Warning Systems: the Extreme vs the Regular Hazard

Case Studies from Japan, the Philippines and Dominica

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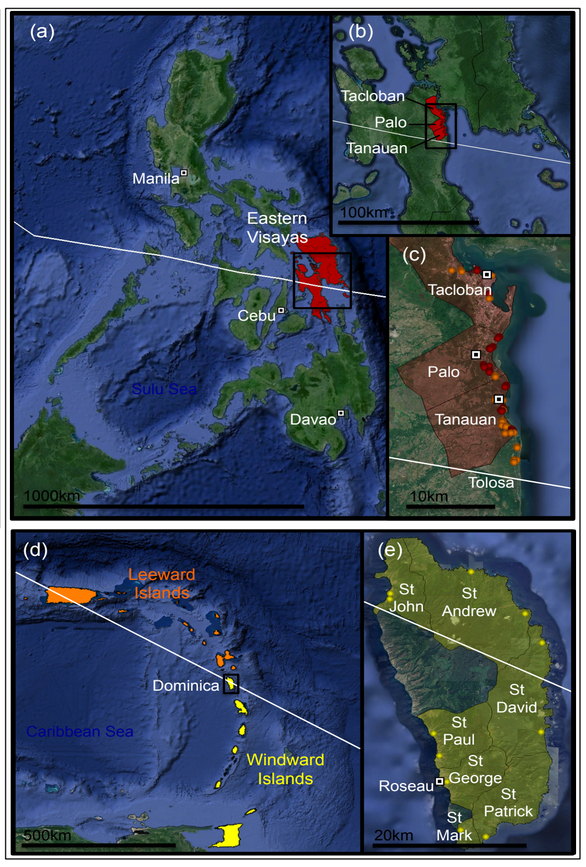
Hazards studied and research locations

Study #1: Great East Japan Earthquake and Tsunami (*Japan, 2011*) [2]
Study #2: Super Typhoon Yolanda (Haiyan) (*Philippines, 2013*) [1]
Study #3: Major Hurricane Maria (*Dominica, Caribbean, 2017*) [1]

The three hazards studied were all rare and extreme in nature, but occurred in locations that experience less severe versions relatively regularly. We looked at if, how, and when warnings were received, what instructions were given, and where and when people decided to seek safety, if at all. A number of key failings were revealed in all cases, leading to catastrophic consequences.

Inclusive (early) warning systems are social processes

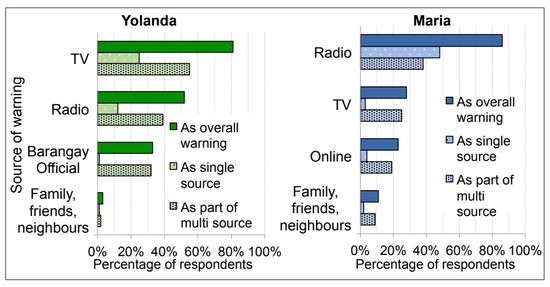
The technical, quantifiable and widely recognised components of warning systems alone are not enough to always provide meaningful messaging and to trigger appropriate response actions among varying populations. Warnings are highly social processes and must be considered in very context-specific ways [1]. The warnings for these large and more infrequent events in Japan, the Philippines and Dominica exposed a number of key weaknesses in official alerting mechanisms, public receipt and warning message interpretation.

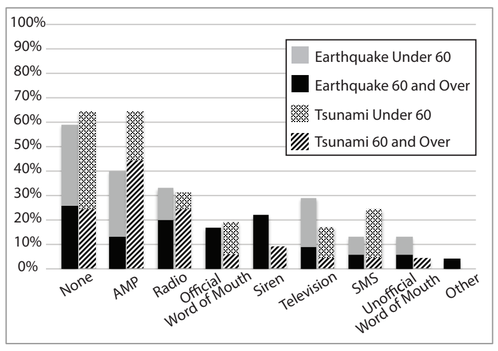


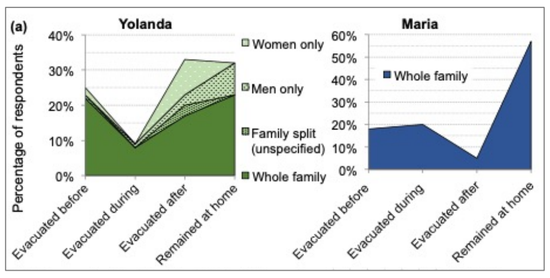
Top: Temporary housing complexes visited along the Miyagi and Iwate coastlines, where severe damage from the tsunami was sustained (Japan).

Top right: (a) the path of Super Typhoon Yolanda through the Philippines, (b) specifically through Leyte Island, and (c) locations of households surveyed.

Right: (d) path of Major Hurricane Maria through the Caribbean, and (e) specifically through the island of Dominica, including locations of households surveyed. All images from Google Maps.



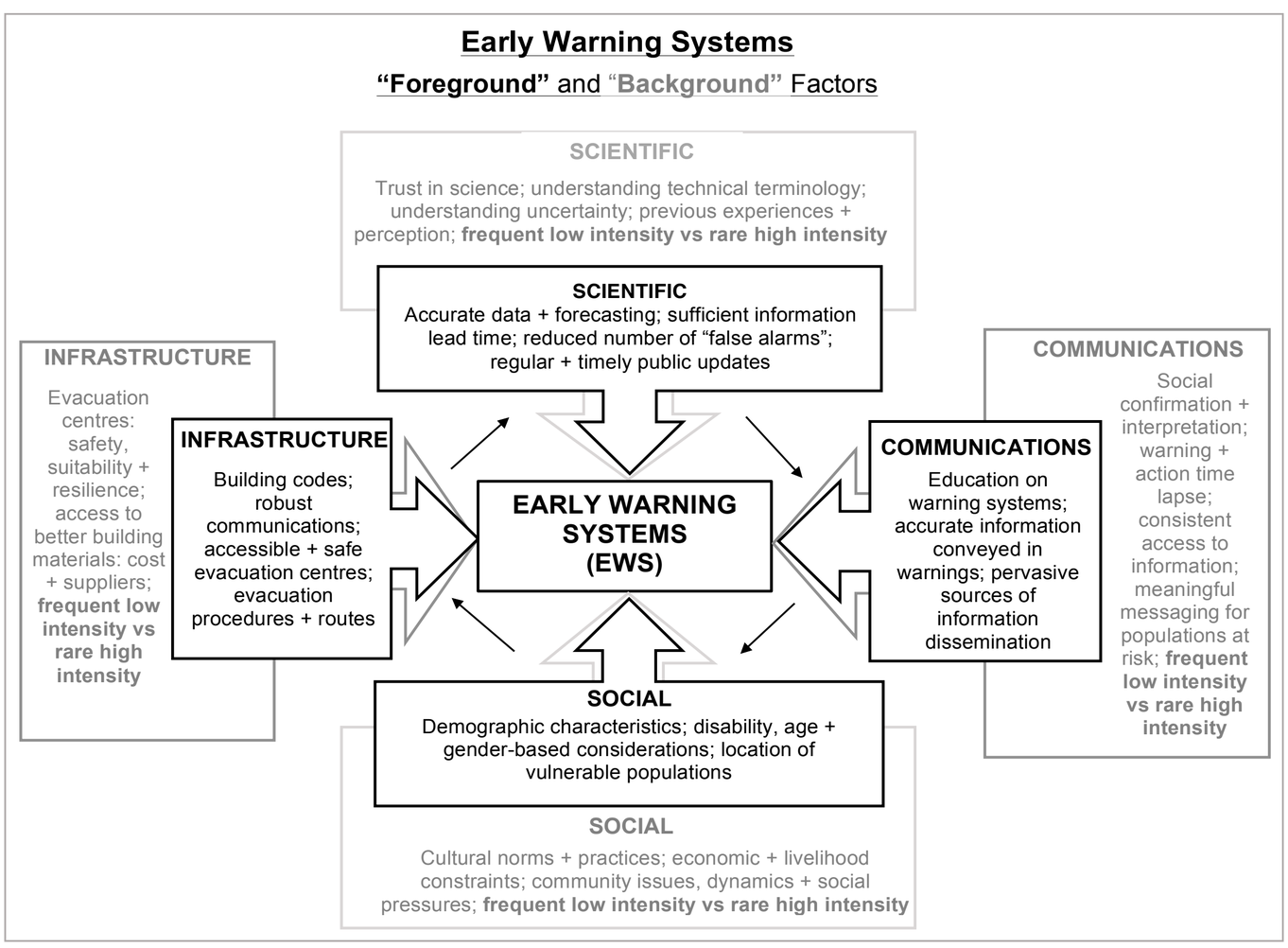




Top left: sources of warning in the Philippines (Yolanda) and Dominica (Maria)
Top right: sources of warning among different age groups, Japan
Bottom left: evacuation choices in the Philippines (Yolanda) and Dominica (Maria)

So what? Recommendations for improving warnings:

- Hazards and their risks must be known to all: understanding uncertainty, changes and heightened risk, and all terminology used in alerts.
- Greater redundancy in warning infrastructure – back-up communication networks, appropriate messaging, multiple channels used.
- More personalisation for at risk populations, accounting for cultural norms, levels of inequality, varying abilities, discrimination and experience of disasters.
- Greater accuracy for informed choices, especially where regular, smaller-scale hazards occur but where extreme hazards are also experienced more rarely.



Four main components of EWS. "Foreground" factors are the widely recognised, physical and quantifiable elements of warning systems; "Background" factors are the more subtle, difficult to measure and unofficial influences often not accounted for or fully considered [1]

We identified several critical "foreground" and "background" points of failure across the three warning systems

COMMUNICATIONS + SOCIAL
Warnings should be integrated into daily life
Japan: topography (high ground) and soundproofing near airport blocked siren sounds.

COMMUNICATIONS + INFRASTRUCTURE
Warnings should contain info important to population
Japan: mobile phone software was not always compatible with warning platforms and telecoms signals failed.

SOCIAL + INFRASTRUCTURE
Should be community awareness among all groups
Japan: Half had no knowledge of a local evacuation plan and many had not participated in any appropriate evacuation drills.

COMMUNICATIONS + INFRASTRUCTURE
Robust communication networks + multiple channels needed
Dominica: Radio networks failed - not reporting rapid intensity to category 5 strength.

SCIENTIFIC + COMMUNICATIONS
Consistent messaging + language should be used
Dominica: conflicting + confusing information given over Maria's track.

SOCIAL + INFRASTRUCTURE
Lowered risk perception based on experience
Dominica: lack of previous experience of such a strong hurricane meant disbelief over the danger posed by Maria.

SCIENTIFIC + COMMUNICATIONS
Warnings should contain info appropriate to population
Philippines: almost no understanding of the meaning of "storm surge" at the time of warning.

COMMUNICATIONS + SOCIAL
Must account for social confirmation + dynamics
Philippines: head of household decision to stay at home or collectively to gather at stronger local houses, not evacuation centres.

SOCIAL + INFRASTRUCTURE
Safety + access for all should be considered
Philippines: many avoided evacuation centres due to lack of safety, overcrowding, unsuitability, lack of access or damage.

[1] Yore, R. & Faure Walker, J. (2020) Early Warning Systems and Evacuation: Rare and Extreme Hazards among Frequent, Small-Scale Events. Disasters, 45: 691-716.
[2] Naylor, A., Faure Walker, J. & Suppasri, A. (2018) Suitability of the early warning systems and temporary housing for the elderly population in the immediacy and transitional recovery phase of the 2011 Great East Japan Earthquake and Tsunami