Signals to Safety: EWARS for Health Emergencies- Present Realities and Future Directions

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BACKGROUND

Bangladesh faces frequent health emergencies driven by climate-sensitive diseases like Dengue, AWD, Malaria and Heat-related illnesses. To protect communities, the country has adopted Early Warning, Alert and Response Systems (EWARS) to rapidly detect and act on health threats.

EWARS integrates climate data, disease surveillance and community reporting to turn early signals into timely action.

Strengthening EWARS through better integration, advanced predictive tools and meaningful engagement of relevant government departments is vital for safeguarding public health in current climate condition of Bangladesh.

While Bangladesh has made progress in rolling out EWARS, ensuring its full effectiveness requires ongoing investment in technology, training, and cross-sector collaboration.

Linking climate forecasts with health surveillance can help to predict disease outbreaks before they escalate, allowing for sustain resource mobilization and more targeted interventions.

Equally crucial is engaging stakeholders, whose timely reporting and participation transform EWARS from merely a system of data into a practical tool for saving lives. By bridging scientific innovation with on-the-ground realities, Bangladesh can move closer to achieving resilient public health protection for its most vulnerable populations.

OBJECTIVES

General objective: Strengthen public health preparedness and reduce disease burden through an effective EWARS for climate-sensitive diseases.

Specific objectives:

- Integrate real time climate and health data
- Develop predictive models
- Establish early warning communication channels
- Define alert thresholds for action
- Coordinate rapid outbreak responses
- Implement monitoring & evaluation to improve EWARS

KEY VARIABLES

General variables: District (catchment area), Epi-week, Annual population in the area

Outbreak indicator: Weekly hospitalized case

Alarm indicator: Weekly humidity mean, Weekly rainfall sum, Weekly temperature mean

METHODOLOGY

1. Data Preprocessing

2. Automatic Calibration

3. Prediction Model: Generalized Additive Model (GAM) predicts outbreak probability using time-related variables, alarm indicators, and district data.

Formula: $g(y) = f_0 + f_1(x_1) + \cdots + f_D(x_D)$

Where: $g(y)$ is the outcome (probability of an outbreak),

f_0 is the intercept,

$f_1(x_1), \ldots, f_D(x_D)$ are smooth functions of the predictor $x_1 + x_2 + \cdots + x_D$, which include time-related variable (e.g., week, season), alarm indicator and other district-specific variables.

This model uses splines to handle non-linear relationships between predictors (e.g., weekly trends or alarm thresholds) and the probability of outbreaks.

4. District-Specific Processing: Calibration and alarm indicators

5. Model Evaluation:

→ **Performance Metrics:**

Sensitivity: Correct identification of outbreaks

Specificity: Correct identification of non-outbreak

False Alarms: Incorrect alarms when no outbreak

Excess Cases: Severity of outbreaks

6. Visualization & Reporting

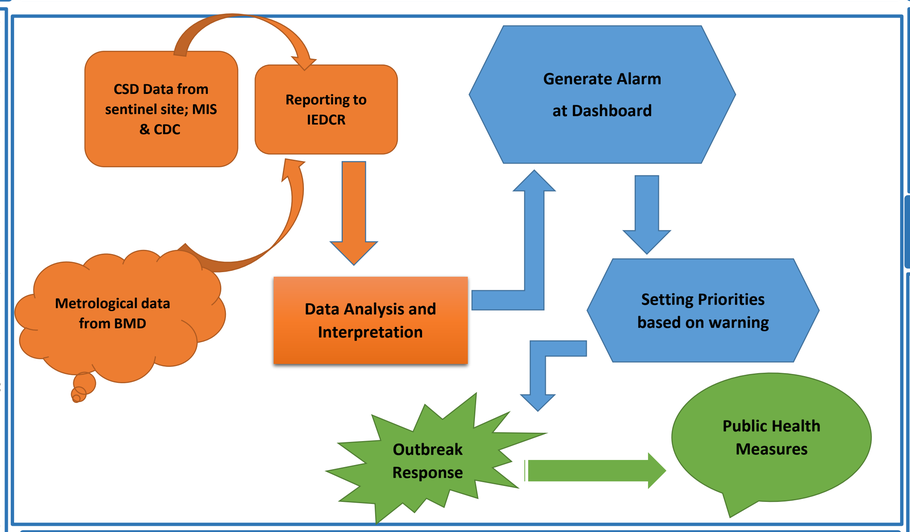
→ **Plots:**

Run-in period: Alarm data over time,

Evaluation period: Predicted vs. actual outbreaks.

→ Dashboard prepares report summarizing results, performance, and visualizations by district.

SURVEILLANCE AND EARLY WARNING



FINDINGS

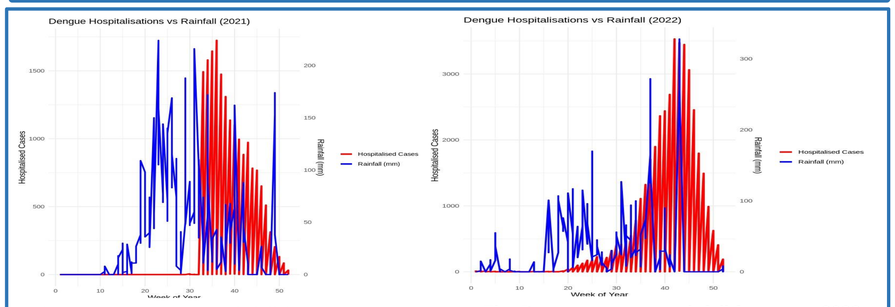


Fig: Dengue cases vs rainfall from year 2021

Fig: Dengue cases vs rainfall from year 2022

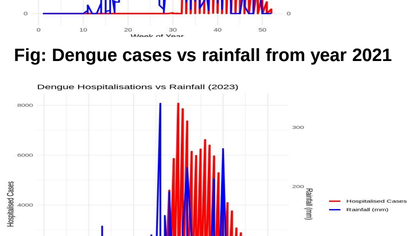


Fig: Dengue cases vs rainfall from year 2023

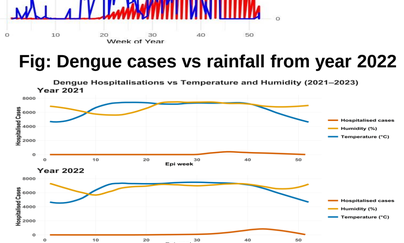


Fig: Dengue cases vs humidity & temperature from year 2021-2023

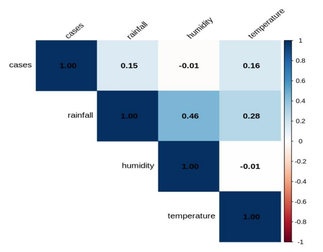


Fig: Correlation matrix between cases and weather data

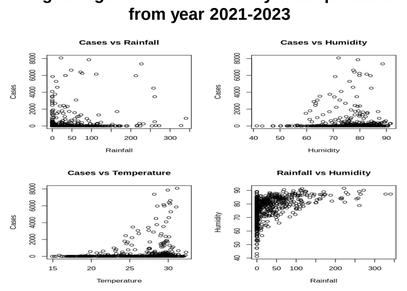
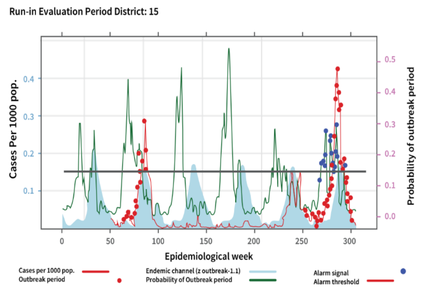
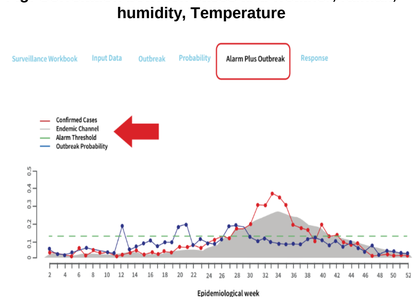
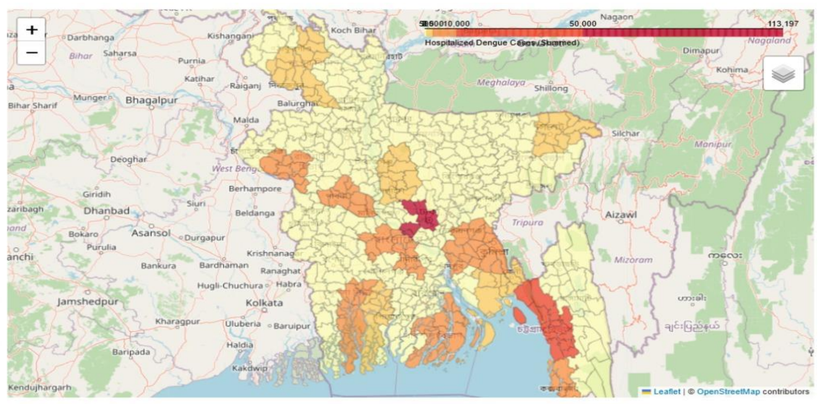


Fig: Correlation between cases and weather; rainfall, humidity, Temperature

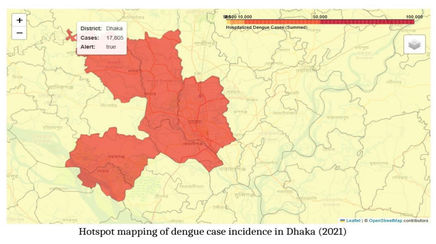




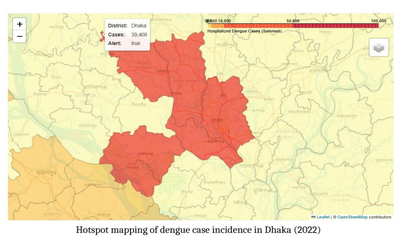
RISK MAPPING



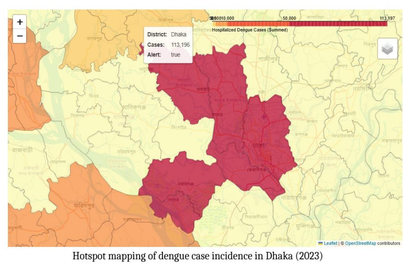
Hotspot mapping of district-level dengue case incidence in Bangladesh (2023)



Hotspot mapping of dengue case incidence in Dhaka (2021)



Hotspot mapping of dengue case incidence in Dhaka (2022)



Hotspot mapping of dengue case incidence in Dhaka (2023)

CHALLENGES

- Lack of smooth coordination mechanism
- Inconsistent data flow
- Least prioritized in policy decisions
- Resource constraints

WAY FORWARD

As Bangladesh faces rising challenges from climate sensitive diseases, the future of EWARS depends on nationwide scale-up and enhanced precision. Expanding EWARS to the district level will enable earlier detection and rapid response. This requires robust collaboration among IEDCR, the Global Fund (currently) and WHO (previously), alongside advancements in predictive modelling, data integration and capacity building. Strengthening advocacy for political commitment will be essential to sustain momentum and ensure resource allocation Incorporating high-resolution climate data into surveillance systems will improve outbreak forecasting by days or even weeks.

CONCLUSION

In Bangladesh, climate-sensitive diseases like dengue, AWD, and malaria are rising threats as climate variability worsens. To move from signals to safety, EWARS must integrate climate and health data, enhance predictive models, and engage relevant stakeholders for rapid action. Strengthening local capacity and cross-sector collaboration can turn EWARS into a vital tool to save lives and build climate-resilient Bangladesh.

COLLABORATION & ACKNOWLEDGEMENT

- Center for Disease Control (CDC, DGHS)
- Institute of Epidemiology, Disease Control & Research (IEDCR)
- Management Information System (MIS, DGHS)
- National Malaria Elimination Programme (NMEP, DGHS)
- Bangladesh Meteorology Department (BMD)
- Department of Public Health Engineering (DPHE)
- International Centre for Diarrhoeal Disease Research, Bangladesh (icddr,b)

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