

QUALITY CRITERIA FOR THE EVALUATION OF CLIMATE-INFORMED EARLY WARNING SYSTEMS FOR INFECTIOUS DISEASES



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ACRONYMS

AN	actual no-outbreak
AO	actual outbreak
CAR	conditional auto-regressive models
EWS	early warning system(s)
FN	false negative
FP	false positive
GI	Getis-Ord Gi statistic
GIS	geographical information system
GLMM	generalized linear mixed models
GWR	geographically weighted regression
IHR	International Health Regulations
IT	information technology
LISA	local indicators of spatial association
M&E	monitoring and evaluation
MoH	Ministry of Health
NPV	negative predictive value
PD	probability of detection
PF	probability of false alert
PPV	positive predictive value
RCT	randomized controlled trial
ROC	receiver operating characteristic
SAR	spatial auto-regression
SMS	short message service
TN	true negative
TP	true positive
WHO	World Health Organization
WMO	World Meteorological Organization

EXECUTIVE SUMMARY

The frequency of infectious disease epidemics is increasing, and the role of the health sector in the management of epidemics is crucial in terms of response (1). In the context of infectious disease epidemics, the use of climate-informed early warning systems – EWS (the organized mechanism to detect as early as possible any out-of-control state of disease phenomena (2)) – has the potential to increase the effectiveness of disease control by intervening before or at the beginning of the epidemic curve, instead of during the downward slope. Currently, the initiation of interventions is heavily reliant on routine disease surveillance systems – data that often arrive too late for preventative response. However, forecasting of disease outbreaks using surveillance and weather information shows promising potential (3,4) – there also remains further scope to examine seasonal climate forecasts (5–7). By combining these elements in new EWS based on computational models, it will be possible to improve both the timeliness and impact of disease control.

Until recently, EWS have rarely applied statistical methods to detect changes in trends or sentinel events that would require intervention, and generally lacked essential assessment for effective, implementable and scalable tools. In most cases, EWS rely on an in-depth review of incoming data by local epidemiologists, which rarely follow a systematic process. The World Health Organization (WHO) is strengthening existing surveillance systems for infectious diseases to enable the development of more robust and timely EWS, which has resulted in the rapid development and innovation of EWS for disease outbreaks.

The core elements of climate-informed EWS are to: (i) monitor environmental conditions; (ii) forecast high-risk conditions, initiate active surveillance; (iii) send alerts and communication; and (iv) establish a mechanism for early response. However, in view of the advances in mathematical modelling, the availability of big data and their complex analytical designs – as well as issues related to the quality of national surveillance programmes and local response protocols – other technical and operational aspects are essential for monitoring the effectiveness and cost-effectiveness of existing decision-support tools.

In June 2019, an expert meeting on using climate and weather information for predicting and preparing for cholera and vector-borne diseases was convened in Geneva, Switzerland, and supported by the Climate Change and Health Unit (WHO), the World Meteorological Organization (WMO), the Met Office (United Kingdom), UK AID and the Department for International Development. One key outcome from this meeting

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