate change on healthcare demand across the European Union. We estimated the relationship between risk, vulnerability, health demand, and the need for health services at the NUTS2 level up to 2050. We used public data covering baseline levels of key variables projected up to 2050 (in the absence of climate change) and projections of changes in climate hazards from the Copernicus Climate Change Service dataset, a service providing science-based information about past, current and future states of the climate in Europe.

Where we found the data

	Type of data	Data sources
Climate risk sources	Climate change data, including current and future predictions	PubMed, Copernicus
Vulnerability factors	Demographics and epidemiologic data	Eurostat, WHO, OECD, PubMed, The World Bank
Health results	Diseases taxonomy, epidemiologic data	ICD-11, WHO, PubMed, ECDC, CDC, Eurostat, EUSEM, AHRQ
Healthcare demand	Healthcare organisation data	OECD, Eurostat

[18] World Health Organization (2021). Climate Change and Health: Vulnerability and adaptation assessment. Available at: https://www.who.int/publications/i/item/9789240036383

[19] World Health Organization (2024). International Classification of Diseases 11th Revision (ICD-11). Available at: https://icd.who.int/en

Our tool uses a “vulnerability index” for each region of Europe. For example, if region X has a higher vulnerability for trauma-related injuries from flooding than region Y, a change in the risk of flooding in region X will lead to more injuries than the same change in flooding in region Y.

To obtain this vulnerability index, each rise in healthcare demand was adjusted for regional differences using categories such as age (under 5 and over 65), pregnant and breastfeeding women, population with chronic diseases, material deprivation and poverty, and reduced access to healthcare. This allowed us to create a unique health and risk matrix. Each vulnerability factor was weighted differently, following a literature review and input from experts.

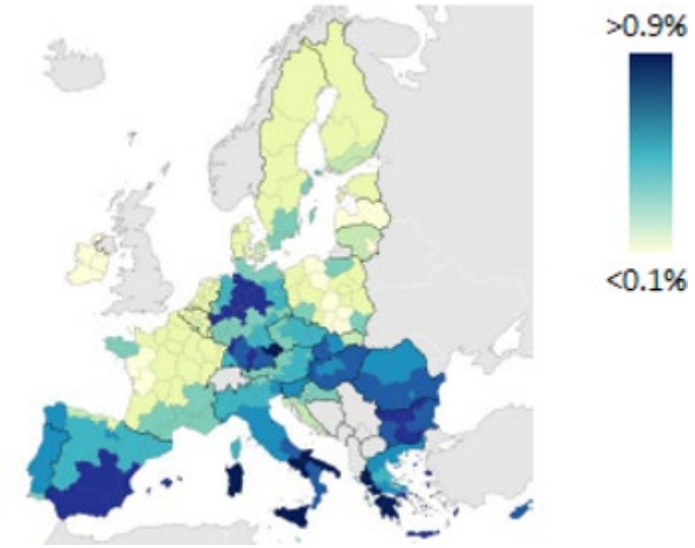
For example, vulnerability to waterborne diseases resulting from changes in water quality was assessed as follows: First, the vulnerability factors were assessed. These factors were assigned weights. For instance, the population under the age of five had a 30% weight, while the share of the population with chronic diseases had a 25% weight. Using these weights, the index was computed for all regions of Europe, and the regions were ranked. The relationship between waterborne diseases and changes in water quality in any region of Europe was then based on the rank of the region. The highest-ranking region was assigned the highest value from the literature review and the lowest-ranking region was assigned the lowest value.

Results

This analytical approach enabled us to estimate the amount of healthcare problems that are related to climate change in Europe up to 2050. **The estimated annual percentage rise in healthcare demand as a result of climate change is 0.5%.** We estimate more than 500 million inpatient care days, 120 million emergency department visits and 380 million outpatient consultations during the period we studied. According to these numbers, climate change is causing many millions of episodes of additional patient care services.[20]

Figure 2 breaks down by country the rise in healthcare demand related to climate change in Europe up to 2050.

Figure 2



Detailed examples

Our tool allows us to focus on specific problems. Table 1 shows how specific diseases rise because of climate change in parts of Spain, Bulgaria and Romania.

Table 1.

	Rise in healthcare demand related to climate change			
	Cardiovascular diseases	**Respiratory diseases**	**Infectious and parasitic diseases**	**Mental and behavioural disorders**
Galicia region of Spain (ES11 in NUTS2 code)	2.8%	2.1%	0.3%	0.3%
Southeastern region of Bulgaria (BG34 in NUTS2 code)	2.7%	1.8%	0.0%	1.0%
Northwest (RO41 in NUTS2 code)	2.8%	1.9%	0.3%	0.8%

[20] These baseline estimates of demand are derived from data published by Eurostat, EUSEM, OECD and AHRQ, using 2019 (pre-COVID-19) data in order to avoid overestimating for infectious and parasitic diseases.

Table 2 shows how we estimate increases in the number of patient stays in hospitals for cardiovascular diseases in Galicia.

Table 2.

Step	Detail	Data used	Source
Estimate regional percentage change in annual healthcare demand for cardiovascular diseases	Identify European change in demand estimate for cardiovascular diseases	9% to 16% estimated increase in healthcare demand for diseases of the circulatory system during heatwaves[21] 6.98% to 8.05% estimated increase in demand from diseases of the circulatory systems during wildfires[22]	Zacharias et al. (2014)[23] Dennekamp et al. (2015)[24] Haikerwal et al. (2015)[25]
	Obtain region-specific annual change estimates, combining regional sensitivity given the vulnerability index, regional exposure and expected change in risk sources	2.6% expected increase in annual demand for diseases of the circulatory system due to heatwaves 0.23% estimated increase in annual demand in diseases of the circulatory system due to wildfires	Eurostat, WHO, World Bank
Estimate the climate-induced increase in inpatients for cardiovascular diseases per risk source	Total regional baseline healthcare demand for cardiovascular diseases (the sum of inpatient, outpatient and emergency demand)[26]	949 087	Copernicus, Eurostat, OECD
	Expected increase in inpatients for cardiovascular diseases	37%	Eurostat

[21] The range of 9-16% was chosen as an indicative, if conservative, range of sensitivity from Zacharias et al. (2014) – please see footnote 23 below – who estimate the effect of heatwaves on mortality from ischemic heart disease under a variety of model specifications.

[22] The upper and lower bounds of 6.98% to 8.05% reflect the estimated effect of outdoor air quality impacts associated with wildfires on out-of-hospital cardiac arrests found, respectively, in Haikerwal et al. (2015) (all population) – please see footnote 25 below – and Dennekamp et al. (2015) (men only) – please see footnote 24 below .

[23] Zacharias, S., Koppe, C., & Mücke, H.G. (2014). Influence of Heat Waves on Ischemic Heart Diseases in Germany. *Climate 2014* 2(3), 133-152. https://doi.org/10.3390/cli2030133

[24] Dennekamp, M., Straney, L.D., Abramson, M.J., Keywood, M., Smith, K., Sim, M.R., Glass, D.C., Del Monaco, A., Haikerwal, A., & Tonkin, A.M. (2015). Forest Fire Smoke Exposures and Out-of-Hospital Cardiac Arrests in Melbourne, Australia: A Case-Crossover Study. *Environmental Health Perspectives* 123(10), 959-964. https://doi.org/10.1289/ehp.1408436

[25] Haikerwal, A., Akram, M., Del Monaco, A., Smith, K., Sim, M.R., Meyer, M., Tonkin, A.M., Abramson, M.J., & Dennekamp, M. (2015). Impact of Fine Particulate Matter ($PM_{2.5}$) Exposure During Wildfires on Cardiovascular Health Outcomes. *Journal of the American Heart Association* 4(7). https://doi.org/10.1161/JAHA.114.001653

[26] Inpatient demand is measured as the total number of inpatient discharges multiplied by the average length of stay in days. Outpatient demand is measured as the number of outpatient consultations. Emergency demand is measured as the number of emergency department visits.

	Regional increase in inpatients attributed to climate change	9 147 due to heatwave (949 087*2.6%*37%) 801 due to outdoor air quality (949 087*0.23%*37%)	
Calculate region-specific increase in inpatients for cardiovascular disease	Regional increase in inpatient climate-related demand due to cardiovascular disease	9 948 (9 147+801)	
	% increase in climate-related inpatients due to cardiovascular disease, all risk sources combined	2.8% (9 948 / 949 087)	

Aligning with development banks' methodology on adaptation finance

Climate risk is one of the many factors that are studied when making investments in the health sector. Multilateral development banks have already created a methodology to estimate the amount of adaptation finance required to address physical climate risks.[27] Our tool is in line with the development banks' methodology. Table 3 highlights how the tool can be used, following the steps of this methodology.

Table 3.

Steps	Information required	Use of the results of this project	Use of other information
Step 1: Has the climate change effect been clarified?	Evidence on the physical climate risks and vulnerabilities that the project addresses.	Evidence on the impact of the physical climate risks related to the project. A summary of the evidence on the potential impacts of climate risks.	Evidence on the effect of climate risks on the project to be built (for example, expected damages or downtime from increased flooding).
Step 2: Is there a statement of intent to reduce the risk caused by climate change?	Confirmation that the project targets climate vulnerabilities, does not increase other risks, and is consistent with other climate policies.	Not applicable.	Statement of intent, confirming that the project will address physical climate risks.
Step 3: Clear link between climate change vulnerability and project activities	We can use an incremental view of specific activities within the project driven by the need for climate adaptation and their related cost or a proportional view outlining the share of project costs driven by physical climate risks.	Baseline proportional view. For example: 5% of the cost of a centre focusing on treating. respiratory illnesses in southern Europe could be attributed to climate since 5% of demand is caused by climate change.	Any further project-specific information that allows a refinement of the modelled analysis. For example, if a respiratory facility was designed to manage problems related to heat exposure, this could support a view that attributes 100% of the cost to adaptation. Evidence that the cost is associated with protecting physical assets against climate hazards.

[27] European Investment Bank (2022). Joint Methodology for Tracking Climate Change Adaptation Finance. Available at: https://www.eib.org/attachments/lucalli/20220242_mdbs_joint_methodology_climate_finance_en.pdf

CONCLUSION

Our tool can improve decision-making, increase the amount of climate finance in health adaptation planning, and can be replicated around the world. Other development banks can conduct similar exercises. Our shared work could lead to a platform dedicated to exchanging information on the significant connection between climate change and healthcare.

Our work on the tool responds to a rising need in healthcare. The scientific evidence measuring climate change's impact on healthcare is limited. This shortage is significant in areas such as infectious and parasitic diseases, which has big implications. Healthcare problems such as infectious and parasitic diseases that increase because of climate change may be underestimated, which would lead to some people's healthcare needs not being met.

One limitation of the tool is its focus on average increases in healthcare demand, when extreme climate events can cause more significant problems for health systems in certain parts of Europe. For example, during heatwaves, the rise in demand for cardiovascular or respiratory healthcare services may exceed 10%.[28,29] Finally, the tool focuses on the relationship between climate risks and healthcare capacity, but it could be extended to highlight impacts on broader public health and emergency management needs.[30]

Academia and entities that finance research on both the national and international level and the European Commission may be able to help fill the shortages in scientific evidence that are described above. This could help us to develop universal types of data to be used to properly measure the impact of climate change on healthcare services. This would be especially useful for parts of the world where the climate is causing more problems than in Europe.

[28] Zacharias, S., Koppe, C., & Mücke, H.G. (2014). Influence of Heat Waves on Ischemic Heart Diseases in Germany. *Climate 2014* 2(3), 133-152. https://doi.org/10.3390/cli2030133

[29] Monteiro, A., Carvalho, V., Oliveira, T., & Sousa, C. (2013). Excess mortality and morbidity during the July 2006 heat wave in Porto, Portugal. *International Journal of Biometeorology,* 57, 155-167. https://doi.org/10.1007/s00484-012-0543-9

[30] McKinsey and Company (2023). Social Sector, Our Insights webpage. Available at: https://www.mckinsey.com/industries/social-sector/our-insights/future-proofing-health-systems-for-climate-risks-and-pandemics

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