



DHIS2 Annual Conference and **Climate & Health Academy**

15-18 June 2026 | Oslo, Norway

Early warning for climate-sensitive diseases: from models to practice

Operational climate-sensitive disease forecasting in Lao PDR

Anticipate • Prepare • Protect



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Health WHO Lao PDR





Outline



01 Climate change and health risks in Lao PDR



02 Climate-sensitive diseases and epidemiological trends



03 Integrating climate data into routine HMIS



04 Operational forecasting, dashboards, and early warning systems

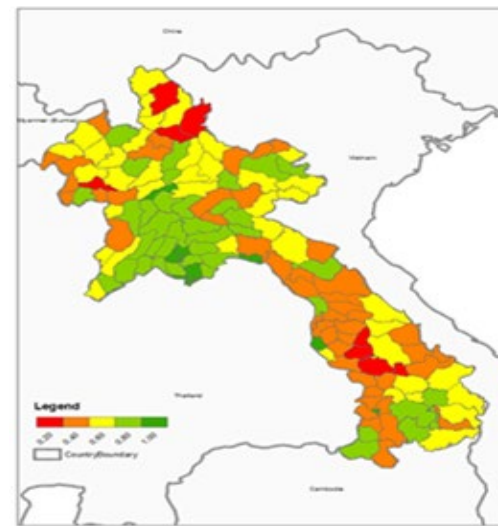
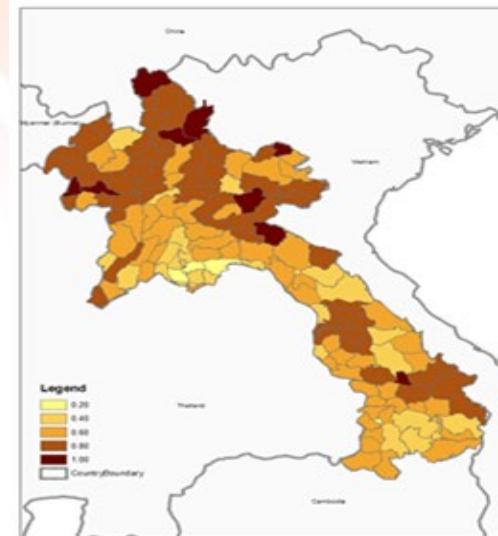


05 Lessons learned, challenges, and future directions



Vulnerability to Climate Change in Lao PDR

- **Rainy season is getting shorter and more intense (Floods)**
 - Flash floods
 - More frequent and larger dengue outbreaks
- **Dry seasons are getting longer and warmer (Droughts)**
 - Affecting agriculture, food security and puts rural population at risk of undernutrition and emerging diseases due to hunting practices
 - Increase in waterborne diseases in dry season and account for 11% of deaths among children under 5
 - Increase in heat related morbidity and mortality

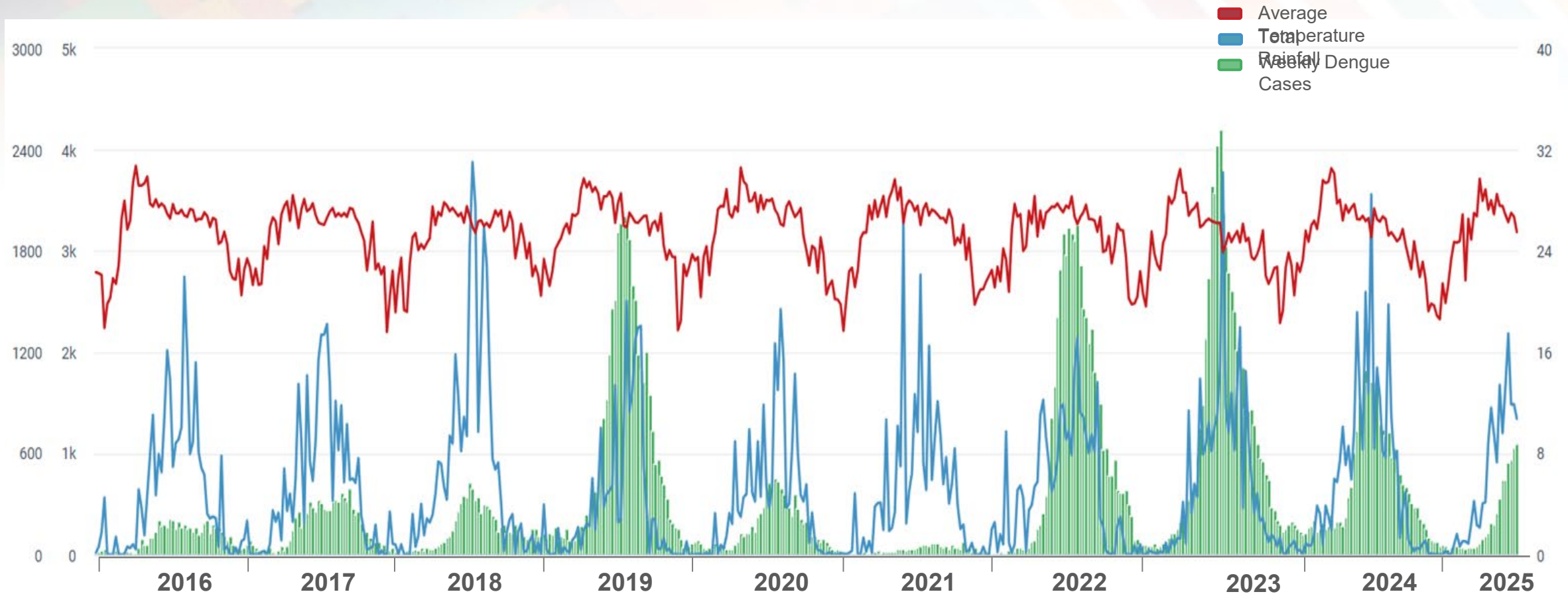


Note:

Most vulnerable areas to climate change (brown color, Map 1)

Low level of Adaptation (red and orange color, Map 2)

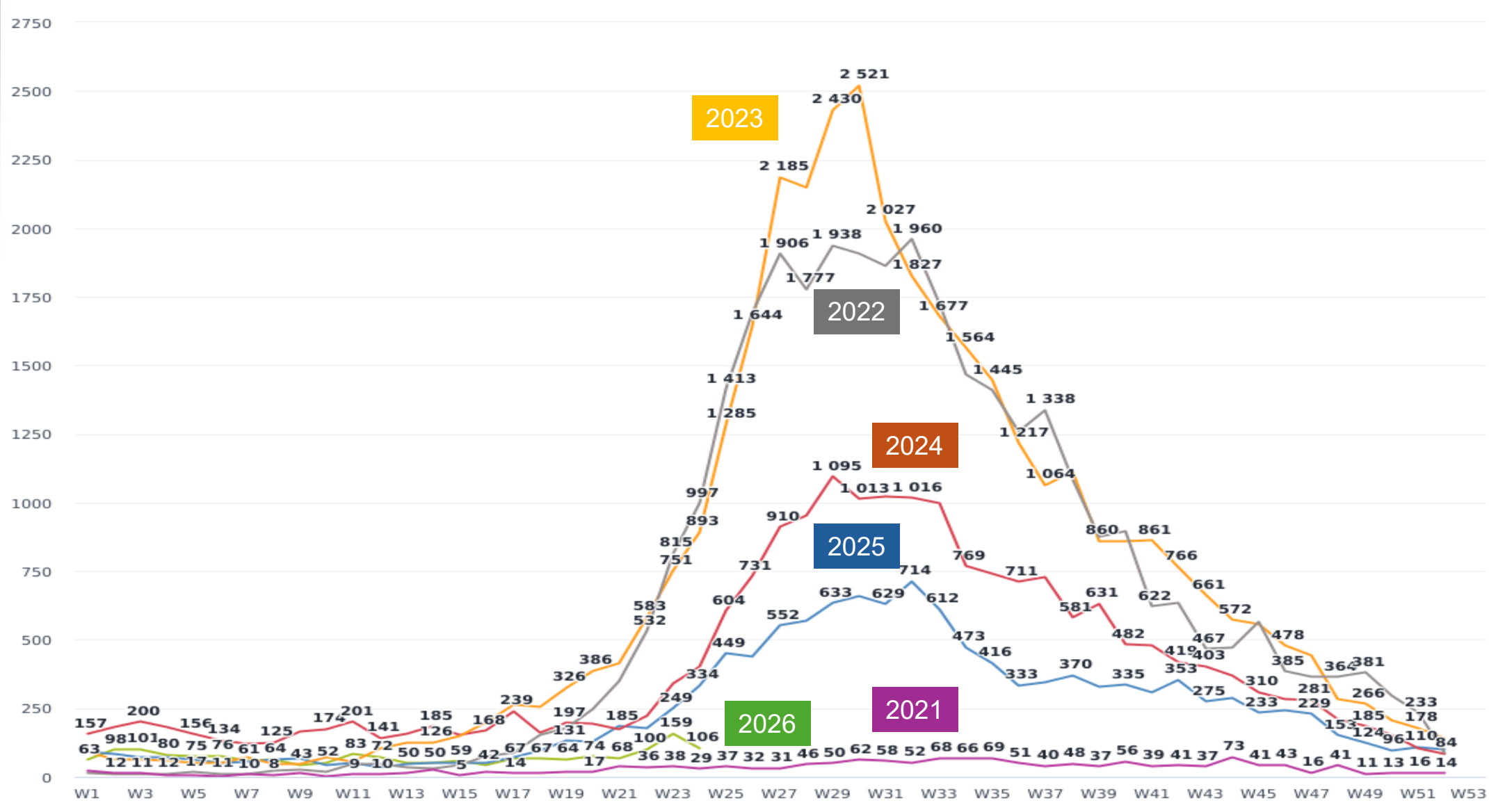
Dengue: Rising with the Rain 2016 -2025



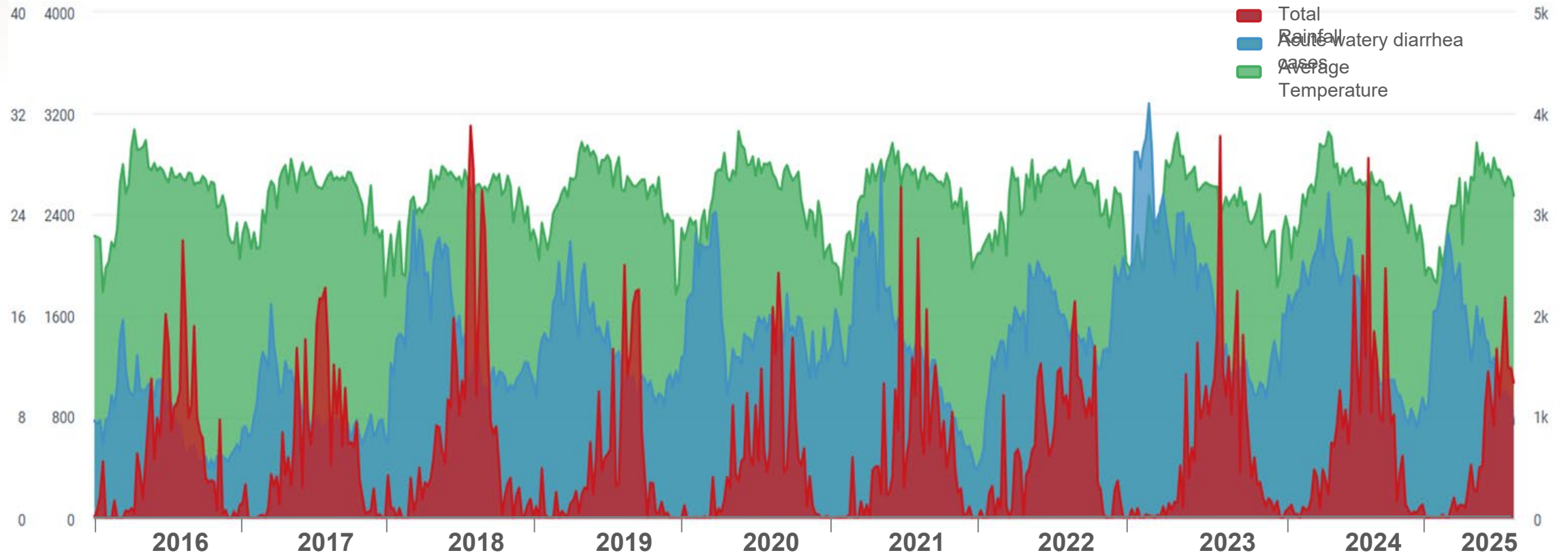
Dengue peaks closely follow rainfall and temperature patterns.



Dengue trends 2021 -2026



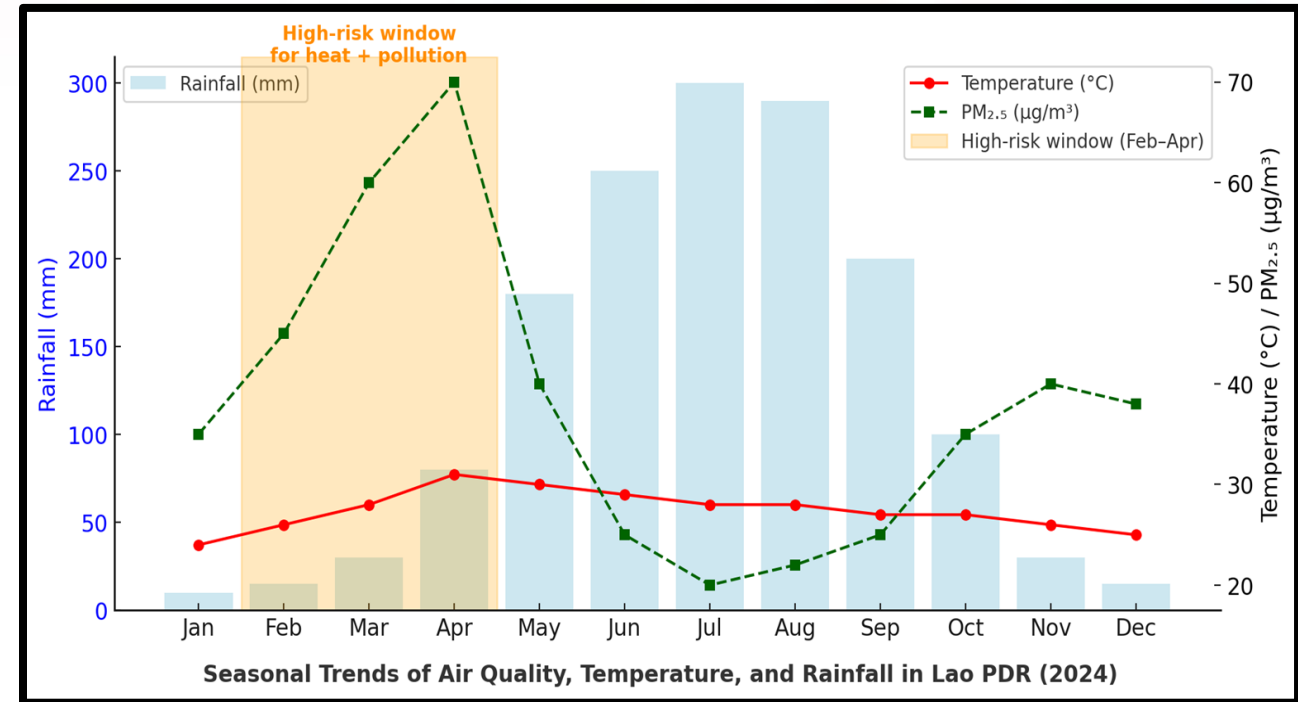
Diarrhea and Rainfall Correlation 2016 -2025



Seasonal Interaction of Heat, Rainfall, and Air Pollution



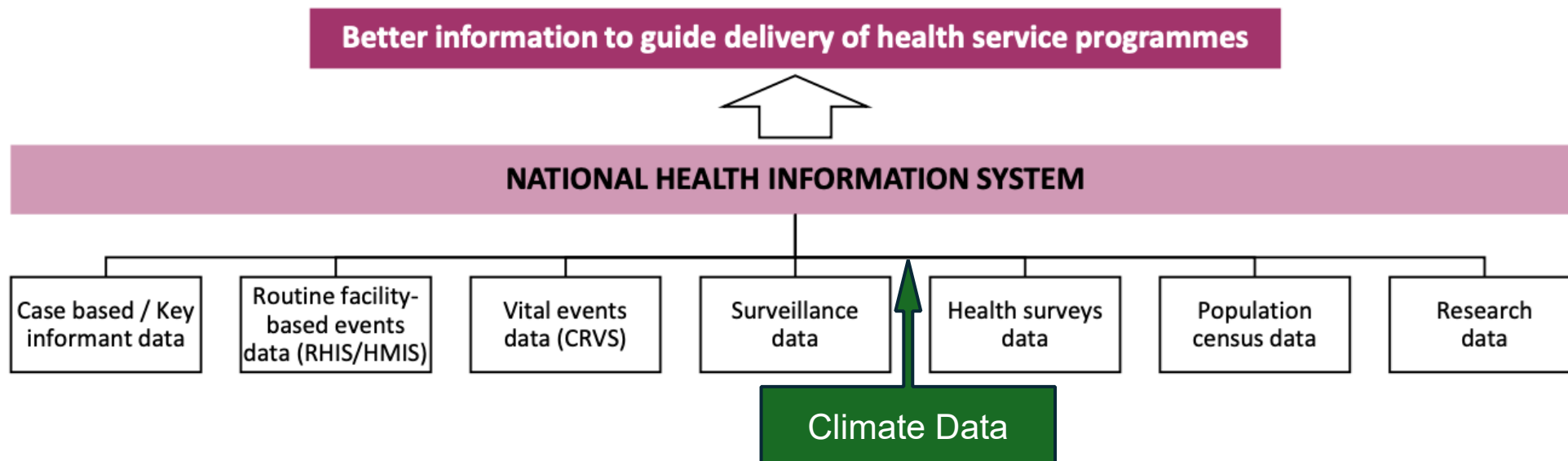
- Heat increases breathing rate
→ higher pollutant intake
- Combined exposure worsens inflammation, respiratory and cardiovascular stress
- Health burden highest among children, elderly, and outdoor workers
- Evidence suggests excess mortality during months with both high heat and high PM_{2.5}.



Source: AI-generated illustration created with ChatGPT (OpenAI), 2025.

Digital and Climate Health Initiative

- WHO-supported integration of weather data - rainfall and temperature data into HMIS (DHIS2)
- Predictive models for dengue and diarrhoea using climate variables
- Forecast visualizations now support early warning and local response
- Demonstrates feasibility of integrating environmental data into



Climate Informed Early Warning System



Data input

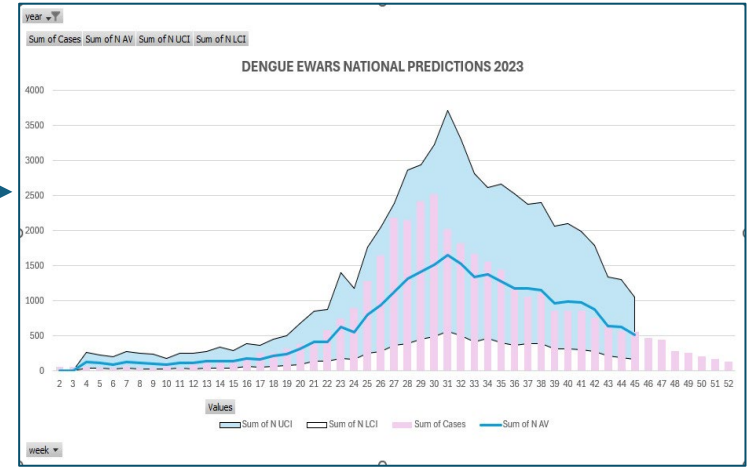
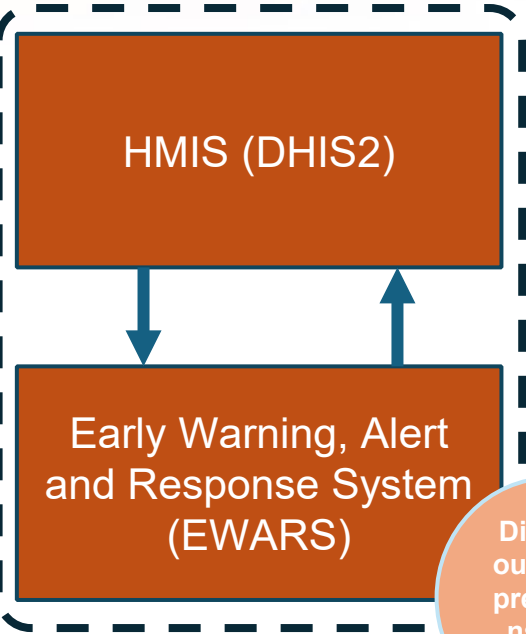
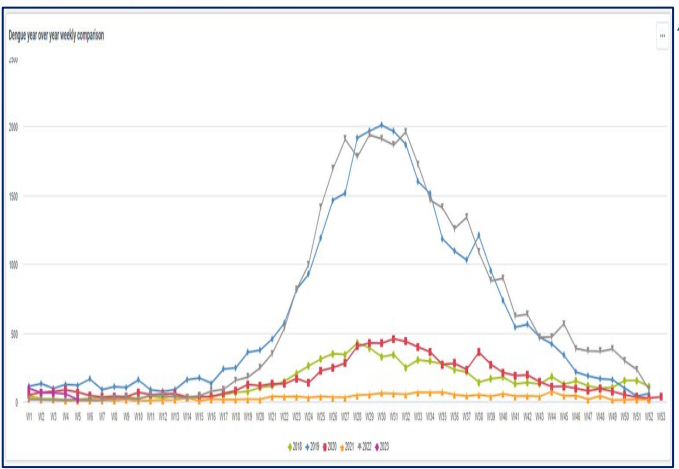
Notifiable Diseases (19) Surveillance Data

Number of climate sensitive disease reported this week?

Temperature and rainfall this week?

Meteorological Data

Data analysis



Response



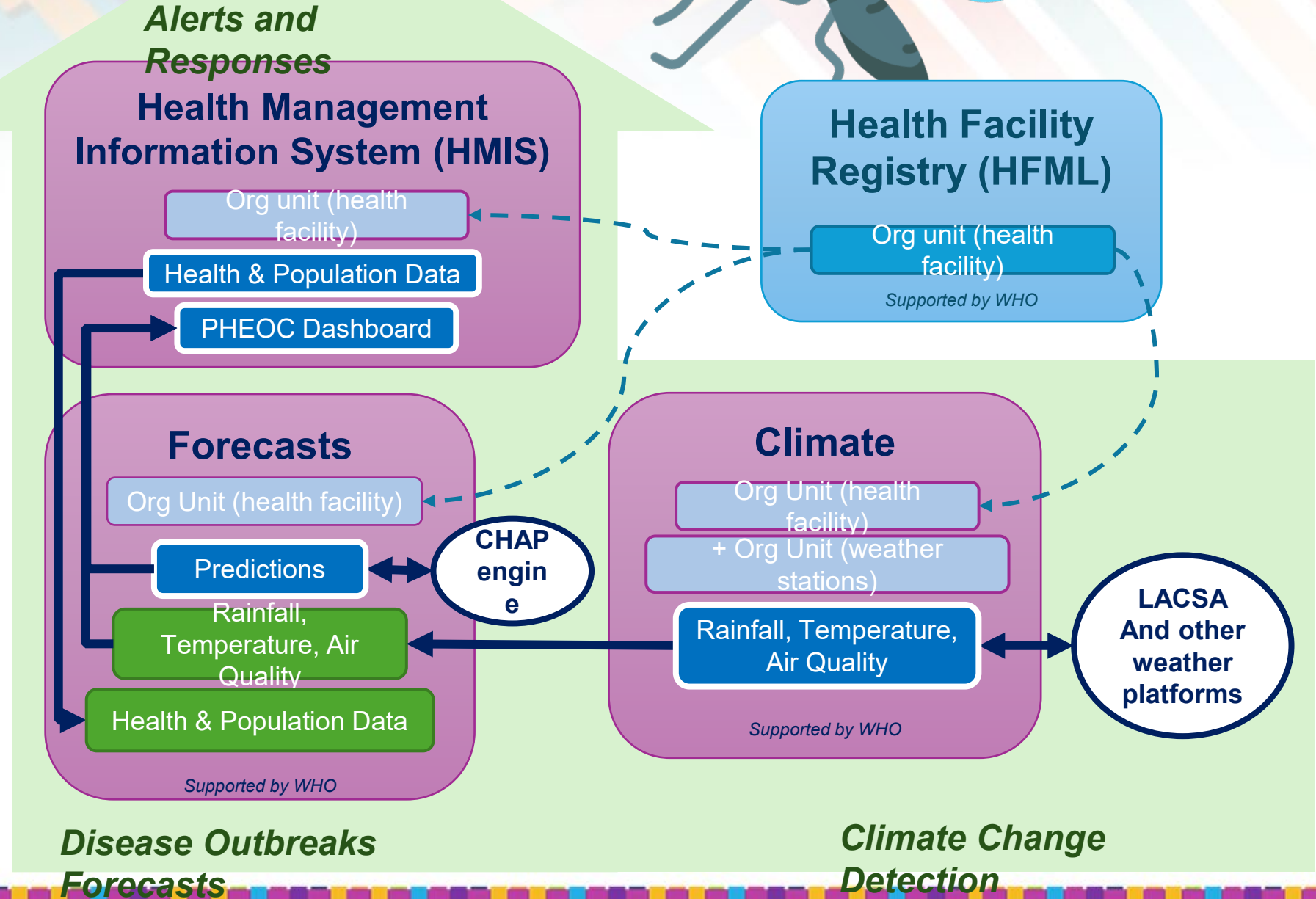
Disease outbreak predictions and alarm

Architecture & Workflows



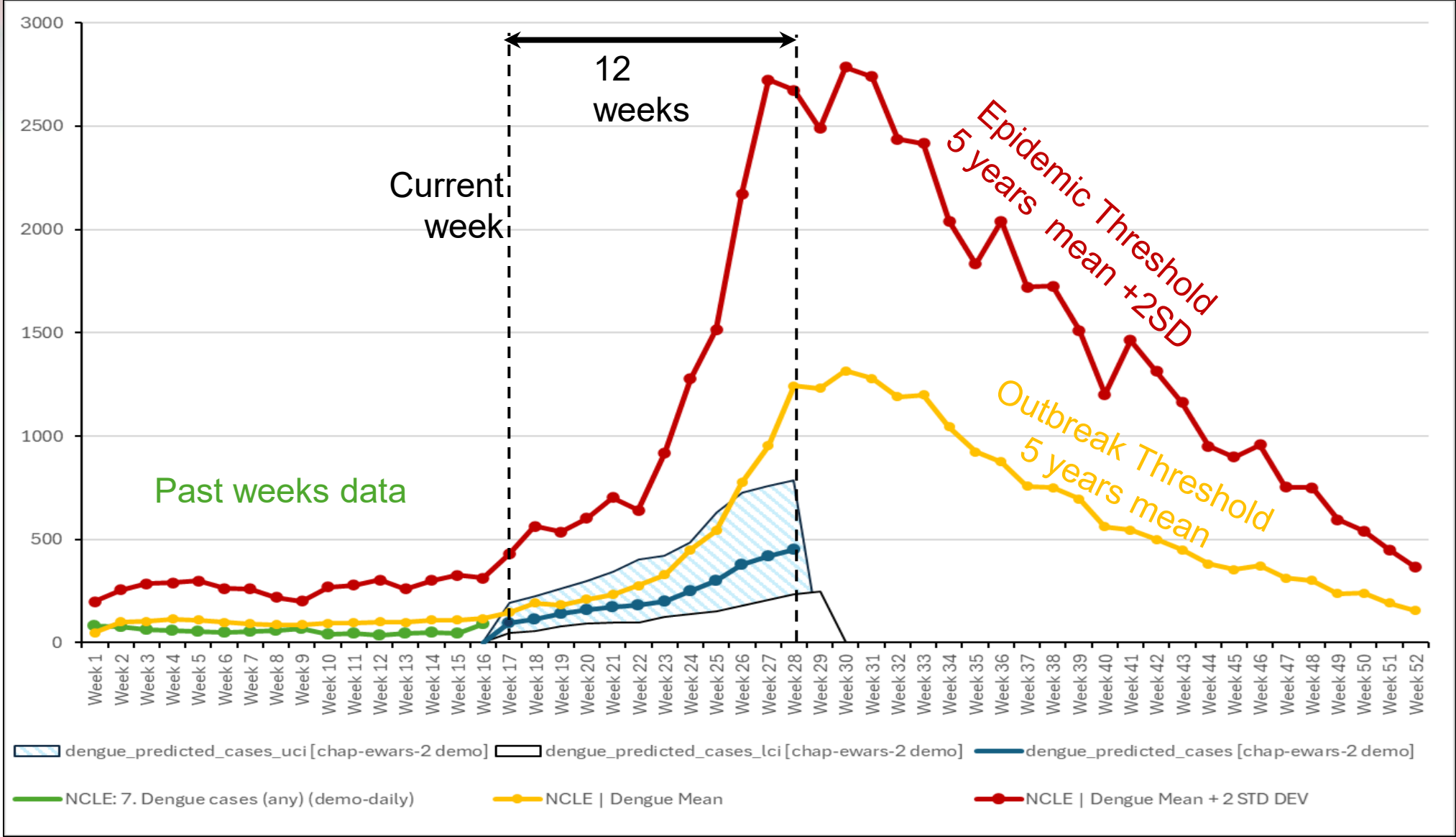
Data Exchange:

- Climate data: Every day (9am)
- Surveillance + Pop data: Mon (11pm)
- Generate predictions (manual): Tue (open)
- Prediction data, alerts: Tue (8pm)
- Refresh Analytics Table: Every day (10pm)
- Alert notifications: dhis2, email: Tue (23pm)

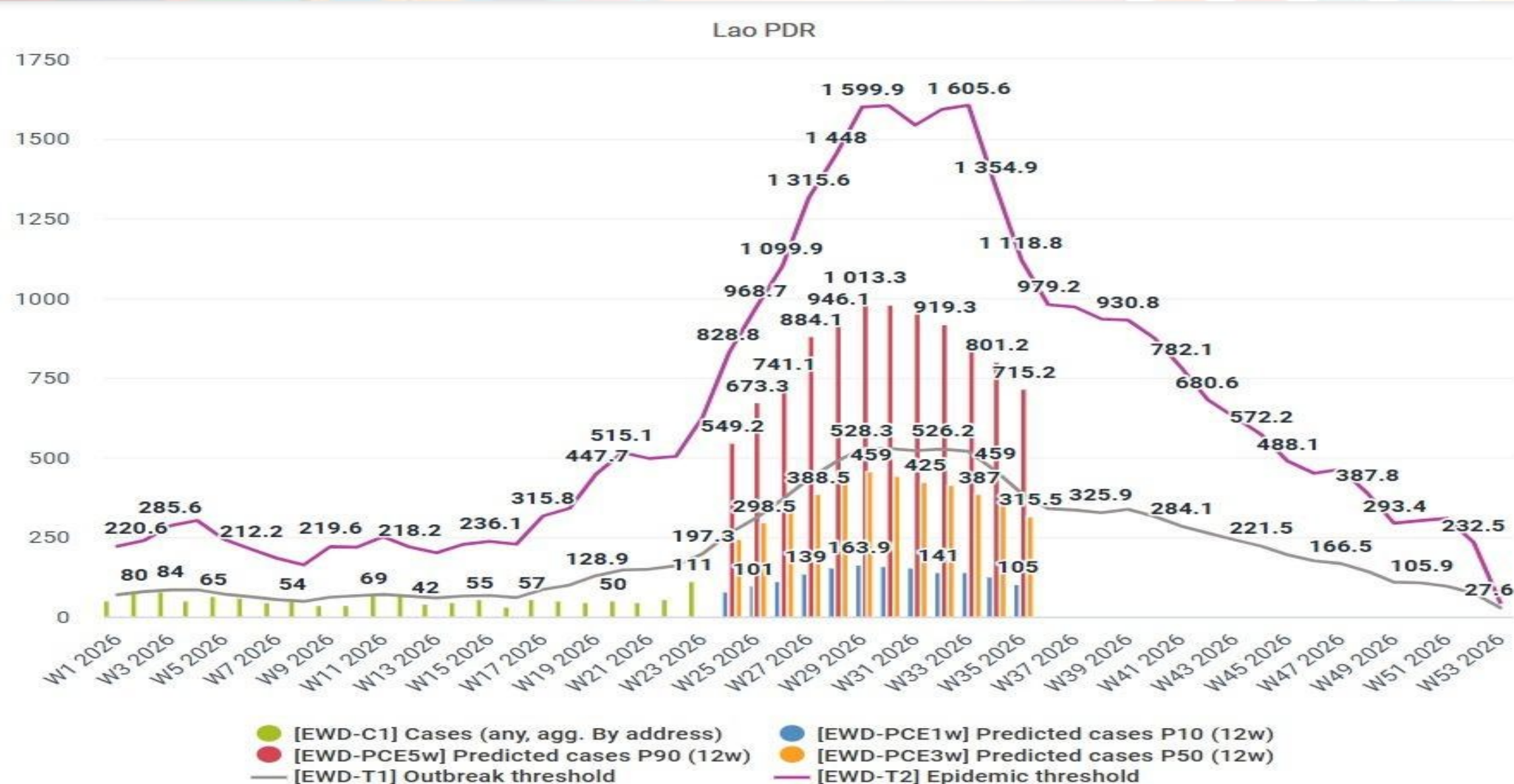




Prediction output and thresholds



Cases, predictions, and thresholds (National)



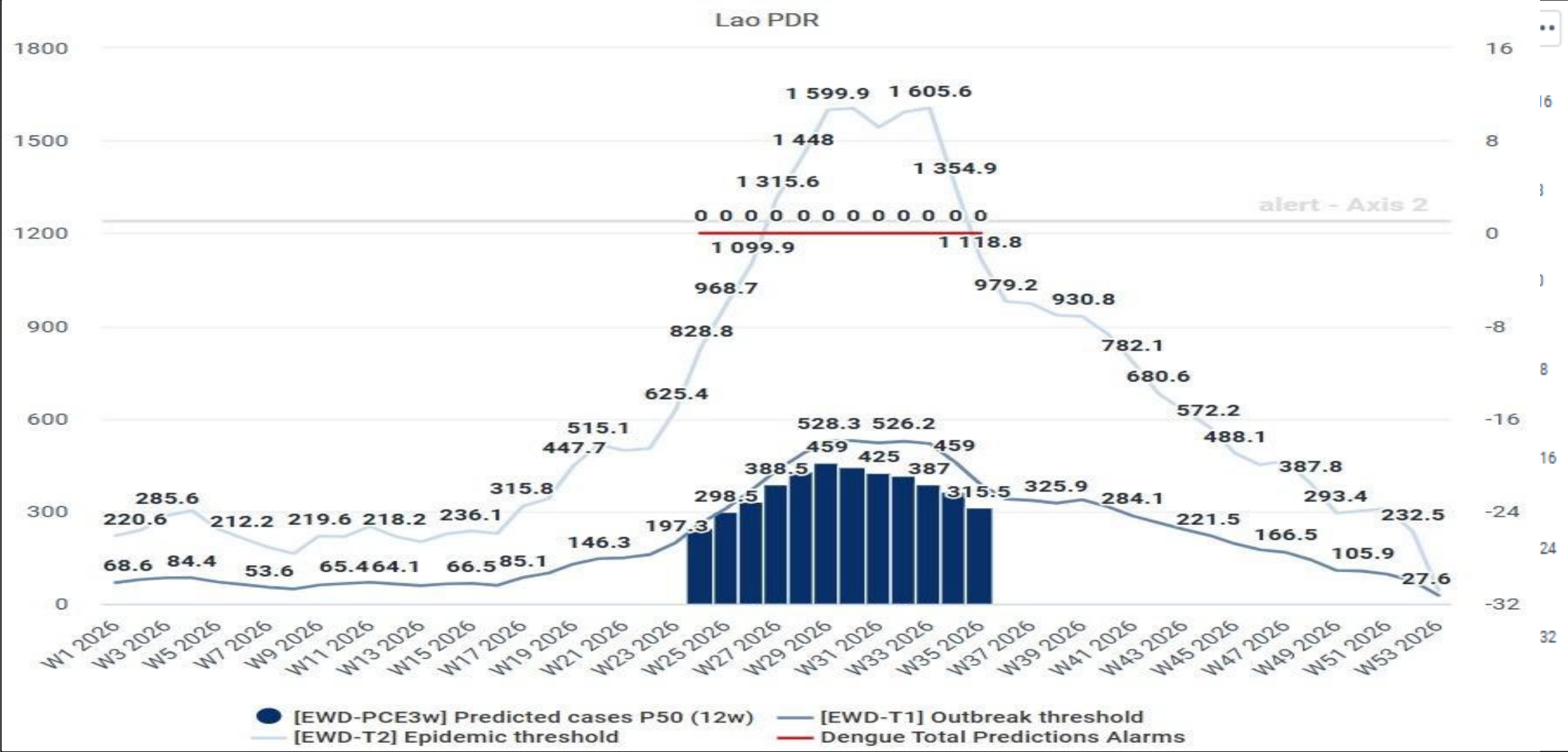
Prediction Alerts



Dengue Total Predictions Alarms												
	W24 2026	W25 2026	W26 2026	W27 2026	W28 2026	W29 2026	W30 2026	W31 2026	W32 2026	W33 2026	W34 2026	W35 2026
01 Vientiane Capital	0	0	0	0	0	0	0	0	0	0	0	
02 Phongsali	1	1	1	1	1	2	1	1	2	2	2	2
03 Louangnamtha	1	1	1	1	1	1	1	1	1	1	1	1
04 Oudomxai	1	1	1	2	1	1	1	1	1	1	1	1
05 Bokeo	0	0	0	0	0	0	0	0	0	0	0	0
06 Louangphabang	0	0	0	0	0	0	0	0	0	0	0	0
07 Houaphan	1	2	2	2	2	2	2	2	2	2	2	1
08 Xainyabouli	0	1	1	1	1	1	1	1	1	1	1	1
09 Xiangkhouang	1	2	2	2	1	1	1	1	1	2	2	2
10 Vientiane	1	1	1	1	1	1	1	0	1	0	1	0
11 Bolikhamxai	0	0	0	0	0	0	0	0	0	0	0	0
12 Khammouan	0	0	1	1	1	1	1	1	1	0	0	1
13 Savannakhet	1	1	1	1	0	0	1	1	0	0	0	0
14 Salavan	1	0	0	0	0	0	0	0	0	0	0	0
15 Xekong	1	1	1	1	1	1	1	0	0	0	1	1
16 Champasak	0	0	0	0	0	0	0	0	0	0	0	0
17 Attapu	0	0	0	0	0	0	0	0	0	0	0	0
18 Xaisomboun	1	1	2	1	1	1	1	1	1	0	0	0



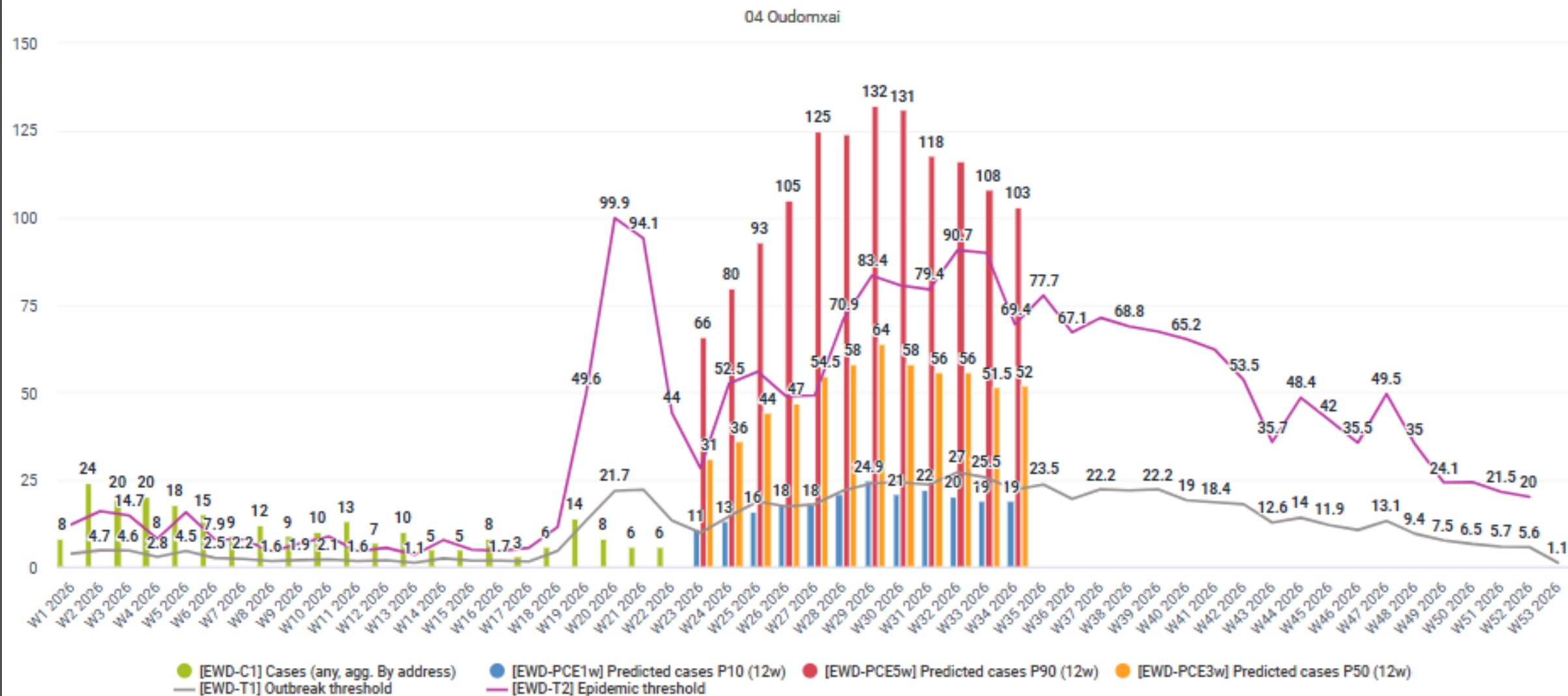
Predictions, thresholds, and alerts (National)



Cases, predictions, and thresholds (Provincial)

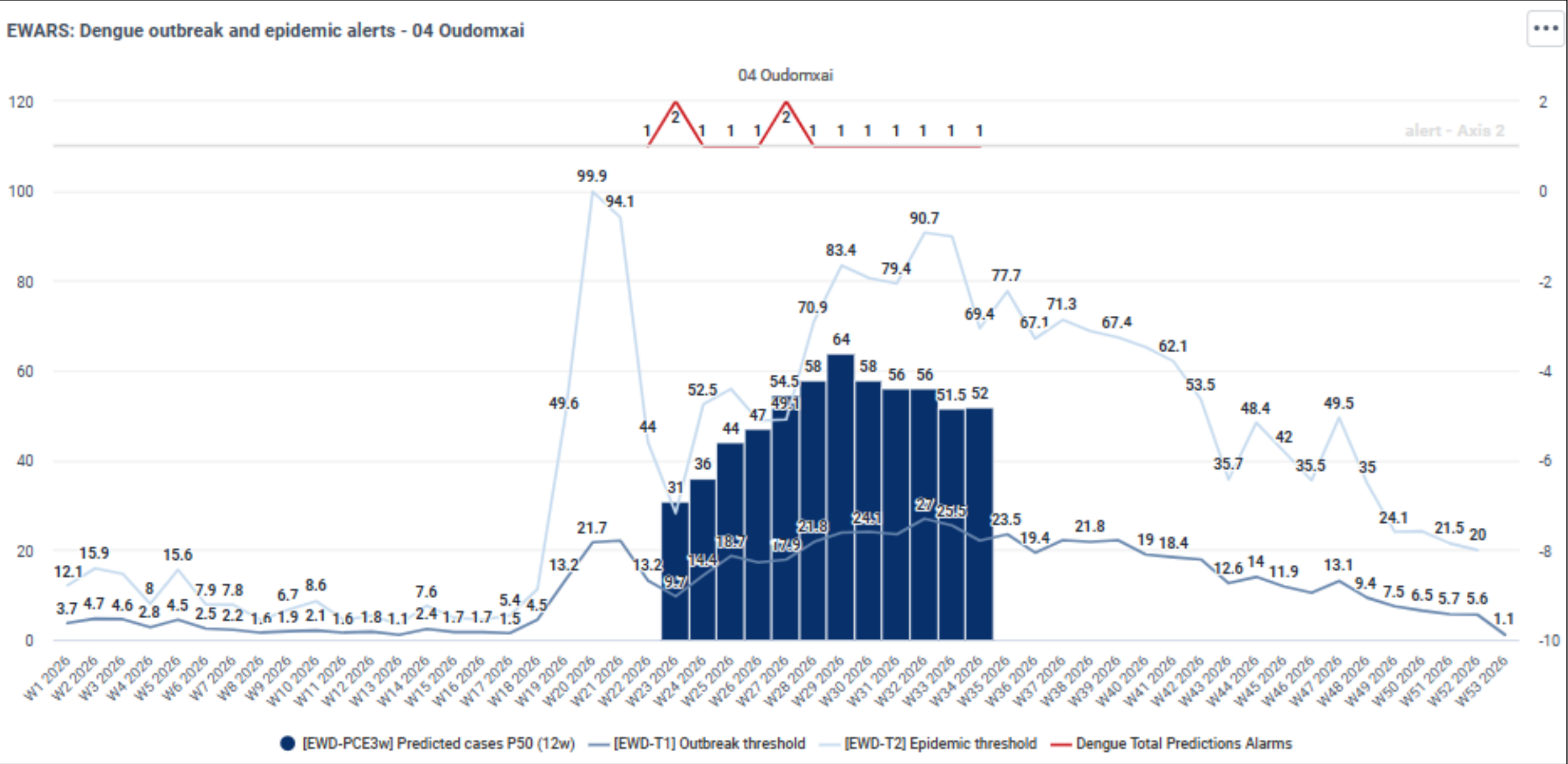


EWARS: Dengue predictions - 04 Oudomxai





Predictions, thresholds, and alerts (Provincial)



Integration with PHEOC dashboards

Updated PHEOC Dashboards on HMIS:

- PHEOC - Disease Surveillance - 2. Maps
- PHEOC - Disease Surveillance - 3. Trends
- Provincial EOC - 02: ກະດານຂ່າວຫ້ອງປະຕິບັດງານສຸກເສີນຂັ້ນແຂວງ - ແຜນທີ່
- Provincial EOC - 03: ກະດານຂ່າວຫ້ອງປະຕິບັດງານສຸກເສີນຂັ້ນແຂວງ - ເສັ້ນສະແດງ

Visualization output types:

1. Cases vs predictions vs thresholds:

- Dengue cases (any) aggregated by patient address (province)
- Dengue predicted cases (12 weeks ahead): P10, P50, P90
- Outbreak threshold: 5 years historical MEAN (exc. Outbreak and COVID-19 years)
- Epidemic threshold: 5 years historical MEAN + 2 STD DEV (exc. Outbreak and COVID-19 years)

2. Predictions vs thresholds and alerts

- Dengue predicted cases: P50
- Outbreak threshold: 5 years historical MEAN (exc. Outbreak and COVID-19 years)
- Epidemic threshold: 5 years historical MEAN + 2 STD DEV (exc. Outbreak and COVID-19 years)
- Dengue Total Prediction Alarms (Outbreak + Epidemic)

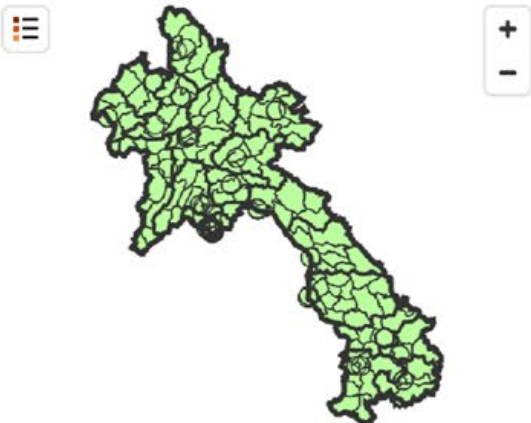
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PHEOC (ການກຳນົດ: 01) ລ່ອຍແຫຼວກະທັນຫັນ - 4 ອາທິດຜ່ານມາ
ໃນແຕ່ລະເມືອງ



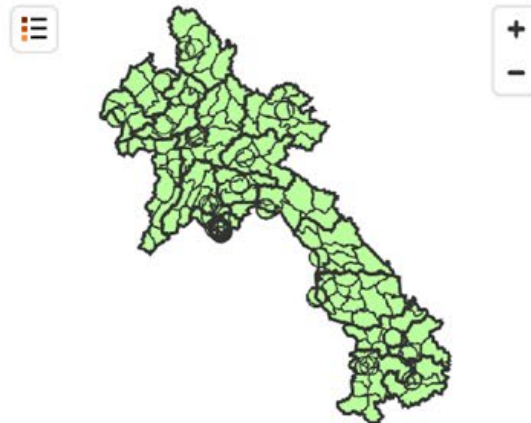
PHEOC ເກນກຳນົດ: 02 ໄຊ້ ແລະ ອອກດຸ່ມ - 4 ອາທິດຜ່ານມາ ໃນ
ແຕ່ລະເມືອງ



PHEOC (ການກຳນົດ: 03 ບາດທະຍັກເດັກເກີດໃໝ່ - 4 ອາທິດຜ່ານ
ມາ ໃນແຕ່ລະເມືອງ)



PHEOC (ການກຳນົດ- 04 ບາດທະຍົກເດັກເກີດໃໝ່- 4 ອາທິດຜ່ານ
ມາ ໃນແຕ່ລະເມືອງ



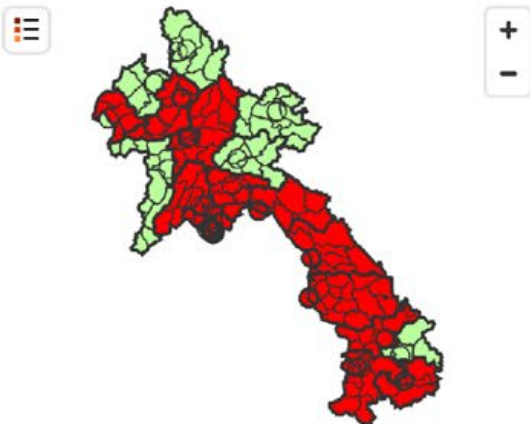
PHEOC រោងភារៈ: 05. ព័ត៌មាន - 4 ទិន្នន័យធានា ប្រព័ន្ធ



PHEOC រោងកាំអិດ- 06 ខែវ៉ា - 4 ខាតິດដ່ານມາ បៃແຕ່ລະ
ម៉ឺន



PHEOC ເກນກຳນົດ - 07 ໄຊ້ຍຸງລາຍ- ຫຼັງອາຫິດຜ່ານໃນແຕ່ລະ
ເມືອງ



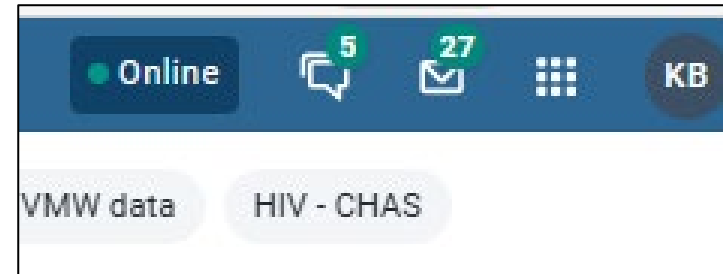
EWARS: Dengue outbreak prediction alerts (next 12 weeks) ...



Alert message notification



- **Use DHIS2 alert functionalities to alert user when thresholds are crossed on the last week of the prediction window (W+11)**
- **Every week, Tuesday 11pm**
- **Channels:**
 - DHIS2 internal messaging
 - Email (future)
- **Recipients:**
 - DCDC – PHEOC and NCLE Alert Notifications (WEEKLY outbreak alert summary from IBS)



Template message



Violations: **High** 3, **medium** 6, low 0

HIGH 02 Phongsalai 2026W34: dengue predicted cases (4.0) > epidemic threshold (1.4)

HIGH 07 Houaphan 2026W34: dengue predicted cases (2.0) > epidemic threshold (1.4)

HIGH 09 Xiangkhouang 2026W34: dengue predicted cases (3.0) > epidemic threshold (2.4)

MEDIUM 02 Phongsalai 2026W34: dengue predicted cases (4.0) > outbreak threshold (0.4)

MEDIUM 03 Louangnamtha 2026W34: dengue predicted cases (41.0) > outbreak threshold (22.9)

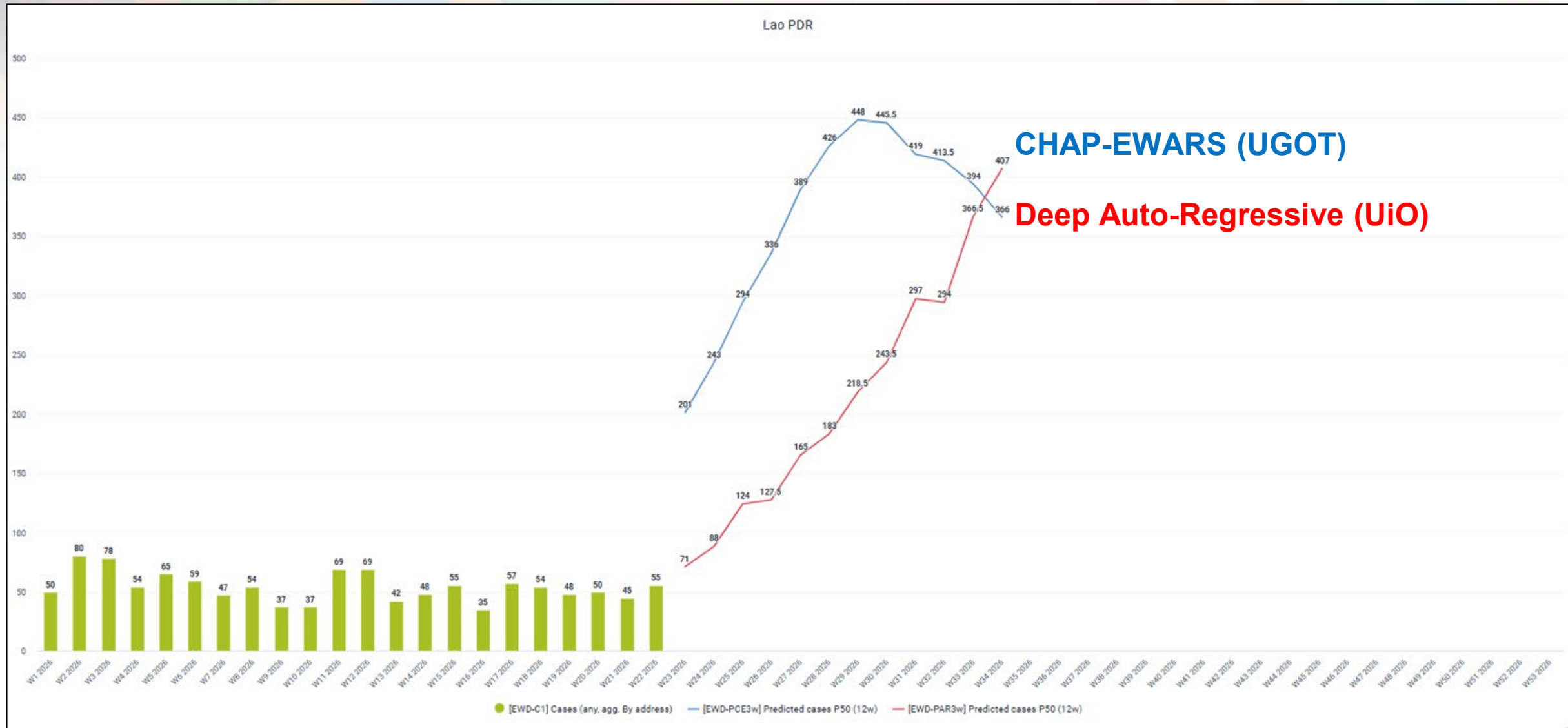
MEDIUM 04 Oudomxai 2026W34: dengue predicted cases (52.0) > outbreak threshold (22.1)

MEDIUM 07 Houaphan 2026W34: dengue predicted cases (2.0) > outbreak threshold (0.3)

MEDIUM 09 Xiangkhouang 2026W34: dengue predicted cases (3.0) > outbreak threshold (1.0)

MEDIUM 15 Xekong 2026W34: dengue predicted cases (50.0) > outbreak threshold (47.6)

Model comparison





Key innovations

- Forecasting embedded within routine HMIS rather than parallel systems
- Automated integration between R models and DHIS2 dashboards
- Strengthened interoperability and governance through CHAP
- Operational use of forecasting for routine surveillance and response

Challenges

- Climate data granularity limitations
- Cross-sectoral data sharing constraints
- Need for periodic model recalibration and validation
- Ongoing capacity-building requirements

Climate-informed disease forecasting can be operationalized within routine HMIS platforms, enabling more proactive and climate-resilient public health action without creating parallel systems.

Thank you!

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Funding

This work was supported through funding from the Green Climate Fund (GCF) through Save the Children International.

Disclaimer

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