Early Warning Systems
Global Perspectives & The Economic Valuation Bottleneck

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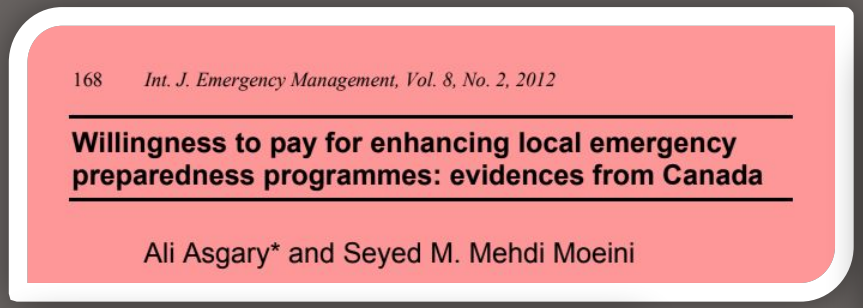
MfPH Workshop on Early Warning Systems for Emerging and Re-emerging Diseases, January 23 - 25, 2023, The Fields Institute

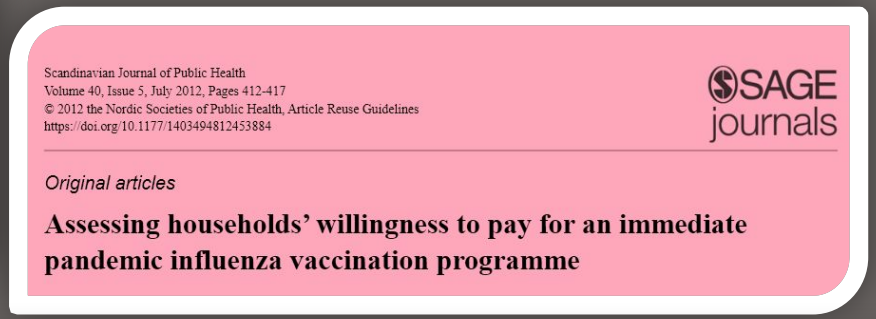
Background



168 *Int. J. Emergency Management, Vol. 8, No. 2, 2012*

Willingness to pay for enhancing local emergency preparedness programmes: evidences from Canada

Ali Asgary* and Seyed M. Mehdi Moeini



Scandinavian Journal of Public Health
Volume 40, Issue 5, July 2012, Pages 412-417
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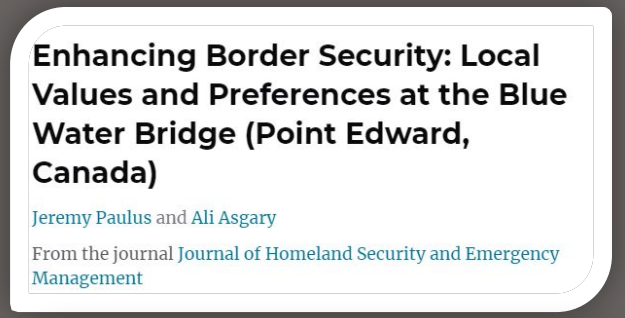
https://doi.org/10.1177/1403494812453884

SAGE journals

Original articles

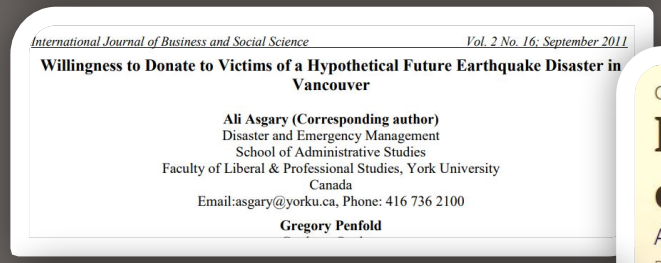
Assessing households' willingness to pay for an immediate pandemic influenza vaccination programme



Enhancing Border Security: Local Values and Preferences at the Blue Water Bridge (Point Edward, Canada)

Jeremy Paulus and Ali Asgary

From the journal Journal of Homeland Security and Emergency Management



International Journal of Business and Social Science *Vol. 2 No. 16; September 2011*

Willingness to Donate to Victims of a Hypothetical Future Earthquake Disaster in Vancouver

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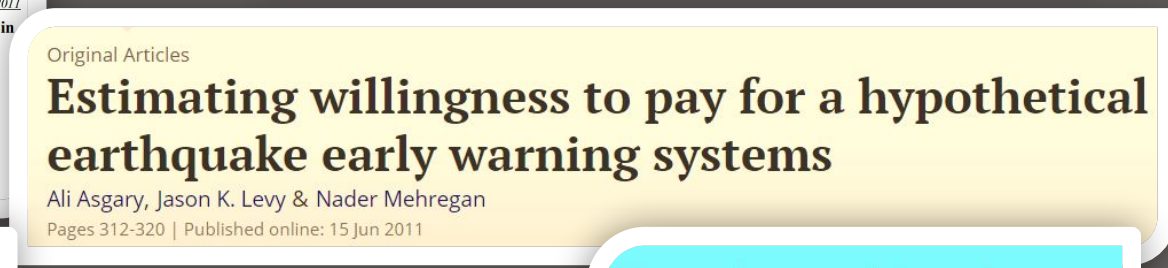
Gregory Penfold

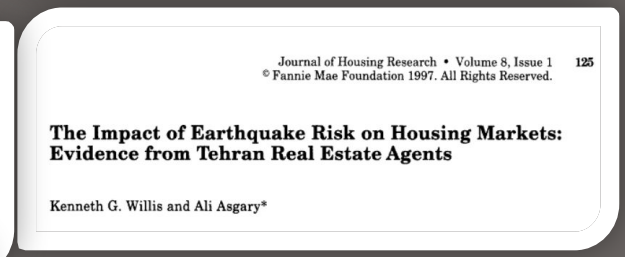


Original Articles

Estimating willingness to pay for a hypothetical earthquake early warning systems

Ali Asgary, Jason K. Levy & Nader Mehregan

Pages 312-320 | Published online: 15 Jun 2011



Journal of Housing Research • Volume 8, Issue 1 125
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The Impact of Earthquake Risk on Housing Markets: Evidence from Tehran Real Estate Agents

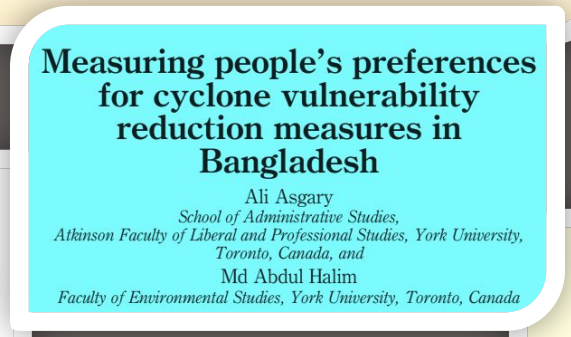
Kenneth G. Willis and Ali Asgary*

Articles

Rural residents and choice of building earthquake-resistant house: results of a choice experiment study

Nooreddin Azimi ✉ & Ali Asgary

Pages 240-257 | Received 06 Apr 2012, Accepted 06 Feb 2013, Pu
Mar 2013



Measuring people's preferences for cyclone vulnerability reduction measures in Bangladesh

Ali Asgary
School of Administrative Studies,
Atkinson Faculty of Liberal and Professional Studies, York University, Toronto, Canada, and
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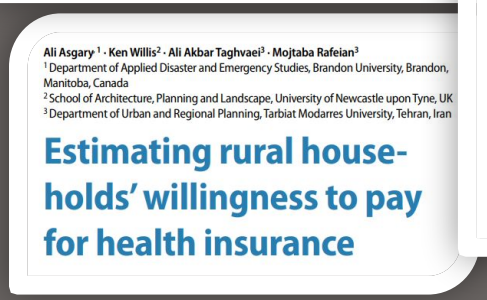
Faculty of Environmental Studies, York University, Toronto, Canada

Estimating the Benefits of Construction Measures to Mitigate Earthquake Risks in Iran

A Asgary ✉ and K G Willis ✉ View all authors and affiliations

Volume 24, Issue 4 | https://doi.org/10.1068/b240613



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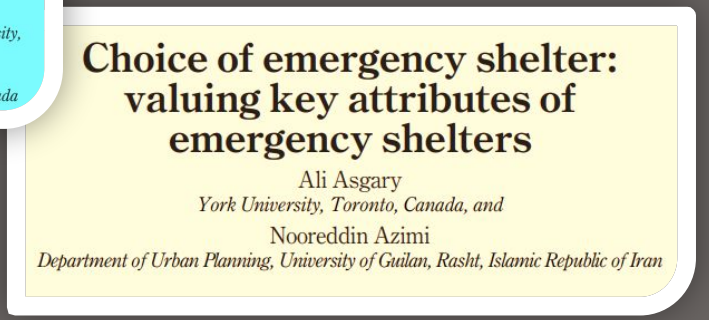
[1] Department of Applied Disaster and Emergency Studies, Brandon University, Brandon, Manitoba, Canada
[2] School of Architecture, Planning and Landscape, University of Newcastle upon Tyne, UK
[3] Department of Urban and Regional Planning, Tarbiat Modarres University, Tehran, Iran

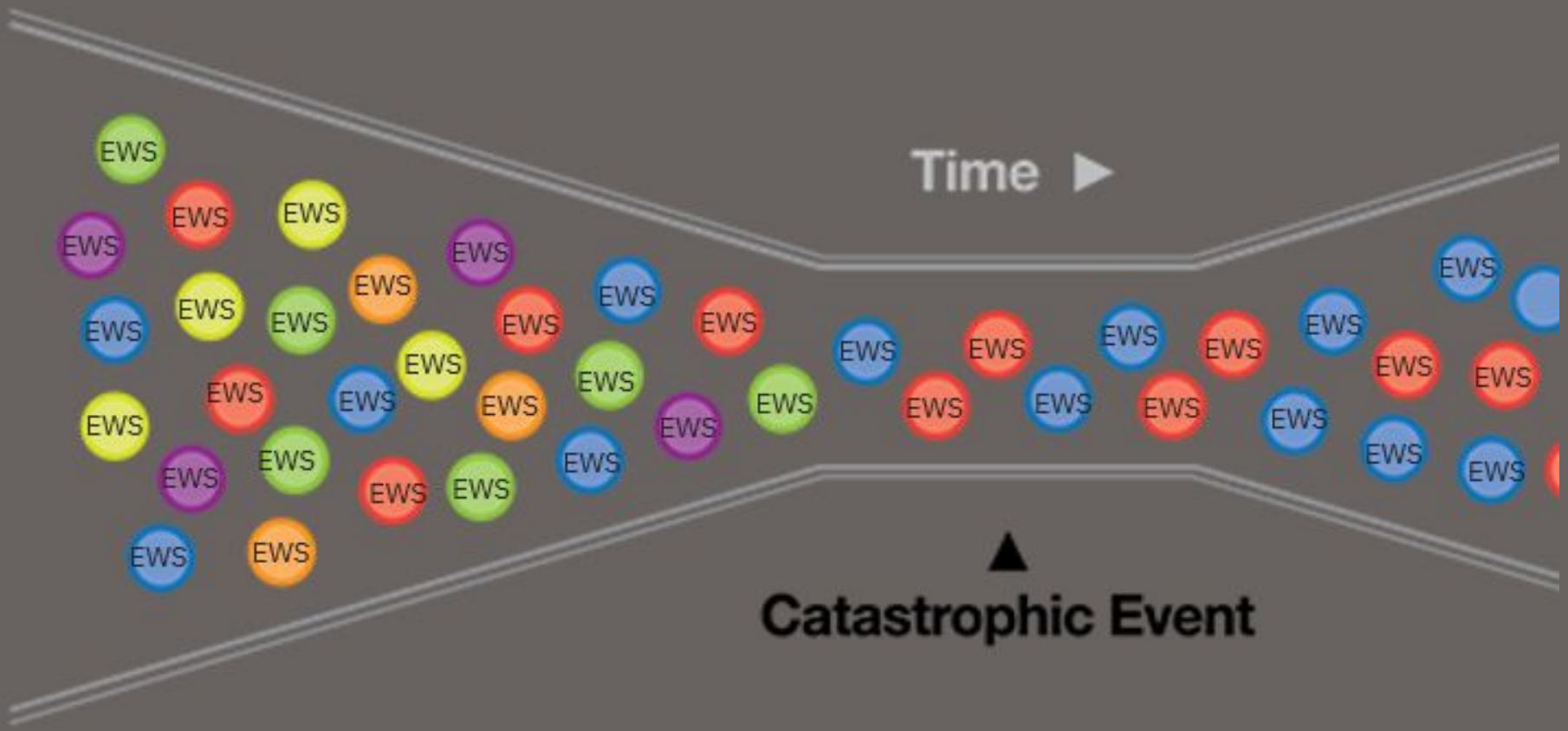
Estimating rural households' willingness to pay for health insurance



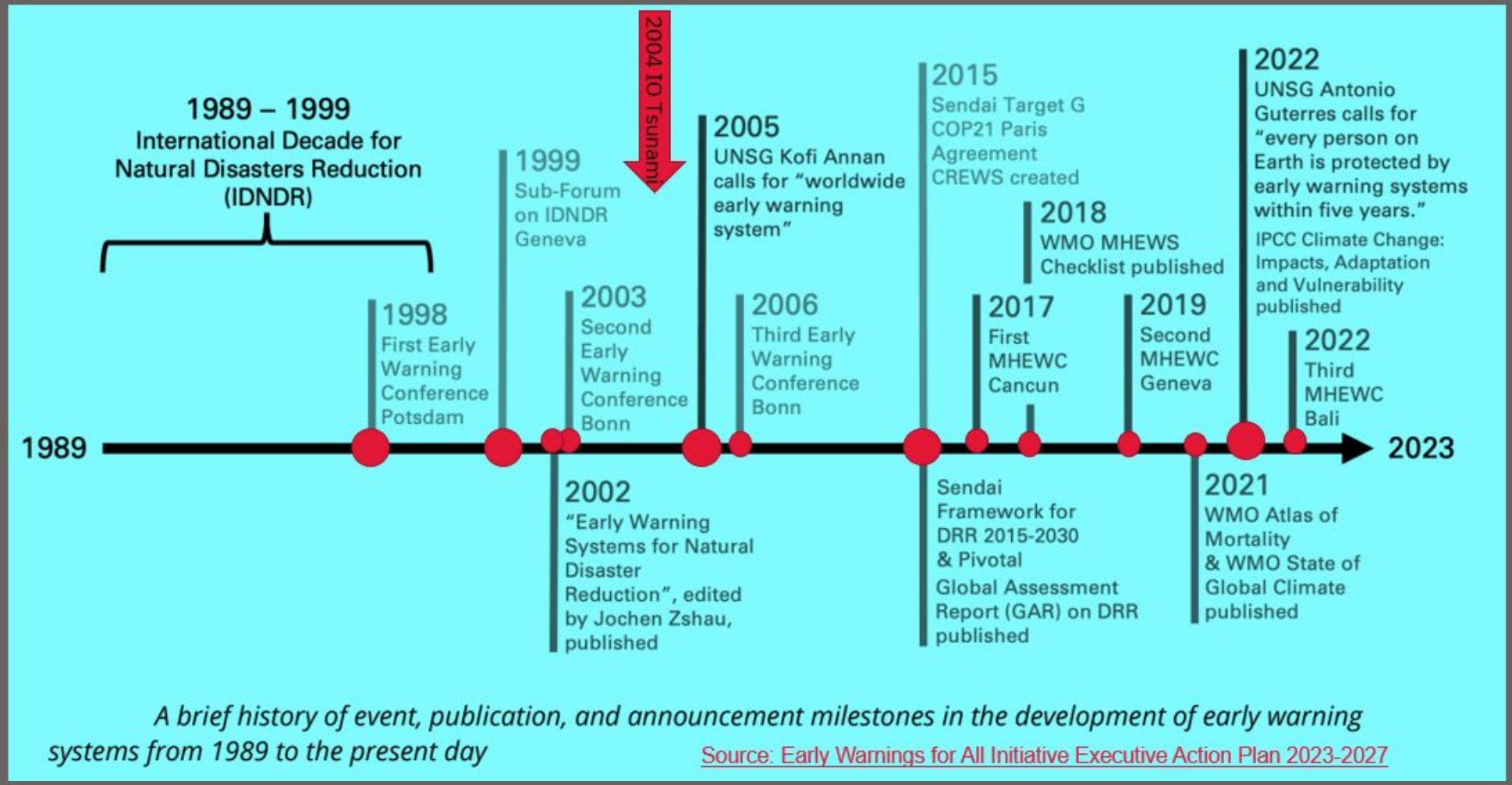
Choice of emergency shelter: valuing key attributes of emergency shelters

Ali Asgary
York University, Toronto, Canada, and
Nooreddin Azimi
Department of Urban Planning, University of Guilan, Rasht, Islamic Republic of Iran

The Bottleneck



Evolution of Global Efforts on Early Warning Systems for Natural Hazards



A brief history of event, publication, and announcement milestones in the development of early warning systems from 1989 to the present day

Source: Early Warnings for All Initiative Executive Action Plan 2023-2027

EWS at Gloal Conferences & Platforms

Early Warning Systems in Sendai Framework for Disaster Risk Reduction 2015-230

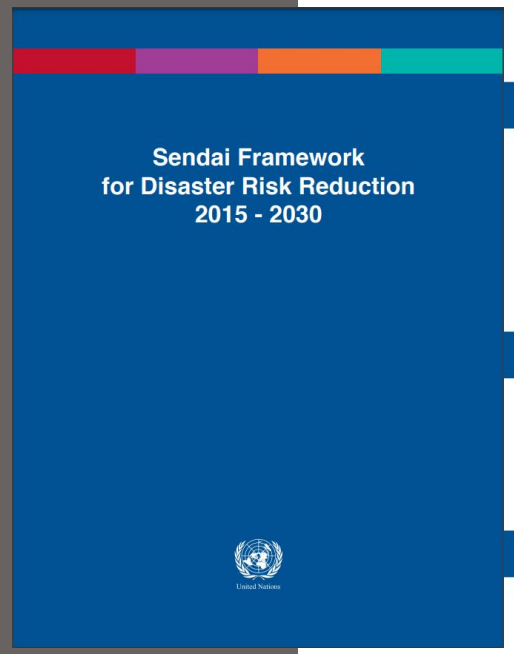


Chart of the Sendai Framework for Disaster Risk Reduction
2015-2030

Scope and purpose

The present framework will apply to the risk of small-scale and large-scale, frequent and infrequent, sudden and slow-onset disasters, caused by natural or manmade hazards as well as related environmental, technological and biological hazards and risks.
It aims to guide the multi-hazard management of disaster risk in development at all levels as well as within and across all sectors

Expected outcome

The substantial reduction of disaster risk and losses in lives, livelihoods and health and in the economic, physical, social, cultural and environmental assets of persons, businesses, communities and countries

Goal

Prevent new and reduce existing disaster risk through the implementation of integrated and inclusive economic, structural, legal, social, health, cultural, educational, environmental, technological, political and institutional measures that prevent and reduce hazard exposure and vulnerability to disaster, increase preparedness for response and recovery, and thus strengthen resilience

Targets

A	B	C	D	E	F	G
Substantially reduce global disaster mortality by 2030, aiming to lower average per 100,000 global mortality between 2020-2030 compared to 2005-2015	Substantially reduce the number of affected people globally by 2030, aiming to lower the average global figure per 100,000 between 2020-2030 compared to 2005-2015	Reduce direct disaster economic loss in relation to global gross domestic product (GDP) by 2030	Substantially reduce disaster damage to critical infrastructure and disruption of basic services, among them health and educational facilities, including through developing their resilience by 2030	Substantially increase the number of countries with national and local disaster risk reduction strategies by 2020	Substantially enhance international cooperation to developing countries through adequate and sustainable support to complement their national actions for implementation of this framework by 2030	Substantially increase the availability of and access to multi-hazard early warning systems and disaster risk information and assessments to people by 2030

Target G

Substantially increase the availability of and access to multi-hazard early warning systems and disaster risk information and assessments to people by 2030

Early Warning Systems in UN Sustainable Development Goals

Global Status : Countries Reporting Having MHEWS

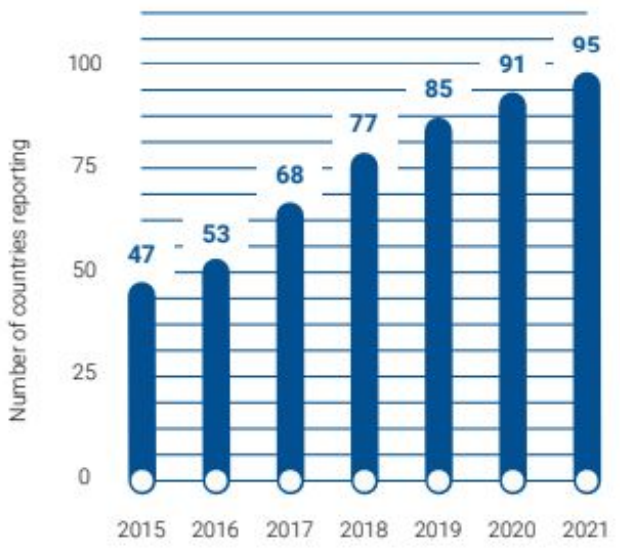
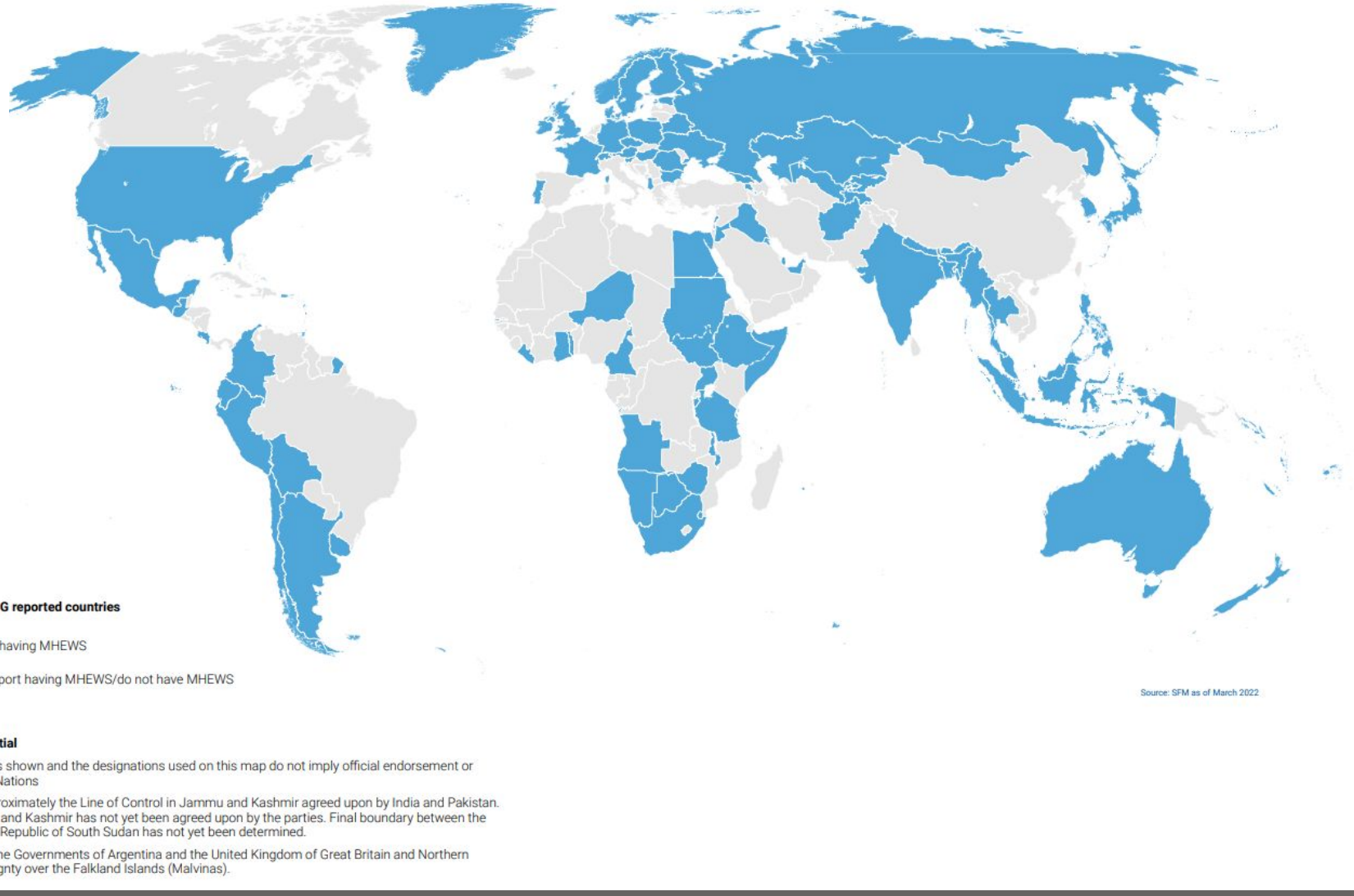


Figure 2.1: Cumulative number of countries reporting existence of MHEWS (Source: SFM)



Global Status of Multi-hazard Early Warning Systems
Countries with Standard Alerting Procedures

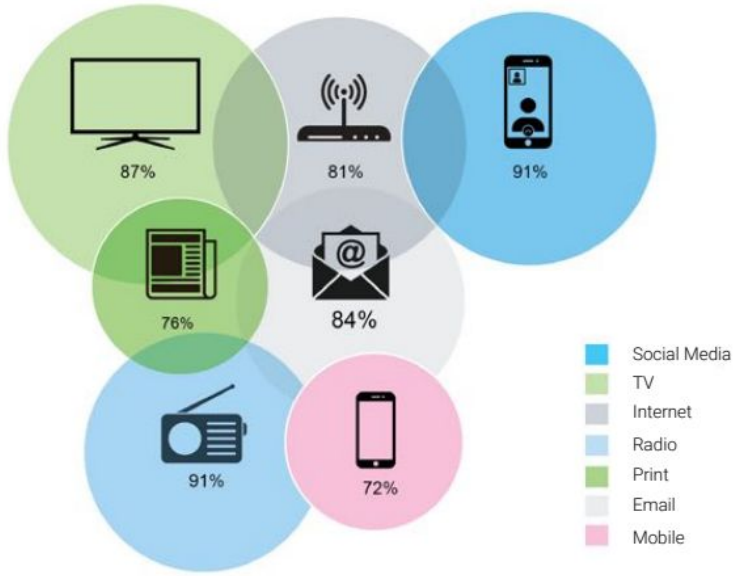


Figure 2.8: Global access to used communication channels (WMO database, 2022)

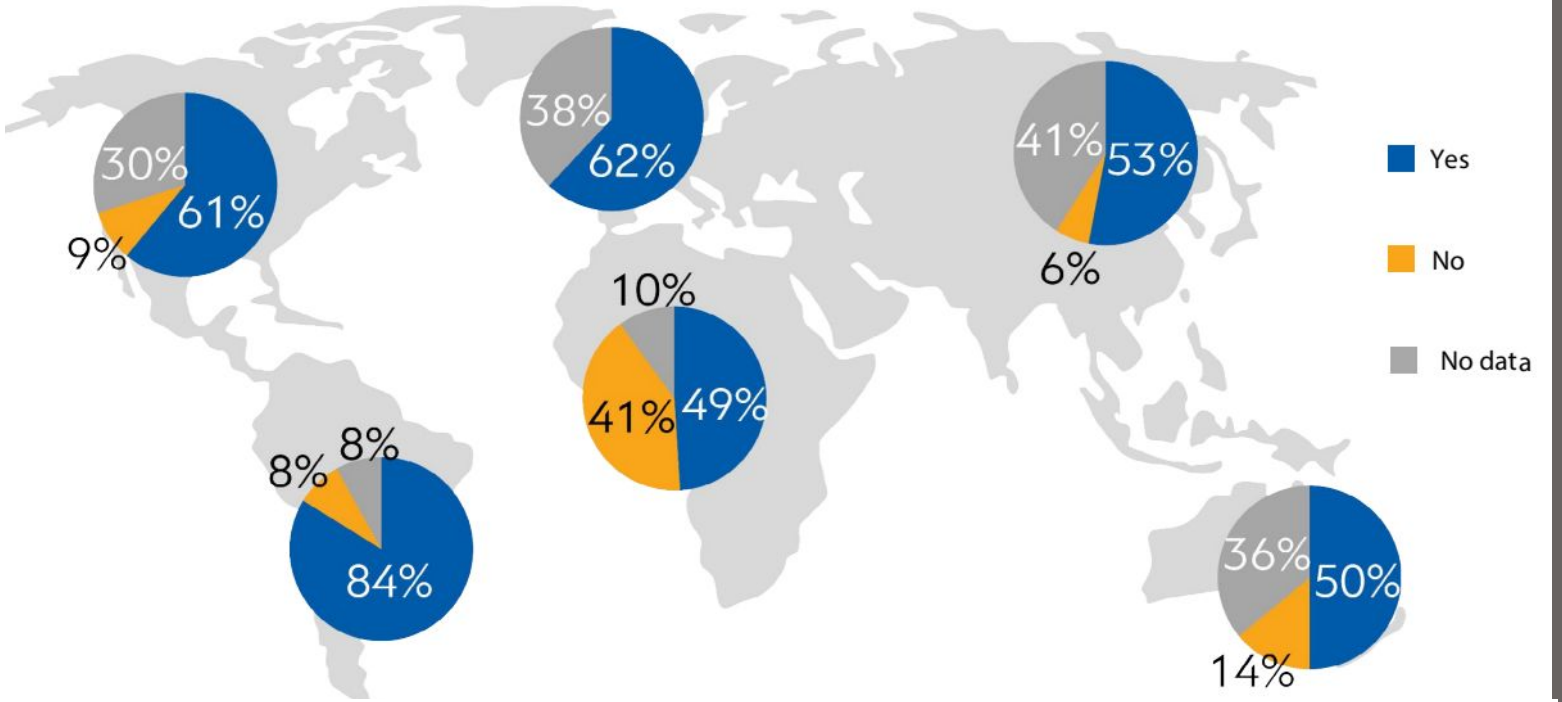
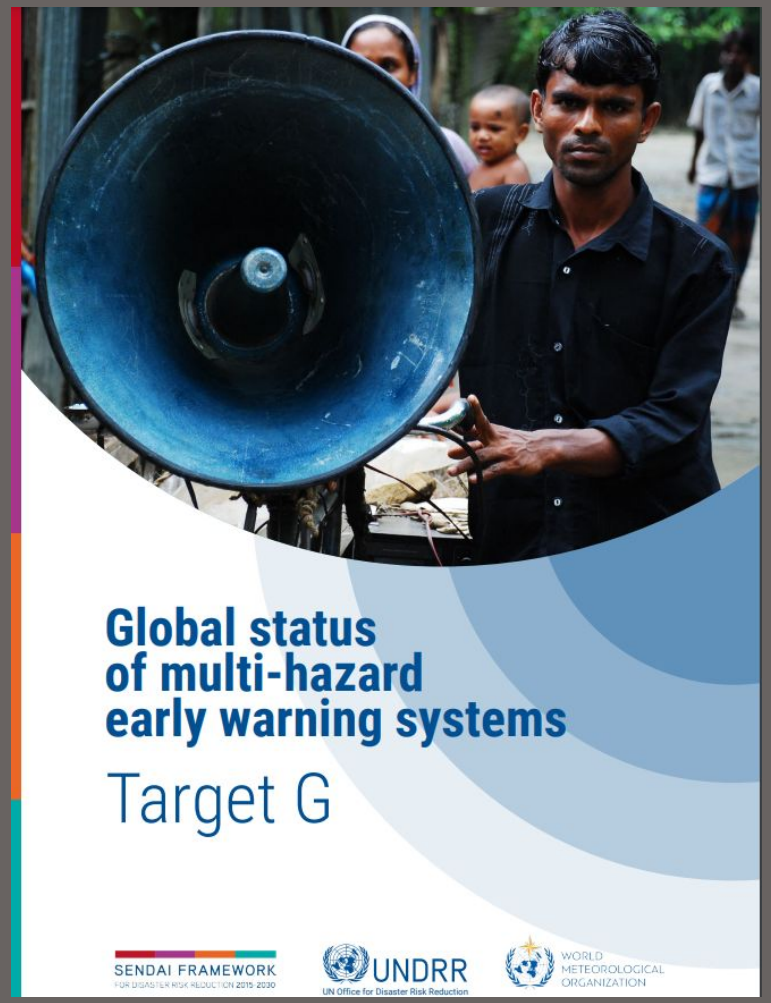


Figure 2.14: Percentage of countries reporting to have standard alerting procedures. Source: WMO

Global Status:
Existence of Early Warning Systems & Mortality Rate



Category of countries by coverage of MHEWS (Target G)	Mortality per 100,000 population, 2005-2021 (Target A)
Limited to moderate coverage	4.62
Substantial to comprehensive coverage	0.60

Table 2 1: Mortality rate by MHEWS coverage

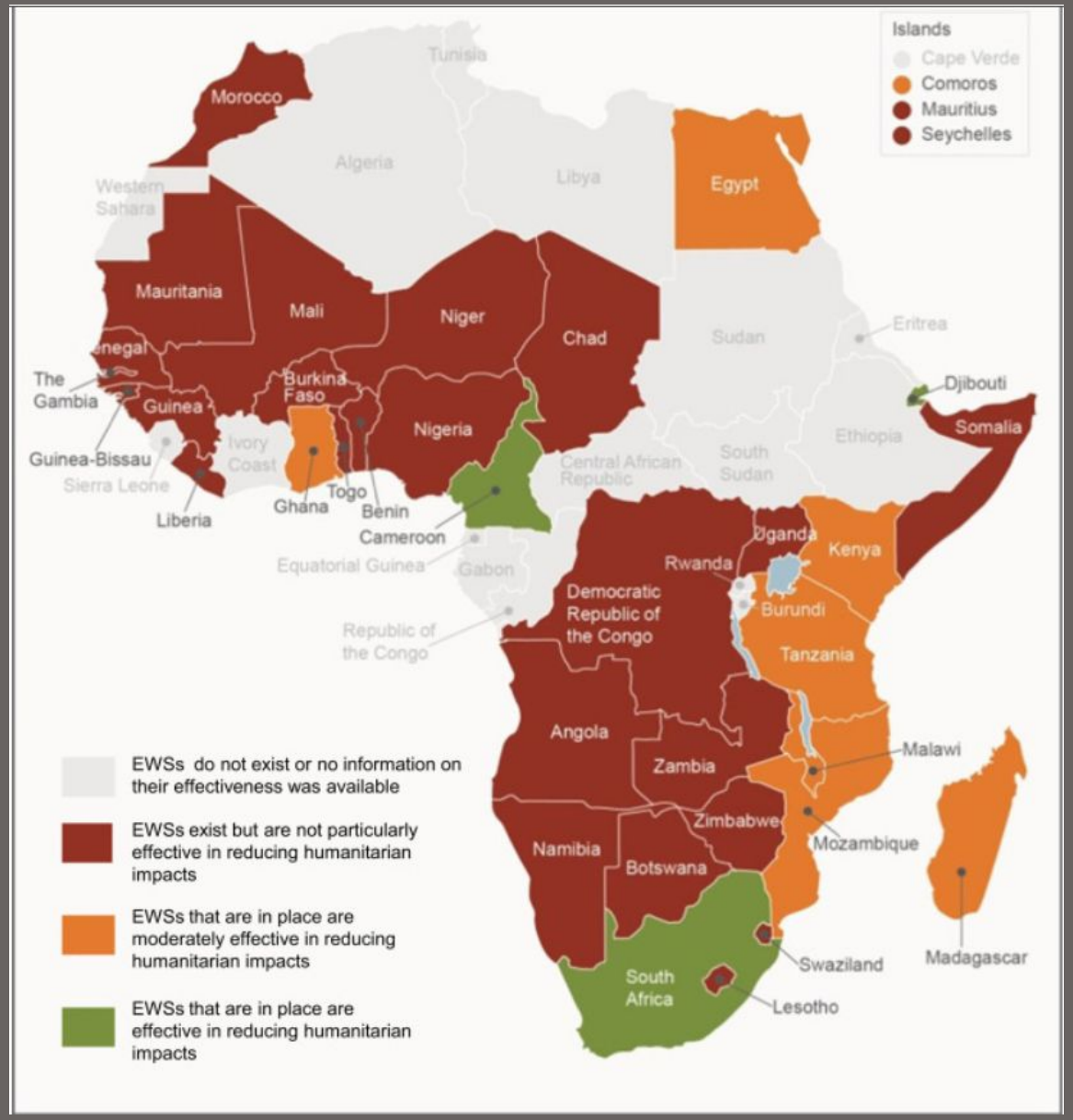
Early Warning Systems: A UN Focus

"All people on Earth must be protected by early warning systems within five years." - UN Secretary-General Antonio Guterres, March 23, 2022

"To achieve the goal set by UN Secretary General, and to meet the Sendai Framework Target G, **more investments** are needed for:

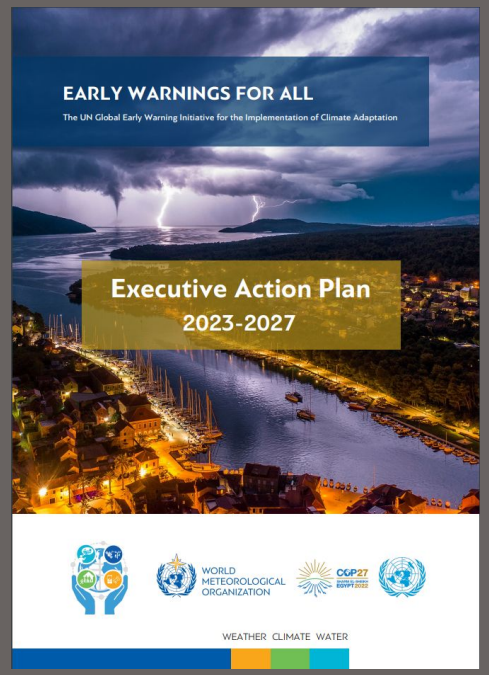
- Developing and improving the MHEWS
- Improving MHEWS' infrastructure capacity
- Enhancing preparedness
- Building capacity for dissemination and communication of warnings globally."

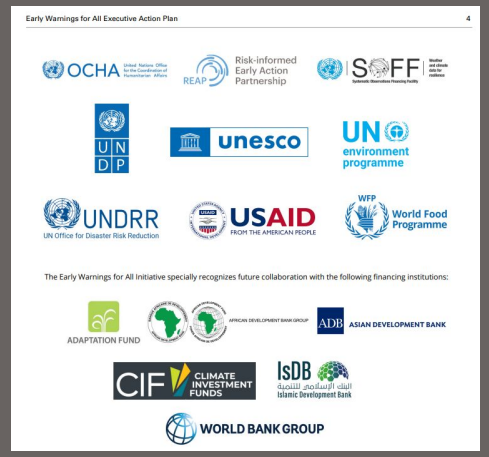
The effectiveness of cyclone EWSs in reducing humanitarian impacts



Lumbroso, D. (2018). How can policy makers in sub-Saharan Africa make early warning systems more effective? The case of Uganda. *International journal of disaster risk reduction*, *27*, 530-540. Chicago

Early Warning Systems: Not Too Costly





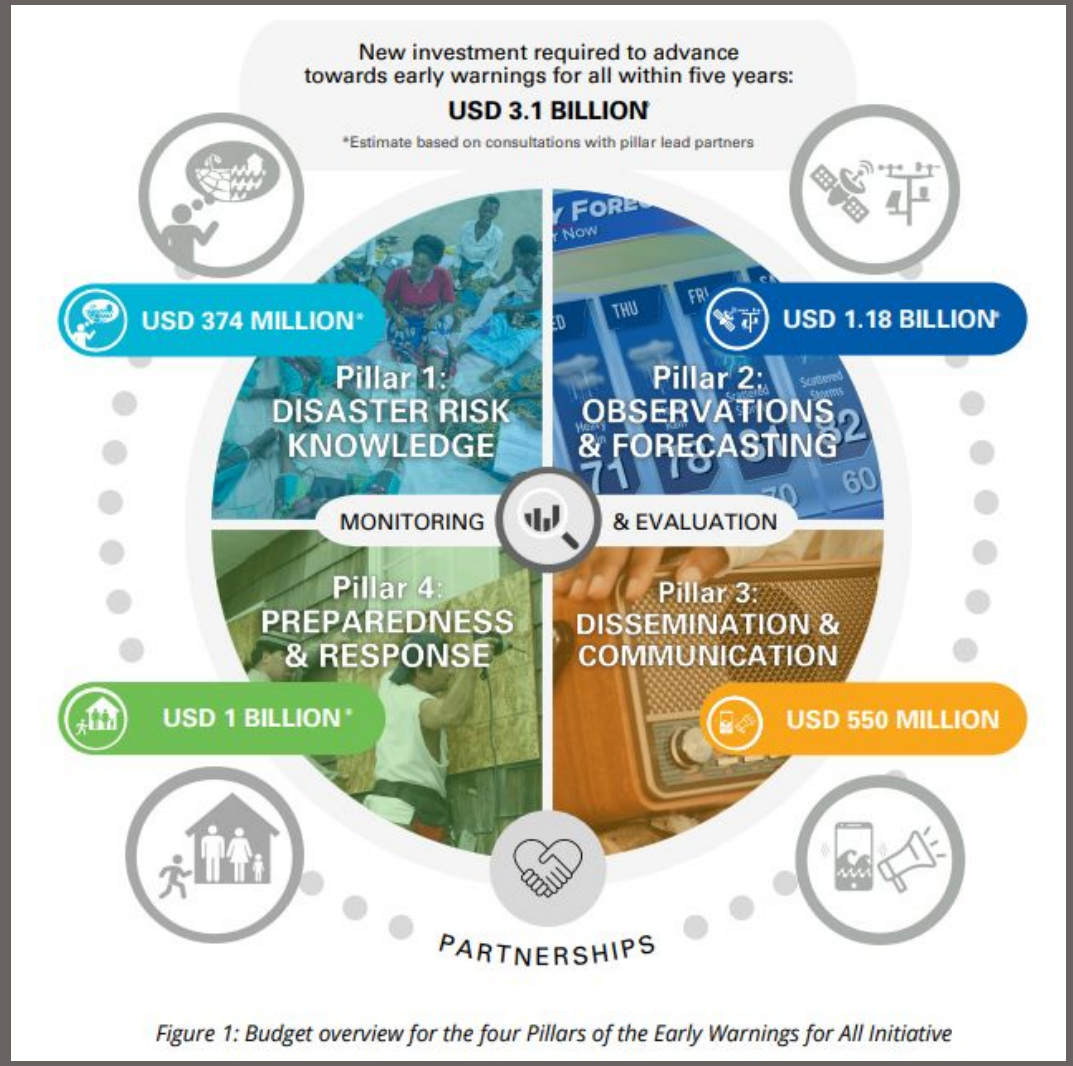
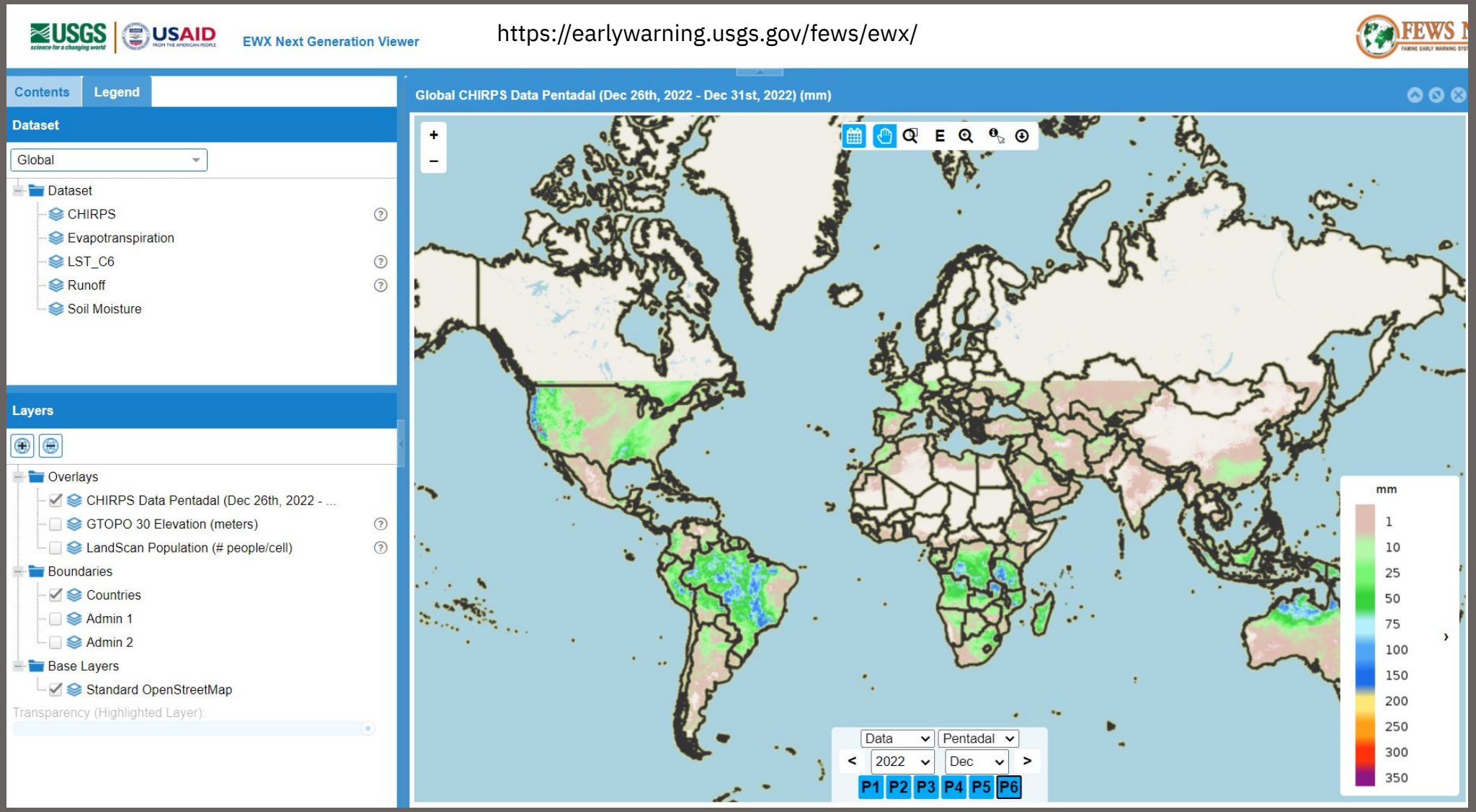


Figure 1: Budget overview for the four Pillars of the Early Warnings for All Initiative

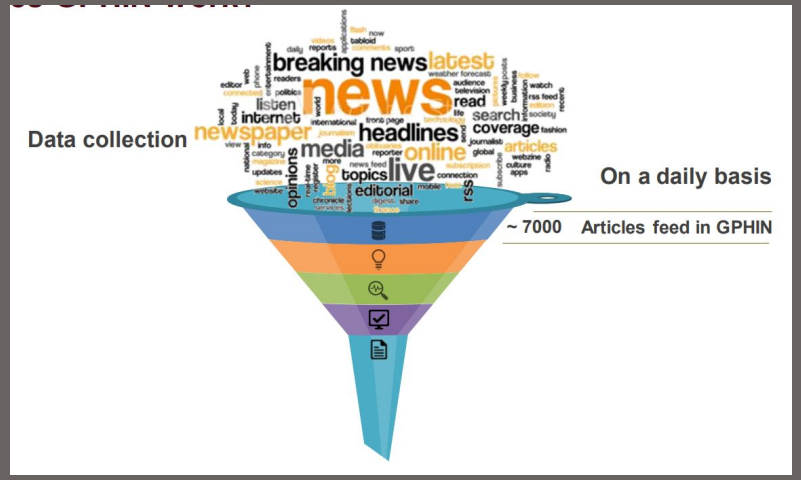

USGS
USAID
EWX Next Generation Viewer
https://earlywarning.usgs.gov/fews/ewx/
FEWS
Contents
Legend
Dataset
Global
Dataset
CHIRPS
Evapotranspiration
LST_C6
Runoff
Soil Moisture
Layers
Overlays
CHIRPS Data Pentadal (Dec 26th, 2022 - ...
GTOPO 30 Elevation (meters)
LandScan Population (# people/cell)
Boundaries
Countries
Admin 1
Admin 2
Base Layers
Standard OpenStreetMap
Transparency (Highlighted Layer):
Global CHIRPS Data Pentadal (Dec 26th, 2022 - Dec 31st, 2022) (mm)
mm
1
10
25
50
75
100
150
200
250
300
350
Data
Pentadal
2022
Dec
P1
P2
P3
P4
P5
P6

A Pioneering Canadian Initiative

GPHIN

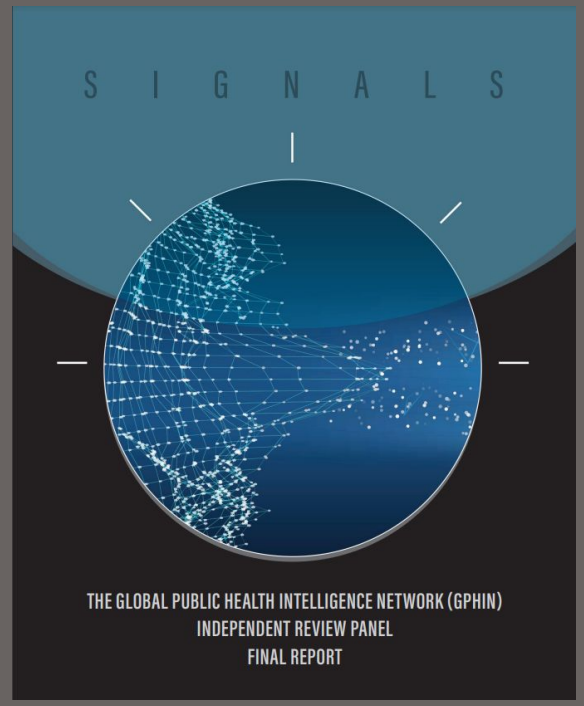
Global Public Health Intelligence Network

Started in 1997 in collaboration with the WHO



Florence Tanguay Senior Epidemiologist, Public Health Agency of Canada November 12, 2019

GPHIN: a pioneer in event-based surveillance



Politics

Canada's pandemic warning system was understaffed and unready when COVID hit, review finds

Details of policy change on issuing of health alerts remain a mystery

Murray Brewster · CBC News · Posted: Jul 12, 2021 1:19 PM EDT | Last Updated: July 12, 2021

EXPLAINER

What happened with Canada's pandemic alert system? The GPHIN controversy explained

Ottawa silenced GPHIN, Canada's highly regarded international alert system for outbreaks, in early 2019, before COVID-19 swept the world. Here's what we know about why that happened, and the controversy since

Over the years, with no major threats materializing, the government grew weary of GPHIN, and sought to use its resources for other purposes

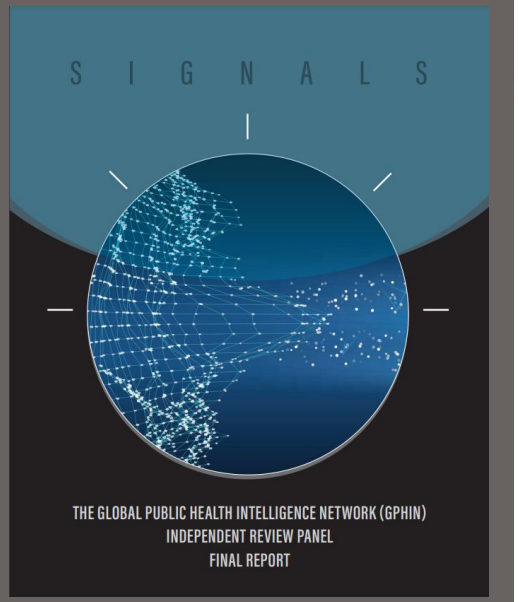


Table 1: total estimated GPHIN expenditures, 2009-10 to 2020-21

FISCAL YEAR	FULL-TIME EQUIVALENTS	SALARY	OPERATIONS AND MAINTENANCE (O&M)	TOTAL ESTIMATED EXPENDITURES
2009-10	**15.1**	$1,291,073	$1,007,095	$2,298,168
2010-11	**16.4**	$1,300,849	$1,783,643	$3,084,492
2011-12	**16.3**	$1,248,081	$1,393,077	$2,641,158
2012-13	**14.4**	$1,418,036	$1,479,592	$2,897,628
2013-14	**15.1**	$1,357,937	$1,232,544	$2,590,481
2014-15	**14.7**	$1,391,618	$725,013	$2,116,631
2015-16	**12.8**	$1,114,407	$2,944,232	$4,058,639
2016-17	**12.3**	$1,033,085	$2,272,780	$3,305,865
2017-18	**11.5**	$1,086,272	$2,018,983	$3,105,255
2018-19	**12.3**	$1,095,169	$1,387,824	$2,482,993
2019-20	**10.9**	$1,066,122	$1,730,278	$2,796,400
2020-21	**12.2**	$1,174,127	$1,540,895	$2,715,022

The Human Side of Early Warning Systems: Three Willingness

- Willingness to pay/invest
- Willingness to listen
- Willingness to act

The Costs & Benefits of Early Warning Systems

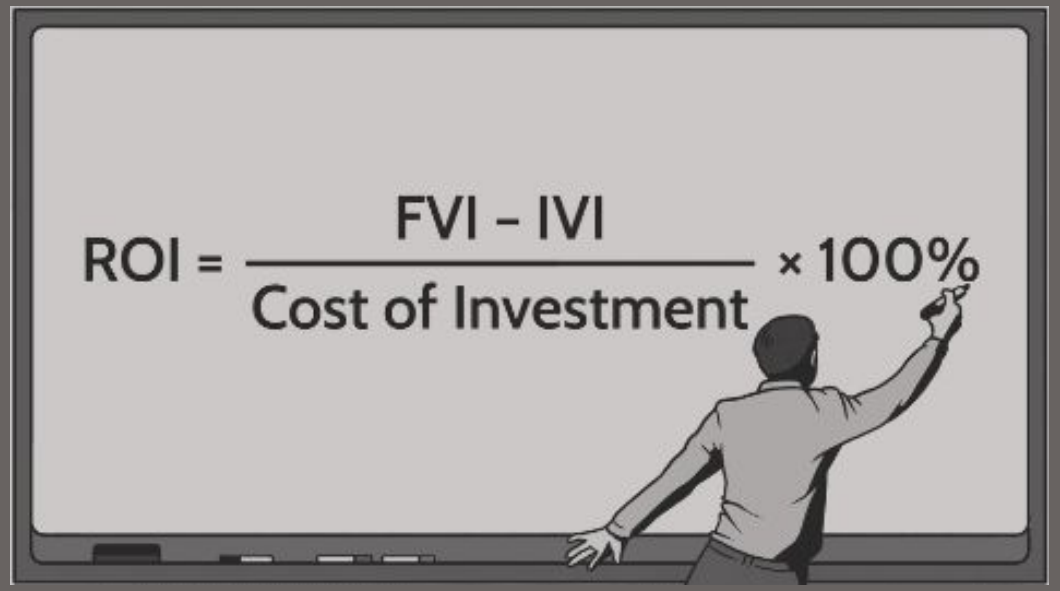
- Cost saving due to mitigation actions
- Cost of false alerts
- Uncertainty level
- Cost and Benefit Analysis of EWS are very limited
- Difficult to convince governments, particularly in developing countries of the socio-economic value of EWS

https://documents1.worldbank.org/curated/pt/609951468330279598/pdf/693580ESW0P1230aster0Risk0Reduction.pdf

Why We Need to Measure the Economic Value of Early Warning Systems?

Determines Return on Investment (ROI)

- Helps policymakers and other decision-makers to make informed decisions.
- Helps identify areas where additional investment is needed to improve the effectiveness of these systems.



$$\text{FVI} = \text{Final value of investment}$$

$$\text{IVI} = \text{Initial value of investment}$$

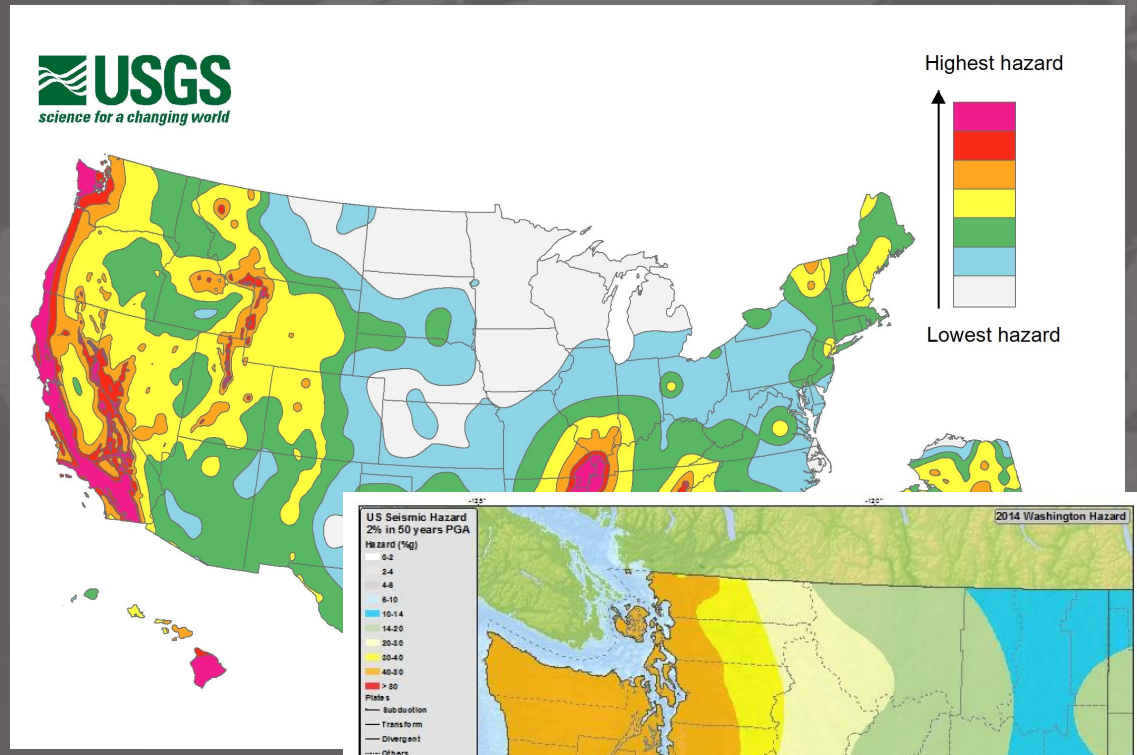
Benefits of EWS Way Exceed Their Costs

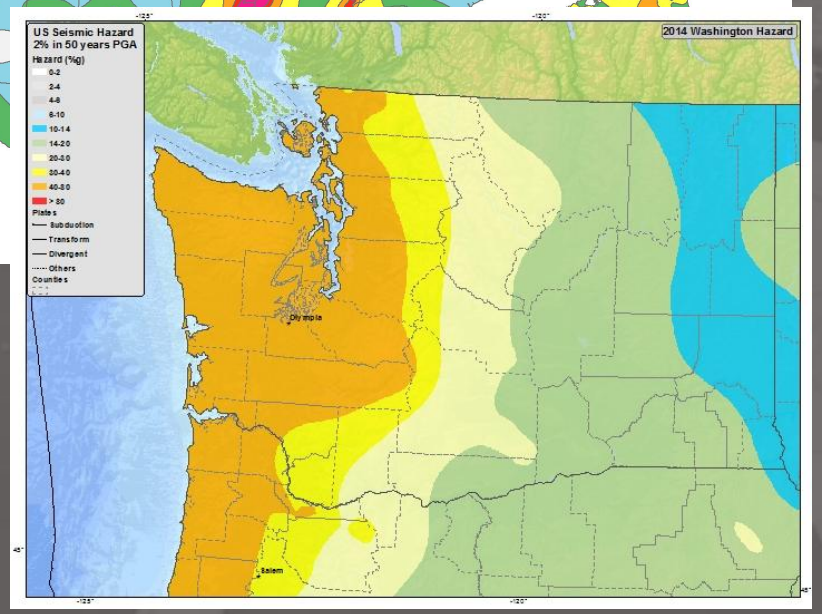
Box IV - Benefits exceed costs sometimes more than 10 times

- An estimate in China in 1994–96 found a benefit-cost ratio between 35 and 40 (Guocai and Wang 2003)
- Meteorological services in Mozambique were estimated to have a benefit-cost ratio of 70 (World Bank 2008)
- The ratio of the economic benefits of improved hydrometeorological information (calculated as avoided losses) to the costs of national hydrometeorological services modernization programs vary between 2.1 to 14.4 for some European and Asia countries (World Bank 2008)
- Benefits of improved weather forecasts estimated for U.S. households exceed the cost of U.S. National Weather Service modernization program more than threefold (Lazo, Teisberg, and Weiher 2007).
- A more recent nationwide survey indicates that the U.S. public obtains several hundred billion forecasts each year, generating $31.5 billion in benefits compared to costs of $5.1 billion (Lazo et al, 2009).

https://documents1.worldbank.org/curated/pt/609951468330279598/pdf/693580ESW0P1230aster0Risk0Reduction.pdf

Benefits of Early Warning Systems: Earthquake Example





ASCE

Benefit-Cost Analysis for Earthquake Early Warning in Washington State

Andrew Bouta[1]; Alicia Y. E. Ahn[2]; Ann Bostrom, Ph.D.[3]; and John E. Vidale, Ph.D.[4]

A mean savings of $289 million is predicted from the implementation and operation of the proposed EEWS, an amount that considers only some of the potential benefits.

$$NPV = \sum_{T=1}^{50} w_T NB_T$$

$$NB_{T,S} = B_{T,S} - C_{T,S}$$

$$B_{T,S} = [C_{T,S} - C_A(EEWS)_{T,S}] \times Pr(earthquake)_T \times Pr(true\text{-}positive\ alarm)_T$$

Why it is hard for policy makers to invest in early warning systems?

- The benefits of EWS may not be immediately visible or tangible
- EWS are complex and expensive to develop and maintain, make it challenging for policymakers to allocate sufficient resources to them.
- EWS often require coordination across multiple government agencies and organizations.
- EWS depend on accurate and timely data.

Measuring the Value of early Warning Systems: Methods

- Choice-based Conjoint Analysis (CBC)
- Contingent Valuation Method (CVM)
- Discrete Choice Experiment (DCE)
- Machine Learning Methods
- Stated-Preference Methods
- Revealed Preference Methods

https://arcg.is/11PjHn

Measuring the Value of Early Warning Systems: Infectious Diseases

The European Journal of Health Economics (2020) 21:763–773
https://doi.org/10.1007/s10198-020-01171-2

ORIGINAL PAPER

Willingness to pay for an early warning system for infectious diseases

Sebastian Himmler[1] · Job van Exel[1,2] · Meg Perry-Duxbury[1] · Werner Brouwer[1]

Received: 5 February 2019 / Accepted: 25 February 2020 / Published online: 16 March 2020

- Contingent Valuation Method
- Six European countries (UK, Denmark, Germany, Hungary, Italy, and The Netherlands).
- February to March **2018**
- Sample size of **3140**

	Mean €	SD
UK	20.74	32.63
Denmark	28.33	42.43
Germany	21.01	30.27
Hungary	8.89	13.80
Italy	27.32	33.05
Netherlands	22.71	29.04
Total	21.80	32.32

19.30 * 21.80*12*50= 252,444 (millions)

CB Ration 6.41

Human costs (VSL) = 1,620,039.37

Measuring the Value of Early Warning Systems: The Impacts of an Ongoing Pandemic

The European Journal of Health Economics (2022) 23:81–94
https://doi.org/10.1007/s10198-021-01353-6

ORIGINAL PAPER

Did the COVID-19 pandemic change the willingness to pay for an early warning system for infectious diseases in Europe?

Sebastian Himmler[1,2] · Job van Exel[1,2,3] · Werner Brouwer[1,2,3]

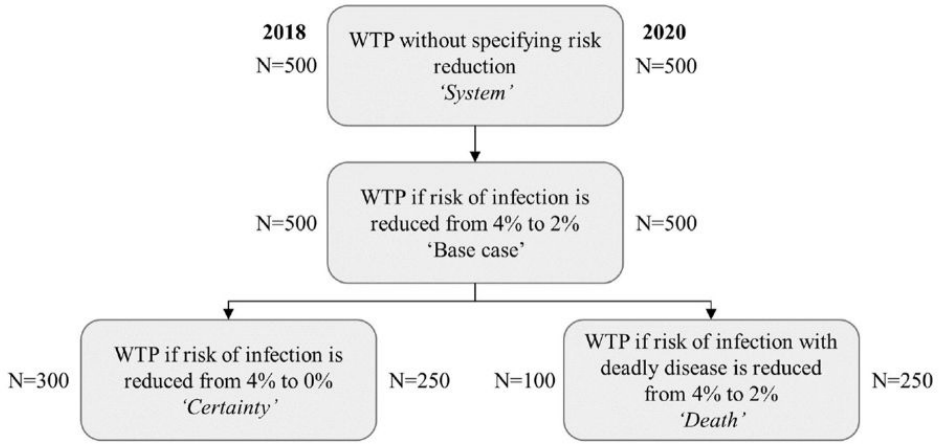


Fig. 1 Willingness-to-pay scenarios and target samples per country for 2018 and 2020 survey. *Note.* The 2018 survey included additional scenarios not shown here. The target sample for Italy in 2020 was 1000, with 500 from northern Italy (north of Lazio and Umbria)

Summary of WTP results

During the onset of the COVID-19 crisis in Europe, we repeated an experiment from 2018 by Himmler et al. which elicited the WTP for improvements in health safety provided by an international, integrated early warning system for identifying, containing and mitigating large infectious disease outbreaks. Overall, we found statistically significant increases in mean monthly WTP by about 50%, depending on the specified WTP scenario (e.g., from €20 to €28 in the 'System' scenario), while the corresponding medians increased by about 30% (e.g., from €9 to €13 in the 'System' scenario). Differences between countries were more pronounced compared to the 2018 data collection. The largest increases in WTP were observed for the UK, Denmark, and Italy. We furthermore found rather stable WTP values in a sub-sample of individuals before and during the COVID-19 outbreak. Most of these individuals did not, or only slightly changed their WTP between the two timepoints (Appendix Fig. A4).

Measuring the Value of Early Warning Systems: Importance of Lead Time

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A Methodological Framework for Economic Evaluation of Operational Response to Vector-Borne Diseases based on Early Warning Systems

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Affiliations + expand

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Net benefit (NB) of EWS triggered response
= Total benefits – Total costs.

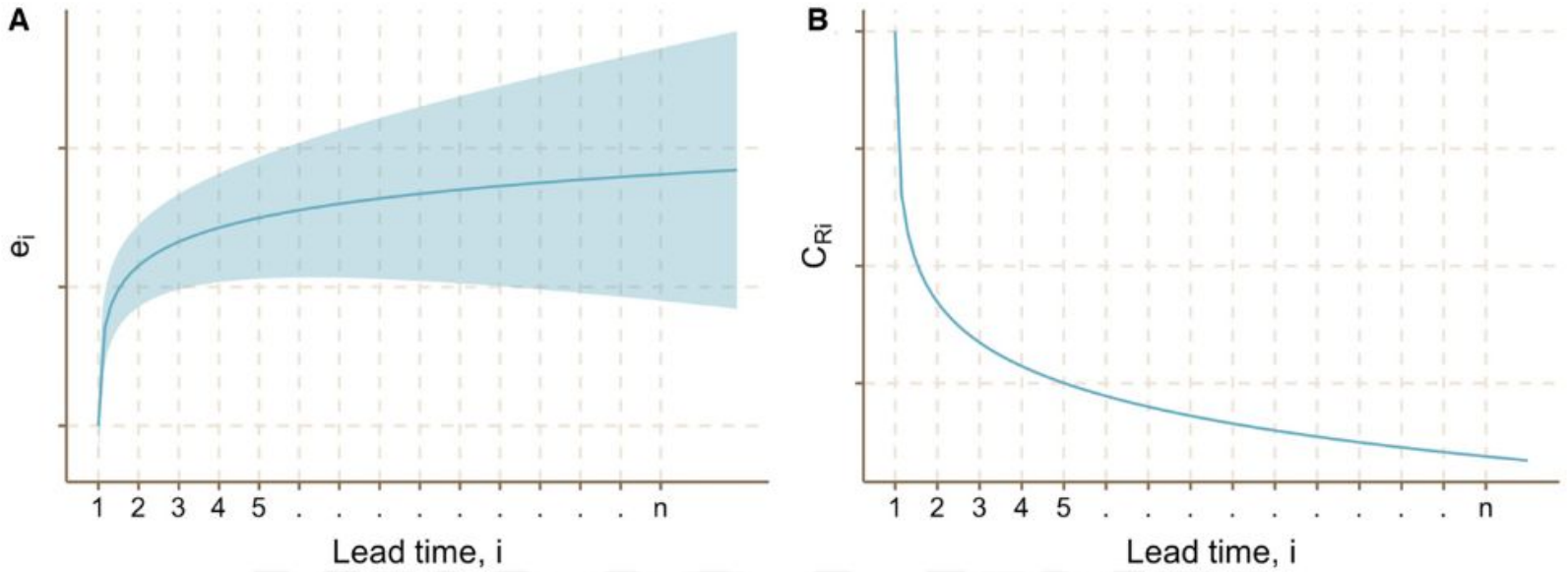

FIGURE 2. **(A)** An illustration of the relationship between forecast lead time (*i*) in weeks or months and response effectiveness (e_i) and its associated uncertainty given a certain level of budget and **(B)** cost of response activities to achieve a certain effectiveness level, assuming a maximum lead time of *n* weeks or months .

Final Remarks & Conclusion

- Another moment of global attention
- Digital transformation
- Humans are humans
- Embedding the cost and benefits in EWS
- Multi-hazard/Multi-disease EWS are more cost effective
- International collaborations is the key to success