STUDY PROTOCOL

Tools and approaches for assessing risk and readiness of health facilities exposed to extreme weather and climatic events in Low-and-Middle Income Countries: A Scoping Review Protocol

[version 1; peer review: awaiting peer review]

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v1 **First published:** 23 Jun 2026, **6**:74
https://doi.org/10.3310/nihropenres.14272.1
Latest published: 23 Jun 2026, **6**:74
https://doi.org/10.3310/nihropenres.14272.1

Abstract

Introduction

Climate change-induced extreme weather and climatic events increasingly threaten health systems, especially those already facing chronic stress such as resource and infrastructure constraints. Additional shocks from extreme weather and climatic events may further undermine progress toward achieving universal health coverage. Indeed, with the increasing frequency and severity of these events, health facilities as health service delivery points, require appropriate tools to assess their exposure, vulnerability, and readiness for such events. However, the availability, scope, and suitability of existing assessment tools, particularly for low- and middle-income countries (LMICs), remain insufficiently documented.

Methods

This scoping review will synthesise evidence on tools and approaches used to assess health facility exposure, vulnerability (sensitivity and capacity), and readiness to extreme weather and climatic events through a health-systems lens. The review will follow the Preferred Reporting Items for Systematic Reviews and Meta-Analysis extension

Open Peer Review

Approval Status *AWAITING PEER REVIEW*

Any reports and responses or comments on the article can be found at the end of the article.

for Scoping Reviews, PRISMA-ScR, guidelines to ensure methodological transparency. An a priori search strategy will be applied to three electronic databases (Ovid Medline, Global Health, and Embase) for literature published between 1990 and 2025. To enhance coverage, we will conduct a structured search of grey literature from relevant national agencies, international organisations, and institutions focused on climate change and health, disaster management, and humanitarian health response. We will also, where feasible, contact subject-matter experts to identify unpublished or in-progress materials. Data will be synthesised narratively using a mixed inductive–deductive analytical approach, with interpretation grounded in LMIC contexts.

Results

Findings will be presented narratively and summarised using explanatory text, tables, and figures to highlight the characteristics, strengths, gaps, and applicability of identified tools and approaches.

Conclusion

This review's synthesis will inform the development of a novel tool for assessing the risk and readiness of health facilities to extreme weather events, complementing ongoing empirical research in Kenya, a low-middle-income country setting.

Plain Language summary

This article describes a scoping review protocol that will identify and summarise the existing tools and methods used to assess how vulnerable and prepared health facilities in low- and middle-income countries (LMICs) are to extreme weather and climate-related events, such as floods, droughts, storms, and extreme heat.

Climate change is increasing the severity and frequency of extreme weather events. Many health systems—especially in LMICs—are already under pressure due to limited staff, old infrastructure, inadequate supplies, and weak governance. Additional climate-related shocks may overwhelm them, interrupt essential health services, and reduce their ability to respond to emergencies. Because it is not clear on the availability, quality, and suitability of existing tools for assessing health facilities level of vulnerability and preparedness in LMIC settings, this scoping review is needed. The scoping review will analyse what these tools measure, how they were developed, and how they are used, with the goal of informing the creation of a new, context-appropriate assessment tool for Kenya. The purpose of the scoping will be to:

- Identify existing tools, checklists, guidelines, frameworks, and approaches used to assess health facility risk, vulnerability, and

readiness to extreme weather events

The findings will support the development of a new assessment tool tailored for Kenya and similar LMIC contexts. Once the tool is ready, it will be deployed across Kenyan health facilities. The health facility survey findings will guide national preparedness, response, and mitigation strategies for extreme weather impacts on health facilities.

The review is part of the NEWRISK project, approved by ethics committees in Kenya and the UK, and funded by the UK's NIHR under the RIGHT programme.

Keywords
Extreme weather events, Extreme weather and climatic events, Climate hazards, Climate change, Exposure, Vulnerability, Risk, Readiness, Assessment, Health system, Health facility.

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Author roles: Wanyama C: Conceptualization, Data Curation, Formal Analysis, Investigation, Methodology, Project Administration, Validation, Visualization, Writing – Original Draft Preparation, Writing – Review & Editing; **Karing'u P**: Formal Analysis, Investigation, Methodology, Validation, Writing – Review & Editing; **Smith C**: Conceptualization, Methodology, Resources, Writing – Review & Editing; **Maina M**: Conceptualization, Data Curation, Investigation, Methodology, Project Administration, Resources, Supervision, Writing – Review & Editing; **McKnight J**: Conceptualization, Funding Acquisition, Methodology, Project Administration, Resources, Software, Supervision, Writing – Review & Editing

Competing interests: No competing interests were disclosed.

Grant information: This project is funded by National Institute for Health and Care Research (NIHR) under its [Research on Interventions for Global Health Transformation (RIGHT) Programme (Grant Reference Number GB-GOV-10-RIGHT_5_NIHR204850)]. The views expressed are those of the author(s) and not necessarily those of the NIHR or the Department of Health and Social Care.
The funders had no role in study design, data collection and analysis, decision to publish, or preparation of the manuscript.

How to cite this article: Wanyama C, Karing'u P, Smith C *et al.* **Tools and approaches for assessing risk and readiness of health facilities exposed to extreme weather and climatic events in Low-and-Middle Income Countries: A Scoping Review Protocol [version 1; peer review: awaiting peer review]** NIHR Open Research 2026, **6**:74 https://doi.org/10.3310/nihropenres.14272.1

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1. Introduction

Climate change and its associated direct impacts of extreme weather events such as droughts, extreme temperatures, floods and storms pose serious threats to populations, communities, institutions and ecosystems.[1] For health systems, majority of which are not climate resilient,[2,3] extreme weather events pose threats such as risk of structural collapse, severe water and energy disruption and accumulation of medical waste, consequences that could seriously undermine ability to efficiently deliver safe routine and emergency healthcare services.[4,5] In Low- and Middle-Income countries, where health systems face chronic stress[6] from severe understaffing, old structures, inadequate medical supplies and equipment, inadequate health financing and leadership and governance challenges, additional shocks from cyclic extreme weather-related events may be difficult to absorb, plan for and correctly adapt to.[7,8] Acute shocks can both worsen already existing vulnerabilities and create new ones, reducing the level of resilience for health systems.[9] Resilient health systems include.

> *'…institutions, infrastructure and populations, that are able to anticipate, prevent, prepare for, absorb and adapt in response to, and recover from a wide variety of shocks and stressors while delivering quality individual and population health services as needed, utilizing lessons from experiences within and outside their settings to continuously improve on their baseline capacities and performance in all contexts…'.*[10]

To build climate-resilient health systems, i.e. those systems with capacity to *'anticipate, respond to, cope with, recover from and adapt to climate-related shocks and stress',*[11] there is need to understand the level of vulnerability and capacity and overall risk that climate-change-induced extreme weather events pose to health systems, particularly at health facility level, where healthcare is delivered. This process can unearth the level of readiness of health facilities and systems to anticipate, prepare for, respond to, cope with, recover from and adapt to both the potential and actual negative impacts of extreme weather events. To do so, tools, approaches and methods that accurately identify and correctly determine the level of health system risk and readiness to extreme weather events are needed.

At the health facility level, it is now acknowledged that the health system comprises both the hardware and the software elements.[12] Hardware elements are the tangible elements (health facility infrastructure, health workers, health products and technologies) of the health system. Software elements include both the tangible software (processes of health governance and service delivery) and the intangible software (organisational culture, relationships and power, interests and social networks, beliefs, values and norms, and practices). It is therefore necessary that tools, approaches and methods used to assess and determine health system level of risk and readiness to extreme weather events capture the most relevant, and where possible, comprehensively all these health system elements. Noteworthy, health systems operate in a wider context, influenced and shaped by political, social, economic, environmental and technological factors, and thus a further consideration of these factors is equally important (Figure 1 below).

These contextual factors, singly or collaboratively, whether at different times or acting at the same time, conspire to positively and negatively shape the health system, a complex and highly adaptive system to current and future shocks and stressors.

1.1 Rationale

Risk of a health system at the health facility to extreme weather and climatic events can be difficult to conceptualise and measure. The concept of risk refers to the potential for adverse consequences or outcomes of an event. Extreme weather and climatic events (EWACEs) pose risk to health facilities through exposure of vulnerable health systems' elements to climate change hazards. Also, response mechanisms[13–15] to cope with the effects of EWACEs may create new or worsen existing vulnerability and therefore additional risk (Figure 2).

Because health facilities exist to serve population health needs, they need to remain open to those who need them, especially those who are most vulnerable. However, EWACEs pose multiple risks including of health facility closure, contamination, service interruption, limited access by those who are most vulnerable, and the health facility being unable to effectively and efficiently respond to climate-sensitive health issues alongside the expectation to deliver routine essential health services.[16] Yet, it is not clearly understood which tools, methods and approaches are the most appropriate for assessing and determining risk and readiness of health facilities to EWACEs, especially for LMIC settings. Also, there is paucity of evidence on which elements or dimensions of a health system which, when assessed, can help characterize and estimate risk and readiness to EWACEs especially in already stressed health systems as is common in LMIC countries. This scoping review therefore aims to build knowledge through a systematic evidence synthesis of the most suitable tools, approaches and methods including the health system dimensions to assess health facilities' level of risk and readiness to EWACEs. The synthesised evidence will inform the development of a novel tool to assess the risk and readiness of health facilities to EWACEs, complementing ongoing empirical work in Kenya, an LMIC setting.

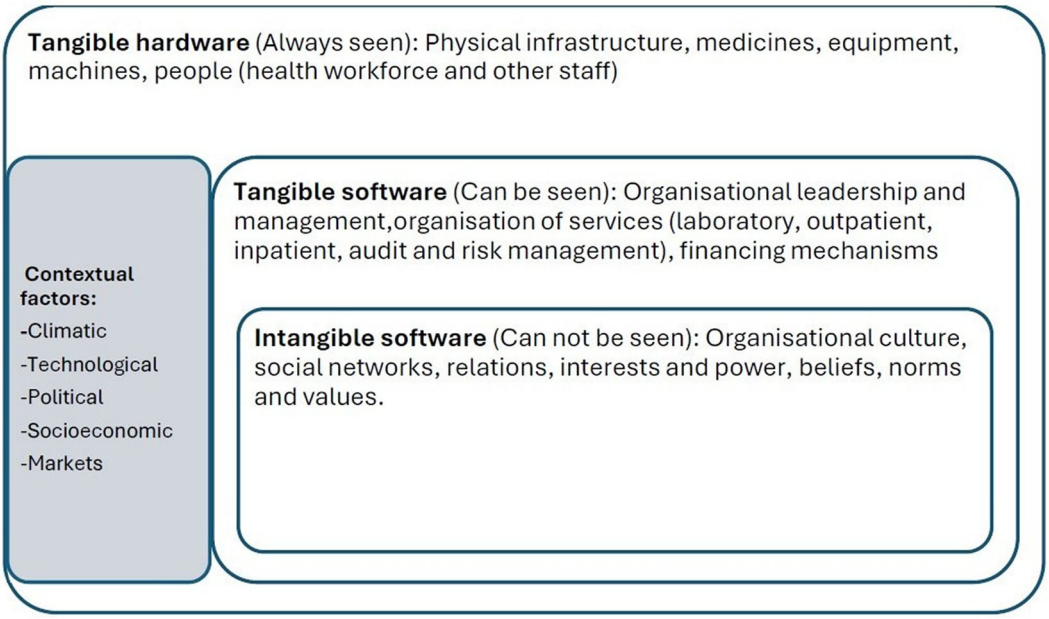

Figure 1. The interplay between health system elements and the context, making the health system complex and highly adaptive to context.[12] Figure 1 above describes broad health system elements (tangible hardware, tangible software and intangible software). It also highlights the value of context where the health system is situated, and the various contextual factors that potentially influence (and are influenced) by the health system elements.

1.2 Objectives

1.2.1 Research Question

What tools, approaches methods exist to assess and determine the level of health system risk (vulnerability, adaptive capacity) and readiness (adaptive capacity, preparedness, response plans) to extreme weather events in low-and-middle income countries?

1.2.2 Primary Objective

This scoping review aims to identify existing tools, approaches and methods for assessing elements of the health system OR health facilities to characterise level of risk and readiness to extreme weather and climatic events in low- and middle-income countries.

1.2.3 Secondary objectives

1. To characterise the extreme weather events for which the available tools were developed, with a focus on health facilities in low- and middle-income settings
2. To identify the process/approaches used in developing these tools
3. To describe the methods used to deploy these tools and approaches
4. To describe the components of health facilities OR health systems targeted for vulnerability, risk, readiness and resilience assessment abstracted from these tools and approaches for low- and middle-income settings

2. Methods

2.1 Patient and public involvement

For this scoping review protocol, the review findings will inform the development of a novel tool for assessing health facilities in Kenya. To contextualise the review, we initiated consultations with Kenya's Ministry of Health and the Kenya Meteorology Department in April 2025 to understand existing health system constraints and identify priority extreme

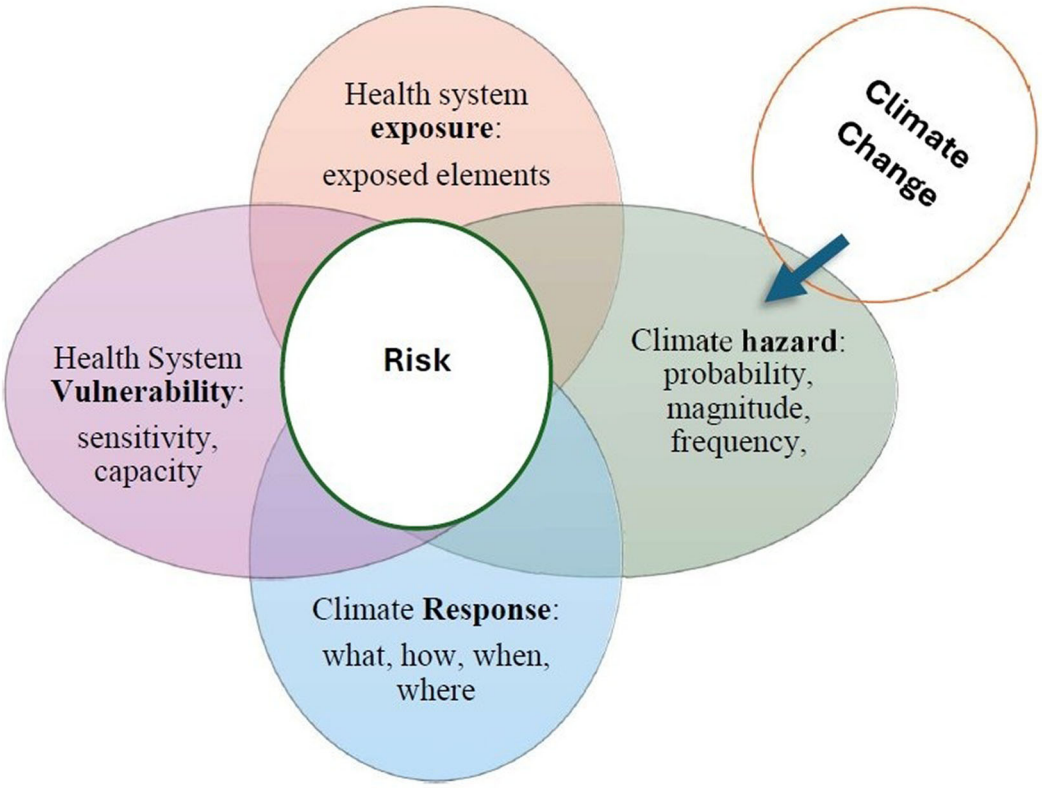

Figure 2. Conceptualising risk of extreme weather and climatic events to a health system. Figure 2 above, adapted from 2023 Climate change synthesis report: contributions of the I, II & III of the sixth annual report of the Intergovernmental panel on climate change: Determinants of risk (page 65),[15] describes how risk of extreme weather and climatic events is conceptualised. The first level of risk is the risk of climate hazards (extreme weather and climatic events) occurring from climate change. The second level of risk is the risk of health system elements to extreme weather events. This risk is linked to exposure, vulnerability and response.

weather events of national relevance. We further plan to engage these government entities together with community representatives from the four counties participating in the NEWRISK project in Kenya to appraise, validate and refine the review outputs. This process will ensure that the review findings are both relevant and applicable within the Kenyan health system and that the novel tool to be developed aligns with local priorities.

2.2 Study design

This will be an exploratory study design following the Arksey and O'Malley scoping review methodological framework originally established by Arksey and O'Malley,[17] updated by Levac[18] and Joanna Briggs Institute (JBI), updated guidelines for conducting and reporting scoping reviews using the **PRISMA Extension for Scoping Reviews (PRISMA-ScR)** guidelines.[19]

2.3 Inclusion and exclusion criteria

We will include articles from primary research studies and secondary studies/reviews (both pre-print and peer-reviewed) that have described the use of tools, approaches and guidelines for assessing health facilities or health system vulnerability, risk and readiness to extreme weather events. This evidence will be sourced from studies of any design whether conducted as observational or experimental, before-and-after, comparative analysis, mixed methods, qualitative, quantitative or reviews. We also search for tools, approaches, guidelines and policy documents from international organisational, government and non-governmental agency websites and experts in the field of climate change, disaster management and humanitarian aid. Where possible, we will also include hard copy documents from reputable humanitarian, health facility and government departments.

We will exclude studies that report assessment of health facilities for other hazards other than climate related ones.

The search will be limited to studies published in English between 1990 to 2025. 1990 has been identified by the Kyoto protocol as the base year for monitoring the impact of climate change and extreme weather events.[20]

We will exclude studies published prior to 1990. All studies published in languages other than English, unless they are already translated to English, will also be excluded at screening point.

2.3.1 Participants/Population

We will include all articled reporting the use of tools for assessing the health system or health facilities to determine risk and readiness to extreme weather and climatic events. The tools of interest may be assigned names such as *tools/ approaches/checklists/guidelines.*

We will exclude studies that report other methods other than tools, approaches, checklists and guidelines or indeed tools/ approaches/checklists/guidelines for assessing communities and non-health sectors/systems such as education, agriculture or trade.

2.3.2 Concept

To be eligible, the concepts of interest in this scoping review include the following

a) **Scope**: The extent to which the tool is used, which in this review is to assess health systems or health facilities, either for some or all levels of risk (i) exposure, (ii) vulnerability, and (iii) readiness to extreme weather events or extreme weather and climatic events or climate-linked hazards in low- and middle-income countries.

b) **Process**: The method used to develop the tool, e.g., expert-driven or through participatory approaches.

c) **Psychometric testing**: How the tool has been tested to assess its validity and reliability (testing and validation), and the contexts or settings in which it was tested and validated.

d) **Format**: The availability of the tool, e.g., whether it is accessible digitally (online, web-based, or other electronic formats) or as hard copies (paper-based tools).

e) **Purpose**: The intended use of the tool, e.g., to assess a health facility's level of vulnerability to climate hazards.

f) **Methods:** Which method (e.g facility inspection, consensus methods, interviews) used in deploying these tools.

g) **Content**: The domains or components or elements of the health system/health facility captured by the tool.

2.3.3 Context

In this scoping review, the context for which these tools have been developed for is the broader health system, and specifically for health facilities, or hospitals, or healthcare settings in low-and-middle income countries or settings.

We will exclude studies that were conducted in high income settings, or those that do not explicitly report the setting as low-income setting or country.

2.4 Search strategy and evidence sources

We will aim to make a comprehensive search of both published and unpublished tools, approaches, checklists, guidelines and frameworks mainly from international (such as World Health Organisation, World Bank and United Nations Climate Change), regional agencies (European Union, Africa CDC, African Union), government (Departments of health, teaching hospitals), humanitarians (Such as Care International, Concern Worldwide, International Federation of the Red Cross), and non-governmental agencies (climate change consortia, climate change consultancy firms). Additionally, relevant primary qualitative and quantitative research studies and reviews of these tools from online databases will be conducted. For online data sources, we will search three major databases (OVID-Medline, Embase and Global Health).

Table 1. Search terms. Table 1 below shows the proposed search terms, including Medical Subject Headings term and controlled vocabularies for Medline Ovid.

Concept: Assessment	((assess* or evaluat* or analys* or analyz* or measure* or identif* or estimat* or review* or quantif* or apprais* or appraiz* or audit* or determine* or gaug* or inspect* or monitor* or scor* or predict* or profil* or test* or validat* or triag* or prioriti*) adj5 (risk* or impact* or vulnerab* or sensitiv* or susceptib* or hazard* or threat* or danger* or exposure* or resilien* or capacit* or readiness or prepare* or severity or consequence* or outcome* or effect*)).ti,ab,kf. (or hw.)
Concept: Extreme weather event	((extreme or severe) adj10 (weather or climat* or temperature or heat or heatwave* or cold or drought* or flood* or rain* or storm*)).ti.exp weather/ or meteorological factors/ or exp temperature/ or exp heat/ or exp lightning/ or exp precipitation/ or exp storms/ or exp wind/or exp drought/
Population: Methods	(techniques/ or analytical methods/ or delphi method/ or longitudinal studies/ or qualitative techniques/ or quantitative techniques/ or rapid methods/ or sample processing/ or exp assessment/ or exp analysis/ or exp analytical methods/ or exp methodology/) and (exp effects/ or exp impact/or exp risk/)
Context: health facility	((health* or hospital* or medical) adj5 (facilit* or infrastructure or service* or system* or program* or action plan*)).ti.exp health services/or exp health facilities/
Context: Low-and-Middle Income Countries	"low-income country" OR "middle-income country" OR "low- and middle-income country" OR LMIC OR "developing country" OR "low- and middle-income populations" OR "low- and middle-income economies" OR "low- and middle-income nations" OR "low-income economies" OR "low-income populations" OR "middle income economies" OR "middle-income populations" OR "resource-limited setting" OR "resource-constrained setting" OR reginal terms according to Organisation for Economic Co-operation and Development (OECD): Afghanistan OR Albania OR Algeria OR "American Samoa" OR Angola OR Argentina OR Armenia OR Azerbaijan OR Bangladesh OR Belarus OR Belize OR Benin OR Bhutan OR Bolivia OR "Bosnia and Herzegovina" OR Botswana OR Brazil OR Bulgaria OR "Burkina Faso" OR Burundi OR "Cabo Verde" OR Cambodia OR Cameroon OR "Central African Republic" OR Chad OR "China (People's Republic of)" OR Colombia OR "Comoros Islands" OR "Congo, Democratic Republic of" OR "Congo, Republic of" OR "Costa Rica" OR "Côte d'Ivoire" OR Cuba OR Djibouti OR Dominica OR "Dominican Republic" OR Ecuador OR Egypt OR "El Salvador" OR "Equatorial Guinea" OR Eritrea OR Eswatini OR Ethiopia OR Fiji OR Gabon OR Gambia OR Georgia OR Ghana OR Grenada OR Guatemala OR Guinea OR "Guinea-Bissau" OR Guyana OR Haiti OR Honduras OR India OR Indonesia OR Iran OR Iraq OR Jamaica OR Jordan OR Kazakhstan OR Kenya OR Kiribati OR "Democratic People's Republic of Korea" OR Kosovo OR Kyrgyzstan OR "Lao People's Democratic Republic" OR Lebanon OR Lesotho OR Liberia OR Libya OR Madagascar OR Malawi OR Malaysia OR Maldives OR Mali OR "Marshall Islands" OR Mauritania OR Mauritius OR Mexico OR Micronesia OR Moldova OR Mongolia OR Montenegro OR Morocco OR Mozambique OR Myanmar OR Namibia OR Nepal OR Nicaragua OR Niger OR Nigeria OR "North Macedonia" OR Pakistan OR "Palestinian Territories" OR Panama OR "Papua New Guinea" OR Paraguay OR Peru OR Philippines OR Romania OR Russia OR Rwanda OR "Saint Lucia" OR Samoa OR "São Tomé and Príncipe" OR Senegal OR Serbia OR "Sierra Leone" OR "Solomon Islands" OR Somalia OR "South Africa" OR "South Sudan" OR "Sri Lanka" OR "St Vincent and the Grenadines" OR Sudan OR Suriname OR "Syrian Arab Republic" OR Tajikistan OR Tanzania OR Thailand OR "Timor-Leste" OR Togo OR Tonga OR Tunisia OR Turkey OR Turkmenistan OR Tuvalu OR Uganda OR Ukraine OR Uzbekistan OR Vanuatu OR Venezuela OR Vietnam OR Yemen OR Zambia OR Zimbabwe

We will also conduct further online search on Google scholar, Google web and from pre-print repositories (such as Preprints.org, BioR and MedRxiv). Additionally, we will search articles from handpicked climate-relevant journals such as Nature Climate Change, PLOS Climate, and the Lancet Countdown on health and climate change, including contacting subject-matter experts to identify unpublished or in-progress materials. All articles and resources sought will be full, open access and in English language.

Table 2. Additional search teams and syntaxes. Table 2 below shows additional search terms and syntaxes for the three databases (Medline Ovid, Embase and Global health).

Thesaurus subject terms (Medline Ovid and Embase Ovid)	Search statement ((Medline Ovid, Embase Ovid and Global health)
MESH/Emtree: Health care facility or health infrastructure.	((health or hospital* or medical) (facilit* or infrastructure or service* or system* or program*)).
MESH/Emtree: Extreme Weather/severe weather or Cold Temperature/ or Hot Temperature/ or Droughts/ or (Sea Level Rise/ or Floods/ or Rain/ or Snow/or Tidal Waves/).	((extreme or severe) (weather or climat* or temperature or heat or cold or drought* or flood* or rain or storm*)).
MESH/Emtree: Health Care Quality/health care survey/ or healthcare access/or Access, and Evaluation/or Healthcare access and quality index.	((assess* or evaluat* or analys* or analyz* or measure* or identif* or estimate* or review* or quantif* or apprais* or appraiz* or audit* or determine* or gaug*) adj5 (risk* or impact* or vulnerab* or sensitiv* or susceptib*)).
Low, and low-middle-income countries, economies, populations and nations.	A list of these regions and countries/nations.

2.4.1 Search question

We will restrict the search to the following search question: What tools (methods, approaches, checklists, frameworks, guidelines) are used for assessing the level of risk or impact, or vulnerability and readiness (adaptive capacity, resilience, preparedness, response plans) of health systems (or health facilities) to extreme weather events or extreme weather and climatic events or climate hazards in low and middle income countries?

We will use Boolean operator words: AND, OR, NOT to combine or restrict the search.

For the online databases, we will search one online database and an additional search on Google to identify and analyse text words (including key terms) used in the title and abstracts of articles. We will then develop key words for subsequent search in the other online databases. We will then find any additional articles from the listed references of the articles found from the databases. This work will be guided by the Librarian, listed as co-investigator.

2.4.2 Proposed Search

The proposed search strategy will be restricted for a period of 1990–2025 using the search terms described in Tables 1-2 below. Key words for search the websites of various organisations have also been proposed in Table 3 below.

2.5 Data management: Storage, cleaning, screening and selection of data

We will export all online articles to Zotero, an open-source online reference manager for reference library storage, deduplication and classification. From the reference manager, stored articles will be imported to Covidence systematic review management software, a web-based review management platform for any further deduplication. Two reviewers,

Table 3. Key words and their operational meaning. Table 3 below shows the key words for use during search on the national, international, government and non-governmental organisational websites.

Key terms	Search words
Tools and/or checklists	• Health facility assessment tools and/or checklists • Health system assessment tools and/or checklists
Approach and/or guidance	• Tools or checklists for assessing health facility level of risk and vulnerability to extreme weather events/or climate change events • Tools or checklists for assessing health system level of risk and vulnerability to extreme weather events/or climate change events • Guidance/Approach to guide the assessment of health facilities level of risk and vulnerability to extreme weather events/or climate change events • Guidance/Approach to guide the assessment of health systems level of risk and vulnerability to extreme weather events/or climate change events

Table 4. Full text extraction table. Table 4 below shows a data charting and extraction template. The table will be piloted and refined during full text extraction.

Preliminary data	*Author(s)*	*Publication Year*	*Country/ Region*	*Type of article (e.g primary study, review)*	*Publication status (Yes/No)*	*If published, Digital Object Identifier*	*If organisational, name of organisation*	*If unclassified, indicate as such*
	e.g Author A et al.	e.g 2020	e.g Kenya	e.g qualitative study	e.g YES		e.g UN IPCC	e.g Not classified
Content	*Type of the tool and if validated or not*	*What the tool focuses on*	*Where the tool was used or meant to be used*	*Component or area being assessed (based on the health system elements or domains)*	*Method of assessment*	*When the tool was be used (or is proposed to be used)*	*Who the research team were (or proposed to be)*	*Purpose of the assessment*
	e. g checklist validated by stakeholders	e. g. Flooding risk assessment	e. g health facility or health system	e. g health workforce	e. g non-participant observation or health facility inspection	e. g after an incident	e. g by trained researcher or by hospital staff	e. g for baseline assessment or for contingency planning
Findings	*component/ element addressed*	*How risk is conceptualised*			*How readiness/preparedness is conceptualised*		*Recommendations*	
	e.g infrastructure							

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CW and PK will screen the articles, combining titles and abstracts electronically using Covidence. CW will manually screen all duplicates and if found as errors, will be returned to the pool of articles for title and abstract screening. Thereafter, articles and abstracts of relevance will be eligible for data extraction. Again, full articles with potential relevance, based on the title will be selected by the 2 reviewers (each 100%) through Covidence. Any duplicates will be manually assessed and if erroneous, will be returned to the pool for data extraction. Any disagreements will be resolved by consensus and, if necessary, by a third reviewer (MM). All articles that are not in English language or not translated to English language will be removed at this point. The description of the selected articles will be presented narratively and using the Preferred Reporting Items for Systematic Reviews and Meta-Analysis extension for Scoping Reviews (PRISMA-ScR) diagram.

2.6 Data management: Data extraction

The primary reviewer, CW, will develop a data charting table for data extraction that details article name, type (checklist, tool, framework, guideline, review), author(s), date, source (online or shelf), ownership and findings (content). The data charting will be shared with the review team for review and edits. Data will be extracted article by article by reading and re-reading the articles and charting the findings in the proposed data charting table. The content of interest is shown in the data charting template below (Table 4). We will (CW and PK) initially pilot this data charting table on approximately 5–10 articles to develop a common understanding, refine it and to resolve any misunderstandings. Where a third reviewer is needed, MM will be the tiebreaker.

2.7 Data analysis

We will conduct a descriptive, narrative synthesis and analysis of data. Additionally, we will also conduct concept analysis of the various concepts used in the various articles to provide meaning and build a common understanding of these concepts.

2.8 Results presentation

Results will be presented in the form of the PRISMA-ScR diagram for the study selection. After analysis, findings will be presented narratively with supporting quotes. Additionally, tables will be used to provide a summary of the findings, as is necessary.

3. Conclusion

This scoping review provides a learning opportunity for persons and institutions interested in conducting an assessment to determine hazard exposure, vulnerability, risk and readiness of health systems/health facilities to extreme weather events. The findings from the scoping review will initially provide a rich learning of what tools and approaches exist, how they were deployed, and what elements/domains/areas of the health system or health facility are given prominence during assessment by these tools and approaches. Secondly, the authors will, upon synthesis of these findings and those from an ongoing empirical work, aim to design a novel extreme weather event vulnerability, risk and readiness assessment tool for health systems in Kenya, a Low- and Middle-Income Country.

3.1 Ethical review

This proposed scoping review is part of Novel Extreme Weather and Risk Insurance for Kenya, (NEWRISK) project[21] whose ethical approval has been obtained from the Scientific and Ethics Review Unit of Kenya Medical Research Institute (KEMRI/SERU/CGMR-C/315/4971). Additional ethics approval was obtained from Oxford Tropical Research Ethics Committee (OxTREC), UK, reference number 1720689.

3.2 Dissemination and utility of findings

The findings of this review will be shared with national and sub-national level stakeholders convened by the Ministry of Health, Kenya, for sense-checking to determine relevance in the Kenyan context. Subsequently, the findings will be used to inform development of a novel health facility assessment tool for Kenyan context. The novel health facility assessment tool will be used to assess health facilities in Kenya to inform preparedness, response and mitigation measures for Kenya's health facilities.

Data availability

No data are associated with this article.

References

1. Curtis S, Fair A, Wistow J, *et al.*: **Impact of extreme weather events and climate change for health and social care systems.** *Environ. Health.* 2017; **16**(Suppl 1): 128.
PubMed Abstract | **Publisher Full Text** | **Free Full Text**

2. Braithwaite J, Leask E, Smith CL, *et al.*: **Analysing health system capacity and preparedness for climate change.** *Nat. Clim. Chang.* 2024 May; **14**(5): 536–546.

3. Lugada E, Ochola I, Kirunda A, *et al.*: **Health supply chain system in Uganda: assessment of status and of performance of health facilities.** *J Pharm Policy Pract.* 2022 Dec 31; **15**(1): 58.
PubMed Abstract | **Publisher Full Text** | **Free Full Text**

4. **Together We Can Build Responsive and Resilient Health Systems for a Changing World – ACCESS Health International.** [cited 2025 Jan 28].
Reference Source

5. Rataj E, Kunzweiler K, Garthus-Niegel S: **Extreme weather events in developing countries and related injuries and mental health disorders - a systematic review.** *BMC Public Health.* 2016 Sep 29; **16**: 1020.

6. Agyei E, Kumah E: **Navigating the complex terrain of healthcare systems in Sub-Saharan Africa: challenges and opportunities for progress.** *Discov. Health Sys.* 2024; **3**: 39.
Publisher Full Text

7. Kangwanja N, Waithaka D, Nzinga J, *et al.*: **Shocks, stress and everyday health system resilience: experiences from the Kenyan coast.** *Health Policy Plan.* 2020 June 2020; **35**(5): Pages 522–535.
Publisher Full Text

8. Barasa E, Mbau R, Gilson L: **What Is Resilience and How Can It Be Nurtured? A Systematic Review of Empirical Literature on Organizational Resilience.** *Int. J. Health Policy Manag.* 2018; **7**(6): 491–503.
Publisher Full Text

9. Copeland S, Hinrichs-Krapels S, Fecondo F, *et al.*: **A resilience view on health system resilience: a scoping review of empirical studies and reviews.** *BMC Health Serv. Res.* 2023; **23**: 129.
PubMed Abstract | **Publisher Full Text** | **Free Full Text**

10. Worl Health Organisation: *Building health system resilience to public health challenges: guidance for implementation in countries.* Geneva: World Health Organization Publishing; 2024. Licence: CC BY-NC-SA 3.0 IGO.
Reference Source

11. World Health Organisation: *Operational framework for building climate resilient health systems.* Geneva: World Health organisation publishing; 2015. Licence: CC BY-NC-SA 3.0 IGO.
Reference Source

12. World Health Organisation: *Knowledge fact sheet: Investments in the health system.* Geneva: WHO regional office for Africa; 2022. WHO publishing.
Reference Source

13. Cardona OD, *et al.*: **Determinants of risk: exposure and vulnerability. In: Managing the Risks of Extreme Events and Disasters to Advance Climate Change Adaptation.** 2012.

14. Lambeti-Castronuovo, *et al.*: **Primary health care disaster preparedness: a review of literature and the proposal of a new framework.** 2022.

15. IPCC: *Climate Change. Synthesis Report.* Geneva: IPCC; 2023; 35–115.
Publisher Full Text

16. Valente M, Del Prete C, Facci G, *et al.*: **The impacts of extreme weather events on health services and systems: A systematic review of reviews**. *Public Health*. 2026 Jan 1; **250**: 106049.
Publisher Full Text

17. Arskey H, O'Malley L: **Scoring studies: towards a methodological framework.** *Int. J. Soc. Res. Methodol.* 2005; **8**(1): 19–32.

18. Levac D, Colquhoun H, O'Brien KK: **Scoping reviews: advancing the methodology.** *Implement. Sci.* 2010; **5**(1): 1.

19. Peters MDJ, Marnie C, Tricco A, *et al.*: **Updated methodological guidance for the conduct of scoping reviews.** *JBI Evid Synth.* October 2020; **18**(10): 2119–2126.
Publisher Full Text

20. United Nations: **Kyoto Protocol to the United Nations Framework Convention on Climate Change.** 1998. Article 3.
Reference Source | **Reference Source**

21. University of Oxford, Centre for Global Health Research: **A Novel Extreme Weather Risk Insurance System for Kenya (NEWRISK): A Novel Extreme Weather Risk Insurance System for Kenya (NEWRISK) — NDM Centre for Global Health Research.**
Reference Source