Forecasting Outbreaks (Part 3)

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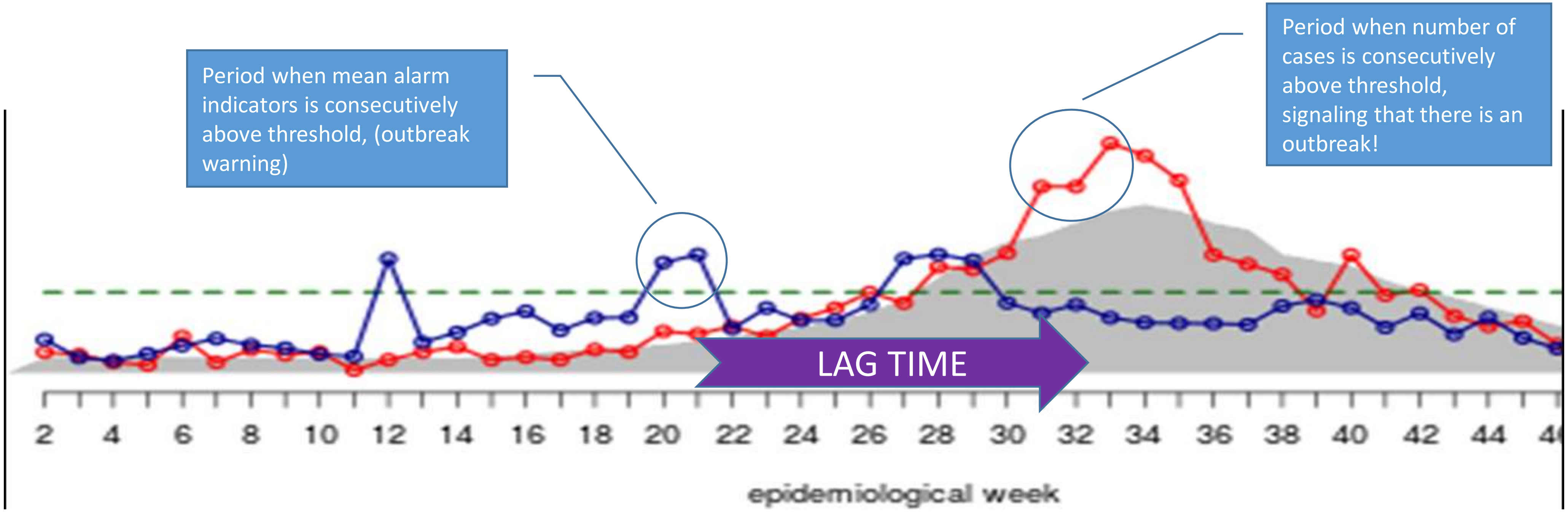
Supported by TDR and ECH WHO, Geneva

Supported by TDR and ECH WHO, Geneva; Freiburg University, Germany; Gothenburg University, Sweden

Definitions (3): Lag time

- The *Lag time* or *prediction period* is the number of weeks from alarm signal to start of the outbreak



The lag time depends particularly on climate variables:

- **Short lag time** = favourable meteorological conditions for vectors (higher temperature and humidity, rainfall)
- **Long lag time** = Unfavourable conditions for the vector e.g. too hot, too cold, too much rain, too dry

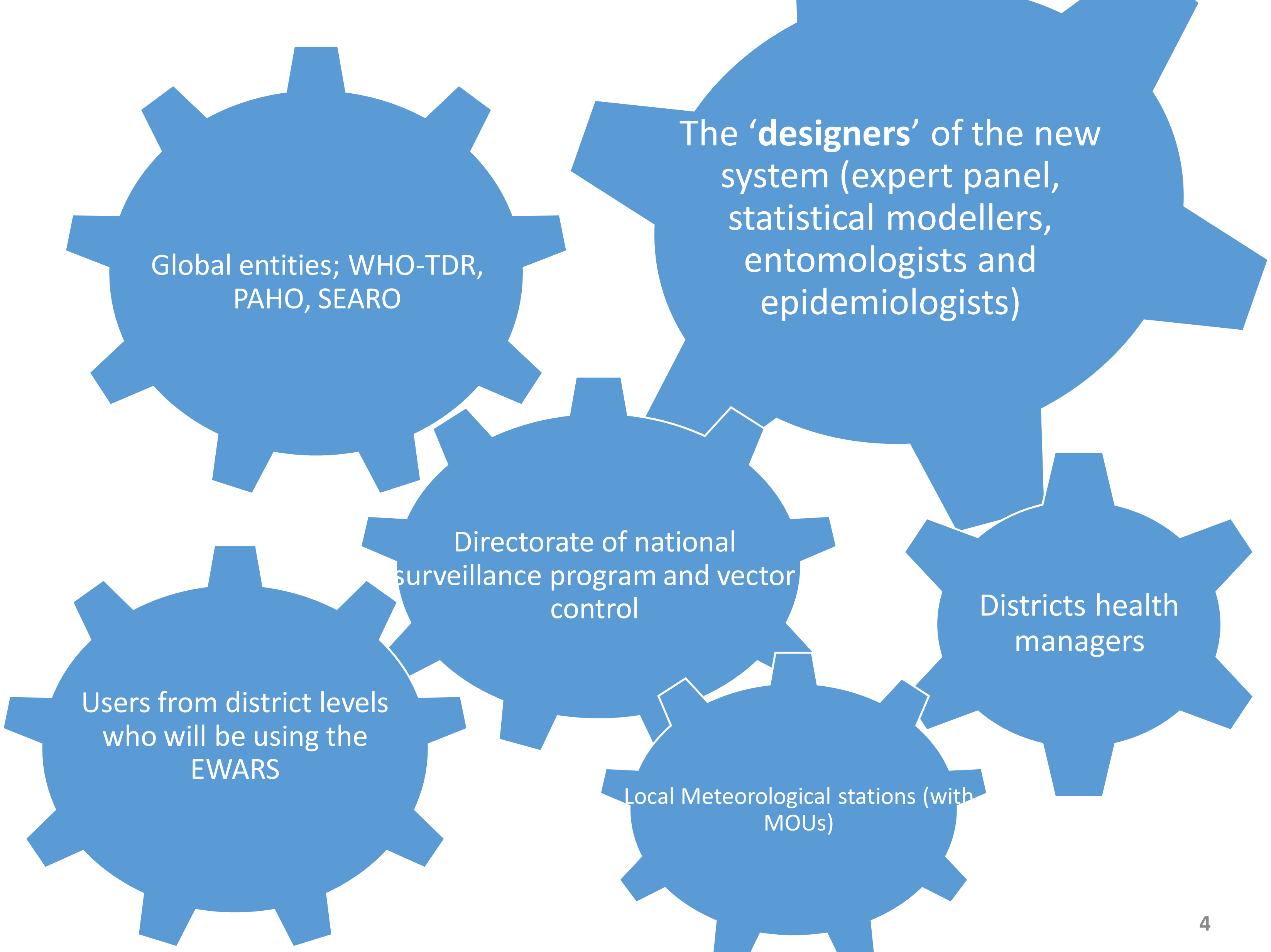
The EARLY WARNING AND RESPONSE SYSTEM (EWARS plus, TDR/WHO)

- The development and validation
- Literature reviews
- How is EWARS used by countries?
- How has it been tested so far

Co-designing the EWARS development maintained participation of all partner countries

Co-design approach

“Co-design involves and maintains working together to design a new product, making full use of each other’s knowledge, resources and contributions, to achieve better outcomes or improved efficiency”



Brief history of EWARS development

Systematic literature reviews

2011-14 + 2021

5 Reviews on:
Surveillance systems,
Contingency plans, cost of
dengue outbreaks,
Vector management

Country case studies on dengue surveillance

2011-12

10 countries:
Brazil, Colombia,
Dom.Re,Mexico,Peru,
Vietnam, Malaysia, Sri Lanka,
Indonesia,
Maldives

Retrospective study on outbreak definition and alarm signals

2012-14

5 countries:
Brazil, Dom.Rep,
Mexico,
Vietnam, Malaysia

Prospective study of new model of outbreak detection & response

2014-16

5 countries:
Brazil, Mexico,
Malaysia
Plus:
Dom.Rep,Vietnam

Innovating EWARS
Automatized dashboards.
Capacity building

2016-21

-Mexico introduced
EWARS at national level.
-Regional & country training.
-Automatic. calibration
EWARS plus
-Systematic review on EWARS

CHARACTERISTICS OF EWARS TDR/WHO (1)

ONE HUB: **https://alramadona.shinyapps.io/Ewars_dashboard/**

- **Officers at national level (Dashboard I)**

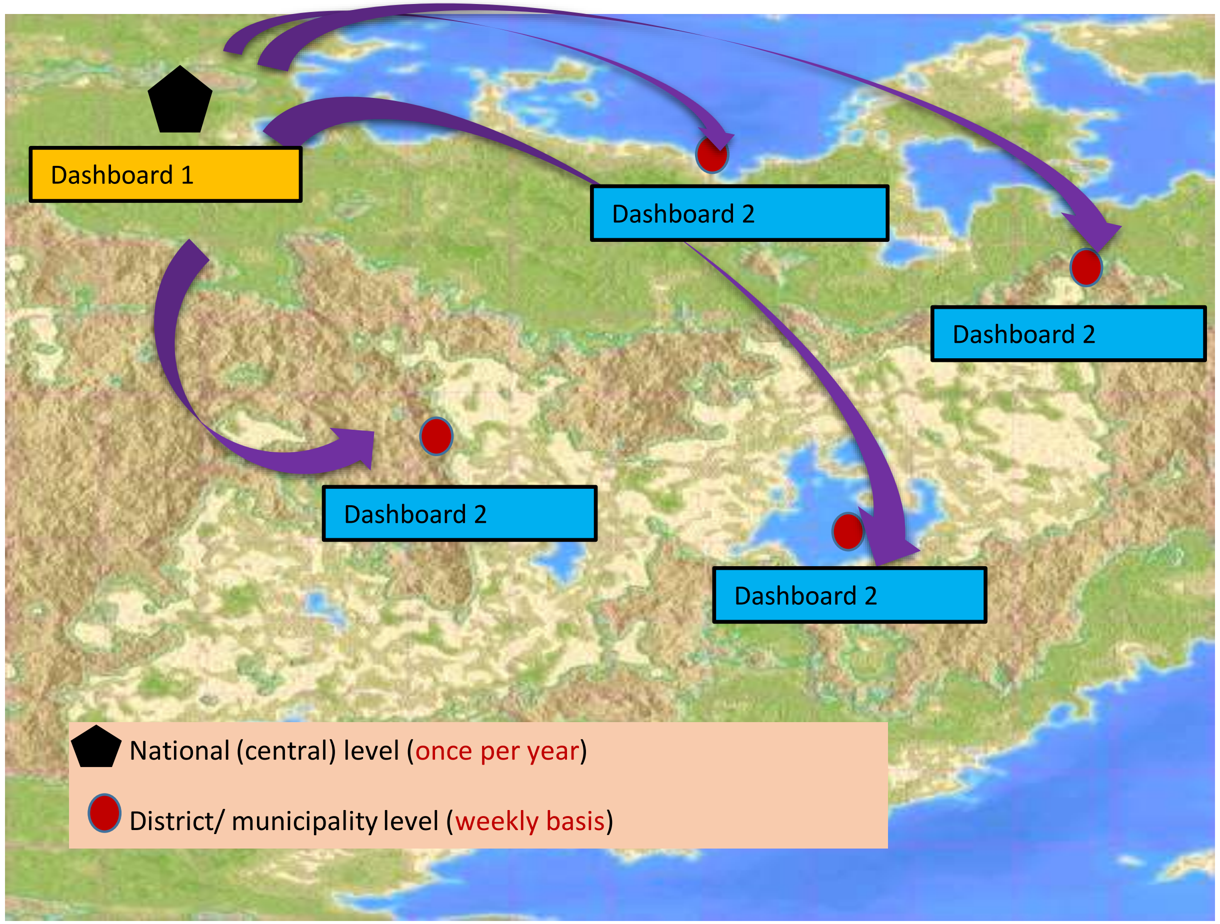
❖ *1st dashboard*: validate model ++ oversee the outbreak prediction at district level ++ train sub-national level

- *Parameters are automatically and instantly linked to sub-national level via web*

❑ **Officers at district/ municipality level**

❖ *2nd dashboard*: weekly prospective data input, interpretation & action

❑ *This platform facilitates a free sustainable DATABASE for the surveillance data*



CHARACTERISTICS(2): Calibrating the model using first half of data

RETROSPECTIVE STUDY
Run-in phase (Dashboard I)

- Define «outbreak threshold» and find best district outbreak indicator
- Identify «alarm indicators» and thresholds for alarm signals
- Defining prediction distance (time lag) that best suits the disease and alarm indicators profile
- Generate graphical assessment for defining adequate endemic channel level, adjusting for endemic severity and adjusting for seasonality

CHARACTERISTICS(3): Evaluating the model using second half of data

Determining validity of prediction (Dashboard I, evaluation phase)

Sensitivity (of the alarm)
The proportion of alarms that successfully predict defined outbreaks

i.e. no. of correct outbreak alarms/ total outbreaks

PPV
(Positive Predictive Value)
The proportion of true alarms out of all alarms
i.e. no. of correct alarm periods/ total no. of alarm periods

Examples:

Sensitivity = 90%
9 out of 10 outbreaks have been correctly detected

PPV= 70%
7 out of ten alarm singals were correct

EXAMPLE for validity testing of outbreak alarms: PPV and Sensitivity (Mexico)

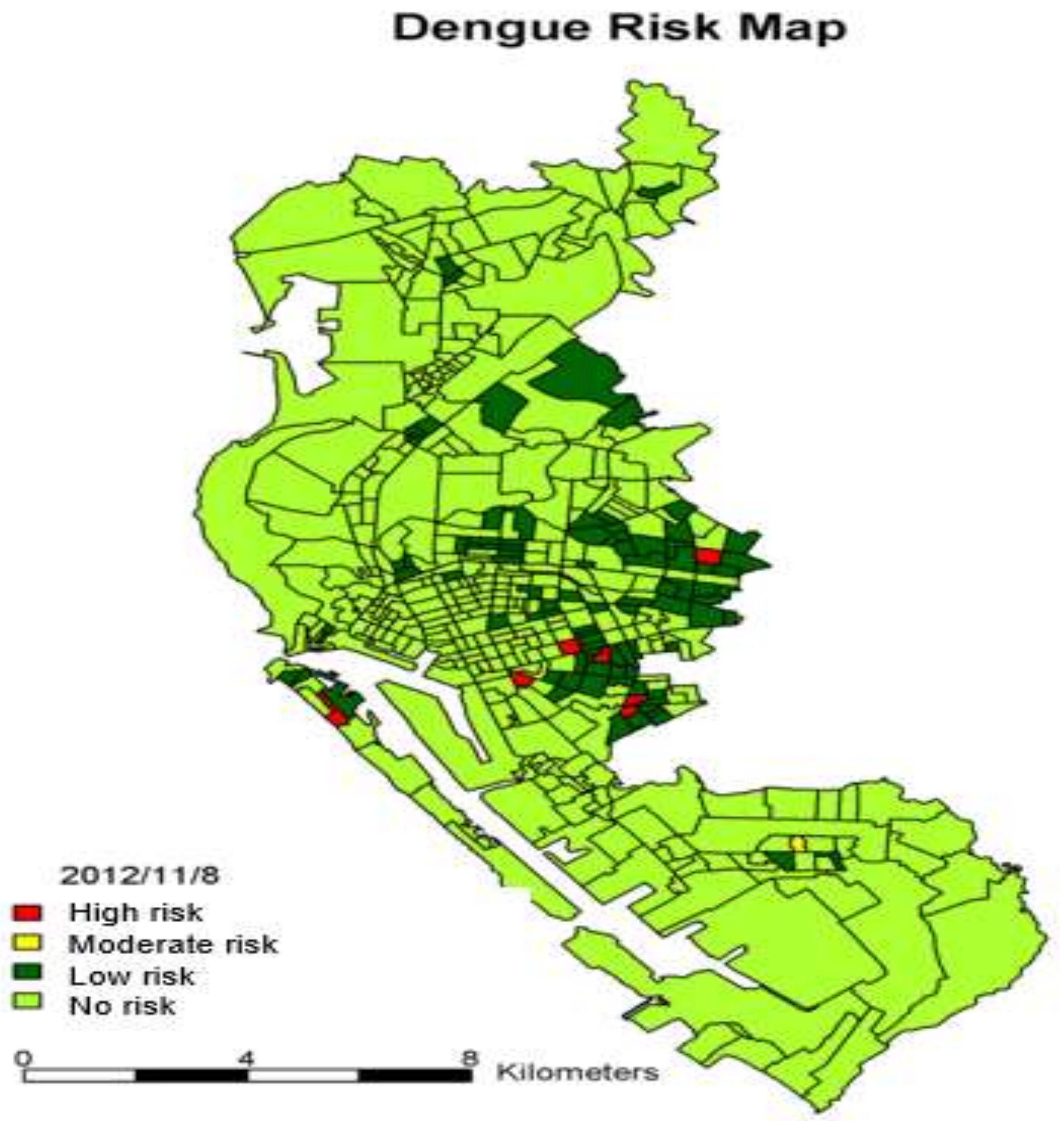
Alarm Indicator	Outbreak indicator	Positive Predictive Value (%)	Sensitivity (%)
mean temp	hospitalized cases	72	81
rainfall	hospitalized cases	65	87
mean age	hospitalized cases	74	89
probable cases	hospitalized cases	83	100
Ovitrap (%positive traps)	hospitalized cases	60	79
humidity	hospitalized cases	50	94
Serotype	hospitalized cases	75	100
multiple indicators*	hospitalized cases	77	84

* temperature, rainfall, mean age, probable cases, positive ovitrap & humidity

CHARACTERISTICS(4):
Spatial analysis

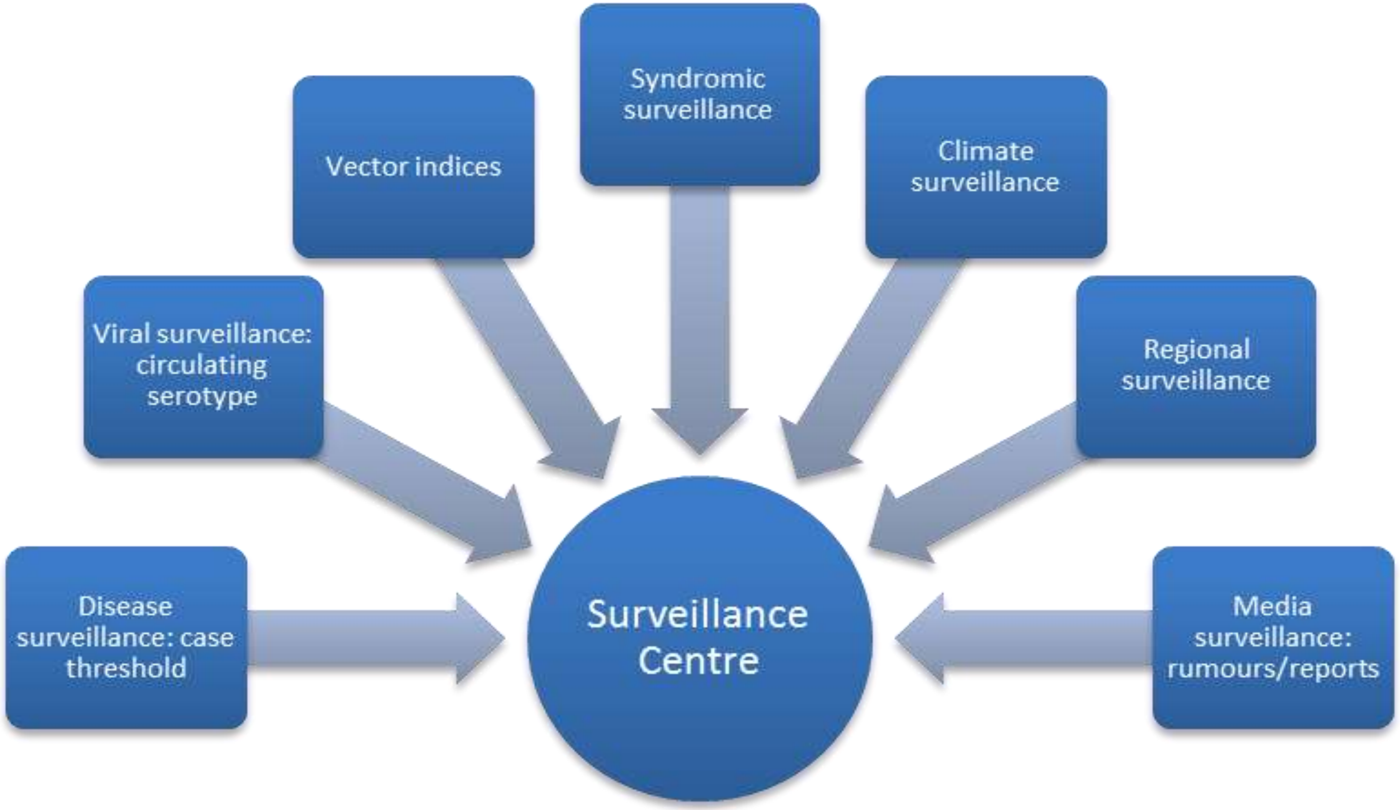
- Provides a rapid visual summary of spatial information
- Crucial for describing the spatial and temporal variation of the disease

- Identifies areas of unusually high risk areas (hot spots)



Source: Ciaran Nugent, Forest Service, Department of Agriculture, Food and the Marine (DAFM).

CHARACTERISTICS(5): Level of alarm leading to staged response



Initial response

- Outbreak Investigation
- Assure contingency plan is availabe
- Update background information
- Enhance surveillance
- Enhance routine activities
- Complete preperatory activities including training
- Prioritize risk areas

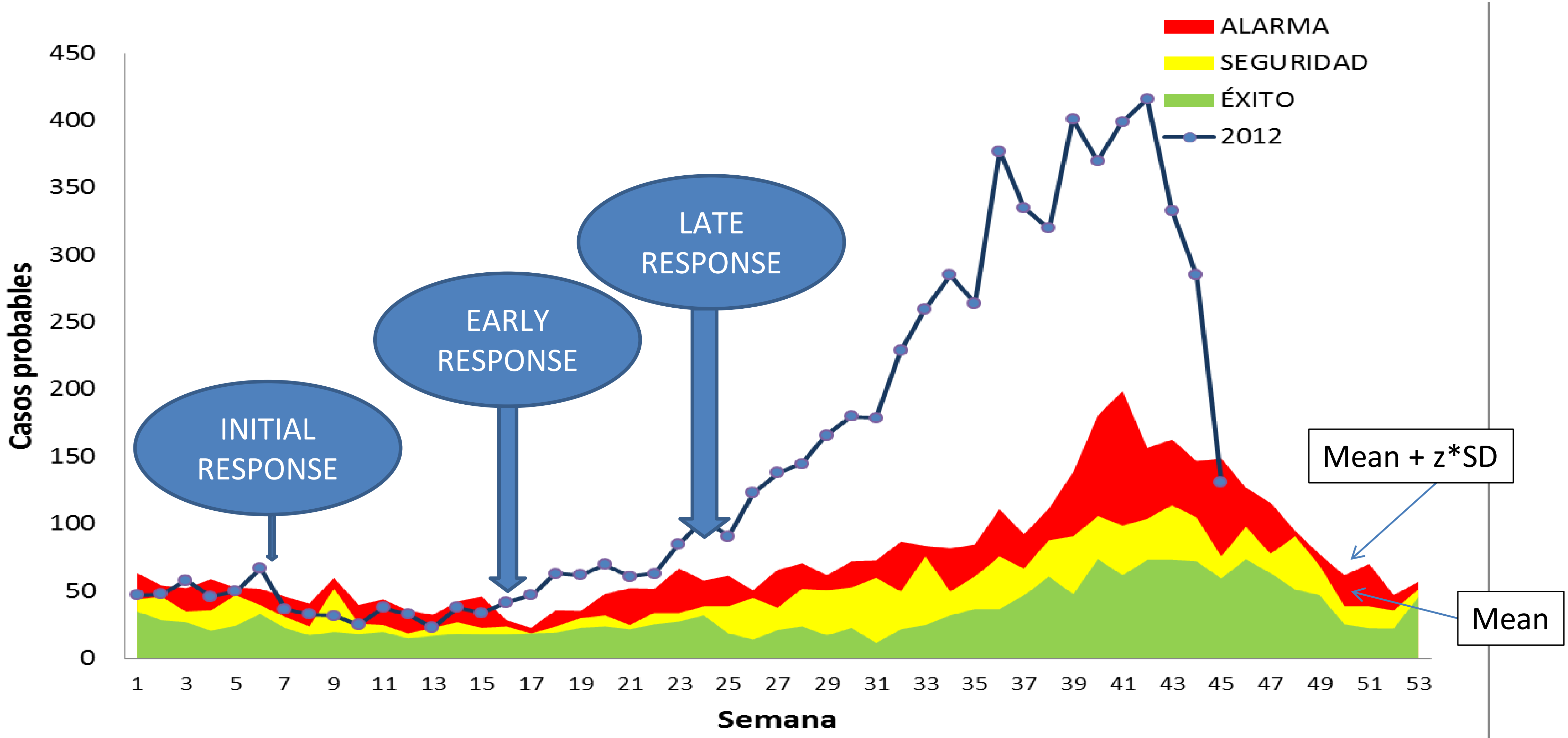
Early response

- Activate communication channels
- Risk communication and outbreak declaration
- Consider M&E activties
- Implemenet community based risk reduction activities
- Inform clinicians and prepare dengue treatment areas
- Ensure guidelines for case detection, treatmnen and triage
- Intensify vector control activities
- Communicate end of aler and response activities

Late response

- Full implementation of continginy plan including M&E activiies and stopping rules

Staged response to an outbreak



BACKGROUND READING

Evidence-based tool

PLOS ONE

Early warning and response system (EWARS) for dengue outbreaks: Recent advancements towards widespread applications in critical settings

Laith Hussain-Alkhateeb, Axel Kroeger, Piero Olliaro, Joacim Rocklöv, Maquins Odhiambo Sewe, Gustavo Tejeda, David Benitez, Balvinder Gill, S. Lokman Hakim, Roberta Gomes Carvalho, Leigh Bowman, Max Petzold

https://journals.plos.org/plosone/article?id=10.1371/journal.pone.0196811

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GLOBAL HEALTH HUB GERMANY

Policy Brief

Innovation and Collaboration: the EWARS Framework for infectious diseases

PLOS NEGLECTED TROPICAL DISEASES

REVIEW

Early warning systems (EWSs) for chikungunya, dengue, malaria, yellow fever, and Zika outbreaks: What is the evidence? A scoping review

Laith Hussain-Alkhateeb[1]*, Tatiana Rivera Ramírez[2], Axel Kroeger[2], Ernesto Gozzer[3], Silvia Runge-Ranzinger[2,4]

https://journals.plos.org/plosntds/article?id=10.1371/journal.pntd.0009686

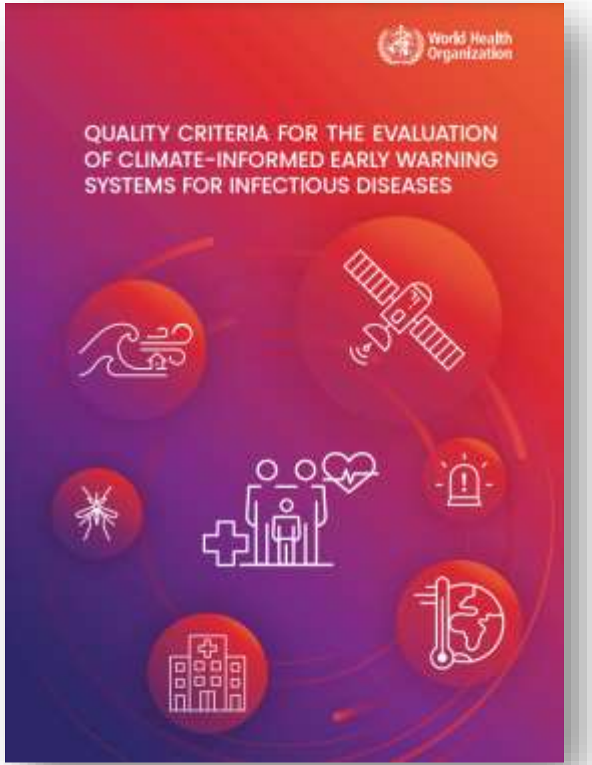
PLOS | ONE

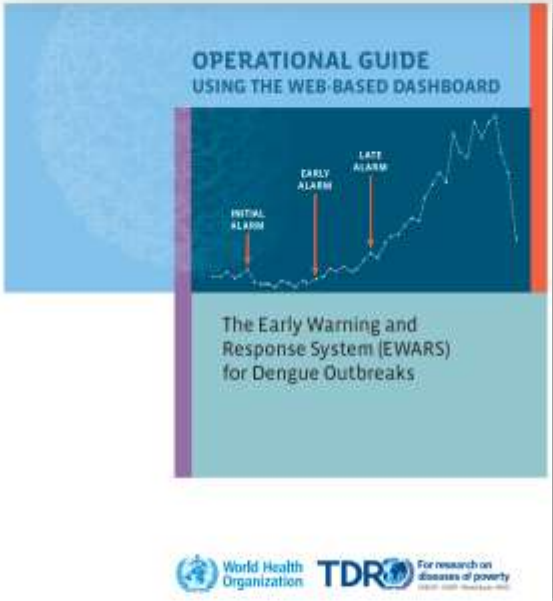
RESEARCH ARTICLE

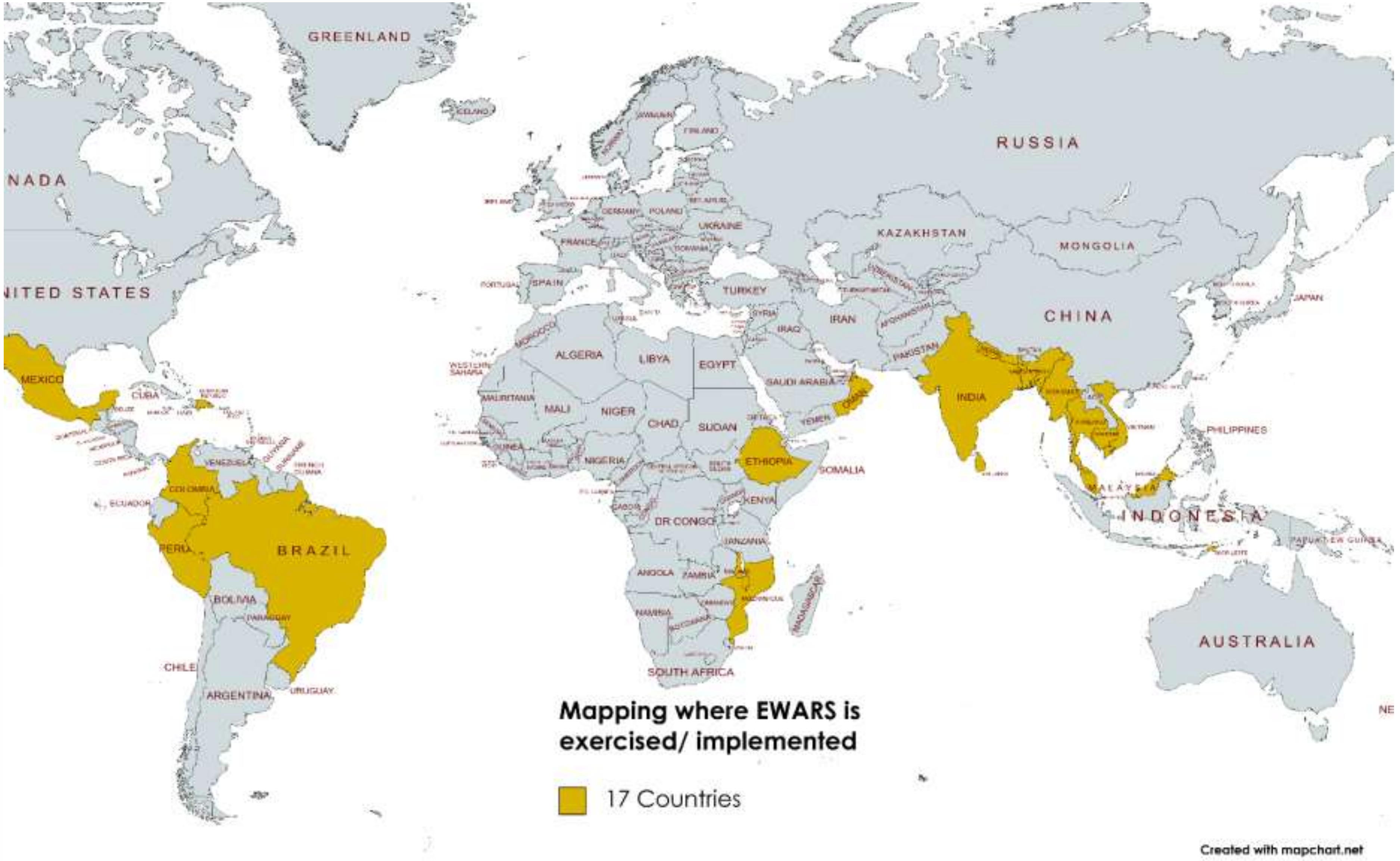
Alarm Variables for Dengue Outbreaks: A Multi-Centre Study in Asia and Latin America

Leigh R. Bowman[1,5]*, Gustavo S. Tejeda[2], Giovanini E. Coelho[3], Lokman H. Sulaiman[4], Balvinder S. Gill[4], Philip J. McCall[1], Piero L. Olliaro[5], Silvia R. Ranzinger[5,6], Luong C. Quang[7], Ronald S. Ramm[8], Axel Kroeger[1,5], Max G. Petzold[5,9]

https://journals.plos.org/plosone/article?id=10.1371/journal.pone.0157971

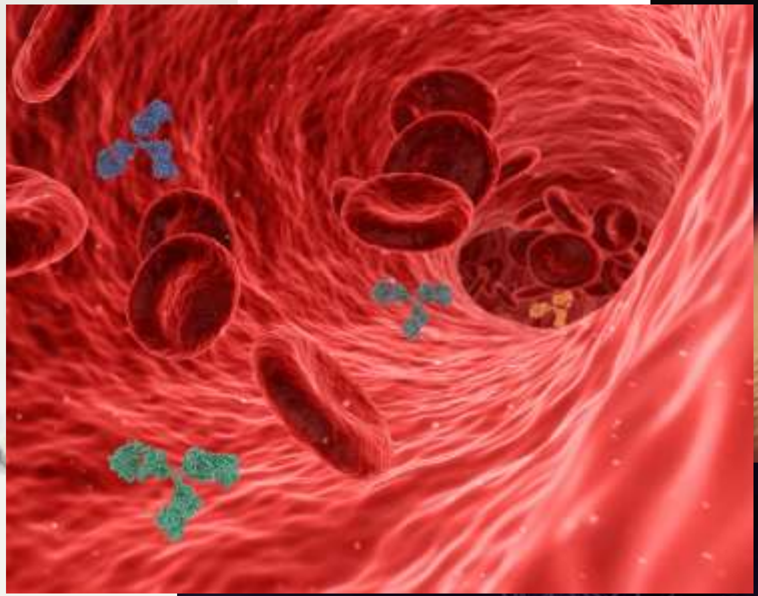






https://www.who.int/publications/i/item/10665345530

https://apps.who.int/iris/handle/10665/332323



MANY THANKS FOR YOUR INTEREST