



# Forecasting Outbreaks

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# OBJECTIVES of the SESSION

To understand:

- What is an outbreak
- What is an outbreak alarm
- How does outbreak warning (prediction) work
- The Early Warning and Response Systems (EWARS plus) – TDR/WHO

# WHAT IS AN OUTBREAK?

”CASE NUMBERS ABOVE NORMAL”

## Outbreak Situation A

NO cases and suddenly one case appears (EBOLA, POLIO, COVID-19, SARS) If another case appears: local transmission = OUTBREAK

## Outbreak Situation B

Continuously sporadic cases. “Sudden unexpected increase of cases” = OUTBREAK

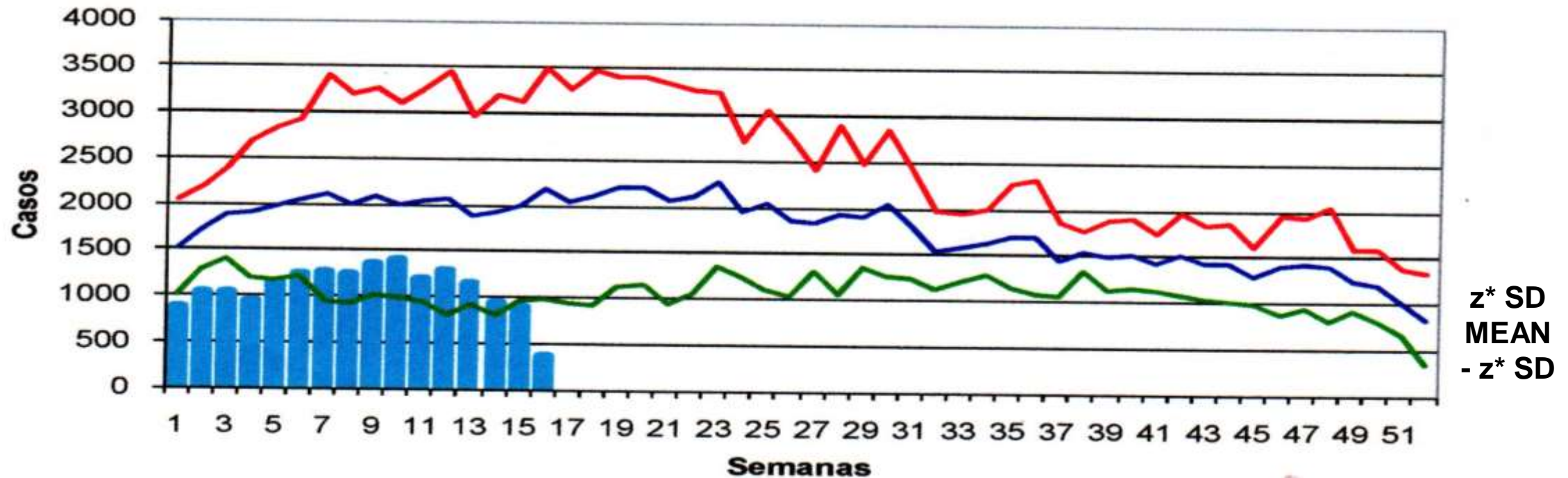
## WHAT IS AN UNEXPECTED INCREASE?

“Unexpected” compared to the average of previous years. This historical pattern is visualised in the ENDEMIC CHANNEL

# Outbreak definition using the ENDEMIC CHANNEL

- Current case numbers exceed the upper limit of the endemic channel  
«upper limit» = outbreak threshold:  $z * SD$  of the moving average

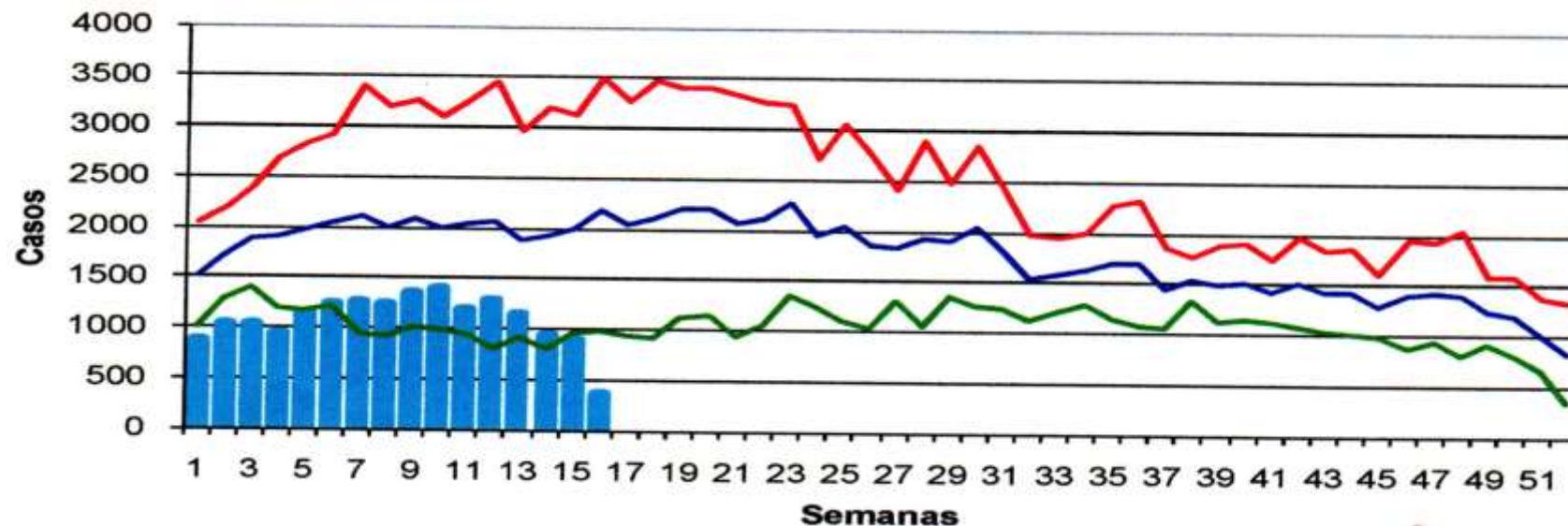
**Z-factor ( $Z*SD$ )** = The multiplying factor of the Standard Deviation which can increase/ decrease the threshold i.e. define fewer/ more outbreaks, respectively



The endemic channel visualizes the **historical pattern** (=«expected cases») with upper and lower thresholds and the **seasonal peak(s)** of case numbers

# CALIBRATING THE ENDEMIC CHANNEL

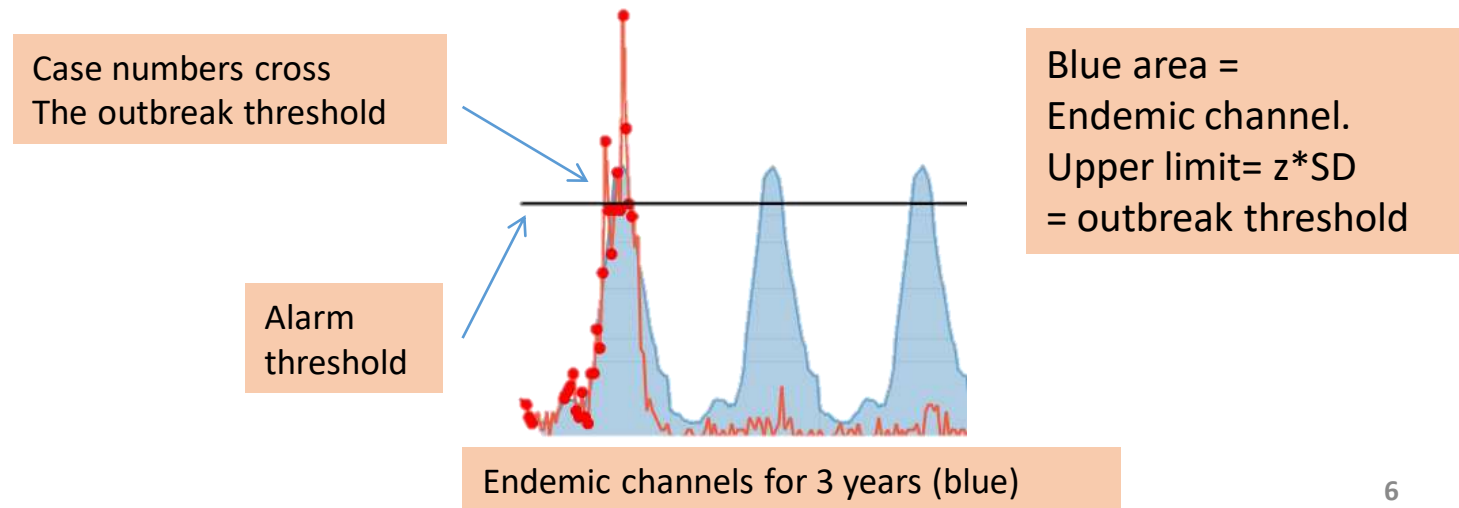
- Each time point on the middle line is the average of cases of the last 5 to 10 years of that week +/- 3 weeks (in total 3+1+3 = 7 weeks, called “moving average”)
- The upper line is the “alarm threshold”, calculated as  $z \cdot SD$  above the mean.
- Z may vary from district to district. The optimal value of z contributes to the highest sensitivities and PPV of outbreak prediction.



# Definitions (1): OUTBREAK

- **Outbreak indicator** = *probable cases* or *confirmed cases* or *hospitalised cases* or *deaths*
- **Outbreak threshold (a)** = upper line of the endemic channel (depending on  $z$ )
- **Outbreak threshold (b)** = a pre-defined incidence level of expected cases
- **Outbreak window** = The time (no. of weeks) we wait after case numbers have crossed the threshold to declare an outbreak (or the end of an outbreak)
- **Outbreak period** = Duration of an outbreak

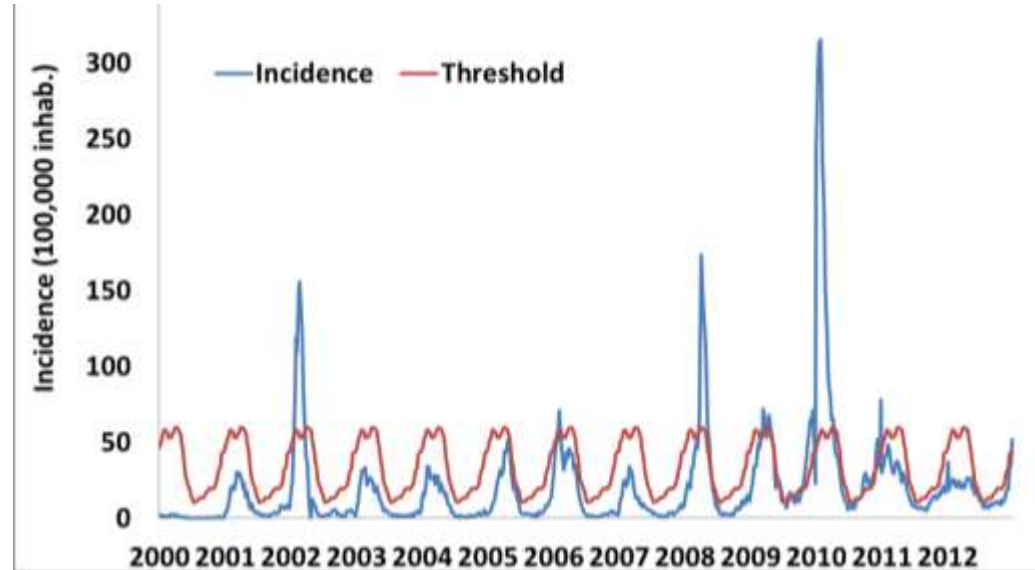
NB “Outbreak” depends on the  $z$  value (defining the upper line of the endemic channel), the minimum accepted *disease incidence* and the “outbreak window”





# MAGNITUDE OF OUTBREAKS

- Large outbreaks
- Small outbreaks



## Brazilian classification

- “High risk” > 300 dengue cases per 100.000 inhabitants or > 0.06 dengue deaths per 100.000 inhabitants

(Boletim dengue Brazil 2014; Plano de Contingencia Nacional de Epidemias Dengue 2015)