A104

Early Warnings for Natural Hazards: Insights from Behavioral Science and the Gaps We Still Face

○Sandra VAICIULYTE

1. Introduction

United Nations' Early Warnings for All initiative aims to ensure universal access to multi-hazard early warning systems by 2027 (World Meteorological Organization, 2022). While this agenda has likely accelerated technical innovation, it has also raised important questions about how warnings are perceived, interpreted, and acted upon by people in real-world contexts.

2. Background research

Wildfires

My earlier research focused on wildfire evacuation decision-making, where early warning systems remain comparatively unevenly implemented. In wildfire scenarios, warnings often do not rely on a single system but instead emerge through a combination of sources, including police instructions, television and radio broadcasts, mobile phone notifications, and informal community-based communication networks. Individuals assess environmental cues such as heat, smoke, wind, dryness of the air, and proximity to vegetation, while also drawing on their own preparedness and mitigation practices, including vegetation management, removal of flammable debris, household preparedness measures, and evacuation planning (Vaiciulyte, 2020).

As a result, alerting in wildfire cannot be understood as a purely technical system; it is deeply embedded in social practices, local knowledge, and individual risk assessments.

Earthquake Early Warning

More recently, my work has also examined early earthquake warning (EEW) systems in Mexico, focusing on multiple settings including the general population, hospitals, the metro system, and schools. Across these contexts, early warning systems are more technologically advanced than in wildfire settings, yet they face equally complex behavioral and organizational challenges. For the general population, without the contextual understanding of what the alert's purpose is, it risks losing their intended effect, as people may default to habitual behaviors regardless of the warning (Vaiciulyte et al, 2023).

In hospitals, the challenges are even more pronounced. Hospitals are not homogeneous environments; the relevance and usefulness of an alert vary across functions and units. The needs of an operating room, an intensive care unit, a labor and delivery ward, and a psychiatric hospital differ substantially. Determining who should receive the alert, at what time, and for what purpose is critical to avoid confusion, overload, or inappropriate responses (Vaiciulyte et al, 2024).

In the metro system, passengers typically rely on staff instructions rather than receiving direct alerts themselves. However, some passengers now receive public or private alerts simultaneously, including presidential alerts and notifications from private providers. These alerts are not always calibrated for underground or crowded environments, raising challenges for managing people's responses in narrow, high-density spaces where inappropriate movement can increase risk (Vaiciulyte et al, 2025).

Cross-hazard learning for alerting

Bringing wildfire and earthquake contexts together, I have recently collaborated with colleagues to explore

how people perceive, cope with, and respond to multiple alerts for the same event within a short period of time (Husker et al., 2025). Data were collected from individuals who experienced the January 2025 wildfires in California, focusing specifically on the sequence of alerts they received during the event drawing parallels with earthquake contexts, particularly during seismic sequences involving aftershocks, where people may also receive repeated alerts in quick succession.

To date, very little is known about how people experience alert repetition during an unfolding crisis. Our data sought to address this gap by examining: (1) how people react to different types of alerts, (2) whether alert fatigue emerges after repeated alerts, and (3) how stress levels and coping strategies evolve as alerts accumulate.

The findings indicate that while a small minority of people consistently ignore alerts, most individuals do engage with warning information. Importantly, alerting itself emerged as a stressor that individuals must cope with in order to respond effectively. When asked about coping strategies following different alert types, the most common responses involved adaptive strategies such as acceptance, refocusing on planning, and putting the situation into perspective. A smaller proportion of participants reported catastrophizing, particularly in response to "leave now" alerts.

Stress analysis revealed that stress levels increased significantly after the first alert, with subsequent stress levels strongly influenced by coping strategies.

Conclusion

While it remains difficult to make universal claims that early warning systems save lives across all hazards and contexts, my talk aims to point to a unifying insight: early warnings are most effective for people who understand what to do with them and who have the cognitive and emotional resources to cope with receiving them. For others, alerts can become sources of confusion, stress, or disengagement. Addressing these gaps requires moving beyond technological deployment toward a more integrated behavioral, organizational, and educational approach to early warning design and implementation.

References

World Meteorological Organization. (2022). Early warnings for all: The UN global early warning initiative for the implementation of climate adaptation—Executive action plan 2023–2027. WMO. https://www.wmo.int

Vaiciulyte, Sandra (2020) *When disaster strikes: human responses to wildfires and evacuation in the south of France and Australia.* PhD thesis, University of Greenwich.

Vaiciulyte, S., Novelo-Casanova, D. A, Husker, A. (2023). Demystifying response to EEW in Mexico: Socio-technical motivations in protective action. Safety Science, Vol 174, 106469, https://doi.org/10.1016/j.ssci.2024.106469

Vaiciulyte, S., Novelo-Casanova, D. (2024). Safeguarding vulnerable populations in hospitals – pertinence of the Mexico City's Early Earthquake Warning. International Journal for Disaster Risk Reduction, Vol 107, 104510, https://doi.org/10.1016/j.ijdrr.2024.104510

Vaiciulyte, S., Novelo-Casanova, D. A., González Huerta, M. I. (2025): Commuters' and metro staff's earthquake preparedness in the Mexico city metro: Who knows what to do?, Journal of Transportation Safety & Security, Vol 17 (9), pp. 1078-1104, https://doi.org/10.1080/19439962.2025.2484770

Husker, A. L., Vaiciulyte, S., Saunders, J., Hulse, L. (2025). From fire to fault: Public reactions to the 2025 Los Angeles wildfire alerting as a model for aftershock earthquake early warning response. American Geophysical Union (AGU) Fall Meeting — New Orleans, USA.