Assessing rabies incidence and geographic variability : an evaluation of surveillance efficacity

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Aknowledgment:
All of E2M2 Team

Background

- **Viral zoonotic disease – Infects the central nervous system of mammals**
  - **Nearly 60,000 deaths in people per year (30,000 to 70,000)**
  - **80% of deaths occur in rural areas**
  - **Africa and Asia has more than 95% of the world's fatal cases**

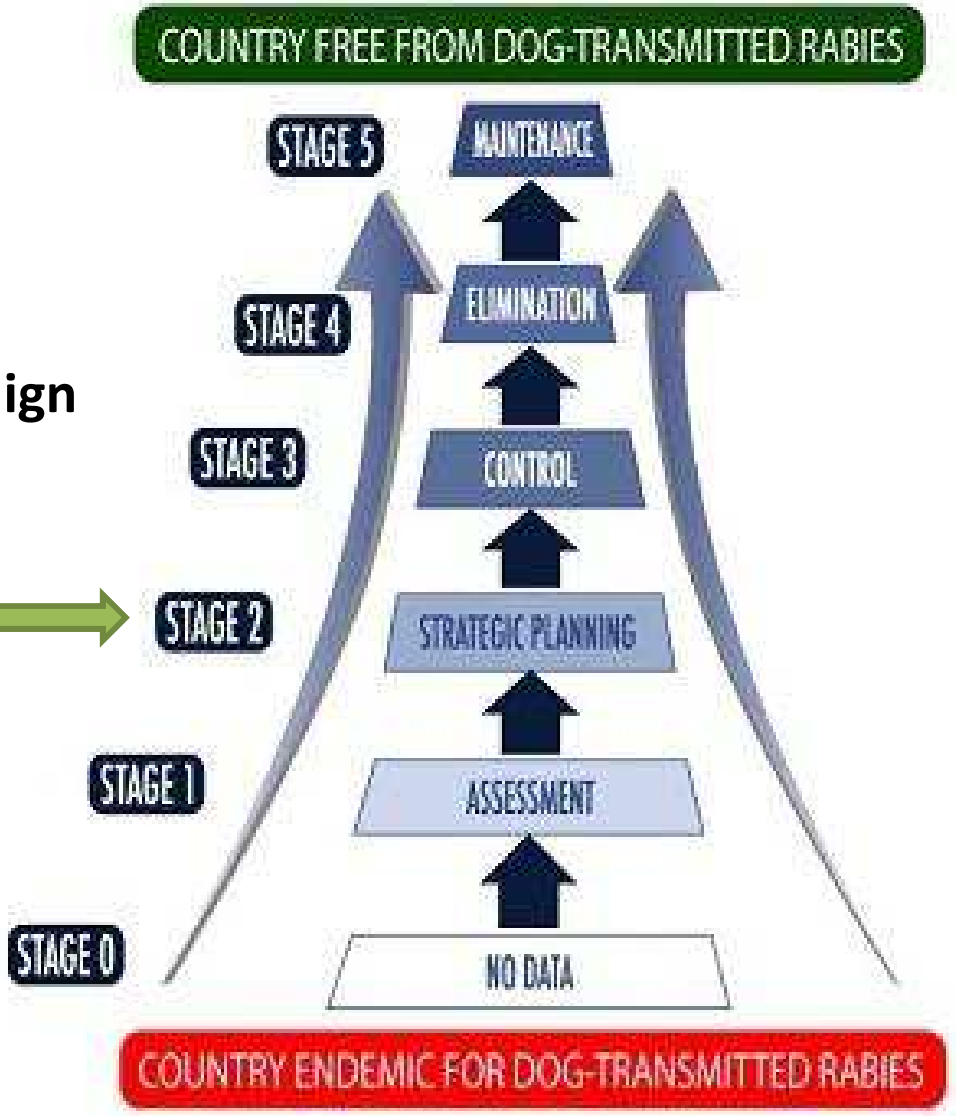
- **Transmitted via the saliva of an infected animal, dog+++**

- **Incubation period: several days to several months (~3 months 95% - range : 1 week to > 1 year)**
- **Notifiable disease but undereported :**
  - **in non-endemic areas**
  - **In areas without a history of reported rabies cases**

Context

Dog vaccination campaign

National level →

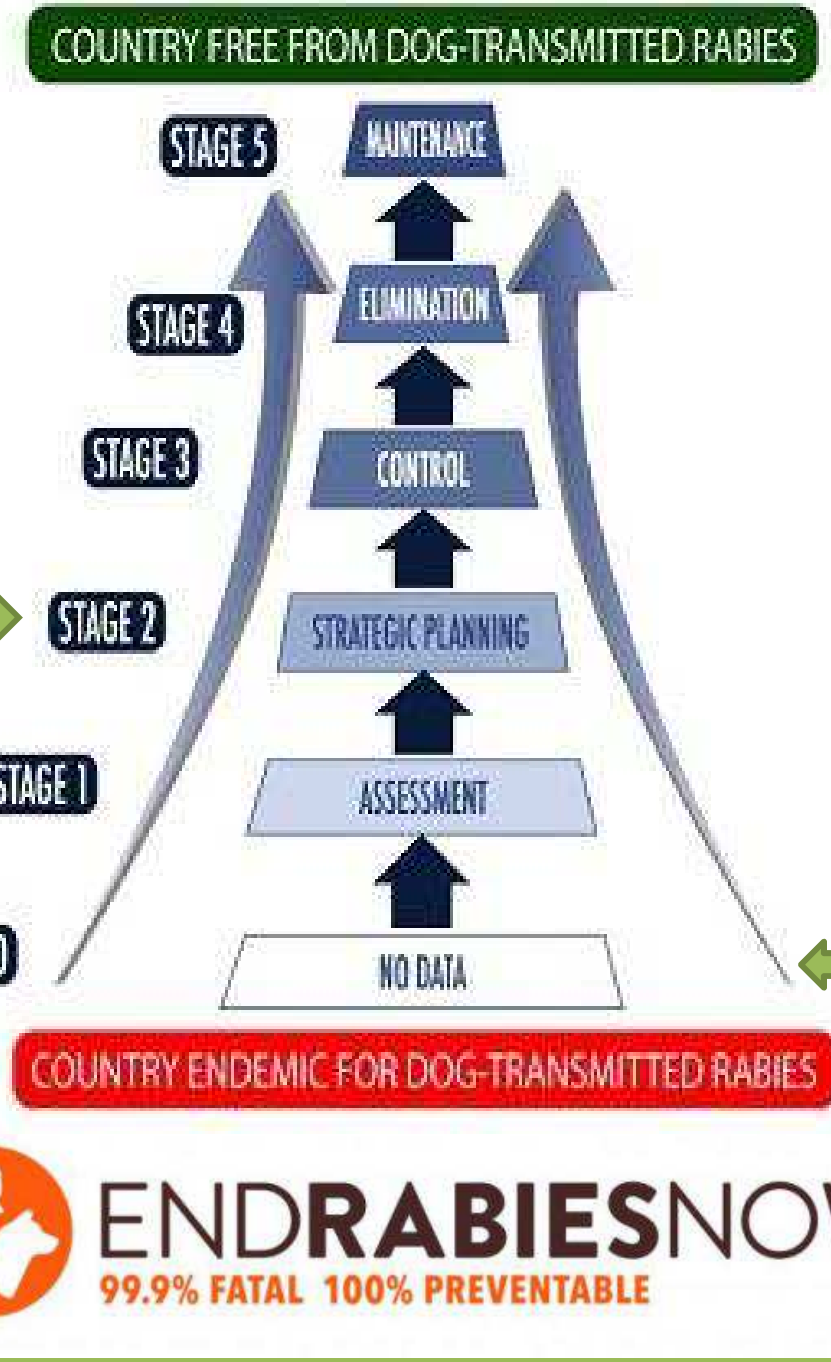


WORLD RABIES DAY SEPTEMBER 28

ENDRABIESNOW
99.9% FATAL 100% PREVENTABLE

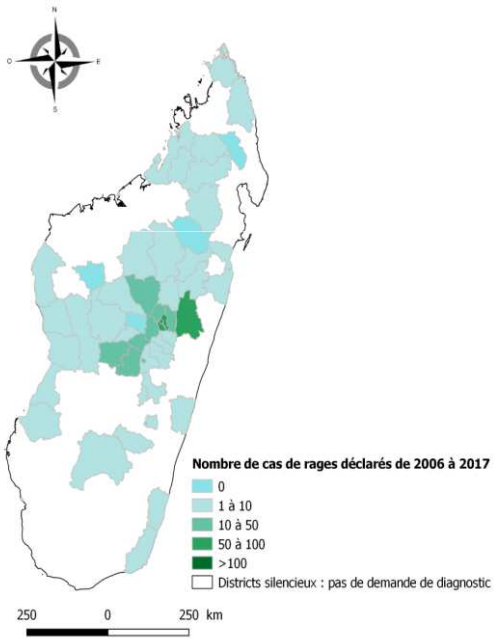
Context

Dog vaccination campaign



National level

District level



ENDRABIESNOW
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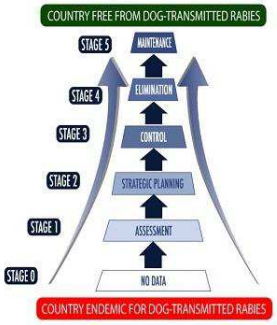
Why do we need good surveillance programs?

"Unless an effective reporting and surveillance programme is developed, there is no prospect whatsoever for a successful ~~eradication~~ elimination programme" **D.A. Henderson**

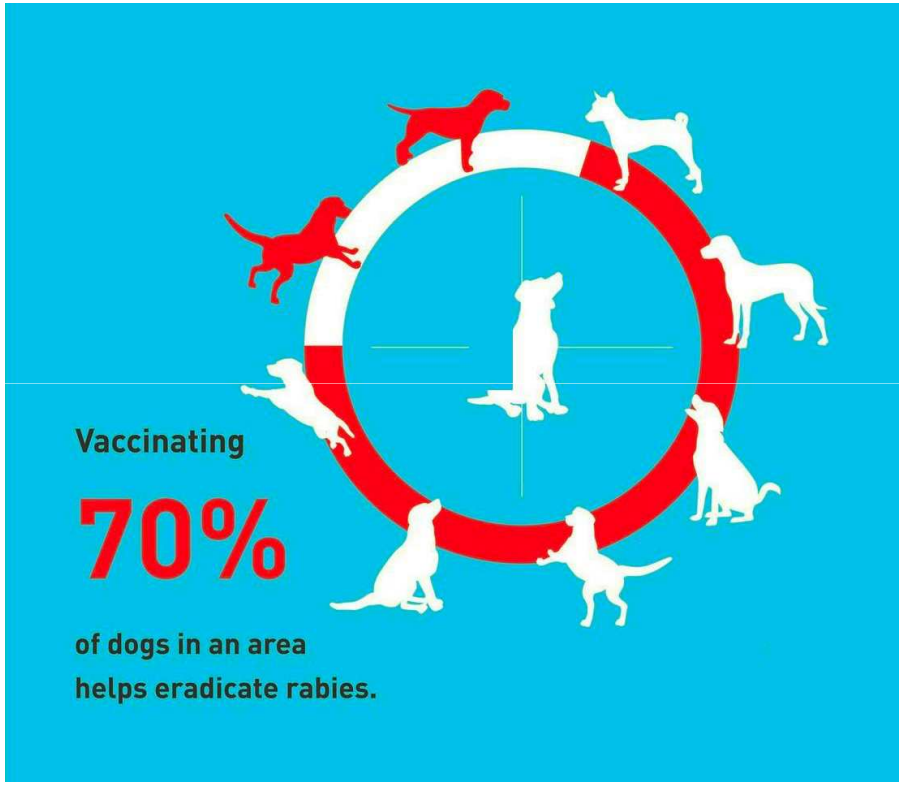


- Rabies control strategy in 2018
  - Surveillance : a critical component of disease control programmes
  - Early reporting, early case management

- **Poorly resourced areas**:
  - Medical center and Vets : the reporting system is inefficient
  - Centre anti-rabique : bite vs rabies exposure
  - Lab surveillance : passive

Why do we need good surveillance programs?

- For rabies control strategies we need to prioritize **where**? **When**?



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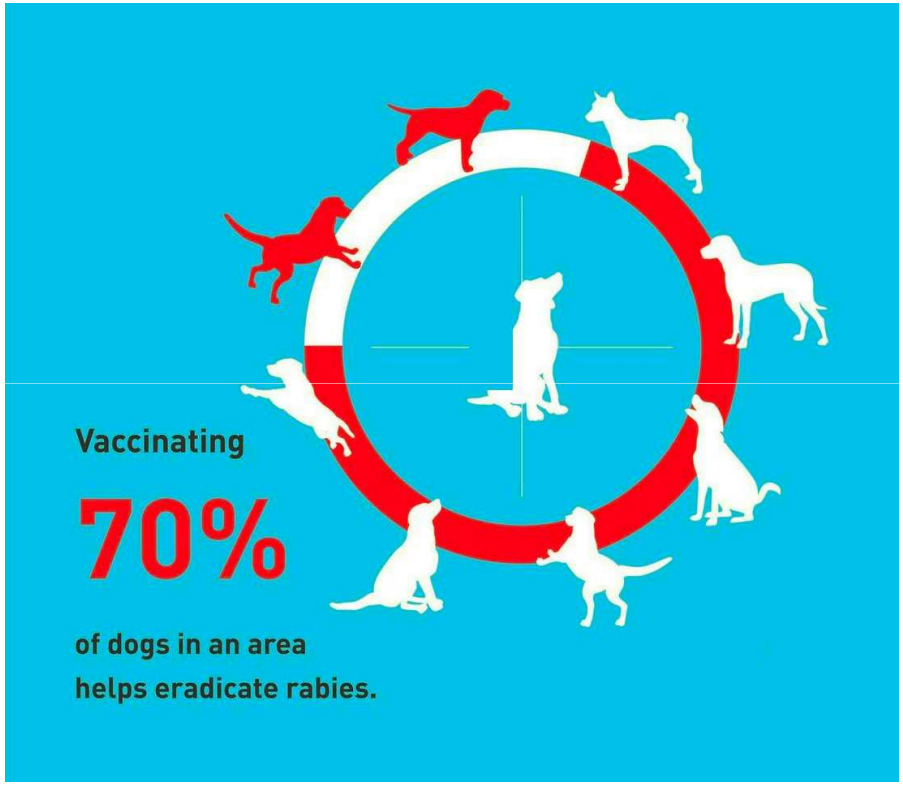

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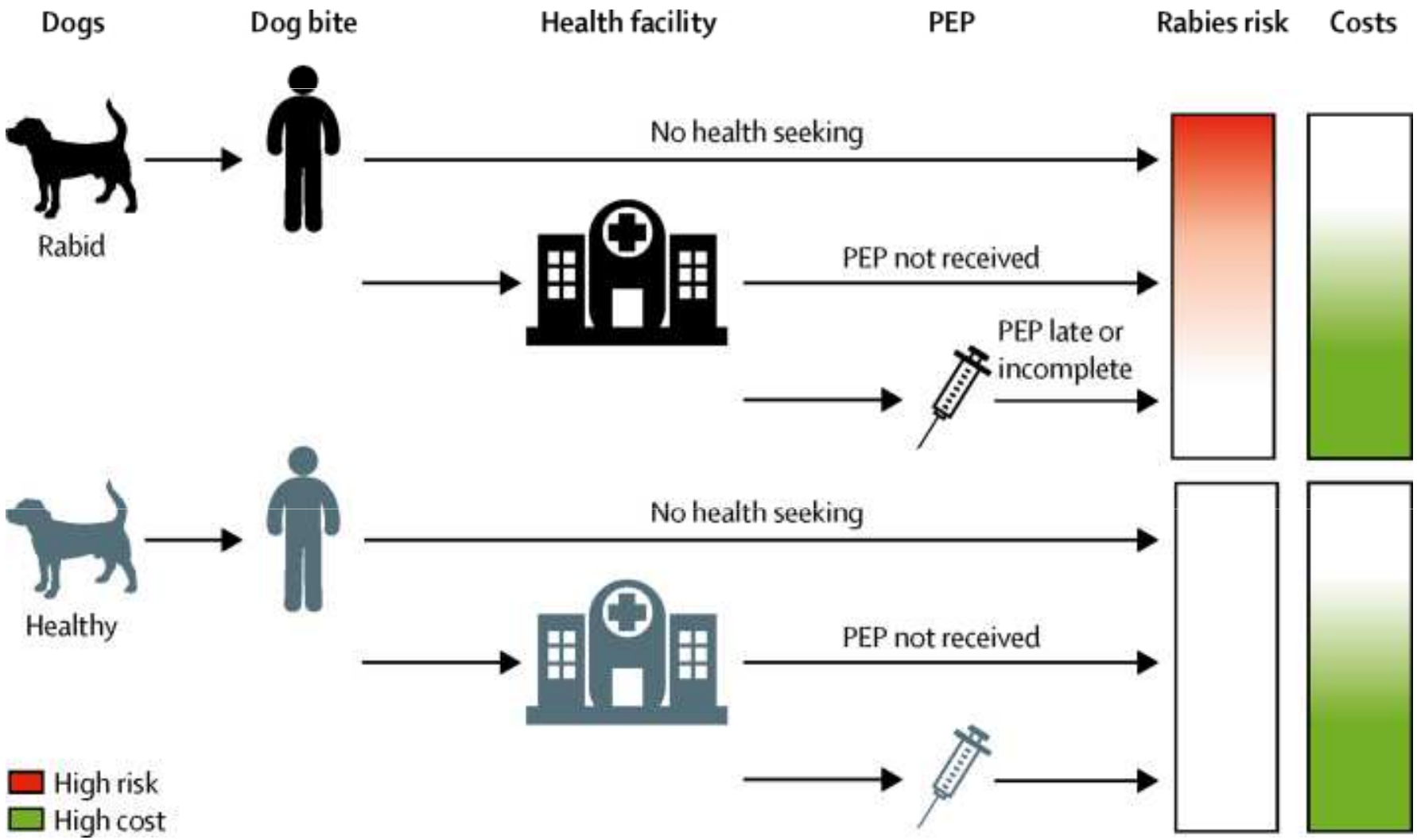
Big country and limited resources (money)

Why do we need good surveillance programs?

- Rabies control strategies : we need to prioritize control options
- PEP : treatment for human : economic impact



Research question

What is the extent of underreporting of animal rabies in Tana? Specifically, what is the animal rabies detection probability at the district and commune levels?

Estimation of rabies incidence

RESEARCH ARTICLE

A graph-based evidence synthesis approach to detecting outbreak clusters: An application to dog rabies

Anne Cori[1]*, Pierre Nouvellet[1,2], Tini Garske[1], Hervé Bourhy[3], Emmanuel Nakouné[4], Thibaut Jombart[1]*

Contact tracing, graphe-based synthesis...

Healthcare utilization, provisioni… …xposure prophylaxis, and estimation of human rabies … …adagascar

Malavika Rajeev[a,*], Glenn Ed… …Hanitriniaina[c], Soa Fy Andriamandimby[d], Helene Guis[e,g,h], Ravo Ramiandrasoa[f], Rila… …aurence Randrianasolo[e], Mamitiana Andriamananjara[i], Jean-Michel Heraud[d] …[e], C. Jessica E. Metcalf[a], Katie Hampson[j]

Surveillance to Establish Elimination of Transmission and Freedom from Dog-mediated Rabies

Katie Hampson, Bernadette Abela-Ridder, Kirstyn Brunker, S. Tamara M. Bucheli, Mary Carvalho, Eduardo Caldas, Joel Changalucha, Sarah Cleaveland, Jonathan Dushoff, Veronica Gutierrez, Anthony R Fooks, Karen Hotopp, Daniel T Haydon, Ahmed Lugelo, Kennedy Lushasi, Rebecca Mancy, Denise A Marston, Zac Mtema, Malavika Rajeev, Lúcia R. Montebello P Dourado, J F Gonzalez Roldan, Kristyna Rysava, Silene Manrique Rocha, Maganga Sambo, Lwitiko Sikana, Marco Vigilato & Victor Del Rio Vilas

Methods

- **Data** from the national lab for rabies diagnosis : 2006 – 2018
  - direct fluorescent antibody (DFA) test
  - RT-PCR test
  - Isolation by cells culture
- **Methods**
  - Temporal series for cases
  - Estimate the probability of detection (1% of infection among dog population (Hampson *et al.,* 2018))
    - Human population number : human/dog ratio
  - Occupancy model – N-mixture model for estimating population size (Royle J.A, 2004)
    - Estimate of probability of detection
    - Estimate the rapid dog population

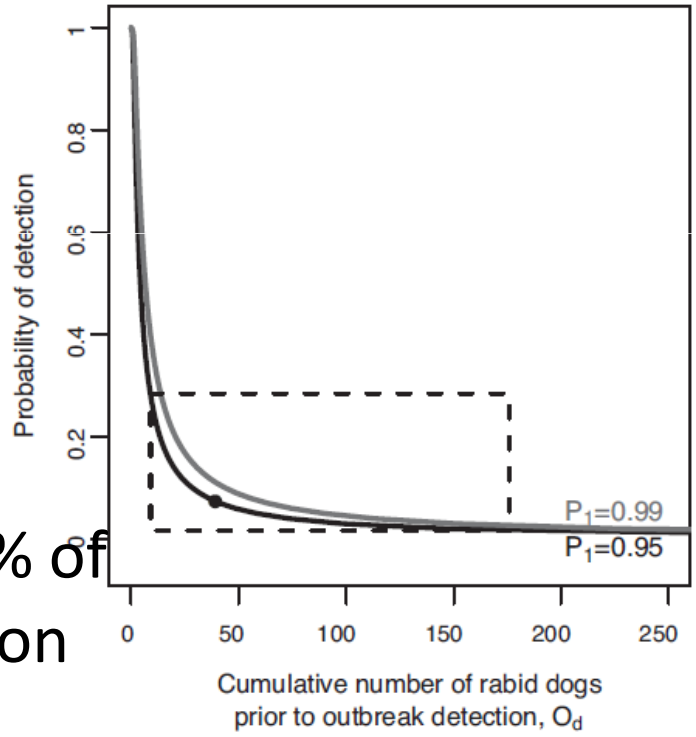
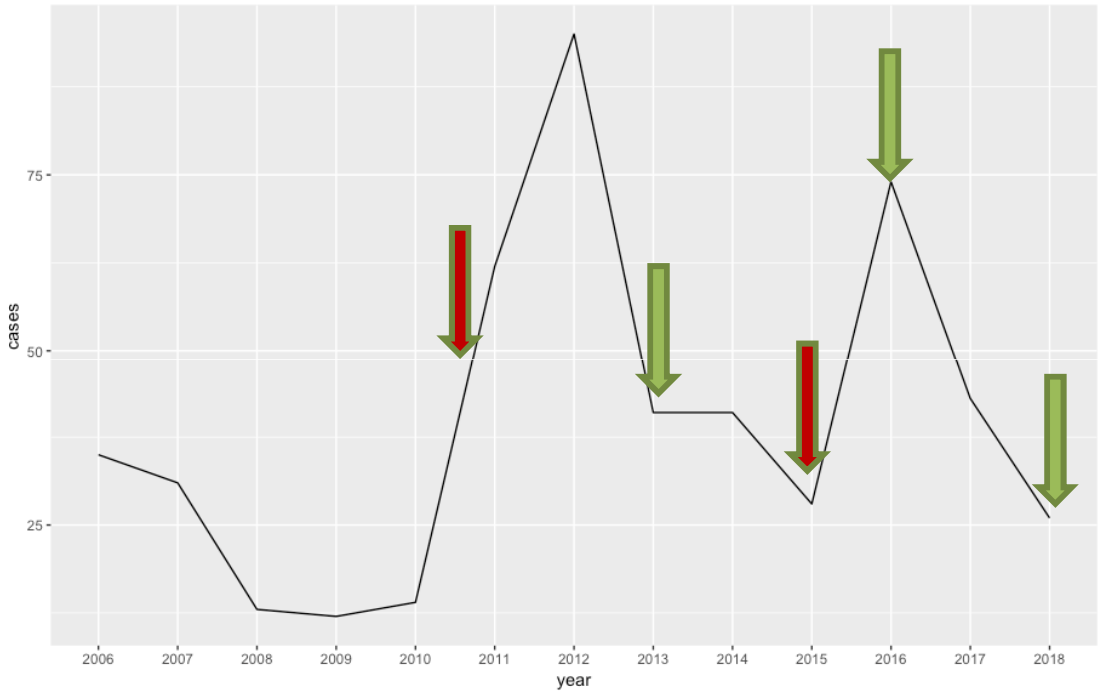


Fig : Probability of detecting outbreak.

From Townsend et al., 2013

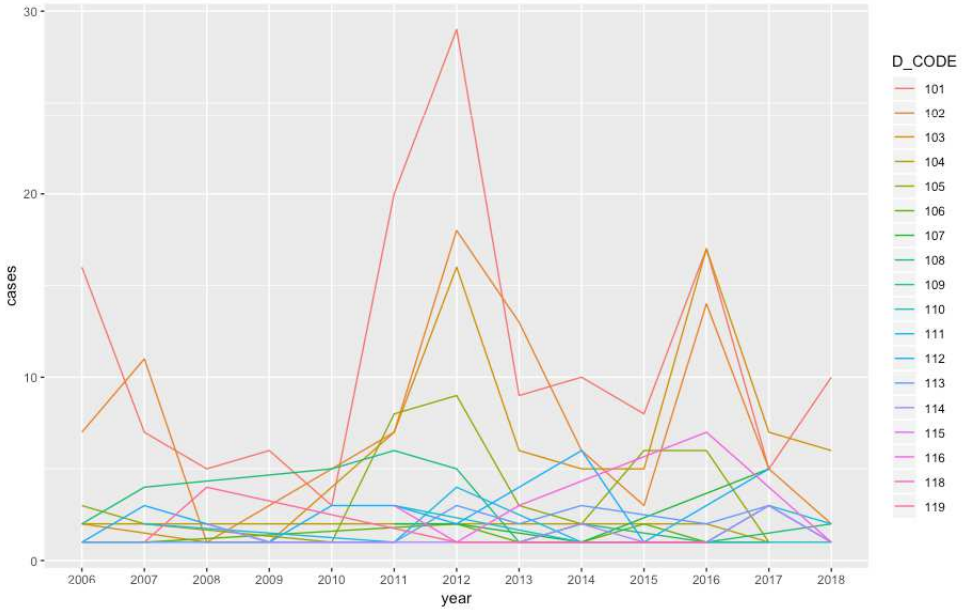
Preliminary Results (1)



Public celebration in Antananarivo

Celebration outside of Antananarivo /media/restricted public

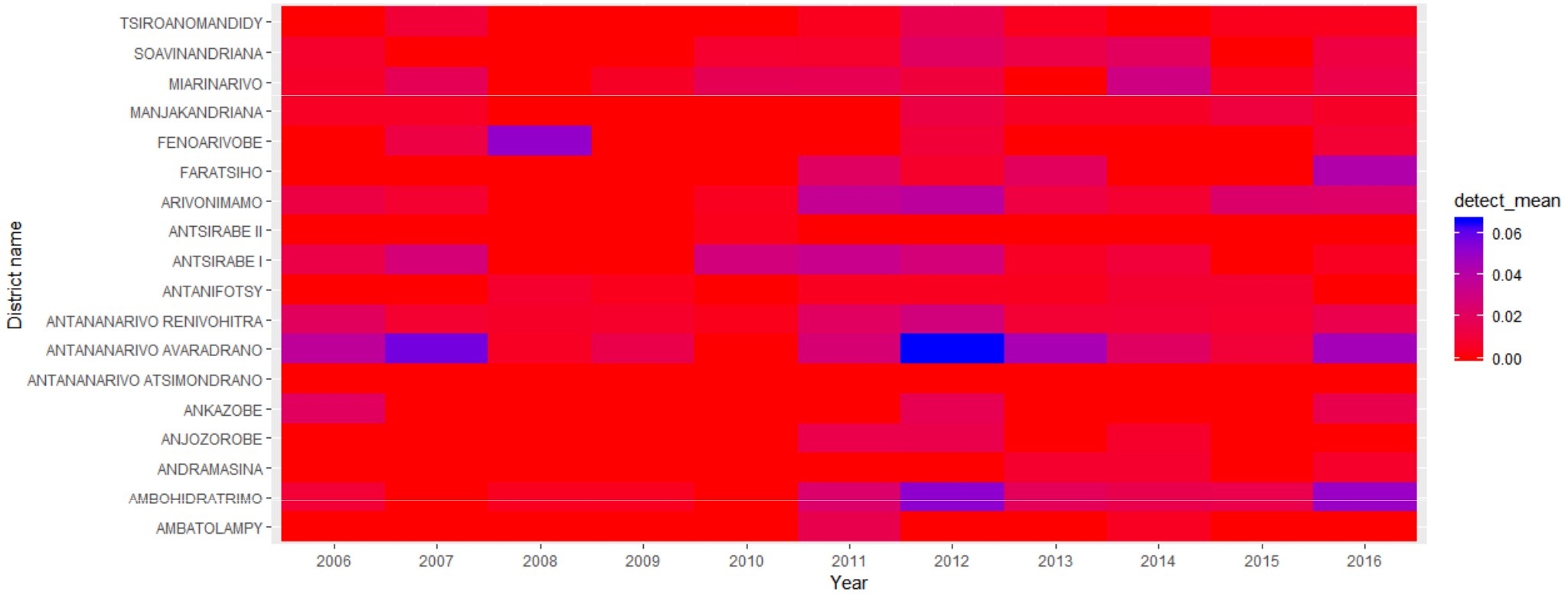
Number of rabies cases notified by lab surveillance : 2016 -2018 in Antananarivo (Province)



District delimitation

Number of rabies cases notified by lab surveillance : 2016 -2018 in each District of Antananarivo

Results



Probability of detection in each district of Antananarivo from 2006 - 2016

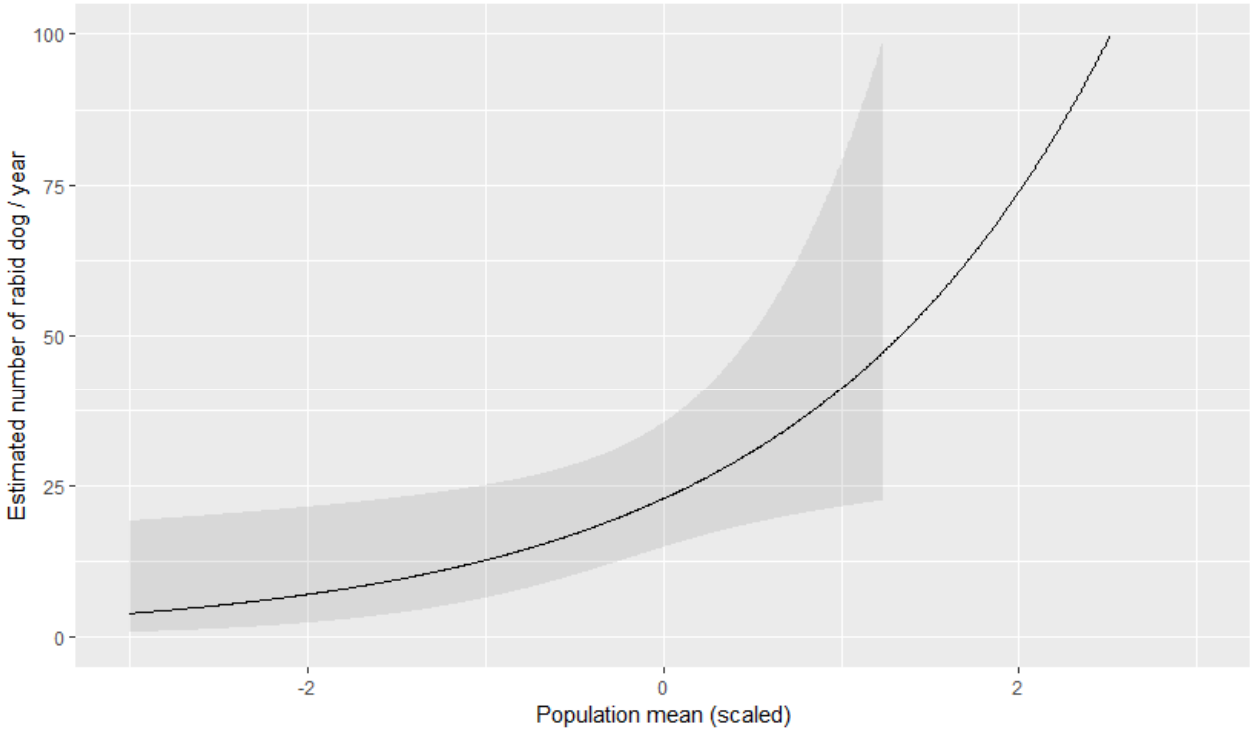
Preliminary Results (2)

Mod1 : w/o covariate

- 28 dog cases /year/ District
- 8% of probability of detection

Mod 2 : w population count

- 15 - 40 dog cases /year/ District
- 8% of probability of detection



Estimation of rabid animal according to human population mean(scaled)

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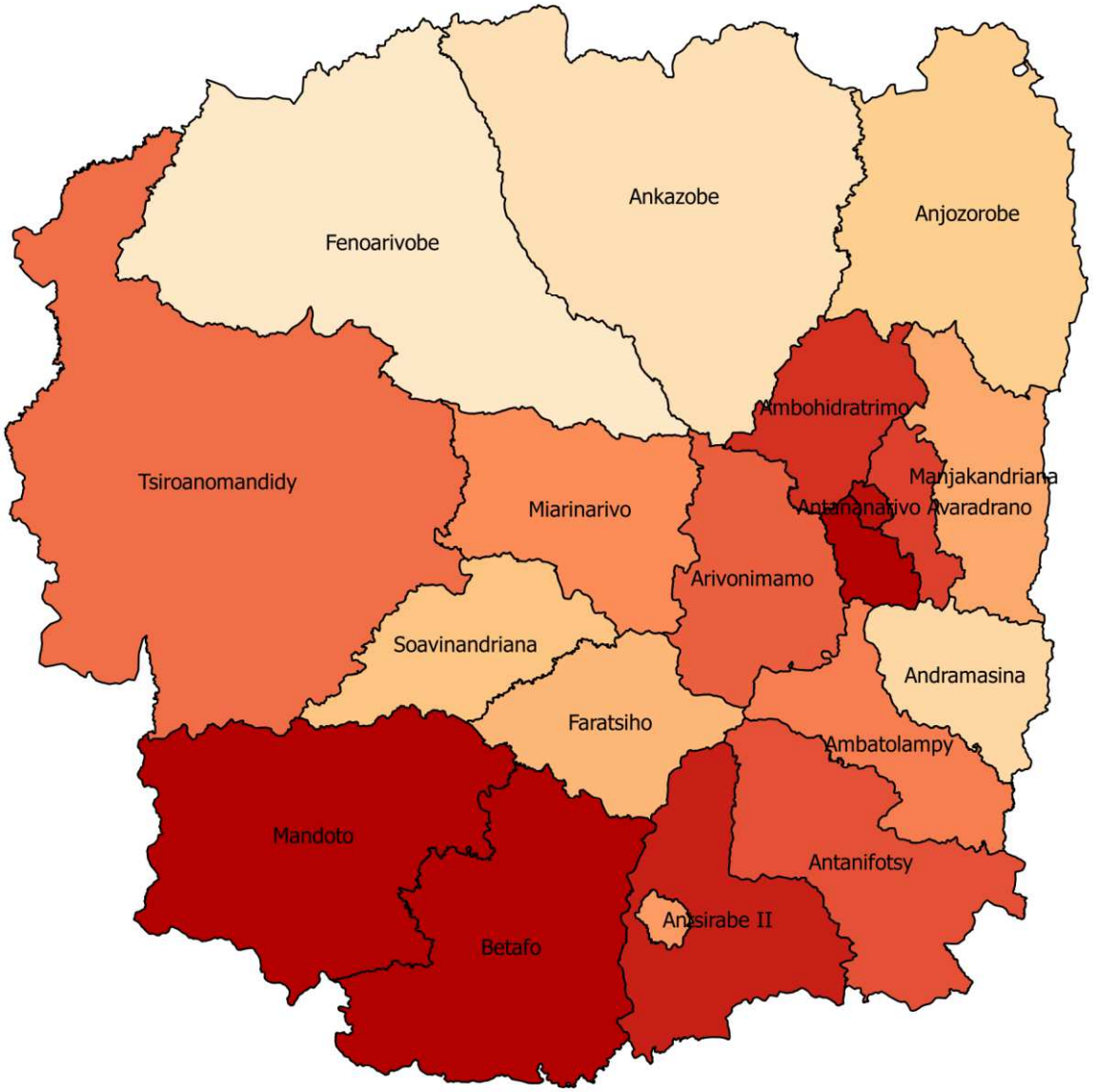
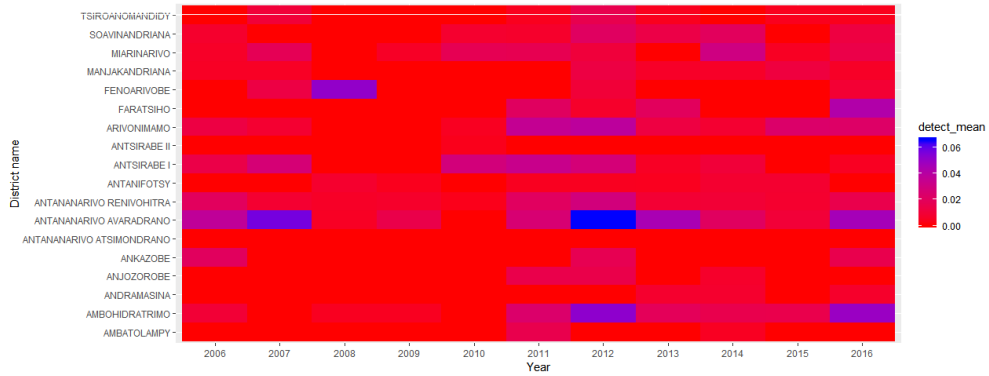
15 cases/year (eg: Fenoarivobe)
95% CI [8-26]

39 cases/year (eg: Mandoto)
95% CI [18-50]



Discussions, conclusion and perspective

- Rabies notification depends mainly on the population's awareness of the disease
- Detection probability is less than 0.3 (threshold)
  - Will understimate the true number of cases
  - May not detect an outbreak



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What's next ?

- Refine the model : covariates (health centers, CTAR, distance from Lab)
- Transmission dynamics of canine rabies (landscape, high risk area and clusterization)
- Real time assessment of spatio-temporal dynamics of transmission (before, during and after vaccination programs have been implemented)

Thank you
Misaotra tompoko
Merci

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