K2P

Evidence Summary

Re-imagining Climate-Resilient Health Systems:

Multi-level Health System Interventions

K2P Evidence summaries
use global research evidence to
provide insight on public health
priority topics that are ambiguous
and have important uncertainty.
This document informs policymakers
and other stakeholders by
synthesizing the best available
evidence and presenting its
relevance to local contexts. Evidence
summaries do not provide
recommendations but rather
articulate evidence
in a clear, objective and
factual manner.

K2P
Evidence Summary

+ Included

Synthesis of evidence on a priority question or topic

Local context

× Not Included

Does not provide recommendations

K2P Evidence Summary

Re-imagining Climate-Resilient Health Systems:
Multi-level Health System Interventions

Authors

Adam F. El-Kadi, Reem Masri, Diana S. Jamal, Fadi El-Jardali

Citation

This K2P Evidence Summary should be cited as

El-Kadi A. F., Masri, R., Jamal D. S., El-Jardali F, K2P Evidence Summary: Re-imagining Climate-Resilient Health Systems: Multi-level Health System Interventions, Knowledge to Policy (K2P) Center. Beirut, Lebanon; November 2022

Contents

Key Messages

Key Messages

According to the World Health Organization (WHO), the single greatest threat to humanity is the multi-sectoral effects of climate change, which include effects on global trade, finance, and citizen health. This threat threatens to undo the past fifty years of human development, global health, and poverty reduction. In this Evidence Summary, the aim is to provide policymakers in the Middle East and North Africa (MENA) region with actionable interventions to improve climate resilience at multiple levels of the healthcare system.

Impact of climate change on health outcomes

- Climate change has impacted global health by increasing deaths and illnesses due to extreme weather events, food system disruptions, compounding the existing burden of diseases, and increasing the prevalence of zoonoses.

- Events arising from climate change (such as extreme weather events) are most strongly felt by those with inequity in the social determinants of health, such as equality and access to healthcare and social support structures.

- Women and children are at an elevated risk of suffering from adverse health outcomes as a result of climate change.

- In the MENA region, the decline in agricultural productivity has increased migration and overpopulation of urban areas which has contributed to water supply challenges in an area where the population is projected to double by 2070.

Impact of climate change and health research in humanitarian settings

- Available evidence suggests that tools such as health impact assessments, serve as enables for policy implementation.

- Knowledge translation and effective communication with policymakers and stakeholders were key enablers of climate policy implementation and intervention uptake.

- The literature suggests that impactful policies should be multi-sectoral in nature to be effective.

- Setting clear objectives and benchmarks of progress was instrumental in improving multi-dimensional collaboration.

Adopting climate-leadership and governance

⇢ Establishing effective monitoring systems for effective waste segregation enhanced strategy implementation and improved strategy integration by staff

⇢ Evidence suggests that effective waste segregation practices should be clearly defined prior to the development and implementation of effective governance systems.

⇢ Advocate and interest groups were found to be vital in building social momentum for change and encouraging policymakers to overcome personal or lobby group interests

⇢ Public participation measures have been shown to be the most effective for creating awareness of potential threats, enhancing public trust, and encouraging protective behaviour.

Establishing climate smart humanitarian supply systems

⇢ Introducing telemedicine in the health sector was shown to facilitate the health sector's transition to a net carbon-zero future

Creating a climate-informed humanitarian health workforce

⇢ Evidence-based frameworks were found to inform a more accurate adaptive response in emergencies by providing more accurate needs assessment and resource allocation.

⇢ The literature emphasized the need to strengthen the role of community health workers to promote and encourage patient behavioural changes that have environmental benefits. Moreover, the evidence emphasizes the need to leverage the role of community health workers in advocating for climate-resilient health systems and raising on-the-ground concerns from the healthcare community to the policymakers.

⇢ Low-quality evidence suggests that education of healthcare professionals on the links between ecosystems and human health may lead to an increased readiness to respond to climate-related illnesses.

Promoting advocacy & communication in the context of the climate crisis

⇢ Mass education campaigns were found to be effective in raising awareness and improving short-term protective health measures.

⇢ Curriculum-based interventions in schools show promise in raising awareness for environmental health hazards (such as weather hazards or water and air pollution), with multi-week educational modules showing positive shifts in behaviour.

⋯⋯⃕ The provision of printed educational materials in classrooms was shown to increase short-term awareness but not shift behaviour.

Implement climate-informed humanitarian needs assessment

⋯⋯⃕ Health impact assessment tools were shown to be promising in systematically understanding the potential health effects of a proposed policy, program, or provision on population health.

⋯⋯⃕ Promoting transparent and inter-organizational collaboration at the local, regional, and international are essential in creating awareness, pooling resources and data, and evaluating the resulting data

الرسائل الرئيسة

وفقًا لمنظمة الصحة العالمية *(WHO)* ، إن أكبر تهديد منفرد للبشرية هو الآثار متعددة القطاعات لتغير المناخ، التي تشمل الآثار على التجارة العالمية والتمويل وصحة المواطنين. هذا التهديد يهدد بالتراجع للخمسين عامًا الماضية من التنمية البشرية والصحة العالمية والحد من الفقر. يهدف ملخص الأدلة هذا إلى تزويد صنّاع السياسات في منطقة الشرق الأوسط وشمال إفريقيا *(MENA)* بتدخلات قابلة للتنفيذ لتحسين المرونة المناخية على مستويات متعددة في نظام الرعاية الصحية.

تأثير تغير المناخ على النتائج الصحية

← لقد أثّر تغير المناخ على الصحة العالمية من خلال زيادة الوفيات والأمراض بسبب الظواهر الجوية الشديدة، واضطرابات النظام الغذائي، ومضاعفة العبء الحالي للأمراض، وزيادة انتشار الأمراض حيوانية المنشأ .

← إن الأحداث الناشئة عن تغير المناخ (مثل الظواهر الجوية الشديدة) يشعر بها بشدة أولئك الذين يعانون من عدم المساواة في المحددات الاجتماعية للصحة، مثل المساواة والحصول على الرعاية الصحية وآليات الدعم الاجتماعي.

← تتعرض النساء والأطفال لخطر كبير من المعاناة بسبب النتائج الصحية السلبية نتيجة لتغير المناخ.

← وفي منطقة الشرق الأوسط وشمال أفريقيا، أدى انخفاض الإنتاجية الزراعية إلى زيادة الهجرة واكتظاظ المناطق الحضرية مما أسهم في وجود عوائق في إمدادات المياه في منطقة يتوقع أن يتضاعف فيها عدد السكان بحلول عام 2070.

أثر تغير المناخ والبحوث الصحية على الظروف الإنسانية

← وتشير الأدلة المتاحة إلى أن أدوات مثل تقييمات الأثر الصحي يمكن استخدامها في تنفيذ السياسات.

← وتمثل ترجمة المعارف والاتصال الفعال مع واضعي السياسات والجهات المعنية عوامل تمكينية رئيسة لتنفيذ السياسات المتعلقة بالمناخ واستيعاب التدخلات.

← وتشير المؤلفات إلى أن السياسات المؤثرة ينبغي أن تكون متعددة القطاعات بطبيعتها لكي تكون فعالة.

← وكان وضع أهداف ومعايير واضحة للتقدم مفيدًا في تحسين التعاون المتعدد الأبعاد.

اعتماد القيادة المناخية والحوكمة

← إنشاء نظم رصد فعالة من أجل تنفيذ استراتيجية معززة لفصل النفايات وتحسين تكامل الاستراتيجية من قبل الموظفين

← وتشير الأدلة إلى أن الممارسات الفعالة لفصل النفايات ينبغي تحديدها بوضوح قبل وضع وتنفيذ نظم إدارة فعالة.

← تم العثور على المناصرين والمجموعات المهتمّة ليكونوا حيويين في بناء الزخم الاجتماعي للتغيير ولتشجيع صنّاع السياسات للتغلب على المصالح الشخصية أو مصالح جماعات الضغط

← وقد ثبت أن تدابير المشاركة العامة هي الأكثر فعالية في خلق الوعي بالتهديدات المحتملة، وتعزيز ثقة العوام، وتشجيع السلوك الوقائي.

إنشاء نظم ذكية للإمدادات الإنسانية المتعلقة بالمناخ

← ثبت أن إدخال التطبيب عن بعد في قطاع الصحة ييسّر انتقال القطاع الصحي إلى مستقبل خالٍ التأثير المناخي السلبي للكربون

إنشاء قوة عاملة في مجال الصحة الإنسانية مستنيرة بالتأثير المناخي

← ووجد أن الأطر القائمة على الأدلة تسترشد بها استجابة أكثر دقة للتكيف في حالات الطوارئ عن طريق توفير تقييم أدق للاحتياجات وتخصيص الموارد.

← وأكدت المؤلفات على الحاجة إلى تعزيز دور العاملين الصحيين المجتمعيين لتعزيز وتشجيع التغييرات السلوكية للمرضى التي تتمتع بفوائد بيئية. علاوة على ذلك، تؤكد الأدلة على الحاجة إلى الاستفادة من دور العاملين الصحيين المجتمعيين في الدعوة إلى أنظمة صحية قادرة على التكيف مع المناخ وإثارة المخاوف على أرض الواقع من مجتمع الرعاية الصحية إلى صنّاع السياسات.

← تشير الأدلة منخفضة الجودة إلى أن تثقيف المتخصصين في الرعاية الصحية حول الروابط بين النظم البيئية وصحة الإنسان قد يؤدي إلى زيادة الاستعداد للاستجابة للأمراض المرتبطة بالمناخ.

تعزيز الدعوة والاتصال في سياق أزمة المناخ

← وتبين أن حملات التثقيف الجماهيري فعالة في زيادة الوعي وتحسين التدابير الصحية الوقائية القصيرة الأجل.

← وتبشر التدخلات القائمة على المناهج الدراسية في المدارس بالخير في زيادة الوعي بالمخاطر الصحية البيئية (مثل مخاطر الطقس أو تلوث المياه والهواء)، حيث تظهر وحدات تعليمية متعددة الأسابيع تحولات إيجابية في السلوك.

← وقد ثبت أن توفير المواد التعليمية المطبوعة في الفصول الدراسية يزيد من الوعي على المدى القصير ولكنه لا يؤدي إلى تغيير السلوك.

تنفيذ تقييم للاحتياجات الإنسانية المستنيرة بالوضع المناخي

← ثبت أن أدوات تقييم الأثر الصحي واعدة في الفهم المنهجي للآثار الصحية المحتملة لسياسة أو برنامج أو توفير مقترح على صحة السكان.

← تعزيز التعاون الشفاف والمشترك بين المنظمات على الصعد المحلي والإقليمي والدولي ضروري للتوعية وتجميع الموارد والبيانات وتقييم البيانات الناتجة عن ذلك

Content

Re-imagining health systems

Problem

Disasters related to weather, climate, or water have occurred every day on average over the past 50 years, resulting in 115 deaths each day and US$202 million in losses daily (WHO, 2021). This burden of climate-related disasters is only expected to increase with estimates projecting US$23 trillion in reduced annual global economic output worldwide (Flavelle, 2021). Heatwaves and extreme weather are associated with a 5% increase in death from mental health disorders with every 1-degree Celsius increase in temperature. Research has also ascertained the links between heatwaves and extreme weather and death from cardiovascular and respiratory disease; 718 and 720 extra deaths, respectively (Walkeden et al., 2021). In the Middle East and North Africa (MENA) Region, water and food security in the area are at greater risk of impact from climate change in light of the current scarcity of available water resources and the likelihood of continued precipitation declines. Various climate modelling studies have highlighted the severe climatic changes that are anticipated in the Mediterranean Basin and the MENA region compared to other parts of the world considering its geographical location as well, making preparedness of increased priority (Lange, 2019). Multi-sectoral impact resulting from climate change, such as its impacts on world trade, finance, and the health of citizens, poses the single biggest threat facing humanity according to the World Health Organization (WHO), threatening to undo the last fifty years of human development, global health, and poverty reduction (Alston, 2019). Despite scientific evidence, the response to climate change by countries globally remains inadequate (Costello et al., 2022)

Size of the Problem

Climate change is impacting global health in a myriad of ways, including deaths and illnesses from extreme weather events, food system disruptions, compounding the existing burden of diseases, and increasing the prevalence of zoonoses (WHO, 2021). Above all, events arising from climate change (such as extreme weather events) are most strongly felt by those with inequity in the social determinants of health, such as equality and access to healthcare and social support structures (WHO, 2021). Vulnerable

groups such as women and girls are particularly endangered by climate change (UN Women, 2022). Decreased accessibility to healthcare services increases the risk of maternal and child deaths (UN Women, 2022). Studies have also indicated that extreme heat and climate change increase the spread of vector-borne illnesses among women and children and increase the incidence of stillbirths (Costello et al., 2022; UN Women, 2022).

In the MENA region, governments are facing challenges in multiple sectors such as agricultural and water supply, as well as resulting economic difficulties. The decline in agricultural productivity has increased migration and overpopulation of urban areas, which has contributed to water supply challenges in an area where the population is projected to double by 2070 (Waha, 2017). In countries such as Lebanon, the increase in temperature is expected to lead to the death of 5, 200 Lebanese citizens per year (Lawrie & Wood, 2021). Moreover, approximately 3,000 premature deaths occur every year in Lebanon from preventable fossil fuel pollution (Lawrie & Wood, 2021). In the wake of the COVID-19 pandemic, many governments and policymakers are looking to enhance their healthcare system preparedness for emergencies and other pandemics. Governments and policymakers worldwide have begun paying attention to climate change and the foreseen impacts of a future pandemic. Specifically, they have begun looking at the Sustainable Development Goals (SDGs) developed by the United Nations for guidance on specific targets and indices of progress for change and sustainable development. The SDGs are 17 goals aimed to increase people and planet health, now and in the future——one of the SDGs is Sustainable Cities and Communities and Climate Action, which this paper aims to investigate (UN, 2015). The objective of this summary is to provide policymakers in the MENA region with actionable interventions to improve climate resilience at multiple levels of the healthcare system.

Interventions at the Multiple Levels of the Healthcare System

The healthcare sector has a fundamental role in the fight against climate change. Beyond being impacted by climate change and its effects, the global healthcare industry makes up the fifth-largest greenhouse gas emitter on the planet, responsible for around 4.5% of worldwide emissions (Batra et al., 2022). In addition, the COVID-19 pandemic exposed the lack of readiness of health systems worldwide to appropriately respond to emergencies; with inadequate training, protocols, know-how, equipment, and slow national responses observed in countries worldwide (Afulani et al., 2021). Therefore, in light of an anticipated rise in climate-related disasters, pandemics, and other emergencies, it is crucial for healthcare systems to create tools and take the necessary measures to support a climate-resilient healthcare system and climate-smart healthcare delivery (Marani, 2021).

Climate change and health research in humanitarian settings

A sound evidence base can be the key to advocating for transformational change in the field of climate change policy (Bikomeye et al., 2021).

Evidence-based policy

⤑ *Employ tools* such as health impact assessments (HIAs), to facilitate policy implementation and advocate for certain policies. For example, HIAs have been very influential in helping quantify the impact on health from strategies across sectors (Fox et al., 2019; Negev et al., 2022).

⤑ *Develop multi-sectoral policies* that take into consideration the socio-ecological processes of cities and recognize their complexities (Bikomeye et al., 2021; Negev et al., 2022).

⤑ *Translate and effectively communicate* climate policies to policymakers and stakeholders to increase the uptake of interventions (Fox et al., 2019; Negev et al., 2022).

⤑ *Promote engagement of researchers* with policymakers and communities to maximize impact on decision-making and gain different perspectives (Negev et al., 2022).

Institutional arrangements

⤑ A lack of intersectoral collaboration between institutional arrangements is a frequently discussed barrier to health and climate policy implementation (Negev et al., 2022).

› Set objectives and benchmarks of progress for multidimensional collaborations such as vertical (e.g., across national, regional, and local governments), horizontal (e.g., across sectors such as health, energy, etc.), and across organizations (e.g., private, governmental, and non-governmental), to enable intersectoral collaboration between institutional arrangements (Austin et al., 2016).

Three domains constitute the barriers and enablers to integrating health co-benefits in urban climate policy: evidence-based policy, political will and leadership, and institutional arrangements.
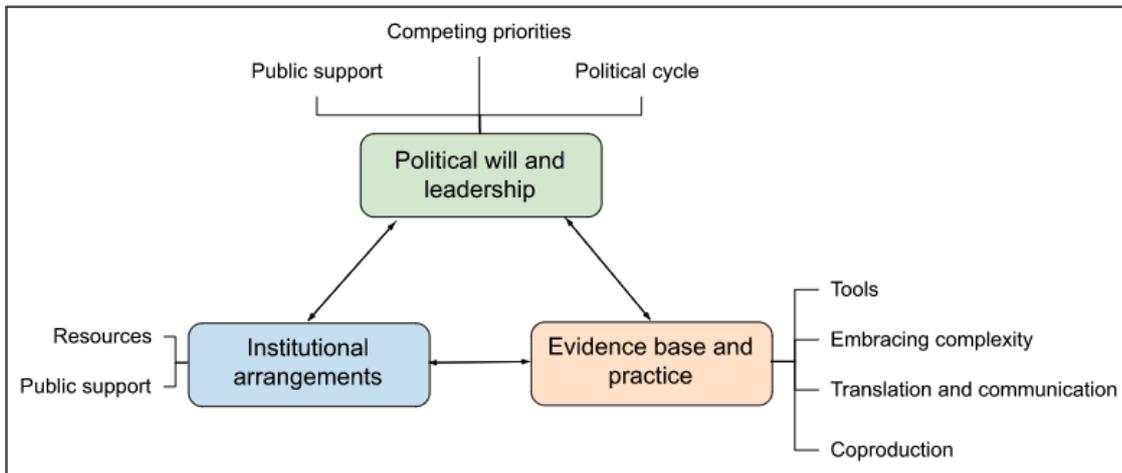

Figure 1. **Barriers and enablers for integrating health co-benefits within urban climate policy**.
Source: Adapted from Negev et al. (2022)[1]

Climate-aware leadership and governance

Waste management

---> A more climate-aware leadership can lead to faster, easier, and more effective waste segregation when containers are more clearly labeled and all healthcare personnel are trained on definitions and waste segregation (Radha et al., 2009).

› Establish effective monitoring systems (for short-, medium-, and long-term) for effective waste segregation to ensure that implementation strategies and procedures are well integrated by staff.

› Ensure financial and human resources support are available to those countries most in need, particularly low- and middle-income countries (Caniato et al., 2015).

› Clearly define effective waste segregation practices prior to developing and implementing effective governance systems (Caniato et al., 2015).

---

[1] Public support refers to the national mood and public opinion, competing priorities refer to other policies that are on the agenda that may compete with the implementation of a new one, and the political cycle refers to whether there is an upcoming election and a risk for a new administration to enter office, which may hinder the agenda of the previous administration or party.

Political will and leadership

⇢ In light of Figure 1. and 'Climate change and health research in humanitarian settings' the major barrier to the integration of certain policies are the lack of political will and commitment to a goal (Negev et al., 2022).

› Build social momentum for transformative change via advocates and interest groups and encourage policymakers to overcome personal or lobby group interests (Aldred, 2019; Negev et al., 2022).

Governance of the environmental determinants of health

⇢ **Experience** of a natural hazard or environmental risk and trust (or lack thereof) in authorities and experts are the primary factors that shape the individual perception of natural hazards (Wachinger, 2013).

› **Promote** public participation to increase awareness of potential threats, enhance public trust, and encourage protective behaviour (Wachinger, 2013).

› Adopt a comprehensive outlook on inclusion criteria such as the social and environmental determinants of health, for environmental health risk assessments to increase the likelihood of capturing exposure to risk (Casa et al., 2015). For example, in the context of mercury exposure, biologically vulnerable groups such as pregnant women, schools in contaminated areas, and general public consumption of environmental risk hazards (foods that may contain high levels of mercury) can sometimes be overlooked by risk assessors. These groups must be studied more closely for better surveillance and risk assessment to inform health workers and alert health systems (Casa et al., 2015).

Climate-smart humanitarian supply systems

Telemedicine

⇢ Telemedicine can provide a viable alternative to in-person consultation and reduce the healthcare sector's carbon footprint (Bozoudis et al., 2022). For example, the total potential carbon-dioxide equivalent (CO_2e) saving is equal to the annual energy consumption of around 2,295 households or 0.018% of the total CO_2 emissions by the United Kingdom's National Health Service (Ravindrane & Patel, 2022). These numbers are variable to the amount of energy consumption of the telemedicine system (e.g., tablet versus larger machines), the number of patients, mode of transport, and distance travelled. In the studies that

discussed urban versus rural, both were found to have benefits, across various specialties (Ravindrane & Patel, 2022).

Introduce telemedicine in the health sector to facilitate the health sector's transition to a net carbon-zero future.

Climate-informed humanitarian health workforce

---> The health sector can help in d**eveloping heat health (comfort with thermal conditions), setting- and population-specific guidelines** (Chersich et al. 2019). For example, the health sector can strengthen the monitoring system by developing or integrating evidence-based frameworks in countries that suffer from low-resolution health data. This can inform a more accurate adaptive response in emergencies by providing more accurate needs assessment and resource allocation.

---> Utilize frameworks such as the **Lancet Countdown** to benchmark the country's progress against others and identify areas of need.

› The framework provides five overarching domains that are important for assessors to know: 1. Climate change impacts, exposures, and vulnerabilities, 2. Adaptation, planning, and resilience for health, 3. Mitigation actions and health co-benefits, 4. Economics and finance, 5. Public and political engagements (Chersich et al. 2019).

Community health workers

---> Community health workers (CHWs) can play a role in making healthcare systems more resilient and improving overall drivers of planetary health by **providing an on-the-ground angle of the effects of environmental health co-benefits** across the various health measures (Behera et al., 2020).

› Strengthen the role of CHWs to promote and encourage patient behavioural changes that have environmental benefits, such as promoting physical active transport rather than motorized or healthier, less meat-based diets.

› Utilize CHWs to lobby and advocate for climate-resilient health systems and raise on-the-ground concerns from the healthcare community to the policymakers.

Workforce Education

---> Evidence in this section is not without limitations. Primarily, there is a lack of a clear definition and theoretical framework in the area of ecosystems. Second, it is difficult to establish the "lack of need" for learning about sustainability in healthcare; in other words, results may be skewed to favour integrating sustainability learning in healthcare curricula (Walpole et al., 2016). However, based on the evidence, the

following interventions could improve the health system's response to climate change.

> › Educate healthcare professionals on the links between ecosystems and human health to increase readiness to respond to climate-related illnesses (Machalaba et al., 2015; Sayre et al., 2010).
> › Utilize the Education for Sustainability framework to engage learners in thinking about the systemic changes needed for global sustainability. The framework could provide a valuable starting point for sustainability education when coupled with practical education on skills to enact sustainability-appropriate behaviours and actions (Walpole et al., 2016).
> › Ensure that education initiatives are supported by local and national bodies and educational leaders to guarantee their integration into curricula (Sayre et al., 2010).

Advocacy & communication in the context of the climate crisis

···⟩ Findings from international evidence suggest that the public health sector has a major role in working with inter-sectoral groups to encourage the public to adopt environmental behaviours and address public misinformation (Plotnikoff et al., 2004). The examples below display the various interventions that can improve short-term public awareness and concern for environmental risk factors––mass education campaigns, curriculum-based, and printed educational materials (Campbell et al., 2000).

> › **Raise awareness through mass education campaigns** (e.g., media outlets, social media, and in-person campaigns) to improve short-term protective health measures such as solar protection practices or increased testing for a condition (Campbell et al., 2000).
> › Yale Program on Climate Change Communication is a program for engaging public opinion via scientific searches to determine climate change knowledge, attitudes, policy preferences, and behaviour, and the underlying psychological, cultural, and political factors that influence them (Yale Program, 2005). The Program is a powerful tool that can be used by policymakers and healthcare professionals aiming to educate patients (as per the health-educated workforce section) to better understand population perceptions and climate education needs (Ros et al., 2002). Results from surveys can be organized according to the Global Warming's Six Americas regarding their beliefs about climate change: Dismissive, Doubtful, Disengaged, Cautious, Concerned,

or Alarmed. Understanding the distribution of these categories within the population has shown benefits in promoting a more appropriate response (Ros et al., 2002).

› **Implement curriculum-based interventions** in schools to raise awareness, among children, about environmental health hazards (such as weather hazards or water and air pollution). Multi-week educational modules have shown positive shifts in behaviour (Curran & Wexler, 2017). However, no impact on behaviour was observed for large group educational sessions such as school-wide assemblies.

› Provide **printed educational materials** in classrooms (on their own) to increase short-term awareness (Campbell et al., 2000). However, this intervention was not effective in shifting behaviour (Campbell et al., 2000).

Climate-informed humanitarian needs assessment

⤏ **Health impact assessments (HIAs)** have been widely used and promoted as a tool for systematically understanding the potential health effects of a proposed policy, program, or provision on population health (European Centre for Health Policy, 1999). Specifically, rapid, intermediate, and comprehensive HIAs provide different levels of insight and action- taken according to the quality of the evidence they provide (Thondoo et al., 2019). In countries with high-quality health data available, quantitative HIAs can use the screening and scoping stages to better understand the health impact of future programs. On the other hand, the limited transparency in the process, weak participation, and inconsistent delivery of recommendations were potential limitations to HIA implementation in low and middle-income countries.

› Scale up and improve the implementation of HIAs in low- and middle-income countries (LMICs) to augment data collection and replace low-resolution or insufficient data. These changes will encourage the building of adaptive models and tools that can aid in research and better reporting practices (Thondoo et al., 2019).

⤏ Promote **transparent and inter-organizational collaboration** at the local, regional, and international to create awareness, pool resources, and data, and evaluate the resulting data (Thondoo et al., 2019).

› The "Clean Up Mekong" initiative for trash collection in Vietnam in 2020 was a cross-sector partnership between the governmental and private sectors that gave evidence of the advantages of resource sharing (World Economic Forum, 2020). In this case, solar-powered boats donated by the private sector helped with the

clean-up, reducing the project's dependency on diesel and CO2 emissions (World Economic Forum, 2020).

Insights for Action

Figure 1 was adapted from the Nayna Schwerdtle et al.'s (2020) framework for building climate-resilient humanitarian health systems. Interventions discussed in the evidence summary have been summarized as actionable takeaways under each element, which can be used to strengthen the health sector's response to climate change in the MENA region. An additional section of the framework was added at the authors' discretion: climate-smart populations. Sections not included in the evidence synthesis from the framework did not have studies that met the inclusion: humanitarian access to climate finance and climate-informed humanitarian programs.
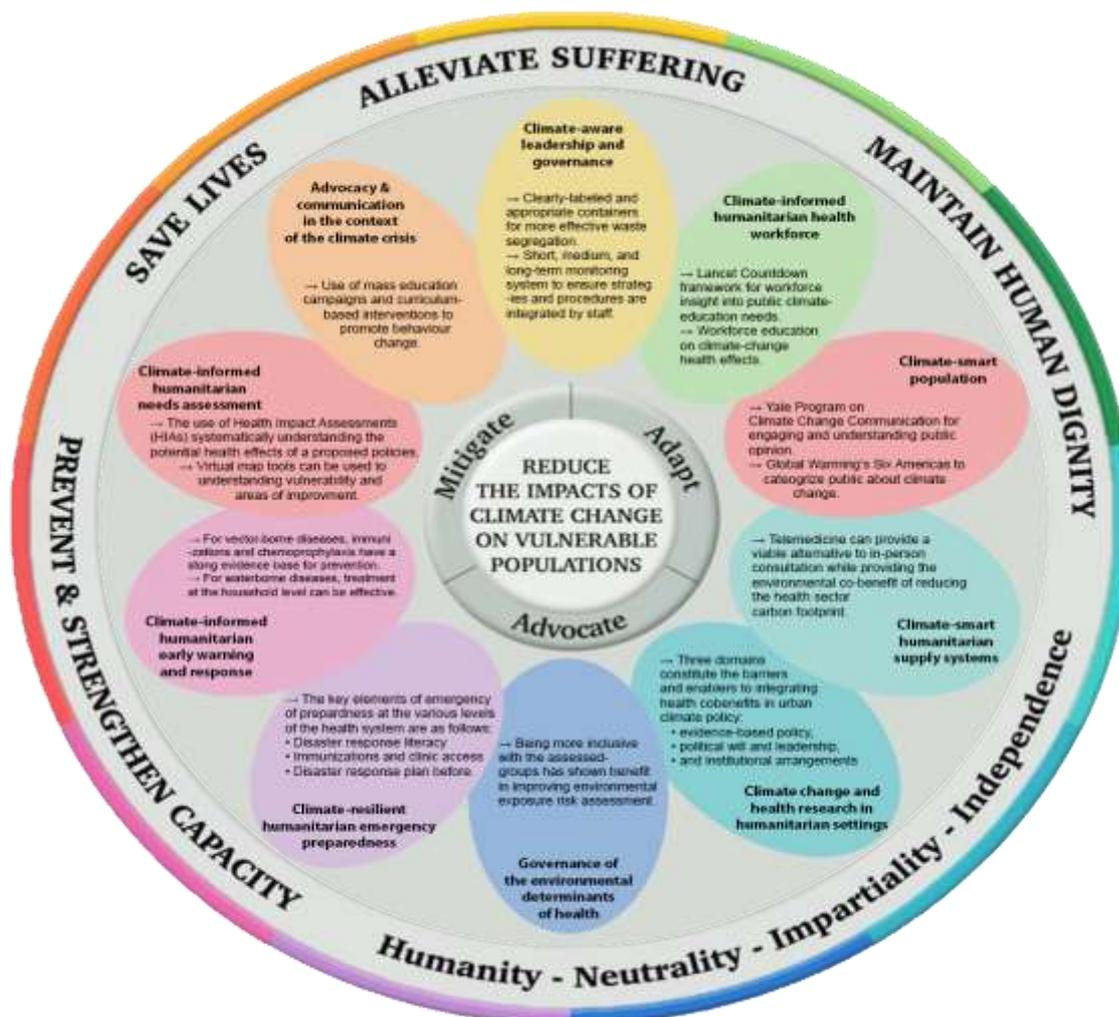
Source: Adapted from Nayna Schwerdtle et al. (2020)

In addition to the evidence listed in Figure 1, countries should take action toward climate-resilient emergency preparedness. The health emergency and disaster risk management (health-EDRM) can be divided into three levels of preparedness: individual/household, community, and system/policy. Interventions within each level can be further categorized into primary (those aiming to prevent the onset of disaster), secondary (aiming to prevent negative health outcomes in the immediate aftermath), and tertiary levels (those aiming to minimize the impact and damage caused by a disaster) (Table 2) (Chan et al., 2019). It is also recommended that countries adopt climate-informed humanitarian early warning and response interventions. To prevent single infection, immunizations and chemoprophylaxis (preventative medications) should be administered for vector-borne diseases (Bouzid et al., 2013). With regard to waterborne diseases, countries relying on small and inadequately treated systems should provide treatment at the household level (Bouzid et al., 2013).

Table 2. **Evidence at the various preparedness levels** of the health-EDRM for monitoring and evaluation

Preparedness level	Primary	Secondary	Tertiary
Individual/ Household	┈┈⟩ Promote disaster prevention literacy amongst individuals, schoolteachers, students, etc. (Chung & Yen, 2016; Chan et al., 2019). ┈┈⟩ Provide incentives (i.e., financial) and increase access to vaccinations clinic (Stone et al., 2002).	┈┈⟩ Stockpile individual medication and equipment, and activate household emergency planning for response and evacuation (Uscher-Pines, 2013).	┈┈⟩ Use of emergency preparedness plans and other education preparedness measures (Chan et al., 2019).
Community	┈┈⟩ Provide appropriate and accurate information to the public, and analysis of the information environment to assess information needs (Savoia et al., 2013). ┈┈⟩ Determine Local and regional stockpiles of medication and important equipment, where and what to include with the help of community stakeholders (Rebmann, 2017).	┈┈⟩ Use local and regional stockpiles in primary prevention (Rebmann, 2017, Chan et al., 2019). ┈┈⟩ Ensure and maintain water, sanitation, and hygiene (WASH) during the secondary response to disasters (Yates, 2018).	┈┈⟩ Triage intake of injuries and ensure hospital clinics collect relevant health data, provide first-aid, and maintain routine healthcare services (Chan et al., 2019).

Preparedness level	Primary	Secondary	Tertiary
System/ Policy	┄┄⟩ Include a disaster risk reduction strategy at the policy level and vulnerability reduction to protect vulnerable populations (Palliyaguru et al., 2014). ┄┄⟩ Establish routine childhood and emergency vaccination programs (Close et al., 2016; Lam et al., 2015; Chan et al., 2019).	┄┄⟩ Ensure effective communication and coordination between different stakeholders and experts for emergency response, such as governmental and non-governmental agencies (Quarantelli, 1988; Chan et al., 2019). ┄┄⟩ Detect the risk of disease outbreak accurately through established data collection methods (Chan et al., 2019).	┄┄⟩ Develop disaster-specific competencies and responses in health facilities to mount an appropriate response (Daily et al., 2010). ┄┄⟩ Ensure adequate human and backup energy resources to ensure the health system infrastructure can withstand impact (Chan et al., 2019).

Source: Adapted from Chan et al., 2019.

References

References

Afulani, P. A., Gyamerah, A. O., Nutor, J. J., Laar, A., Aborigo, R. A., Malechi, H., ... & Awoonor-Williams, J. K. (2021). Inadequate preparedness for response to COVID-19 is associated with stress and burnout among healthcare workers in Ghana. PloS one, 16(4), e0250294.

Aldred R, Croft J, Goodman A. (2019). Impacts of an active travel intervention with a cycling focus in a suburban context: one-year findings from an evaluation of London's in-progress mini-Hollands programme. Transp. Res. Part A Policy Pract. 123:147–69

Alston, P. (2019). UN expert condemns failure to address impact of climate change on poverty. Retrieved from https://www.ohchr.org/en/press-releases/2019/06/un-expert-condemns-failure-address-impact-climate-change-poverty#:~:text=%E2%80%9CClimate%20change%20threatens%20to%20undo,poor%20people%20live%20and%20work.%E2%80%9D

Austin SE, Biesbroek R, Berrang-Ford L, Ford JD, Parker S, Fleury MD. (2016). Public health adaptation to climate change in OECD countries. Int. J. Environ. Res. Public Health 13(9):889.

Bais, A. F., McKenzie, R. L., Bernhard, G., Aucamp, P. J., Ilyas, M., Madronich, S., & Tourpali, K. (2015). Ozone depletion and climate change: impacts on UV radiation. Photochemical & Photobiological Sciences, 14(1), 19-52.

Batra, N., Baca, E., Johnson, M., Sekhon, J., & Gerhardt, W. (2022). Why building climate change resilience is a key for the future of Health. Retrieved from https://www2.deloitte.com/xe/en/insights/industry/health-care/climate-change-and-health.html

Behera, M. R., Behera, D., & Satpathy, S. K. (2020). Planetary health and the role of community health workers. Journal of Family Medicine and Primary Care, 9(7), 3183.

Bikomeye JC, Rublee CS, Beyer KMM. (2021). Positive externalities of climate change mitigation and adaptation for human health: a review and conceptual framework for public health research. Int. J. Environ. Res. Public Health 18(5):2481

Bouzid, M., Hooper, L., & Hunter, P. R. (2013). The effectiveness of public health interventions to reduce the health impact of climate change: a systematic review of systematic reviews. PloS one, 8(4), e62041.

Bozoudis, V., Sebos, I., & Tsakanikas, A. (2022). Action plan for the mitigation of greenhouse gas emissions in the hospital-based health care of the Hellenic Army. Environmental Monitoring and Assessment, 194(3), 1-13.

Campbell, M., Buckeridge, D., Dwyer, J., Fong, S., Mann, V., Sanchez-Sweatman, O., Stevens, A., & Fung, L. (2000). A systematic review of the effectiveness of environmental awareness interventions. Canadian Journal of Public Health, 91(2), 137-143.

Costello, A., Romanello, M., Hartinger, S., Gordon-Strachan, G., Huq, S., Gong, P., Kjellstrom, T., Ekins, P., & Montgomery, H. (2022) Climate change threatens our health and survival within decades. The Lancet. https://doi.org/10.1016/S0140-6736(22)02353-4

Caniato, M., Tudor, T., & Vaccari, M. (2015). International governance structures for health-care waste management: A systematic review of scientific literature. Journal of environmental management, 153, 93-107.

Casas, I. C., Gómez, E., Rodríguez, L. M., Girón, S. L., & Mateus, J. C. (2015). Toward a national plan to control health effects of mercury in Colombia. Biomédica, 35, 30-7.

Chersich, M. F., & Wright, C. Y. (2019). Climate change adaptation in South Africa: a case study on the role of the health sector. Globalization and health, 15(1), 1-16.

Chan, E. Y. Y., Man, A. Y. T., & Lam, H. C. Y. (2019). Scientific evidence on natural disasters and health emergency and disaster risk management in Asian rural-based area. British medical bulletin, 129(1), 91.

Chan, E. Y. Y., Sham, T. S. T., Shahzada, T. S., Dubois, C., Huang, Z., Liu, S., ... & Shaw, R. (2020). Narrative review on health-edrm primary prevention measures for vector-borne diseases. International journal of environmental research and public health, 17(16), 5981.

Chung, S. C., & Yen, C. J. (2016). Disaster prevention literacy among school administrators and teachers: a study on the plan for disaster prevention and campus network deployment and experiment in Taiwan. Journal of Life Sciences, 10.

Close, R. M., Pearson, C., & Cohn, J. (2016). Vaccine-preventable disease and the under-utilization of immunizations in complex humanitarian emergencies. Vaccine, 34(39), 4649-4655.

Curran, T., & Wexler, L. (2017). School-based positive youth development: A systematic review of the literature. Journal of school health, 87(1), 71-80.

Daily, E., Padjen, P., & Birnbaum, M. (2010). A review of competencies developed for disaster healthcare providers: limitations of current processes and applicability. Prehospital and disaster medicine, 25(5), 387-395.

Eliakimu, E. S., & Mans, L. (2021). Addressing Inequalities Toward Inclusive Governance for Achieving One Health: A Rapid Review. Frontiers in Public Health, 9.

European Centre for Health Policy WHO. Health Impact Assessment: Main Concepts and Suggested Approach; Gothenb Consens Pap Geneva WHO: Brussels, Belgium, 1999.

Flavelle, C. (2021). Climate change could cut world economy by $23 trillion in 2050, insurance giant warns. Retrieved from https://www.nytimes.com/2021/04/22/climate/climate-change-economy.html

Fox M, Zuidema C, Bauman B, Burke T, Sheehan M. (2019). Integrating public health into climate change policy and planning: state of practice update. Int. J. Environ. Res. Public Health 16(18):3232

Harhay et al. (2009) Health care waste management: a neglected and growing public health problem worldwide. Tropical Medicine and International Health 14(11):1414-1417

IPCC 5th report Chapter 8, p677 https://www.ipcc.ch/pdf/assessment-report/ar5/wg1/WG1AR5_Chapter08_FINAL.pdf

Krishnamoorthy, Y., M. V., Sakthivel, M., & Sarveswaran, G. (2018). Emerging public health threat of e-waste management: global and Indian perspective. Rev Environ Health, 33(4).

Lam, E., McCarthy, A., & Brennan, M. (2015). Vaccine-preventable diseases in humanitarian emergencies among refugee and internally-displaced populations. Human vaccines & immunotherapeutics, 11(11), 2627-2636.

Lawrie, C. & Wood, D. (2021). The urgent need for climate change adaptation in Lebanon. Triangle.

Lange, M. A. (2019). Impacts of climate change on the Eastern Mediterranean and the Middle East and North Africa region and the water–energy nexus. Atmosphere, 10(8), 455.

Machalaba, C., Romanelli, C., Stoett, P., Baum, S. E., Bouley, T. A., Daszak, P., & Karesh, W. B. (2015). Climate change and health: Transcending silos to find solutions. Annals of Global Health, 81(3), 445-458.

Marani, M., Katul, G. G., Pan, W. K., & Parolari, A. J. (2021). Intensity and frequency of extreme novel epidemics. Proceedings of the National Academy of Sciences, 118(35), e2105482118.

Nayna Schwerdtle, P., Irvine, E., Brockington, S., Devine, C., Guevara, M., & Bowen, K. J. (2020). Calibrating to scale: a framework for humanitarian health organizations to anticipate, prevent, prepare for and manage climate-related health risks. Globalization and health, 16(1), 1-10.

Negev, M., Zea-Reyes, L., Caputo, L., Weinmayr, G., Potter, C., & de Nazelle, A. (2022). Barriers and Enablers for Integrating Public Health Cobenefits in Urban Climate Policy. Annual Review of Public Health, 43, 255-270.

Palliyaguru, R., Amaratunga, D., & Baldry, D. (2014). Constructing a holistic approach to disaster risk reduction: the significance of focusing on vulnerability reduction. Disasters, 38(1), 45-61.

Parry, J.M.; Kemm, J.R (2005). Criteria for use in the evaluation of health impact assessments. Public Health, 119, 1122–1129.

Plotnikoff, R. C., Wright, M. F., & Karunamuni, N. (2004). Knowledge, attitudes and behaviours related to climate change in Alberta, Canada: Implications for public health policy and practice. International Journal of Environmental Health Research, 14(3), 223-229.

Quarantelli, E. L. (1988). Disaster crisis management: A summary of research findings. Journal of management studies, 25(4), 373-385.

Ravindrane, R., & Patel, J. (2022). The environmental impacts of telemedicine in place of face-to-face patient care: a systematic review. Future Healthcare Journal, 9(1), 28.

Radha, K. V., Kalaivani, K., & Lavanya, R. (2009). A case study of biomedical waste management in hospitals. Global journal of health science, 1(1), 82-88.

Rebmann, T., McPhee, K., Osborne, L., Gillen, D. P., & Haas, G. A. (2017). Best practices for healthcare facility and regional stockpile maintenance and sustainment: a literature review. Health security, 15(4), 409-417.

Romanello, M., McGushin, A., Di Napoli, C., Drummond, P., Hughes, N., Jamart, L., ... & Hamilton, I. (2021). The 2021 report of the Lancet Countdown on health and climate change: code red for a healthy future. The Lancet, 398(10311), 1619-1662.

Ros, A. V., LaRocque, R., Fortinsky, R., & Nicholas, P. (2020). Addressing climate change communication: effective engagement of populations for climate action in the US and globally. Annals of global health, 86(1).

Savoia, E., Lin, L., & Viswanath, K. (2013). Communications in public health emergency preparedness: a systematic review of the literature. Biosecurity and bioterrorism: biodefense strategy, practice, and science, 11(3), 170-184.

Sayre, L., Rhazi, N., Carpenter, H., & Hughes, N. L. (2010). Climate change and human health: the role of nurses in confronting the issue. Nursing administration quarterly, 34(4), 334-342.

Stone, E. G., Morton, S. C., Hulscher, M. E., Maglione, M. A., Roth, E. A., Grimshaw, J. M., ... & Shekelle, P. G. (2002). Interventions that increase use of adult immunization and cancer screening services: a meta-analysis. Annals of internal medicine, 136(9), 641-651.

Thondoo, M., Rojas-Rueda, D., Gupta, J., de Vries, D. H., & Nieuwenhuijsen, M. J. (2019). Systematic literature review of health impact assessments in low and middle-income countries. International journal of environmental research and public health, 16(11), 2018.

United Nations (UN). (2015). The 17 goals | Sustainable Development. Retrieved from https://sdgs.un.org/goals

UN Women. (2022). Explainer: How gender inequality and climate change are interconnected. https://www.unwomen.org/en/news-stories/explainer/2022/02/explainer-how-gender-inequality-and-climate-change-are-interconnected

Uscher-Pines, L., Chandra, A., & Acosta, J. (2013). Household Preparedness Is Not Enough. Journal of public health management and practice, 19, S70-S76.

Waha, K., Krummenauer, L., Adams, S., Aich, V., Baarsch, F., Coumou, D., Fader, M., Hoff, H., Jobbins, G., Marcus, R., Mengel, M., Otto, I. M., Perrette, M., Rocha, M., Robinson, A., & Schleussner, C. F. (2017). Climate change impacts in the Middle East and Northern Africa (MENA) region and their implications for vulnerable population groups. Regional Environmental Change, 17(6), 1623-1638.

Walpole, S. C., Pearson, D., Coad, J., & Barna, S. (2016). What do tomorrow's doctors need to learn about ecosystems?–A BEME Systematic Review: BEME Guide No. 36. Medical teacher, 38(4), 338-352.

Wachinger, Gisela, Ortwin Renn, Chloe Begg, and Christian Kuhlicke. (2013) "The risk perception paradox—implications for governance and communication of natural hazards." Risk analysis 33, no. 6 (2013): 1049-1065.

Walkeden, J., Hunt, C., & Masding, V. (2022). Climate-related mortality and hospital admissions, England and Wales: 2001 to 2020. Retrieved from https://www.ons.gov.uk/peoplepopulationandcommunity/birthsdeathsandmarriages/deaths/articles/climaterelatedmortalityandhospitaladmissionsenglandandwales/2001to2020

World Meteorological Organization (2021) Weather-related disasters increase over past 50 years, causing more damage but fewer deaths. Retrieved from https://public.wmo.int/en/media/press-release/weather-related-disasters-increase-over-past-50-years-causing-more-damage-fewer

World Economic Forum. (2020). How collaboration is driving the global climate agenda. Retrieved from https://www.weforum.org/agenda/2020/01/how-cross-sector-collaboration-is-driving-the-global-climate-agenda/

World Health Organization (WHO). (2021). Climate change and health. Retrieved from https://www.who.int/news-room/fact-sheets/detail/climate-change-and-health

Yates, T., Vujcic Allen, J., Joseph Leandre, M., Gallandat, K., Lantagne, D. (2018) "Efficacy and effectiveness of water, sanitation, and hygiene interventions in emergencies in low-and middle-income countries: a systematic review." Waterlines: 31-65.

Yale Program. (2021). About the program. Retrieved from https://climatecommunication.yale.edu/about/the-program/

Knowledge to Policy Center draws on an unparalleled breadth of synthesized evidence and context-specific knowledge to impact policy agendas and action. K2P does not restrict itself to research evidence but draws on and integrates multiple types and levels of knowledge to inform policy including grey literature, opinions and expertise of stakeholders.

Knowledge
to Policy
Center
K2P