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GLOBAL HEALTH HUB GERMANY

Policy Brief

Innovation and Collaboration: the EWARS Framework for infectious diseases

Summary:
Worldwide, infectious diseases are an unrelenting economic and health burden. The Early Warning and Response System (EWARS) is an organised mechanism to predict any out-of-control state of disease phenomena as early as possible. EWARS can strengthen health systems and interventional programmes to respond more efficiently to disease outbreaks.

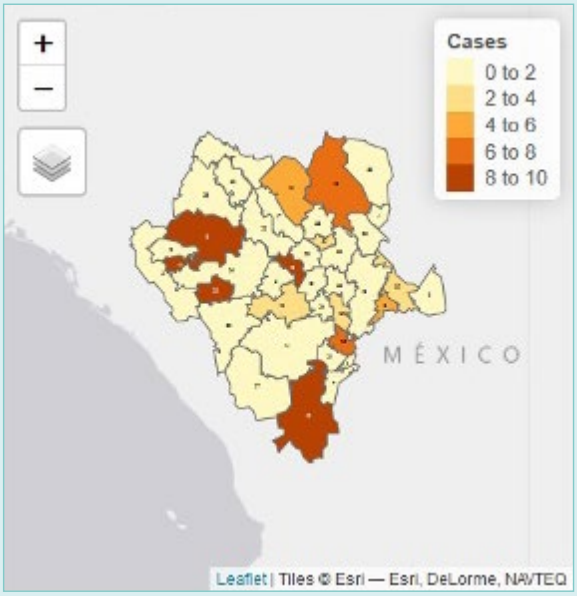
Background

The emergence and re-emergence of infectious diseases are influenced by the interaction between changing climate and human systems. Vector- and water-borne diseases (infections transmitted by blood-feeding insects – i.e. 'vectors' – to humans or bacteria/viruses ingested via contaminated 'water') are sensitive to climate change. Increased temperatures directly affect disease transmission by shifting the geographic range of disease vectors, increasing their reproductive and biting rates and shortening the incubation period of pathogens, while the amount of water-borne diseases is related to the variability of rainfall.

The global burden

Climate change and unplanned urbanisation have significantly impacted the global public health profile by forcing population migration, creating vulnerable groups and favouring the spread and intensity of infectious diseases.

Hence, disease outbreaks are not normally distributed but inextricably linked to disadvantaged households and communities in tropical and sub-tropical areas where health systems are often weak and over-stretched.


Cases
0 to 2
2 to 4
4 to 6
6 to 8
8 to 10
MÉXICO
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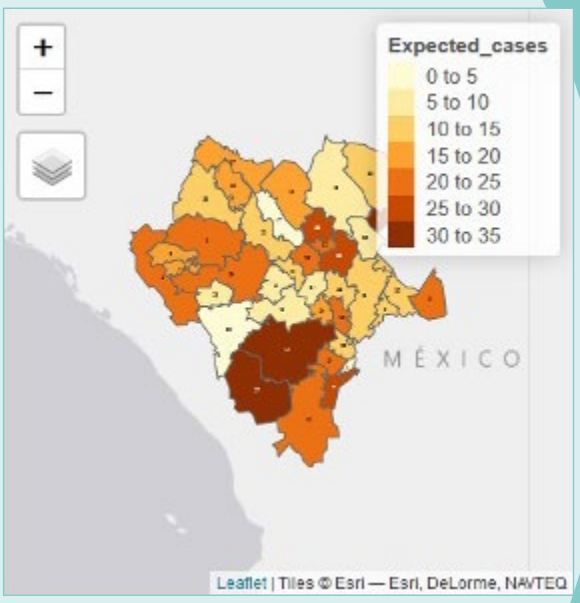
Expected_cases
0 to 5
5 to 10
10 to 15
15 to 20
20 to 25
25 to 30
30 to 35
MÉXICO
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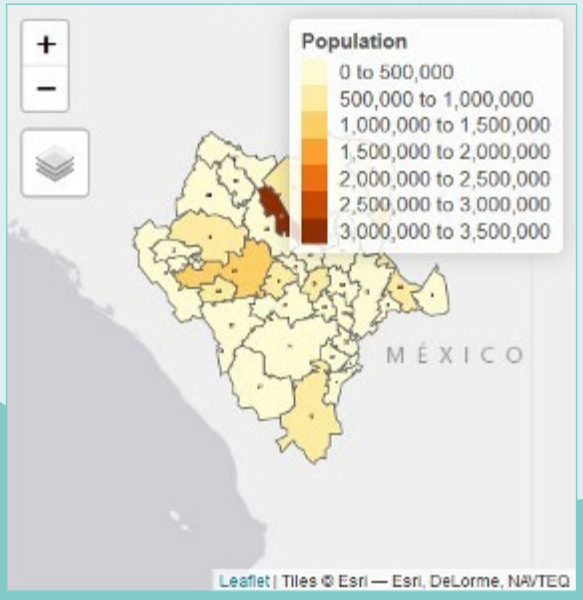
Population
0 to 500,000
500,000 to 1,000,000
1,000,000 to 1,500,000
1,500,000 to 2,000,000
2,000,000 to 2,500,000
2,500,000 to 3,000,000
3,000,000 to 3,500,000
MÉXICO
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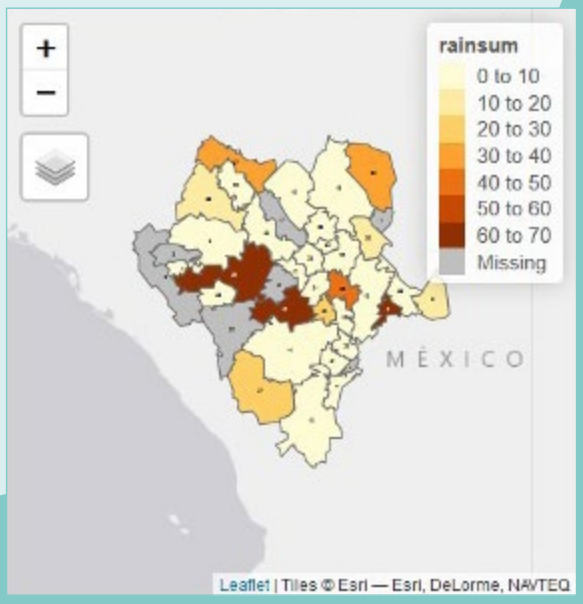

rainsum
0 to 10
10 to 20
20 to 30
30 to 40
40 to 50
50 to 60
60 to 70
Missing
MÉXICO
Leaflet | Tiles © Esri — Esri, DeLorme, NAVTEQ

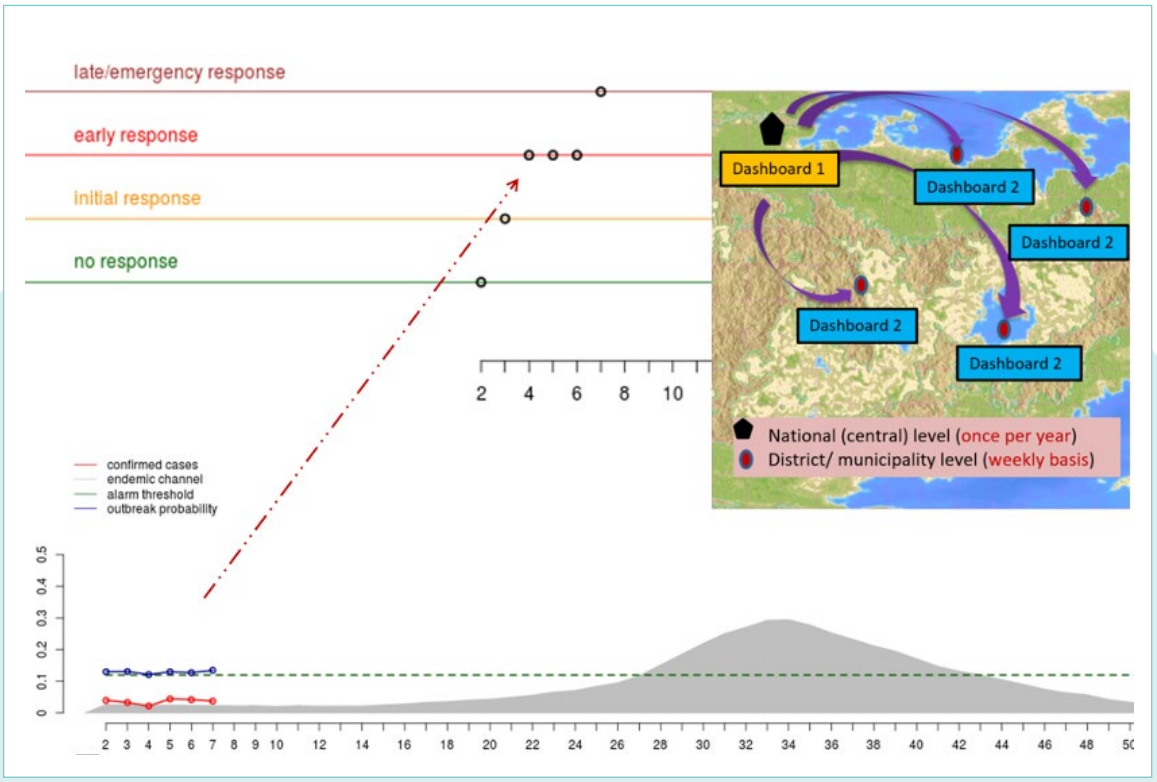
Endemic countries and countries with low-level or no transmission are all threatened by outbreaks. Such outbreaks are frequently detected late, and the response mechanisms are often ineffective. The early detection of and response to outbreaks is heavily reliant on routine disease surveillance systems that often send data too late for an effective response. However, forecasting disease outbreaks using digital surveillance systems and weather information shows promising potential. The use of the Early Warning And Response System – EWARS (the organised mechanism to detect any suspected disease outbreaks as early as possible) – is crucial to increasing the effectiveness of outbreak control by intervening before or at the beginning of the epidemic curve, rather than during the downward slope.

Tools innovation for Global Health applications

Applying an interdisciplinary approach to establish a structured and sustainable framework for climate-informed policy-making can significantly contribute to the attainment of Sustainable Development Goals #3: good health and wellbeing, and #13: climate action. Leveraging know-how from data science methods, unexplored implementation research methods and digital science will add great value in this disease control and prevention process.

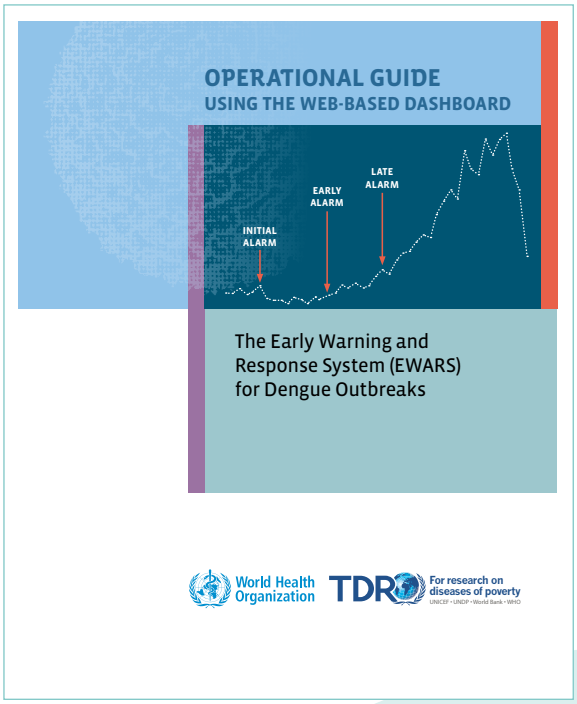
Essential frameworks for policy making

EWARS should be perceived as an information system designed to support decision-making for national and local-level institutions, enabling vulnerable groups in society to take action to mitigate the impacts of an impending risk. Although this is as yet outside the scope of this framework, the tool has the potential to improve collaboration at regional levels (i.e. regional surveillance, data sourcing, joint response, etc.), which can promote its integration and use for monitoring within international hubs. Against this background, EWARS not only includes a time-and-space function to predict imminent disease outbreaks, but also helps improve coordination among the relevant stakeholders, such as local epidemiologists, meteorologists, entomologists, the national and local management agencies that assess risk and develop response strategies, and the public communication channels used to disseminate warning information. It also allows essential stakeholders of international bodies such as the World Meteorological Organization (WMO) to get involved and help countries with access to meteorological data.



The EWARS framework

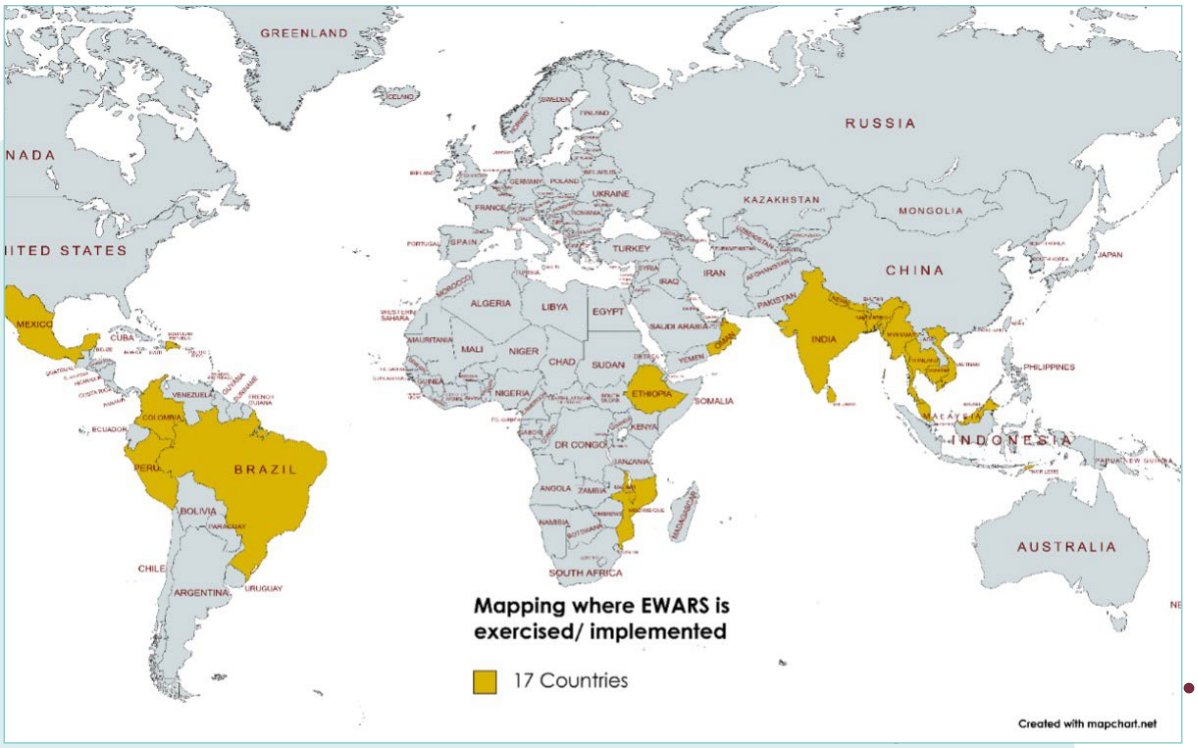
In previous years, TDR-WHO together with endemic countries, the University of Freiburg (Germany) and the University of Gothenburg (Sweden) have developed a temporal and spatial framework for vector- and water-borne disease outbreak prediction – a model disease outbreak contingency plan, which combines the best existing strategies with proven novel approaches and tools, including a series of handbooks and user-guides explaining the local development and use of alarm indicators for outbreaks. The EWARS has been used and validated in more than 17 countries in PAHO, AFRO, WPRO and SEARO regions and was fairly recently fully implemented in Mexico. Over the last several years, routine monthly trainings and follow-ups have helped achieve significant progress in integrating the tool into national surveillance programmes. Countries from the Middle East region have now joined as well.



The Global Health Hub Germany (GHHG) has joined forces in supporting and promoting the advancement and validation of the EWARS tool to improve its prediction ability and design for larger-scale applications – particularly in data-poor settings and among unskilled users. The scope of support covers the technical modification of the mathematical component of the EWARS design by applying the robust *Distribution Lag Non-Linear Model* and combining it with the *INLA Bayesian regression* framework. This work will also include a tool validation process where i) data from multiple partner countries will be used to validate the tool performance, and ii) its application will be prospectively piloted in some partner countries across PAHO, SEARO and AFRO regions.

The new EWARS^{Plus} model has additional features to support unskilled users performing early measures to ensure data reliability and useful for the prediction purposes and, includes interactive graphical features to improve results interpretation for users at the national (central) and local (district) levels. The EWARS^{Plus} tool will not only predict in time and space disease outbreaks, but also quantify the magnitude (outbreak rate) and its certainty interval, which will have significant vector control implications.

Since the conceptualization and validation of EWARS, which started a decade ago, there have been significant transitions in key aspects like data availability/accessibility, users' skills, diseases trends and patterns, local appreciation of the EWARS and essentially, better understanding of the role of EWARS in the operational (vector control and response) perspective, which all entail further modifications to the tool.



The EWARS overall implications

Climate change will increasingly affect the transmission dynamics and geographic spread of infectious diseases; its influence on emergence and incidence risk can only be understood in the presence of multiple climate and non-climate drivers. Today, public health preparedness and decision-support for climate-sensitive infectious disease are underdeveloped, and data limitations hinder further advancements in disease prediction and control. EWARS has thus far developed a crucial environment for interdisciplinary research, dialogue and innovation environment, as well as a global platform of logical applications for handling disease outbreak risks from climate change. It has generated novel means for addressing key unfinished global health goals for neglected tropical infectious diseases; i) it has developed robust and user-friendly methods for filling gaps in 'time' and 'space' by forecasting and enabling effective and efficient disease control and, ii) it has improved coordination and cooperation among relevant stakeholders for timely risk assessment and response strategies.

The unfinished global health agenda

Despite recent advances in EWARS, detecting disease outbreaks remains a challenge particularly where new pathogens are emerging or where endemic levels of disease outbreaks vary within and between countries. While the cost of building EWARS is generally low, there is still a need to deploy models for disease outbreak prediction cautiously. Typically, an assessment of the cost of failures arising from the alert signals missed by the prediction models is important. It is also critical to maximize the number of true alarms in EWARS models so that district health managers can be confident in allocating constrained resources in a cost-effective manner. The feasibility of integrating and operating EWARS within functioning national surveillance programmes in resource-poor settings and of managing EWARS to improve coordination among stakeholders remain a challenge. It requires involving research institutes as well as international bodies (e.g. the WHO and WMO) to effectively support and monitor research on the implementation of EWARS and its (cost-) effectiveness in reducing unwanted health outcomes within communities, which is currently missing on a global level. EWARS will be implemented and tested in four countries across three regions (PAHO, AFRO, SEARO) using the EWARS^{Plus} model, and the results will be published in 2023.

EWARS Success story

As a validated user-friendly tool, EWARS was well accepted by users. It strengthened the communication between the central (national) and district levels, and promoted national and international partnerships as reported by a study in Mexico, Malaysia and Brazil.[1] Furthermore, the EWARS tool has been integrated into the Mexican national surveillance program (CENAPRECE) since 2017. Based on a national validation study in Mexico, the lack of a timely and adequate response to alarm signals generated by EWARS had a negative impact on the disease outbreak control process, while districts with an adequate and timely response guided by alarm signals led to a successful outbreak prevention.[2]

Demo-link for EWARS:

For the purpose of demonstration and training, demo Dashboard accounts and a demo dataset are provided in the box below:

Dashboard I & II: https://github.com/maquins/ewars_Plus

Once you access Dashboard I under the EWARS^{Plus} package, you can download the "Demo Dataset" from the "HELP" tab for further practical understanding of the tool.

1 Hussain-Alkhateeb L, Kroeger A, Olliaro P, Rocklöv J, Sewe M O, Tejeda G, et al. Early warning and response system (EWARS) for dengue outbreaks: Recent advancements towards widespread applications in critical settings. *PLoS ONE;* 13. Epub ahead of print May 1, 2018. DOI: 10.1371/journal.pone.0196811.

2 Benitez-Valladares D, Kroeger A, Tejeda GS, Hussain-Alkhateeb L (2021) Validation of the Early Warning and Response System (EWARS) for dengue outbreaks: Evidence from the national vector control program in Mexico. PLoS Negl Trop Dis 15(12): e0009261. https://doi.org/10.1371/journal.pntd.0009261

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