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Examining the role of community health workers amid extreme weather events in low- and middle-income countries: a scoping review

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ABSTRACT

Objectives: The increased frequency and severity of extreme weather events (EWEs) have underscored the need to strengthen climate-resilient health systems and capacity. Community health workers (CHWs) are integral health systems actors with the potential to protect and improve population health in a changing climate. The aim of this review was to synthesize the literature on the roles of CHWs amid EWEs in low- and middle-income countries, the barriers and facilitators to implement these roles, and program supports to strengthen CHW capacity and health system functions.
Study design: Scoping review.
Methods: Four academic databases and gray literature published between January 2000 and June 2023 were searched. Data were thematically analyzed using a deductive-inductive approach guided by the World Health Organization's (WHO's) Operational framework for building climate-resilient health systems.
Results: Thirty sources were included. Amid EWEs, CHW roles included: 1) delivery of diagnostic, treatment, and other clinical services; 2) support with access, utilization, or navigation of health services and/or referrals; 3) community education and health promotion; 4) data collection and health surveillance; 5) psychosocial supports; and 6) weather-related health emergency response. Facilitators and barriers to the provision of CHW supports amid EWEs were categorized within WHO's building blocks of health systems. Considerations for strengthening CHW programs to enhance climate-resilient health systems are also discussed.
Conclusions: CHWs are uniquely positioned to provide health-related supports amid EWEs that extend to emergency preparedness and response to climate-health challenges. These efforts can contribute to the community and health systems resilience to climate change.

Introduction

In recent years, climate change has increased the frequency and severity of extreme weather events (EWEs) affecting health systems globally.[1] Floods, droughts, extreme heat (also commonly known as a "heat wave"), and tropical storms have direct impacts on population health arising from illness, infrastructure damage, and disruption of livelihoods.[1–5] These events can place strain on community health systems within resource-limited settings.[4,6,7] With climate change expected to significantly impact the health of populations in low- and middle-income countries (LMICs), the resilience of health systems will continue to be challenged.[8–11] It is therefore necessary to identify adaptive measures and approaches to reduce and manage climate-health risks.[1] Moreover, engagement with community health system actors is critical for enhancing capacity to build climate-resilient health systems.[12] Global calls for collective

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action on health systems resilience to climate change have also been raised by the World Health Organization (WHO) and United Nations (UN) (e.g. Framework Convention on Climate Change).[1,13–15]

Community health workers (CHWs) are critical actors within global health systems.[16] As members of the communities they serve, CHWs are integral to providing health supports by acting as intermediaries between communities and health services.[4,17–19] Further, CHWs are often tasked to provide frontline care for maternal and child health,[2,20,21] treatment of communicable and non-communicable diseases,[19,22] and education and awareness of health-promoting practices.[23,24] As such, CHW programs are increasingly being expanded in scale, particularly in LMICs.[16,25] However, as new threats or shocks emerge from climate change, an expansion in CHW roles may be needed to effectively respond to emergencies while maintaining essential health systems functions. Thus, identification and evaluation of the various supports required to enhance CHW program capacity are needed to protect and improve community health in the context of climate change.

Previous systematic reviews on CHW programs have focused on the role of CHWs in improving disease-specific outcomes.[26,27] Other reviews have examined factors for integration into the health system and program improvements for maternal and child health.[26,28–30] Moreover, while there is attention to the opportunities for CHW engagement with planetary health,[31] consideration of the climatic conditions in which CHW programs operate within health systems and approaches for strengthening responses to prevent and manage climate-health risks has been limited. The aim of this review was to synthesize the literature on the roles of CHWs amid EWEs in low- and middle-income countries, the barriers and facilitators to implement these roles, and program supports to strengthen CHW capacity and health system functions. Using the WHO's Operational framework for building climate-resilient health systems, we also highlight considerations for strengthening CHW programs to enhance CHW capacity and health system functions in a changing climate.

Methods

Search strategy

We followed the Preferred Reporting Items for Systematic reviews and Meta-Analyses extension for Scoping Reviews (PRISMA-ScR) checklist.[32,33] In addition, Arksey and O'Malley's (2007) framework guided our multi-stage approach to conduct the scoping review.[34] Academic and gray literature published between January 2000 and June 2023 was searched. In consultation with a university librarian, a search strategy was developed that consisted of terms related to CHWs and EWEs. The search strategy, including all identified keywords and index terms, was adapted for four academic databases: PubMed, Scopus, EMBASE (OVID), and CINAHL. A systematic search of gray literature informed by Godin and colleagues (2015),[35] consisted of a search of published documents in Google (in incognito mode), the WHO website, and the UN Evaluation Group database. The first ten pages were screened for sources using the title, URL, and first screen view. The full search strategy is described in Supplementary File 1. All citations from database searches were exported in .ris format then uploaded into Covidence (review management software) for automatic de-duplication and screening. Gray literature was manually retrieved using Microsoft Excel®.

Screening process and eligibility criteria

A two-step screening strategy was employed by two independent reviewers (AD, BB). Step one involved title and abstract screening of all retrieved sources. For gray literature, the process was adapted by screening the titles, summaries, or tables of contents of published reports and documents. All title/abstracts meeting inclusion criteria were then screened in step two (full text) to confirm inclusion. In addition, reviewers met to discuss conflicts, and a third reviewer (WD) was engaged when needed to reach a resolution. Interrater reliability was assessed through Cohen's Kappa coefficient. Reference lists of included papers were hand-searched for additional sources meeting the inclusion criteria.

Included sources met all inclusion criteria outlined in Table 1. Non-weather-related disasters and planetary health challenges related to air pollutants, biodiversity loss, and exposure to toxic chemicals were excluded. We searched for sources published from the year 2000 onwards, given the focus on health systems strengthening through the launch of the Millennium Development Goals, as well as the global increase in EWEs observed since 2000.[36] Geographic location was restricted to LMICs due to significant climate-health risks within LMICs and growing interest in scaling up CHW programs within these regions.[1,16]

Data extraction and analysis

The following data were extracted from each source by two independent reviewers: key characteristics, study design, geographic region, CHW program, and components of the health systems supported by CHWs (i.e. CHW roles within health systems). A hybrid deductive-inductive approach was used to thematically analyze facilitators and barriers to the provision of health-related supports and services by CHWs amid EWEs and considerations for strengthening CHW programs.[41] The WHO Operational framework for building climate-resilient health systems[1] was used to guide the analysis. The framework was developed to provide guidance on strengthening health systems capacity to prevent and manage climate-health challenges within LMICs. As such, application of the framework provided the opportunity to consider the role of CHWs and the potential for such programs to strengthen health systems resilience to climate change.[1] The ten components for building climate resilient health systems from the WHO Operational framework include: (1) leadership and governance; (2) health workforce; (3) vulnerability, capacity, and adaptation assessment; (4) integrated risk monitoring and early warning; (5) health and climate research; (6) climate resilient and sustainable technologies and infrastructure; (7) management of environmental determinants of health; (8) climate-informed health programs; (9) emergency preparedness and management; (10) climate and health financing.[1] These components are connected to six foundational building blocks of health systems: (1) leadership and governance; (2) health workforce; (3) health information systems; (4) essential medical products and technologies; (5) service delivery; (6) finance. In adapting the WHO Operational framework to the scope of this review, modifications were made to better align findings from sources with the components of the WHO Operational framework.[1] Specifically, the component “leadership and governance” was disaggregated to include “cross-sectoral collaboration and partnerships” and “community engagement and leadership support.” Additionally, the component “climate and health financing” was modified to “program funding and incentives” to align with the structure and function of CHW programs observed across included sources. Using Microsoft Excel®, codes and themes were organized deductively according to the framework's 10 key components for building climate resilience within the six building blocks of health systems.[1] Where extracted data did not align with predetermined components of the framework, themes were

Table 1
Eligibility criteria used to screen sources that examine the role of community health workers amid extreme weather events in low- and middle-income countries.

Criteria	Inclusion	Exclusion
Study population	Community health workers who live in the communities they serve; were active in their community prior to, during, or following an EWE; received lower levels of training and education than other healthcare professionals[16,18]	Healthcare providers/professionals with high levels of training and education (e.g. doctors, nurses; midwives; paramedics)[16,18]; individuals from the community who mobilized for the exclusive purpose of extreme weather event response
Extreme weather events	Weather-related disasters, including those that were hydrological (e.g. floods, landslides), meteorological (e.g. storms, extreme heat, commonly known as a "heat wave"), and/or climatological (e.g. droughts)[5,11,37–39]	Disasters that were geophysical (e.g. volcanic activity, earthquakes, tsunamis), biological (e.g. animal accident, epidemic, insect infestation)[37–39]; planetary health challenges related to air pollutants, biodiversity loss, poor soil quality, and exposure to toxic chemicals detrimental to human health
Geographic context	Countries classified as low income, lower-middle income, or upper-middle income in the World Bank List of Economies[40]	Countries classified as high income in the World Bank List of Economies[40]
Type of source	Primary research published in a journal, government documents and reports; non-governmental organization or civil society documents and reports; research reports	Secondary sources, conference papers/proceedings, theses and dissertations, field notes, blogs, newsletters
Language of publication	English	Any language other than English
Date of publication	Sources published in the year 2000 and onwards	Sources published before the year 2000

inductively derived during subsequent rounds of coding based on CHW programs and roles described in sources.

Results

Characteristics of sources

A total of 3427 academic and 31 gray sources were identified for eligibility assessment. From these sources, 30 met our inclusion criteria, of which 27 were academic and three were gray literature sources (Fig. 1). Cohen's Kappa coefficient to assess interrater reliability was 0.73 for title/abstract screening and 0.86 for full text review, indicating strong agreement.[42] Academic sources employed qualitative ($n = 15$), quantitative ($n = 5$), mixed methods ($n = 4$), and program evaluation ($n = 3$) study designs.

Most sources were from Africa ($n = 12$) and Southeast Asia ($n = 9$) (Table 2). In addition, five sources included case examples from multiple countries. The depth of information on the impact of EWEs varied across studies. While some sources commented on EWEs as context for which the program operates within the health system, other sources detailed the direct impacts of EWEs on the role of CHWs and population supported. The most frequently reported EWEs were floods ($n = 17$), storms ($n = 8$), and droughts ($n = 6$). Tables 2 and 3 provide a summary of descriptive characteristics of sources. Additional details can be found in Supplementary File 2, Tables 1 and 2.

Community health worker roles amid extreme weather events

CHWs perform a range of roles within health systems that vary by program, geographic region, and population-specific health

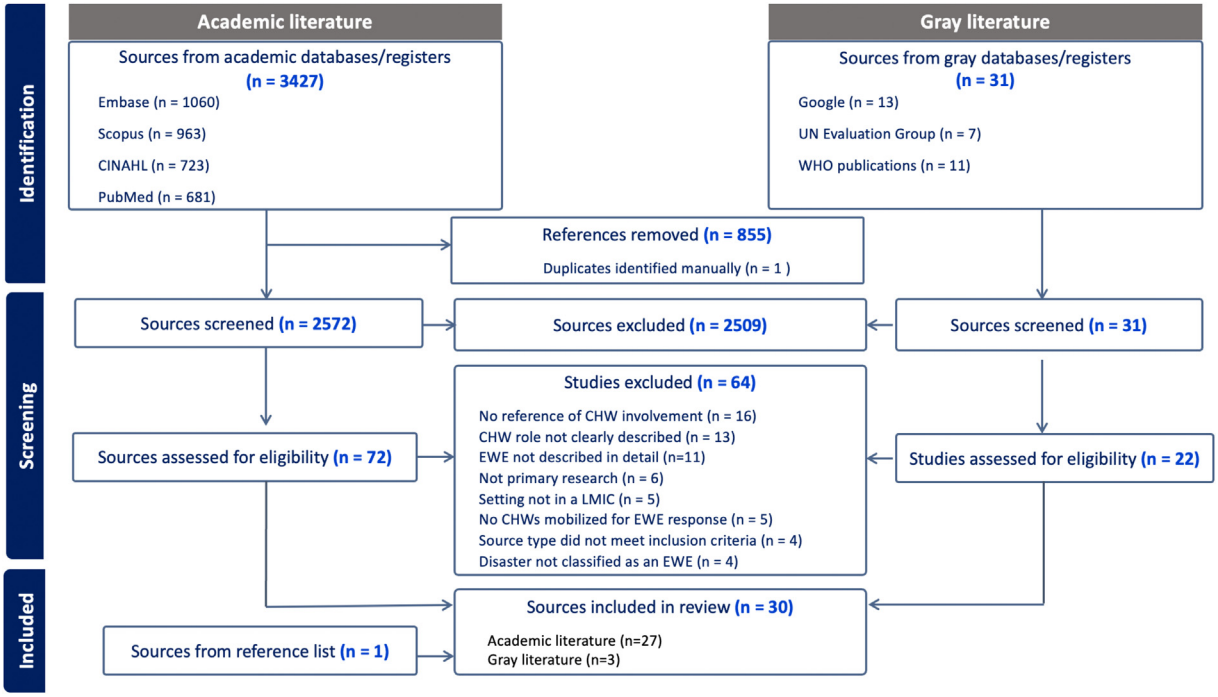

Fig. 1. Flow chart illustrating selection of relevant sources on the role of community health workers amid extreme weather events (EWE) in low- and middle-income countries (LMICs) ($n = 30$).

Table 2
Descriptive characteristics of sources (n = 30).

Characteristics	Number of sources[a]
Geographic region[b]	
Africa	12
Southeast Asia	9
Eastern Mediterranean	5
Western Pacific	4
Americas	4
Methods[c]	
Qualitative	15
Quantitative	5
Mixed methods	4
Program evaluation	3
Extreme weather events[b]	
Flood	17
Storms	8
Cyclone	4
Hurricane	2
Typhoon	2
Drought	6
Extreme heat	3
Landslide	2
Health outcome or concern[b]	
Maternal health	9
Child health (e.g. identification and management of malnutrition)	9
Health promotion and disease prevention	6
Communicable/infectious (e.g. water-borne; soil-transmitted infections; HIV)	6
Weather-related emergencies (e.g. dehydration; heat exhaustion; flood disaster management; water quality)	6
Mental health (e.g. posttraumatic stress disorder; depression; anxiety; substance abuse)	5
Health systems component supported[b]	
Community education and health promotion	22
Delivery of diagnostic, treatment, and other clinical services	15
Support with access, utilization, or navigation of health services and/or referrals	15
Data collection and health surveillance	5
Psychosocial supports	4
Weather-related health emergency response	3

[a] Numbers may not sum to 30 due to sources missing information or accounted for in multiple categories.
[b] Non-mutually exclusive categories. See Table 3 for further details.
[c] Academic sources only ($n = 27$).

needs. Amid EWEs, sources highlighted six broad CHW roles: 1) community education and health promotion; 2) delivery of diagnostic, treatment, and other clinical services; 3) support with access, utilization, or navigation of health services and/or referrals; 4) data collection and health surveillance; 5) psychosocial supports; and 6) weather-related health emergency response. Within the WHO's building blocks of health systems and across included sources, the role of CHWs amid EWEs fell primarily within service delivery but also extended to areas of emergency preparedness and management, as well as integrated risk monitoring and early warning. Within flood-affected communities, for example, CHWs played a fundamental role in disseminating early warning messages[43] and flood disaster management for older adults.[44] Other CHW supports provided amid floods included safe drinking-water testing;[45] referral of mental health supports;[7,46,47] coordination of hospital treatment of medical emergencies such as maternal health complications;[48–50] and treatment of malnutrition[21,22] and water-borne diseases (e.g. diarrhea, dysentery, typhoid).[22]

Within countries affected by drought, shocks included elevated rates of food insecurity, malnutrition, internal displacement, disease outbreaks, and destroyed crops, affecting the livelihood of communities.[3,4,20] Under such circumstances, CHWs were essential in leading drought responses and providing health supports such as delivery of health messages,[20] health surveillance of measles cases,[3] and the treatment of pneumonia, malaria, and diarrhea.[4]

Additional supports provided by CHWs amid EWEs included treatment of heat emergencies and related illnesses such as dehydration, heat cramps, heat exhaustion, and heat stroke.[51–53] Several sources also highlighted the role of CHWs in leading health-promoting activities to raise awareness of risk factors, preventive measures, and management of illnesses amid EWEs (e.g. extreme heat, flood) through household visits and sharing of resources.[44,53,54] Further, mental health supports provided by CHWs following floods or hurricanes included support for stress management,[46] substance abuse,[46] depression,[7] anxiety,[7] post-traumatic stress disorder,[7] and domestic violence.[24]

Facilitators and barriers to provision of health-related supports and services by community health workers amid extreme weather events

Sources documented several considerations for strengthening CHW programs (Table 4). These considerations have been synthesized within six building blocks of health systems in the WHO Operational framework for building climate-resilient health systems.[1] Facilitators and barriers to provision of health-related supports by CHWs are also summarized below within each health systems building block and components for climate resilient health systems.[1]

Leadership and governance

Sources emphasized cross-sectoral collaboration and partnerships as important for sustaining CHW responses to community health challenges amid EWEs ($n = 8$). For example, the prioritization of community health by local governments[6,22] and collaboration between CHWs, community groups, and other professionals in health care and education were identified as important for coordinating supports and disaster responses. These partnerships were also highlighted as important for brokering local knowledge in community systems of care and programmatic responses to emergencies.[19,22,59] Limited knowledge of climate-health risks among policymakers and health workers, however, was identified as a barrier to collective actions and responses to heat-related illnesses (e.g. heat exhaustion or stroke).[6,52]

Additionally, community engagement and leadership support were emphasized as important for fostering trust to promote awareness and acceptance of CHW programs amid EWEs ($n = 9$). For example, community openness to CHW services was identified as important for supporting CHWs response to climate-related shocks.[6,20] In addition, recognizing the role of community in managing health needs was identified as important for building adaptive capacity to manage health needs during floods.[55]

Health workforce

Building technical and professional capacity among CHWs was documented by many sources as critical for strengthening CHW-led emergency responses and quality of care amid EWEs ($n = 10$). For example, disaster preparedness[4,22,43] and heat prevention training[53] were important competencies for equipping CHWs with knowledge and tools to respond to EWEs. Conversely, inadequate training,[51] high workload,[4] lack of career advancement opportunities,[61] and poor-quality supervision[61] were identified as barriers to effective EWE responses. In addition, psychological shocks and stress among CHWs following EWEs were discussed as factors that influence capacity to support others in the community.[6]

Table 3
List of eligible sources presented alphabetically by country and author (n = 30).

#	First Author (Year)	Country	Methods	EWE	CHW program	Health systems component supported
1	Abdullah (2019)[49]	Bangladesh	Qualitative research; case study; interviews; focus groups	Flood	Village doctors (rural medical practitioners without formal medical degree), local kabiraj (practicing traditional Ayurveda), traditional birth attendant	Support with access, utilization, or navigation of health services and/or referrals; other supports and services provided during weather-related disasters or health emergencies
2	Al-mueed (2021)[43]	Bangladesh	Qualitative research; interviews	Flood	Community volunteer	Community education and health promotion; data collection and health surveillance; other supports and services provided during weather-related disasters or health emergencies
3	Goudet (2010)[21]	Bangladesh	Qualitative research; focus groups	Flood	Community health workers, Bangladesh Rural Advancement Committee, Manoshi program	Community education and health promotion
4	Shah (2019)[22]	Bangladesh	Mixed methods	Flood; Cyclone	Community health care providers and village doctors, integrated community case management service delivery	Delivery of diagnostic, treatment, and other clinical services; support with access, utilization, or navigation of health services and/or referrals; community education and health promotion
5	Saulnier (2020)[55]	Cambodia	Qualitative research; Interviews; focus groups	Flood	Village chiefs, village health support groups, traditional birth attendants	Support with access, utilization, or navigation of health services and/or referrals; community education and health promotion; data collection and health surveillance
6	Irenso (2022)[20]	Ethiopia	Qualitative research; Focus groups	El Niño drought	Traditional birth attendants Health Development Army leader	Support with access, utilization, or navigation of health services and/or referrals; community education and health promotion
7	Rawat (2022)[4]	Ethiopia	Qualitative research; interviews; focus groups	El Niño drought	Health extension workers, health extension program	Delivery of diagnostic, treatment, and other clinical services; support with access, utilization, or navigation of health services and/or referrals; community education and health promotion; data collection and health surveillance
8	Mosley (2004)[45]	Fiji	Quantitative research	Flood; cyclone	Community health workers	Other supports and services provided during weather-related disasters or health emergencies; other: could safely test water supplies within the community.
9	James (2020)[7]	Haiti	Quantitative research; Randomized controlled trial	Hurricane Flood Landslide	Haitian lay mental health workers, Mental health integrated disaster preparedness intervention	Delivery of diagnostic, treatment, and other clinical services; community education and health promotion
10	Sripad (2021)[6]	Haiti	Qualitative research; interviews	Hurricane	Agents de santé communautaire polyvalent, Haitian Ministry of Health	Delivery of diagnostic, treatment, and other clinical services; support with access, utilization, or navigation of health services and/or referrals; community education and health promotion; psychosocial supports
11	Kiran (2021)[46]	India	Program evaluation	Flood	Accredited Social Health Activists, project Pariraksha (government)	Delivery of diagnostic, treatment, and other clinical services; support with access, utilization, or navigation of health services and/or referrals; community education and health promotion; psychosocial supports
12	Kumar (2005)[56]	India	Qualitative research; Case study	Drought	Anganwadi workers, Nutrition care centres	Delivery of diagnostic, treatment, and other clinical services; support with access, utilization, or navigation of health services and/or referrals; community education and health promotion
13	Karani (2013)[57]	Kenya	Mixed methods	Flood	Community health extension worker National school-based de-worming program	Data collection and health surveillance
14	Khan (2021)[51]	Pakistan	Qualitative research; Interviews; Focus groups	Extreme heat	Community health workers, heat emergency awareness and treatment trial, emergency departments of local hospitals	Delivery of diagnostic, treatment, and other clinical services; support with access, utilization, or navigation of health services and/or referrals; community education and health promotion
15	Maheen (2017)[48]	Pakistan	Qualitative research; Interviews	Flood	Traditional birth attendants (Dai)	Delivery of diagnostic, treatment, and other clinical services

(*continued on next page*)

Table 3 (*continued*)

#	First Author (Year)	Country	Methods	EWE	CHW program	Health systems component supported
16	Razzak (2022)[53]	Pakistan	Quantitative research; Randomized controlled trial	Extreme heat	Community health worker, heat emergency awareness and treatment intervention	Community education and health promotion
17	Contreras (2018)[24]	Peru	Mixed methods	Flood; landslide	Community health worker, Socios En Salud	Support with access, utilization, or navigation of health services and/or referrals; community education and health promotion; psychosocial supports
18	Czaicki (2015)[58]	Philippines	Quantitative research; Survey	Typhoon	Community health worker, community-based alcohol intervention program	Delivery of diagnostic, treatment, and other clinical services
19	Perez (2020)[54]	Philippines	Qualitative research; Focus groups	Typhoon	Village health worker; Barangay health worker	Support with access, utilization, or navigation of health services and/or referrals; community education and health promotion
20	Seal (2021)[3]	Somalia	Quantitative research; Prospective Cohort	Drought	Community health worker, A Nutrition and Mortality Monitoring System	Data collection and health surveillance
21	National Department of Health (2020)[52]	South Africa	Report	Extreme heat	Community health workers	Community health education and awareness
22	Kozuki (2018)[50]	South Sudan	Mixed methods	Flood	Community-based distributors	Delivery of diagnostic, treatment, and other clinical services
23	Wilunda (2017)[2]	South Sudan	Qualitative research; Interviews; Focus groups	Flood	Community health worker, traditional birth attendant	Delivery of diagnostic, treatment, and other clinical services; support with access, utilization, or navigation of health services and/or referrals; community education and health promotion
24	Yodsuban (2021)[44]	Thailand	Qualitative research; Interviews; Focus groups; Observation	Flood	Community/village leaders	Community education and health promotion
25	Pasara (2022)[23]	Zimbabwe	Program evaluation; Mixed methods	Cyclone Flood	Community health workers, community-based rehabilitation programs	Delivery of diagnostic, treatment, and other clinical services; community education and health promotion
26	Skovdal (2013)[59]	Zimbabwe	Qualitative research; Interviews; Focus groups	Drought	Community health worker	Community education and health promotion; psychosocial supports
27	Maat (2021)[19]	Ethiopia; Sierra Leone; Madagascar; Uganda	Qualitative research; Case study; Interviews; Focus groups; Other: participatory workshops	Flood; cyclone	Madagascar: Community health workers Sierra Leone: Village health worker Ethiopia: Health Extension Workers and WDA community volunteers	Delivery of diagnostic, treatment, and other clinical services; support with access, utilization, or navigation of health services and/or referrals; community education and health promotion
28	Kohrt (2018)[60]	Liberia; Nepal; Uganda	Program evaluation	Unspecified	Liberia: General Community Health Volunteers Nepal: Auxiliary Health Workers, World Health Organization' Mental Health Gap Action Programme Uganda: Village Health Team members	Delivery of diagnostic, treatment, and other clinical services; support with access, utilization, or navigation of health services and/or referrals; community education and health promotion
29	Perry (2013)[61]	Bangladesh; Brazil; Ethiopia; India; Iran; Nepal; Pakistan	Report	Flood; drought; other unspecified	Bangledesh: Shasthya Shebika Program CHW program of Bangladesh Rural Advancement Committee Brazil: Community health agent, Family Health Strategy Ethiopia: Health extension workers, Health Development Army	Delivery of diagnostic, treatment, and other clinical services; support with access, utilization, or navigation of health services and/or referrals; community education and health promotion

Table 3 (*continued*)

#	First Author (Year)	Country	Methods	EWE	CHW program	Health systems component supported
					volunteers; India: Accredited social health activists; Iran: Village health workers Nepal: Village health worker, Nepal Health Sector Program; Pakistan: Lady health workers, Lady Health Worker Program	
30	Save the children (2012)[62]	Malawi; Mozambique; South Sudan	Report	Unspecified	Community health workers	Delivery of diagnostic, treatment, and other clinical services; support with access, utilization, or navigation of health services and/or referrals; community education and health promotion

EWE - Extreme weather event.
CHW - Community health worker.

Health information systems

Few sources discussed integrated risk monitoring and early warning ($n = 3$) of EWEs within CHW programs. However, early warning was identified as an enabler for supporting CHWs and their capacity to collaborate with key stakeholders and make decisions on collective actions to support communities amid EWEs (e.g. flooding).[22] Four studies referenced vulnerability, capacity, and adaptation assessments. In particular, the need for continuous risk assessment[4] and repositioning CHWs to disseminate information on risk vulnerability was highlighted to support community adaptive capacity to EWEs.[20] Prior work (e.g. teaching) and lived experiences through multiple shocks (e.g. storms, disease outbreaks) were also discussed as facilitators that enabled CHW emergency preparedness and response amid EWEs.[6] In addition, two sources highlighted the need for future health and climate research as important for building community resilience and strengthening CHW interventions to various shocks from climate change.[4,58]

Essential medical products and technologies

Climate-resilient and sustainable technologies and infrastructure were discussed by several sources ($n = 8$). One study examined the distribution of a water quality test kit and its benefits in enabling communities and CHWs to assess safe drinking water following the effects of a cyclone.[45] Other studies highlighted investment in medical supplies,[4,45,50] use of mobile medical units,[50] and other appropriate infrastructure as important for expanding CHW reach and response across communities amid EWEs.[6,54]

Service delivery

Many sources emphasized the development of climate-informed health programs as important for enhancing CHW program responses to EWEs ($n = 6$). Facilitators such as disaster reduction and risk-informed programming, strategies, health policies, and tailored messaging on infection prevention and mental health following EWEs were highlighted as opportunities to strengthen CHW responses to EWEs.[4,6] Other studies discussed the impact of EWEs as a barrier to the delivery of health services by CHWs, including referral and outreach activities, due to limited transportation and damaged roads.[22,49]

Opportunities to enhance CHW emergency preparedness and management were identified through training opportunities ($n = 7$). Further, consideration of environmental determinants of health was referenced in two sources regarding CHW training to promote community health and prevention of malnutrition in flood-affected communities.[21,62]

Financing

Sustainable program funding and incentives were identified as important components for supporting CHW performance and capacity ($n = 5$). Financial program support was discussed as important for responding to shocks, as additional resources were often required to support CHW extended outreach to those in need. This support included financial resources for increased transportation costs, medical supplies, and delivery of care from mobile health units.[4] Provision of incentives to sustain the long-term impact of CHW programs and support increased workloads amid EWEs were also highlighted to facilitate CHW responses to EWEs.[4,6,54,61]

Discussion

This review synthesized the role of CHWs and the facilitators and barriers to the provision of health-related supports and services amid EWEs. CHWs provide a range of health-related supports and services that span several overlapping functions of the health systems. Further, amid EWEs, their roles extend to providing emergency responses to a range of climate-related shocks, including affected livelihoods,[22,43,46] internal displacement,[3,4] food insecurity,[19–23] water quality,[20,22,45,46] disease outbreaks,[6] and mental health.[7,24] These findings are similar to the role of CHWs in high-income countries affected by EWEs.[47,63–65] For example, in hurricane-affected areas in the United States, CHW supports extended to mental health and disaster recovery, such as rebuilding homes and public infrastructure.[47,63,64] Thus, further research is needed to consider how geography, existing health systems capacity, and the availability of financial and human resources may shape CHW experiences amid EWEs.

Few sources included in this review examined the role of CHWs in the context of extreme heat and heat waves. The limited focus on

Table 4
Strengthening community health worker programs to build climate resilient health systems.

WHO building blocks of health systems	WHO components for building climate resilience (from n = 30 sources)	Key considerations for strengthening community health worker programs amid extreme weather events
Leadership and governance	Cross-sectoral collaboration and partnerships[a] (n = 8)	Partnerships between communities and CHWs;[59] integration of activities with multi-sectoral stakeholders such as those working in the fields of health, education, local government, and public health engineering;[22] collaboration with researchers and community practitioners (e.g. community-embedded health workers and non-government organization staff) to support integration of community knowledge and response planning and action.[19] Prioritization of community health by government and support of policymakers for community health initiatives that can improve access to high quality care.[6,49,56]
	Community engagement and leadership support[a] (n = 9)	Community participation to inform awareness of local challenges and best approaches to improve effectiveness of community programming (e.g. HIV programming; deworming)[57,59] and hospital referral.[56] CHW involvement to identify gaps, solutions, and supports during and following shocks from EWEs;[6] communication between health system actors, local administration, and communities to support program awareness and uptake.[22]
Health workforce	Building of technical and professional capacity (n = 10)	Provide training and resources to enhance CHW preparedness and response to EWEs;[4,22,43] training to enhance flood risk communication;[6,43] repositioning nutrition messaging to skill-based activities to support community adaptive capacity;[20] equipping CHWs with referral and counter-referral tools;[6] supervisory support and coaching opportunities (e.g. telephone-based and monthly supervisor meetings).[6] Establish minimum competency requirements within CHW training; adopt standardized measures of knowledge to evaluate training and supervision as important for integration of mental health supports in primary care and community settings affected by EWEs.[60]
Health information systems	Integrated risk monitoring and early warning (n = 3)	Establish risk communication systems to disseminate risk messaging of EWEs (e.g. floods);[22] support preidentification of high-risk zones (e.g. flood-prone areas);[22] disseminate risk messaging early to support CHW emergency response to community members in greatest need;[4,22] develop action plans to support continuity of CHW services during EWEs and local strategies for adaptation.[22,52]
	Vulnerability, capacity and adaption assessment (n = 4)	Enhance community education and awareness of vulnerability, climate-health risks, and preventive measures (e.g. wearing shoes to prevent soil-transmitted infection amid floods).[57]
	Health and climate research (n = 2)	Research on the determinants of building resilience with a focus on community strengths.[4]
Essential medical products and technologies	Climate resilient and sustainable technologies and infrastructure (n = 8)	Develop and implement context-specific action plans and strategies for providing timely information of weather conditions to support CHWs services;[22,51,52] public-triggered activation system;[51] and the implementation of alternative community-based models to improve access to mental health services.[24] Improve infrastructure, such as roads, to support greater CHW outreach amid EWEs;[22,49,54] use of mobile medical units to extend community outreach and address barriers in access to care.[4,50] Invest in greater availability of essential supplies and equipment (e.g., hygiene kits; culturally appropriate clothing; essential toiletries; sanitary pads);[4,45,50] use of rapid diagnostic tests for malaria, deworming, and vitamin A supplementation.[50]
Service delivery	Climate-informed health programs (n = 6)	Establish relief camps with a birthing station managed by a female CHW;[45] develop an effective referral system with the involvement of the community to support the use of local resources (e.g. boats or rickshaws for travel during floods);[21,22] update globally used frameworks to include considerations for EWEs to drive political agendas.[21]
	Emergency preparedness and management (n = 7)	Embed disaster preparedness training in curricula to enhance CHW adaptive capacity;[6,22,51,52,61] strengthen primary care services to address heat-related illnesses.[51]
	Management of environmental determinants of health (n = 2)	Address environmental determinants of health (e.g. EWEs) within CHW prevention efforts for malnutrition;[21] support CHW awareness of the social determinants of health in training.[62]
Financing	Program funding and incentives[a] (n = 5)	Greater investment in community health systems and CHW workforce;[4,6] create opportunities for professional development and career advancement (e.g. scholarships for continuing education in nursing);[6,61] establish performance-based awards (e.g. cash awards); support transportation needs (e.g. bicycles)[4,61]

WHO - World Health Organization.
CHW - Community health worker.
EWE - Extreme weather event.
HIV - Human immunodeficiency virus.
[a] Components adapted and modified from the WHO Operational framework for building climate resilient health systems.[1]

extreme heat and heat waves is surprising, given the growing concern of negative health impacts and outcomes associated with extended heat waves.[66,67] Of note, several sources did examine the engagement of CHWs with issues connected to heat waves, such as drought and food insecurity. Overall, this shortage of studies on extreme heat may reflect a greater focus on rapid-onset EWEs (e.g. tropical storms, floods) within the sources included in this review. Alternatively, the limited number of sources that examined the role of CHWs amid extreme heat and heat waves may point to a greater level of baseline adaptation to extreme heat in many of the countries represented across included sources.[68,69]

The review demonstrates the potential for CHW programs to enhance climate resilient health systems to prevent, monitor, and manage health risks posed by EWEs. Within each health system building block, several points of intervention were highlighted to increase CHW capacity and program readiness to effectively prepare for and respond to climate variability and associated health risks. Disaster preparedness training and other tools to equip CHWs, for example, could support technical competencies and professional skills to enhance awareness of climate-health risks and strategies to respond to climate-related shocks. Additionally, early risk messaging may enable timely communication and collaboration between CHWs and local stakeholders for coordinated decisions to mobilize services and resources for emergency preparedness and responses. Sustainable program investment to support provision of medical supplies, communication tools, and transportation were also identified as essential for enhancing CHW program effectiveness amid EWEs. Financial and non-financial incentives including support for transportation costs, professional development, and

career growth opportunities can be considered to strengthen CHW responses to EWEs.

Implications for policy, research, and public health practice

As countries develop and implement national adaptation plans under the UN Framework Convention on Climate Change,[1,13] policymakers and health systems leaders may seek strategies and programs that involve CHWs to build a foundation for community and health systems resilience to climate change. The considerations raised in this review may therefore serve as a guide for policymakers and health systems leaders to strengthen CHW programs in ways that enhance climate-resilient health systems. Community engagement and prioritization of community health by local governments, for example, can support integration of community knowledge in program planning that aligns with local challenges and health needs.[6,19,22,59] Cross-sectoral collaboration and leadership support were also identified as important components for fostering community trust and awareness of CHW services.

In addition, health professionals engaged in planning for scale-up of CHW programs may involve CHWs to inform community challenges and solutions to strengthen program readiness and adaptive capacity to climate-related shocks. Incorporation of CHW experiences and community health needs in programming could support sustainability, impact, and long-term health system investment. Further, providing CHWs with continuing education in emergency preparedness and management could support their knowledge of EWEs to mobilize community awareness and actions to respond to climate-health risks.[4,22]

With adequate resources and investment (e.g. financial, human, and infrastructure), CHW programs can be strengthened, and their adaptive capacity can be supported to build climate-resilient health systems. Leveraging these resources can equip CHWs as key mobilizers for action to enhance climate resilience in community systems of care. Based on our review, an awareness of the rights of CHWs and incorporation of gender considerations are needed to guide resource allocation to support CHWs' values and preferences in programming. Additionally, impact evaluations of CHW programs are needed to assess the effectiveness of CHW supports in improving health outcomes alongside supporting EWE preparedness, response, and recovery. Future research on promising approaches for raising climate awareness and disseminating risk messaging within communities are also needed to strengthen CHW responses amid EWEs.[43]

Limitations

This review has several limitations. First, sources that discussed CHW involvement in non-weather-related disaster response such as earthquakes or volcanic activity were excluded. However, these sources may have provided additional insights into opportunities to support CHW programs to enhance health system resilience amid emergencies. Additionally, the review only included published articles in English. Future reviews may expand the search strategy to include CHW responses to geophysical disasters.

Conclusions

CHWs are critical actors uniquely positioned to contribute to climate-resilient health systems. Our synthesis of the literature reinforces the potential role for CHWs to lead programmatic responses to climate-health challenges within community systems of care. The considerations raised offer insights into enhancing the adaptive capacity of CHWs to facilitate the building of health systems resilience to climate change. By strengthening CHW programs within communities and globally, the core health systems functions performed by CHWs can be sustained while extending their role and impact to prevent and manage future shocks from climate change.

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Competing interests

The authors declare no competing financial interests or personal relationships that could influence the work reported in this paper.

Protocol registration

This scoping review is registered under JBI registration of systematic review titles.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.puhe.2024.07.023.

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