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Scoping review protocol: Lessons learned from non-*Aedes*-borne arbovirus epidemics for future epidemic and pandemic preparedness

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Abstract

Introduction.
The emergence and reemergence of arboviral disease in previously arboviral-free regions make it essential to document and report the lessons learned regarding preparedness and response to these outbreaks. Recent literature has focused on four *Aedes*-borne arboviruses (dengue, Zika, chikungunya, and yellow fever). However, there is less available information on non-*Aedes*-borne arboviruses. This scoping review aims to synthesise the existing literature on lessons learned from understudied arbovirus epidemics. Understanding and disseminating the lessons from these outbreaks can provide critical guidance for strengthening epidemic and pandemic preparedness and response strategies.

Methods. This scoping review will follow the Joanna Briggs Institute's methodology for scoping reviews and Preferred Reporting Items for Systematic reviews and Meta-Analyses (PRISMA) extension for scoping reviews. We will include peer-reviewed and grey literature on 28 selected non-*Aedes*-borne arboviral disease outbreaks, written in English or Spanish, with no geographical limitations, published between 2000 and 2025. Studies or reports should include specific reflections or discussions about arboviral outbreak preparedness and response strategies (e.g., challenges, gaps, lessons, recommendations). Pairs of reviewers will conduct literature screening at the abstract/title and full-text stages. A data charting form will be developed collectively to extract relevant data from the included papers. Lessons learned, including strengths, successes, gaps, and challenges, will be constructed
from the literature following reflective thematic analysis.

Introduction

1 Arthropod-borne viruses (arboviruses) are a group of viruses that can cause diseases in humans and animals and are distributed worldwide. Some of the most important vectors for arbovirus transmission include mosquitoes, ticks, midges, and sandflies (Socha et al.,2022). Mosquitoes and ticks, in particular, transmit some of the most recognised arboviral diseases, including dengue, chikungunya, Zika, yellow fever, Japanese encephalitis, West Nile fever, tick-borne encephalitis, and Crimean–Congo haemorrhagic fever (Viglietta et al., 2021).
It is estimated that more than 5.6 billion people are at risk of dengue, chikungunya and Zika infection, and 1.54 billion people are at risk of yellow fever (Lim et al., 2025).
Several factors, such as urbanisation, climate change, international travel, and poor socioeconomic conditions, have contributed to the increase (Abbasi, 2025; de Souza & Weaver, 2024; Power et al., 2022; Swei et al., 2020). For these reasons, it is not surprising that in the 21st century, there has been an explosion of arbovirus epidemics and localised outbreaks worldwide. The Zika virus, which was sporadically reported in Africa and Asia before 2007, has
now caused outbreaks in Africa, the Americas, Asia, and the Pacific (Song et al., 2017; World Health
Organization, 2016). The 2015-2016 Zika virus outbreak, declared a public health emergency of international concern, also highlighted how these types of infections might also lead to severe complications such as microcephaly and Guillain-Barre syndrome in infected adults and children (Ferraris et al., 2019). More recently, in 2024, there was a record of dengue cases, over 14 million cases and more than 10,000 deaths (**WHO,global dengue surveillance dashboard**). A recent peer-reviewed study documented 29 arboviral outbreaks in 25 African countries in 2023 (Bangoura et al., 2025). Other disease outbreaks have also been reported, including multi-country outbreaks of Oropouche infection
(Americas) and Yellow Fever (Africa) (Wesselmann et al., 2024; World Health Organization, 2024a, 2024b).

The emergence and reemergence of arboviral disease in previously arboviral-free regions make it essential to document and report what lessons have been learned regarding the preparedness and response to these outbreaks. In 2024, the WHO Global Arbovirus Initiative published the technical report "*Global arbovirus initiative: preparing for the next pandemic by tackling mosquito-borne viruses with epidemic and pandemic potentia*l", which focused on four *Aede*s-borne arboviruses (dengue,zika, chikungunya and yellow fever). However, there remains a gap in assessing the lessons from other arbovirus epidemics to inform the strengthening of the preparedness system and capacities.
This scoping review aims to synthesise existing literature on lessons learned from past

non-*Aedes*-borne arbovirus epidemics, addressing this gap. Understanding and disseminating the lessons from past understudied arbovirus outbreaks can provide critical guidance for strengthening epidemic and pandemic preparedness and response strategies.

Objectives

2 The primary purpose of this study is to conduct a scoping review of published and grey literature to **identify key lessons learned from past non-*Aedes*-borne arbovirus epidemics.** The specific objectives are:

2.1 a) To map the available evidence on lessons learned from non-*Aedes*-borne arbovirus outbreaks,
b) To identify gaps and challenges in preparedness and response efforts and
c) To extract key recommendations for enhancing future pandemic preparedness

Methods

3 This scoping review will follow the Joanna Briggs Institute's methodology for scoping reviews and PRISMA extension for scoping reviews (Aromataris et al., 2024; Tricco et al., 2018). The research team developed this protocol in collaboration with WHO partners.

4 **Eligibility criteria.** We will include peer-reviewed and grey literature on arboviral disease outbreaks written in English or Spanish without geographical limitations. As different definitions of 'outbreak', 'epidemic' or 'pandemic' depend on the transmission level and context of the particular region or country, we willadopt the methodological approach used by Matthews and collaborators, and we will rely on the author's characterisation of the event (R. J. Matthews et al., 2022). Studies or reports should include specific reflections or discussions about arboviral outbreak preparedness and response strategies (e.g., challenges, gaps, lessons, recommendations).

This review will focus on 28 arboviruses: Alkhurma haemorrhagic fever virus, Barmah Forest virus, California encephalitis virus, Chandipura virus, Crimean–Congo haemorrhagic fever virus, Eastern Equine Encephalitis virus, Japanese Encephalitis virus, Kyasanur Forest disease virus, La Crosse virus,
Madariaga virus, Mayaro virus, Murray Valley Encephalitis virus, O'nyong'nyong virus, Oropouche virus, Powassan virus, Rift Valley fever virus, Rocio virus, Ross River virus, Saint Louis Encephalitis virus, SFTS virus (Severe Fever with Thrombocytopenia Syndrome virus), Sindbis virus, Spondweni virus, Tick-borne encephalitis virus, Toscana virus, Usutu virus, Venezuelan equine encephalitis virus, West Nile virus, and Western Equine Encephalitis virus (Table S1). This selection was based on an exploratory review of peer-reviewed literature and discussions within the

research team and our WHO partners. The selection covers a range of arboviral diseases in which preparedness and response approaches must be tailored to the specific context, considering factors such as disease burden, vector type, host range, geographical and climatic distribution, evidence of emergence and reemergence (e.g. Oropouche virus, Usutu virus) and
bioterrorism potential (e.g. Venezuelan equine encephalitis virus, Crimean–Congo haemorrhagic fever virus). Table S2 summarises some of the most recent outbreaks of 12 of the 28 selected pathogens to illustrate their relevance and
importance.

4.1 Documents will be excluded if they have any of the following criteria:

- Randomised clinical trials or clinical trials, as this review focuses on lessons learned from public health
  strategies, not interventions.
- Publications in languages other than English or Spanish.
- The main focus is on vector biology or genetic variations.
- The main focus is on individual clinical care of patients or pharmacological treatment.
- Mathematical modelling studies
- The main focus is on vaccine development.
- Fully descriptive with no reflection or discussion on lessons learned.
- Papers where full article cannot be retrieved.
- Training manuals.

5 **Search Strategy and Information Sources.** The search strategy was initially informed by similar scoping reviews discussing outbreak preparedness and responses (Antonio et al., 2025;Mphande-Nyasulu et al., 2024; Sigfrid et al., 2020) and indicators for public health emergency preparedness (Lee et al., 2023). The final selected search terms will focus on identifying papers that a) are related to outbreaks, epidemics or pandemics, b) are related to lessons learned/reflections/evaluation/assessments and c) are related to one of the selected 28 arboviral diseases. We used AI technology (Claude 3.7 Sonnet, developed by Anthropic) to refine the initial search terms, particularly those related to the lessons learned. Our search strategy was developed in consultation with an experienced health research librarian. To identify peer-reviewed journals, we will search the following databases: Scopus, CINAHL, and Ovid MEDLINE. Tables S3-S5 show the detailed search strategy and search terms.
The grey literature search will focus on official reports that provide lessons learned from past arboviral
outbreaks and were published in the last 10 years (2015-2025). The search will cover multiple types of
sources including: WHO repositories for after-action reviews, intra-action reviews, and simulation exercises; Pan American Health Organization, European Centre for Disease Prevention and Control, World Bank Group, Global Preparedness Monitoring Board, Secretariat for Pacific Communities, Food and
Agriculture Organization, World Organisation for Animal Health , Latin American and

Caribbean Literature on Health Sciences Database and Scientific Electronic Library Online. These sources will be
searched directly on the site or using Google's advanced search for specific domains. The search strategy will use broad arbovirus outbreak terms and pathogen-specific searches, particularly focusing on six priority pathogens: West Nile Virus, Crimean-Congo Haemorrhagic Fever, Oropouche Virus, Japanese Encephalitis, Kyasanur Forest Disease, and Rift Valley Fever.
Global experts, such as WHO members of the Preparedness and Resilience for Emerging Threats (PRET) group, and the Quadripartite (FAO, UNEP, WHO and WOAH) will also be consulted to provide relevant documentation to complement this literature search.

6 **Selection of Sources of Evidence.** All references identified in the literature databases will be imported into Endnote. The records will be deduplicated using the Automated Systematic Search Deduplicator (ASySD) (Hair et al., 2023) and Rayyan, a web-based software.
The team members in charge of the screening process will independently review approximately 50 selected documents, and a consensus meeting will take place to review the findings and adjust and refine
(if necessary) using the eligibility criteria. After that, a pair of reviewers will be assigned to independently review a set of articles (dual screening). Each reviewer will independently review the title and abstract to decide whether the article is potentially eligible for the full-text screening stage. The reviewers will assign each paper an "Included" or “Excluded” label. Discrepancies will be solved by consensus. A third reviewer will be consulted if needed.
In the full-text screening, the document will be reviewed entirely, and the final papers to be included in the review will be selected by applying the same process as the abstract screening. Reasons for exclusion papers at the full-text screening stage will be recorded and reported. The search results and the study inclusion process will be fully noted in the final scoping review and presented in a PRISMA flow diagram.
All reviews (narrative, systematic, scoping) will not be evaluated in the first stage of the full-text screening. If, after assessing empirical literature, we consider data to be scarce for any or all of the selected pathogens, these reviews might be included in the final analysis.

7 **Data Charting.** To extract relevant data from the papers and reports, an Excel data extraction charting form will be developed collectively. Table 1 shows a list of the items considered to be part of this form.

Table 1. Items to be collected in the data extraction charting form.

	Item	Description
	Author	List of all the authors of the document
	Gaps, weaknesses, and barriers in the preparedness and response efforts	List of author's reflection on the gaps, weaknesses, and barriers reported for a particular preparedness or response strategy
	Strengths and facilitators of the preparedness and response efforts	List of author's reflection on the strengths and facilitating factors reported for a particular preparedness or response strategy
	Arbovirus	List of the arbovirus or arboviruses that are the focus of the report/paper
	Recommendations	List of the author's recommendations
	Outbreak preparedness/response strategies†	List of the outbreak preparedness/response strategies reported to control the outbreak
	Vector	List of the vector/s that are the focus of the report/paper
	Objective	Objective of the document
	Type of publication	Original research, review, policy/guidance document
	Other	Other topics that arise during the review (e.g. health system structural factors, economic/cost considerations)
	Event type	Outbreak, epidemic, pandemic (as listed by the authors)
	Outbreak characteristics	Time (including season), place and duration of the outbreak
	Title	Title of the document
	Year	Year of publication

†Informed by the WHO recommended strategies and interventions for preparedness and response (e.g.

Global Arbovirus Initiative, WHO Health Emergencies Programme technical report).(World Health Organization, 2023,2024c)

This draft data extraction tool will be piloted in 10 randomly selected articles, modified and revised if needed. Then, senior team members will lead the manual data extraction from the included studies.

8 **Synthesis of the results.** The characteristics of the included studies will be summarised using descriptive
statistics. Descriptive summaries will be presented as frequencies and percentages for categorical variables and median, interquartile range, and range for continuous variables. The strengths, facilitators, gaps, barriers, weaknesses, and key lessons and/or recommendations will be narratively summarised using thematic analysis, deductively informed by the WHO-recommended arbovirus, vector-borne and related strategies and interventions for preparedness and response, and inductively informed by the literature and reports. Findings will be presented graphically, diagrammatically, or tabularly.

9 **Validation of the results.** A draft report will be shared and discussed with the WHO team partners and key experts for additional insights, comments and refinements. A final report and a high-level summary format will be produced that can be used for advocacy purposes with multi-sectoral, policy and decision-makers.

Declarations

10 **Author's contributions.**
Conception and design of the study: DRA, OWA, IR, SH, MW, TA, MEC. Design of search strategy: MEC,
MW, TA, AAS. Data charting forms improvements: AAS, ISD, RG, AD, LP, TB; Writing protocol: MEC, MW, TA, AAS, ISD. Review and edit of the manuscript; DRA, OWA, IR, SH. All authors approved the final version of this protocol.

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12 **Competing interests**
The authors declare that they have no competing interests.

13 **Competing interests**
The authors declare that they have no competing interests.

14 **Data availability statement**

The data generated and analysed in this scoping review will be synthesised and presented in the finalised version of the review.

Supplementary Material

15 See attached file. Lessons_Arbovirus_Protocol_Scopi... 132.8KB

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