Climate risk communications in the humanitarian health sector in East Africa: A case study from Médecins Sans Frontières

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Abstract

By 2030, it is estimated that the number of medium- to large-scale disaster events may increase to 560 per year, compared to 400 in 2015. People less than 60 years of age in 2020 have been estimated to experience unprecedented extreme climate event exposures; the risk is even greater for younger generations as the planet gets warmer. This descriptive study aimed to explore how Médecins Sans Frontières' (MSF) Humanitarian Action on Climate and Environment (HACE)'s climate risk communication between 2020 and 2024 supported MSF's operational readiness in Kenya and South Sudan. The critical analysis employed a qualitative mixed-methods approach, incorporating documentary review, in-depth interviews, and focus group discussions (FGDs). The findings offer insight into both the strengths and the limitations of current practices, as well as opportunities for more tailored strategies that support humanitarian actors in responding to climate-related health emergencies. This study highlights the critical but underdeveloped role of climate risk communication—an emergent area situated at the intersection of climate change communication and risk communication—in supporting humanitarian operations. There is a clear demand for communication that is timely, localized, simplified, and action-oriented—characteristics that are not fully captured in existing frameworks of either climate change or risk communication. Humanitarian organizations, including various national and international organizations responding to climate emergencies, are uniquely positioned to contribute to, and benefit from, the development of this field; this is an area of potential research. Ultimately, as climate change intensifies, the ability to communicate risk will be as critical as any medical or logistical response. By contributing to the development of climate risk communications, humanitarian organizations can improve not only their own

readiness but also help define new global standards for risk-informed action in the age of climate crises, thus establishing a community of practice.

Introduction

By 2030, it is estimated that the number of medium- to large-scale disaster events may increase to 560 per year, compared to 400 in 2015 (1). People less than 60 years of age in 2020 have been estimated to experience unprecedented extreme climate event exposures; the risk is even greater for younger generations as the planet gets warmer (2). Climate change is likely to increase the intensity and frequency of these events and adds to the challenges of emergency response efforts worldwide (3). These hazards increasingly intersect with public health emergencies, resulting in compound crises. Humanitarian organizations are thus confronted with complex environments. This is most consequential to affected communities and actors responding to the emergency—communities, local governments, national and international nongovernmental organizations (INGOs), and other external actors. Médecins Sans Frontières (MSF)/Doctors Without Borders is an international, independent medical humanitarian organization providing medical assistance to people affected by conflict, epidemics, disasters, and/or exclusion from healthcare in over 75 countries (4). MSF is increasingly faced with responding to these colliding challenges, making effective communication of risk essential in its response. MSF has committed at the international governance level to recognize the climate crisis and to adapt and mitigate its operations, it has endorsed the Climate and Environment Charter[1] for Humanitarian Organizations to integrate a climate lens into their healthcare operational response. It also aims to involve local leadership, communities, and committed humanitarian organizations, to embrace local leadership and increase capacity in understanding climate and environmental risks and strengthening action.

[1] https://www.climate-charter.org/

In climate science, multi-hazard early warning systems (MHEWS) and disaster risk reduction (DRR) strategies play a crucial role in addressing the challenge of responding to emergencies *(5,6)*. MHEWS, encompassing disaster risk knowledge, observation and forecasting, dissemination and communication, and response preparedness, is a proven method for reducing disaster risks and adapting to climate change with the potential to save lives and minimize economic impacts (7). However, these are focused on hazard-specific forecasts and technical communication rather than the operational realities of MSF. On the other hand, for public health emergencies, the World Health Organization (WHO) has defined risk communication as "an integral part of any emergency response, involving the real-time exchange of information, advice, and opinions between experts, community leaders, or officials and those at risk" (8). Risk communication enables those at risk to make informed decisions to protect themselves, their families, and their communities against threats to their survival, health, and well-being and reduces risks (8,9). Preparedness planning increasingly emphasizes that risk communication and community engagement go hand-in-hand, ensuring transparency and trust-building and also advocating for integrating anticipatory action (10). Emphasizing two-way communication with communities (CwC), rather than simply disseminating information to them, marks a pivotal change in the approach to disaster response (11).[2] A scoping review on risk communication for extreme weather events and climate change has proposed a conceptual framework comprising communicating risk, building adaptive capacity, coordinating actions, and

[2] The principle of working with communities in health and humanitarian communication and response has long been recognized as essential. A landmark moment was the Alma-Ata Declaration of 1978, which asserted that effective health responses must be designed and implemented with the meaningful involvement of local communities. This remains a foundational commitment today, underscoring that communication is most effective when it reflects people's lived realities, knowledge systems, and priorities.

a loop of knowledge translation and dissemination between communities and decision-makers (12).

These frameworks, however, focus on health-specific crises rather than health emergencies unfolding alongside extreme climate events. The humanitarian sector tries to address this gap by using risk communication for preparedness and recovery. Yet, despite these tools and projects, a 2023 study found a significant lack of adaptive capacity across global MSF operations (13). Therefore, neither discipline, in isolation, sufficiently addresses the operational needs of humanitarian actors working in volatile, high-risk environments where climate hazards overlap with health emergencies. Addressing these inconsistencies is crucial to enhancing the effectiveness of MHEWS to ensure comprehensive coverage and timely action, particularly for humanitarian actors.

Additionally, adaptation strategies must avoid maladaptive outcomes, which can occur when policies or infrastructure projects increase vulnerabilities or deepen inequalities (13,14). These challenges are heightened by projections that the planet will surpass the 1.5°C warming threshold by 2027, increasing the frequency and intensity of disasters (IPCC, 2023); thus, requiring humanitarian actors to improve their awareness and integration of adaptive strategies and capacity in medical operations. Such actions are consistent with MSF's humanitarian charter and expanding environmental and climate change commitments, such as the MSF General Assembly Motions on Environment and Climate (2017, 2019), MSF Environment Pact (2020), The Climate and Environmental Charter for Humanitarian Organizations (2021).

The Humanitarian Action on Climate and Environment (HACE) initiative of MSF Canada was founded in 2020. Within MSF, it has mobilized actors to increase awareness and

understand climate risks and resilience in humanitarian response, particularly through the timely provision of climate and hazard information. HACE supports the MSF movement in adapting its medical operations to the growing impacts of climate change and environmental degradation. It provides on-demand meteorological and climate preparedness support to MSF project teams, develops Regional Seasonal Outlooks, facilitates Climate Scenario Workshops, and coordinates the Climate Adaptation Community of Practice (CACoP), a platform fostering collaboration across the MSF movement (15). These efforts are especially critical in disproportionately affected regions of West-, Central-, and East Africa, South Asia, Central and South America, Small Island Developing States, and the Arctic, where the impacts of the climate crisis have dramatically intensified (5). MSF has medical operations in most of these regions (4).

Climate change has increased the frequency and intensity of extreme events in East Africa, including droughts and heavy precipitation (5,6). Médecins Sans Frontières' (MSF) operations, in East Africa, have been heavily affected by climate-related disasters over the last five years, with extended drought since 2020 in most regions, and unprecedented flooding (16). "Heavy rainfall resulted in extensive flooding in Somalia, Ethiopia, and Kenya in October and November 2023, with more than 700,000 people displaced and 100 recorded deaths" (17) and is expected to continue through May 2024 (18). In South Sudan, MSF has responded to five consecutive years of major flooding due to intense rainfall in the Lake Victoria basin and high White Nile water levels, leading to food insecurity, loss of healthcare access, and increased climate-sensitive diseases such as malaria, dengue, and Rift Valley fever (15). HACE has supported these responses through tailored climate forecasts, risk analyses, and tools such as the flood monitoring dashboard used in Old Fangak to inform dike reinforcement efforts (15). The team also contributes to research on climate-health linkages, including heat impacts on displaced

129 populations and the Malaria Anticipation Project, which explores whether historical health and
130 climate data can be used to predict the malaria burden in South Sudan (19). In earlier responses,
131 such as the 2019 floods in Pibor, South Sudan, MSF relied on support from the MACA
132 (Meteorological and Climate Action) project to inform real-time decisions (20). In Kenya,
133 UNDRR supported the government of Kenya in setting up a tagging system to mainstream
134 disaster risk reduction and climate change adaptation into sectoral budgets (6). Kenya has
135 developed resilience and adaptation strategies alongside INGOs and could provide a learning
136 model for other countries in the region facing similar crises. Therefore, the focus of this study is
137 the East Africa region due to recurrent compound crises in the region, its operational relevance to
138 MSF, and the presence of multiple INGOs.

139 This study aims to evaluate HACE's existing climate risk communication strategies in
140 Kenya and South Sudan from 2020 to 2024 and offer targeted recommendations to improve
141 HACE's climate risk communications using a mixed methods approach—including documentary
142 research, in-depth interviews, and focus-group discussions—in Nairobi, Kenya (MSF
143 headquarters) and virtually. The 2020–2024 timeframe reflects the formal establishment and
144 operationalization of the HACE initiative (including incorporating the MACA project
145 methodologies) and also aligns with intensifying climate impacts in East Africa and marks a
146 critical phase in integrating climate risk into MSF's health response.

147 By systematically examining and understanding how climate risks were communicated
148 during this time, the research aims to identify ways to tailor risk communication strategies to
149 MSF's operational needs and decision-making. Such tailoring and improvements can support
150 adaptive, health-centered operational responses to extreme weather events alongside the
151 communities it serves in the region, reflecting the organization's Charter commitment to

anticipate and respond effectively to humanitarian crises. The findings offer practical insights across diverse humanitarian and public health contexts.

Methods

Study Design

Study objective: This research sought to explore risk communications for climate adaptation in East Africa in humanitarian projects by asking:

- How can the analysis of the implementation of HACE's climate-risk communication on early warning systems from 2020-2024 inform the development of a tailored climate-risk communication strategy for MSF's operational humanitarian response to climate-driven events in Nairobi, Kenya, and Juba, South Sudan?

This descriptive study employed a qualitative mixed-methods approach, incorporating documentary review, in-depth interviews, and focus group discussions (FGDs).

Study design: Observational

Research methodology: documentary research, qualitative methods (in-depth interviews, and focus groups).

Study Population and Sampling

The target population was MSF personnel involved in humanitarian responses and climate risk communication in Kenya and South Sudan. The study evaluated the impact of HACE's climate risk communication on MSF's operational responses in these regions. HACE was formally established in 2020, initially with one staff member, and expanded with the addition of a meteorologist in 2021 and a heat specialist in 2023.

The study population included MSF Headquarters (HQ) staff in Nairobi and operational personnel[3] from Kenya and South Sudan who had engaged with HACE's climate predictions between 2020 and 2024. Participants were selected using a purposive sampling approach, with the inclusion criterion being MSF staff involved in climate-related operational decision-making in MSF projects. Participants were excluded if they were non-MSF personnel, not affiliated with Kenya or South Sudan operations, or not involved with HACE's communications.

Data Collection

Documentary research preceded IDIs and FGDs. Documentary research helped create a baseline and outline the topic guides. A total of 15 MSF staff were interviewed in Nairobi, Kenya and virtually in 2024. Although 27 participants were initially approached, several opted out, as they felt their insights were not relevant to the study due to their lack of involvement in operational responses. In-depth interviews (IDIs) and focus group discussions (FGDs) were guided by pre-defined topic guides to ensure consistency and robustness, while allowing for emerging themes to be integrated throughout data collection, reflecting the iterative nature of a qualitative approach. Two focus group discussions (FGDs) were organized in 2024. One FGD included MSF Kenya personnel responsible for operations in both Kenya and South Sudan, while the other FGD included the HACE team. The data from the HACE team was used solely for background information and was not included in the analysis. All interviews and focus group

[3] In Médecins Sans Frontières (MSF), *HQ staff* typically include decision-makers, technical advisors, and policy referents based in headquarters who shape strategic direction and provide guidance. In contrast, *operations (ops) staff* or "field staff" are implementers working on the ground—often in crisis-affected regions—delivering medical care and executing programs directly.

discussions were conducted in English and audio-recorded, with verbatim transcription. The recordings were stored in the PI's computer (password-protected).

Data Analysis

Data were manually analyzed using thematic coding by OT (PI). The first interview analysis was independently verified by the research team (LR, UP). The coding process was independently verified by the Primary Investigator (PI) to ensure reliability and consistency of the findings.

Ethical Considerations

Ethical approval was obtained for the study from the MSF Ethics Review Board in 2024 April 2024 and from the Kenya Medical Research Institute KEMRI/RD/22 September 2024. Informed consent was secured from all participants. Confidentiality was maintained throughout the study, and personal identifiers were removed before analysis to ensure participant anonymity.

Results

Participant characteristics

The study population included MSF Headquarters (HQ) staff in Nairobi and operational personnel from Kenya and South Sudan who had engaged with HACE's climate predictions between 2020 and 2024. In Médecins Sans Frontières (MSF), HQ staff typically included decision-makers, technical advisors, and policy referents based in headquarters who shaped strategic direction and provided guidance. In contrast, operations (ops) staff or "field staff" were implementers working on the ground—often in crisis-affected regions—who delivered medical care and executed programs directly.

1. Humanitarian experience and institutional knowledge

MSF staff interviewed have extensive experience in managing humanitarian crises across diverse emergencies and roles, from coordination to project management:

"Since 2002, I've spent my life in humanitarian work, moving in almost all the major disasters."

"MSF, I started earlier in 2008. So, a little bit longer. From coordination office to projects, and I held several different positions. Emergency response. Field coordinator, and head of mission."

"I'm a finance coordinator and I've been around in this office, working here for the last 23 years."

2. Bearing witness: intensifying climate and extreme weather impacts

Frequent climate-related events increasingly disrupt MSF operations, especially in South Sudan and Kenya:

"In South Sudan, many floods, we cannot go to do any work in the Decentralized Model of Care (DMC) or in the communities."

"Now in Kenya again, I can say that this year we had another form of El Niño, with the flooding and everything that happened here. And then now between the end of 2019 and 2020, the floods in South Sudan."

"I came to Kenya in 1997, that was my first experience with El Niño. So, it was really rainy and flooding and yeah, a lot of um drownings during that year. That was my first experience of extreme weather conditions and then working in South Sudan, um I experienced it as extreme heat."

Humanitarian staff is also impacted, and their mobility is also directly affected:

"We have some of our colleagues at MSF who, during the flooding season in April this year, couldn't leave their homes."

3. Climate and health information: sources and sharing

Information is accessed from both external and internal channels:

"The information that we receive about the climate conditions, mainly, it's from locally, we have the Kenya MET, Kenya Meteorological organization."

"Every time that it's published, I put it in on the Internet page that we have on climate and OCB, there is a link to HACE report, so I try to make sure that they're on the Internet, but also depending on the region, I send it also to the respective cell."

"Information on flooding comes from the MSF desk and project."

"The first and most important information that we have is coming from the mission level."

4. Building understanding and communicating risks

MSF engages globally and through partnerships to strengthen climate-health adaptation:

"I'm part of the climate adaptation community of practice that HACE is leading."

"We are doing a partnership with a company that is super experienced with emergency response to floods in the US, indeed, and other places, and they make they manufacture a lot of pumps…"

Participants stressed the importance of proactive, accessible communication:

"Information should be shared before an emergency."

"We need to package our information with the view, with the aim that everyone can be able to understand."

"It's just that people, they need time to digest it, and they need someone who accompanies them to digest it."

5. Challenges in using climate and health information

Turning climate information into operational decisions remains difficult:

"There's a ton of information and a lot of times very high-level information that is a bit difficult to land if you are not really like a little fanatic of the topic."

"I'm happy with the report. Just contextualize it. Make it more practical."

"Knowing when to prepare and for what and how much to prepare for, is what we are still struggling with."

"I go to the field to support mission every once in a while, and even as we support them, they can't do much work, under extreme weather conditions."

6. Experiences with HACE products and services

Participants described both value and challenges in engaging with HACE climate-health products:

Usefulness and complexity:

"They are very interesting and the information that is there is pretty useful."

"I think very useful information, but there's also a lot. Some level of synthesized."

"The feedback at the beginning was I don't what to do with this. It's nice. It's a lot of information, but then what?"

Clarity and accessibility issues:

"Sometimes I find the graphics too detailed."

"It's a bit too technical and the whole thing about climate change is new to all of us, so if it can be a bit more simplified."

"It's too complex for the team. Really simplify it too."

"Maybe simplify in a way that even people like me, who are not teaching meteorology or geography, can be able to understand the different forecasts and relate to our daily work or operations."

Requests for local context and examples:

"I'm happy with the report. Just contextualize it. Make it more practical."

"More the specific input from the teams in the field."

"Give an example. We've been really monitoring the situation… with the predictions that we see, we expect for the next year or two… What are you guys seeing on the ground?"

Format and timing preferences:

"We don't really have time for long report, and we prefer whenever it's possible just to come straight to the point, OK."

"If I have to go through the whole document… I'll probably keep it aside and eventually not come back to it."

"You have so much as Ops and you have a lot, but I think a bit of summarized versions per country."

"More visual, less text."

"The three-month update, It's too long… How would you predict for the whole 3 months and expect yourself to be that accurate?"

"It should at least be able to follow the important periods within the organization."

Suggestion for less material and hands-on support:

"Instead of doing five seasonal outlooks, you do one. But every time that you do one someone from his teams go to sit down with the East Africa Office."

Discussion

This study aimed to explore how HACE's climate risk communication between 2020 and 2024 has supported MSF's operational readiness in Kenya and South Sudan. The findings offer insight into both the strengths and the limitations of current practices, as well as opportunities for more tailored strategies that support humanitarian actors in responding to climate-related health emergencies.

Recent Yale research on climate change communication has concentrated on public beliefs, attitudes, and risk perceptions—often addressing the general public in high-income Western settings—rather than deeply examining systemic or structural barriers to change (21). At the same time, risk communication—primarily developed within the fields of public health, disaster management, and emergency response—emphasizes the timely exchange of information during acute crises (8). Neither discipline, in isolation, sufficiently addresses the operational needs of humanitarian actors working in volatile, high-risk environments where climate hazards overlap with health emergencies.

The findings suggest that, given the relatively recent availability of scientific climate information, a gap remains in its uptake and application within humanitarian operations. While it is new that MSF provides initial climate anticipation and adaptation tools and information to operational projects, MSF personnel described challenges in understanding, contextualizing, and applying available forecasts. There is a clear demand for communication that is timely, localized, simplified, and action-oriented—characteristics that are not fully captured in existing frameworks of either climate change or risk communication (9,11).

The increased frequency and severity of climate-related hazards reported by MSF staff, in South Sudan and Kenya, correspond with global projections of escalating disaster risks due to climate change (3,5). Participants' testimonies about flooding, heat, and mobility constraints during extreme weather underscore the growing importance of integrating climate risk information into humanitarian planning. These events disrupt access to healthcare and threaten continuity of care in South Sudan and indeed as one participant noted, also hamper humanitarians' own ability to respond.

Findings also point to existing systems for climate information sharing within MSF, including both formal platforms like intranet pages and informal pathways through MSF desks and projects. However, the perceived disconnect between the content of HACE reports and their operational applicability emerged as a recurring concern. Although HACE products are widely acknowledged as valuable, the volume, technical language, and level of detail were cited as barriers to accessibility. The need for simplification—through visual formats, summary versions, and practical guidance in plain and direct language—was expressed by staff across different roles and operational levels. These findings echo challenges documented in broader humanitarian risk communication literature, emphasizing the need to translate high-level scientific information into operationally relevant formats (7–9).

The results also point to an uneven understanding of how to apply HACE's forecasts and reports during field operations. While some MSF staff actively circulate climate information and recognize its action potential, others reported uncertainty in interpreting and acting upon the data. In the MSF context, operational plans are typically finalized well in advance—often a year ahead—which can make it challenging to incorporate climate forecasts that provide shorter-term or evolving risk information. This planning structure means decision-makers may have limited

flexibility to adjust activities based on new climate data once budgets and programs are set. To improve the integration of HACE's climate information, it is crucial to develop communication and planning tools that fit within MSF's operational timelines and allow for adaptive management. However, climate hazards unfold according to environmental dynamics rather than project cycles. As such, this requires a two-way adaptability: HACE can seek to align its reporting with MSF's planning and funding rhythms where possible, while MSF operational teams must remain prepared to adjust strategies and resources in response to climate and risk information as it becomes available. This implies a broader institutional recommendation beyond HACE—namely, that both climate support functions and operational planners cultivate flexibility to navigate the tension between structured project timelines and the unpredictability of climate hazards.

Supporting decision-makers through ongoing training and embedding climate data into routine planning cycles can enhance responsiveness and ensure that forecasts translate into effective, context-specific humanitarian action. This highlights an opportunity for enhanced training and more structured engagement around the use of climate information for operational planning. Calls for contextualized examples and locally relevant scenarios suggest that risk communication should be designed not just for awareness and accessibility, but to enable decision-making at the project level. This aligns with the "response preparedness" and "dissemination and communication" pillars of the Multi-Hazard Early Warning Systems (MHEWS), where user-centered design is essential for meaningful action (7). As Vaughan and Dessai (2014) emphasize, bridging the gap between climate information providers and users requires tailoring communication to users' specific contexts and capacities to ensure forecasts are

actionable and effectively integrated into decision-making processes (Vaughan and Dessai 2014).

Moreover, timing was a prominent theme in the feedback. Several participants emphasized the importance of receiving information early enough to prepare adequately for seasonal and acute climate events. This suggests that not only the content but also the cadence of climate communication should be considered in relation to the operational cycles of MSF projects. At the same time, MSF operational teams, managers, and budget holders must remain prepared to adapt to sudden events and climate hazards that do not align with project cycles. In practice, this calls for a two-way adaptability: climate information services should seek to anticipate humanitarian decision-making rhythms where possible, while MSF must foster organizational flexibility to respond rapidly when climate hazards arise outside expected cycles.

Findings also reveal that staff value two-way engagement—both in the creation of information and its interpretation. Some participants referenced local actors or project staff as critical sources of information. Suggestions to increase collaboration between the HACE team and field offices, such as joint analysis sessions or post-report debriefs, point to a need for more participatory approaches. These perspectives echo the growing emphasis on community-centered communication in disaster preparedness and are consistent with WHO's definition of risk communication as a real-time exchange, rather than a one-way dissemination process (8).

Finally, the study highlights a key challenge in humanitarian climate communication: reconciling global scientific expertise with locally relevant, actionable information. While standardized forecasts offer valuable data, humanitarian staff need context-specific insights to make timely decisions.

Although initiatives like MSF's Climate Adaptation Community of Practice help bridge these gaps, further efforts are needed to fully embed climate information into everyday humanitarian operations. Overall, this study reinforces the importance of tailored, practical, and collaborative climate risk communication to enhance climate preparedness and health resilience in climate-affected regions.

Several limitations also point to directions for future research. Limited resources prevented a larger, multi-site investigation, and the study did not examine specific target populations such as different cadres of MSF staff, local partners, or affected communities. Moreover, the lack of existing literature on climate risk communication constrains opportunities for comparison and synthesis.

These gaps highlight constructive opportunities: future studies should expand to diverse contexts, engage distinct target populations, and build a stronger evidence base that links global climate science to locally actionable insights. Such work can advance the development of communication strategies that are not only scientifically robust but also operationally relevant and contextually grounded.

Conclusion

The increasing frequency and severity of climate-related disasters demand a shift in how humanitarian organizations respond, including how they understand, engage with and disseminate climate information. This study highlights the critical but underdeveloped role of climate risk communication—an emergent area situated at the intersection of climate change communication and risk communication—in supporting humanitarian operations. Humanitarian

411 organizations such as Médecins Sans Frontières (MSF) are uniquely positioned to contribute to,
412 and benefit from, the development of this field. Their operational presence in climate-vulnerable
413 settings, coupled with a mandate for needs-based medical humanitarian responses, situates them
414 at the frontline of both communicating and acting on climate-related risks (3,13).

415 As discussed above, climate communication focuses largely on awareness, while with
416 this study we illustrated the relevance of operationalizing climate information for field-based
417 decision-making in complex humanitarian contexts**,** therefore, this study argues for the formal
418 recognition and development of climate risk communications as a new interdisciplinary field.
419 This would integrate the anticipatory, systems-oriented approach of climate change
420 communication with the immediacy and behavioral focus of risk communication, while also
421 acknowledging the unique and increasing challenges faced by humanitarian actors. Such a field
422 would aim to produce tools, methods, and strategies that support real-time decision-making,
423 long-term planning, and cross-cultural communication in crisis contexts (5,7).

424 Humanitarian organizations like MSF are well-placed to help shape this field. Initiatives
425 such as HACE demonstrate early efforts to bridge scientific forecasting and operational
426 relevance through tailored reports, seasonal outlooks, and scenario planning. These practices
427 offer valuable models for how climate information can be more effectively translated into action
428 on the ground—provided they are matched with effective communication strategies.

429 Ultimately, as climate change intensifies (5), the ability to communicate risk will be as critical as
430 any medical or logistical response. By contributing to the development of climate risk
431 communications, humanitarian organizations can improve not only their own readiness but also
432 help define new global standards for risk-informed action in the age of climate crisis. Further

research from other organizations would help inform best practices and establish a community of practice.

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Author contributions

This study was conceptualized as part of the Climate, Environment, and Health Operational Research Training Program conducted by Luxembourg Operational Research Unit; funding as needed was provided as part of the training. OT was responsible for the initial conceptualization. Further formulation or overarching research goals and aims and methodology were done in the training program under supervision of LR and UP as mentors and LT and CD as content specialists. OT did Data Curation, Formal Analysis, and Investigation. Project administration was done by OT, LR, and UP. The study was visualized by OT with support from LR or UP at various stages of the research. Writing of the original draft was done by OT, supported by LR as needed. Review and editing of the draft were done by CD, LT, UP, EY, and LR.

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