Should we vaccinate now or wait for the arrival of the new disease?

Modeling pre-event x post-event vaccination policies

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Coimbra, january 2010

Concern of epidemiologists

Potential new diseases

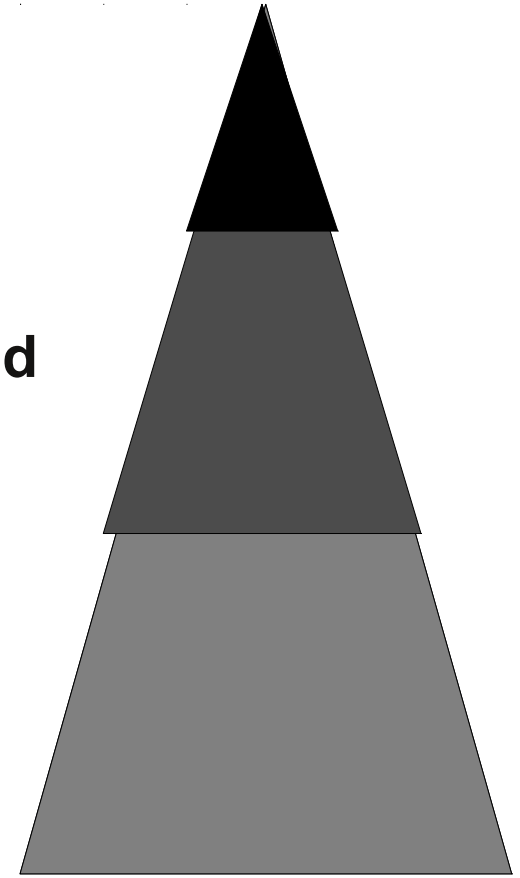
Pandemic flu
Smallpox
Urban Yellow Fever

Recently emerged diseases

Dengue
AIDS

Endemic diseases

TB
Hansen
Malaria
Leishmaniosis



The New York Times

A NATION CHALLENGED: THE BIOTERRORISM THREAT

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By ROBERT PEAR

Published: March 30, 2002

- Bioterrorism (smallpox, anthrax)
- Pandemic Flu
- Urban Yellow Fever
- Dengue Fever (futurely)

Frankly, we believe that these were threats that were worth looking into very seriously.

JOHN ASHCROFT, Attorney General

CNN

Poll: Majority of adult Americans don't want H1N1 shot

November 18, 2009 1:34 p.m. EST

The smallpox calculation:

	Epidemic YES
Vaccination NO	1 million deaths
Vaccination YES	300 deaths

The smallpox calculation:

	Epidemic YES	Epidemic NO
Vaccination NO	1 million deaths	0 deaths
Vaccination YES	300 deaths	300 deaths

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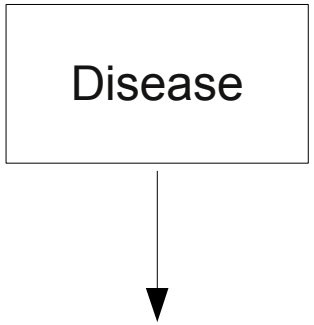
Pre-event vaccination is *not* a typical public health program

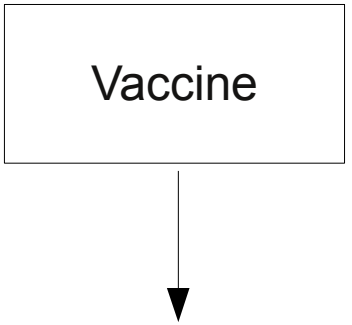
- Public health vaccination programs are typically undertaken knowing the risks of the disease, and knowing they outweigh the risks associated with the vaccination.
- In a pre-event vaccination program, the risk of the disease is based on a risk estimate derived by "expert" opinion.

Ref.

The reason to vaccinate

Competing risks





Pd = Prob acquiring
Rd = Risk (outcome|infection)

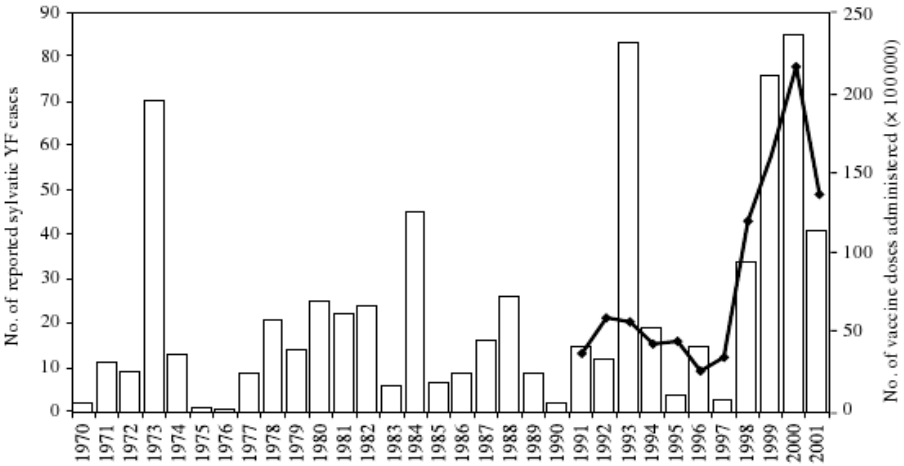
Rv = risk(unwanted outcome|vaccine)

Vaccinate if: **Pd Rd >> Rv**

But if the area is disease-free? Pd = p(arrival) x p(infection|arrival)

Vaccinate if: **u Pd Rd >> Rv**

Endemic area
Sylvatic reservoir
Transmitted by sylvatic mosquitos
Mandatory vaccination
High vaccination coverage



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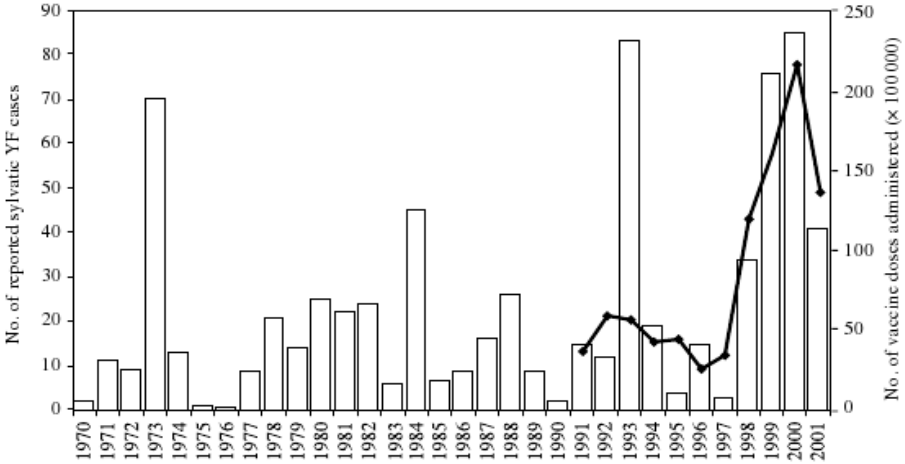
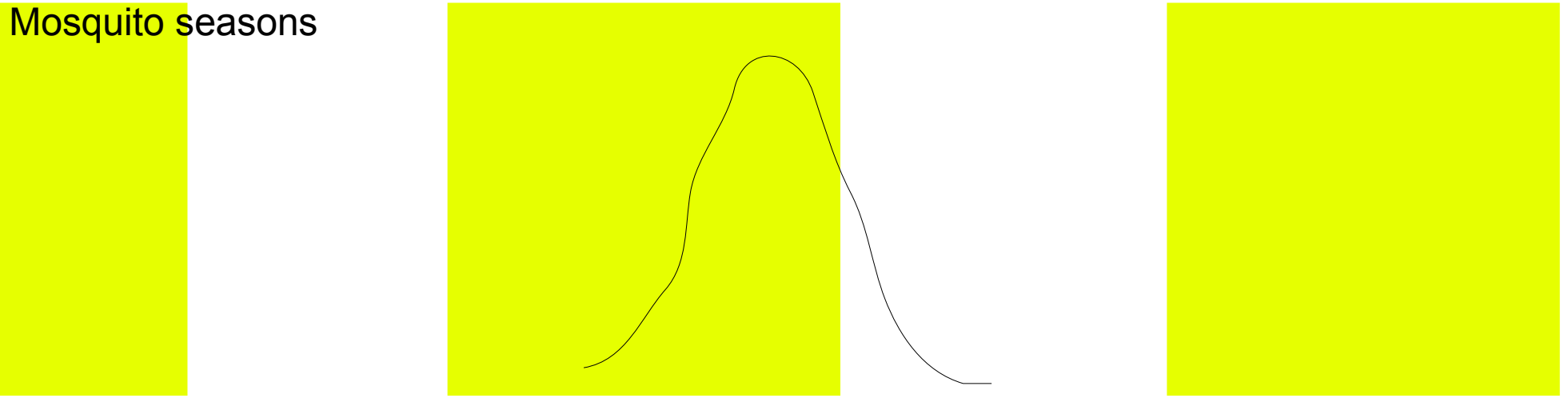


Disease-free area
Majority of the population (>100million)
Competent mosquito (dengue vector)
Past-history of disease
Very low vaccine coverage

Formalizing the YF problem



Best strategy: the one that maximizes the rewards

Vaccinate before?

Or after?

pr(arrival)

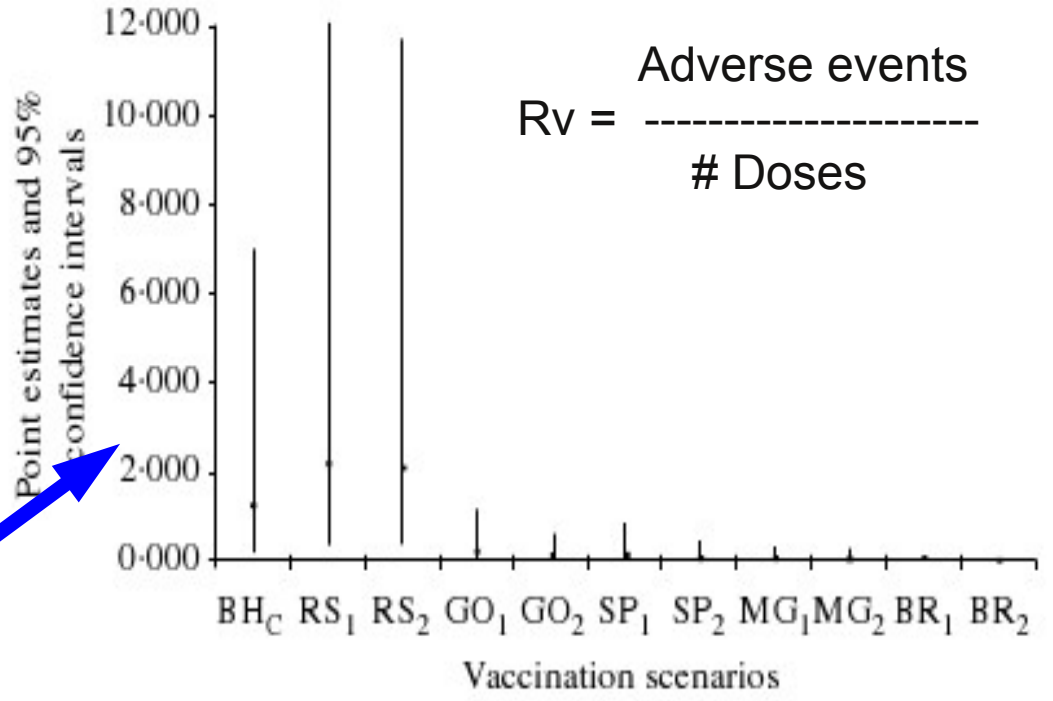
pr(vaccine) and serious event

Rewards: 1-rv

1-u(pd rd + pv rv)

Infection and serious disease

Formalizing the YF problem



$$Rv = \frac{\text{Adverse events}}{\text{\# Doses}}$$

Vaccinate before?

Vaccinate after?

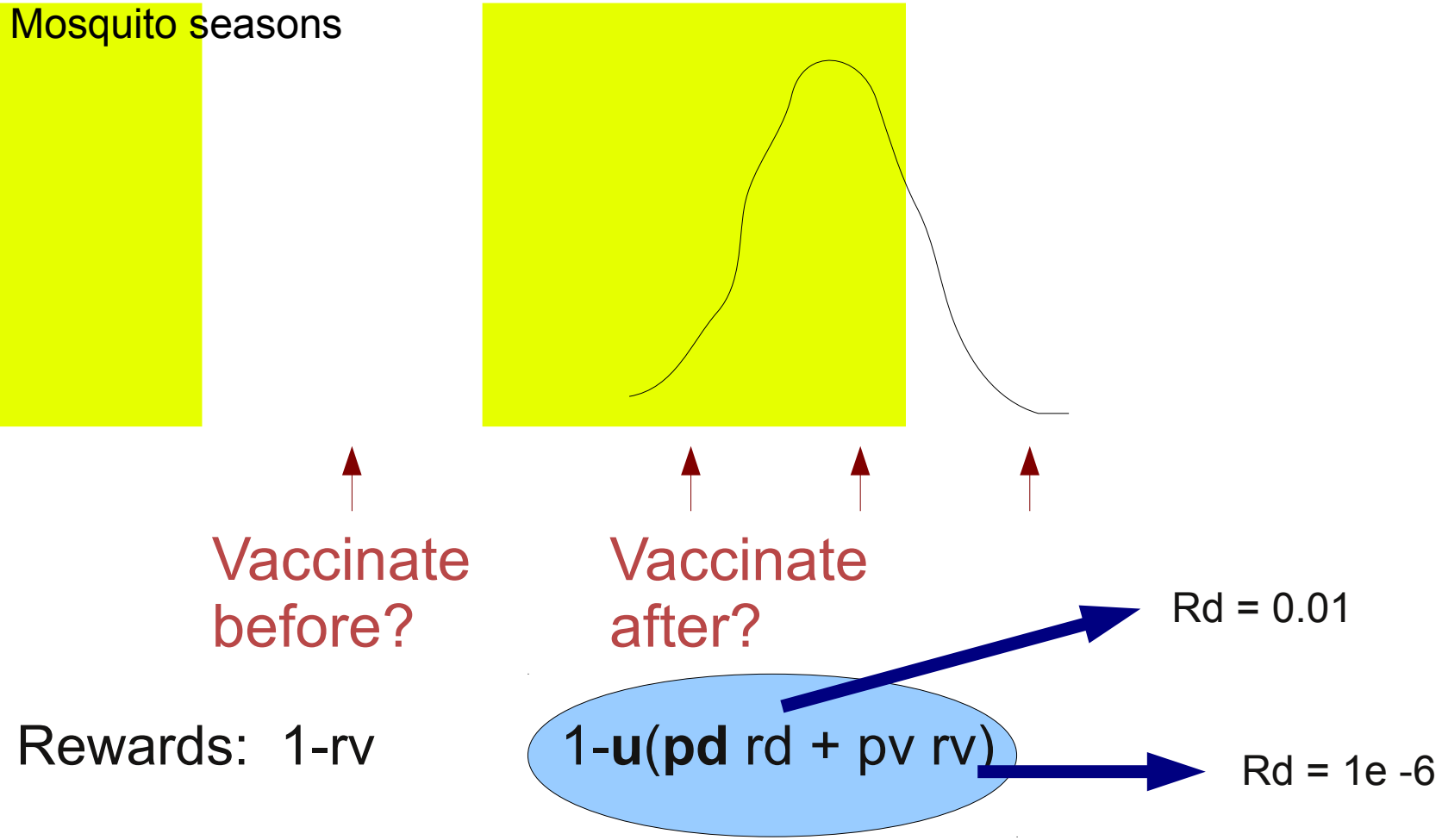
Reward of vaccinating now: 0.999999

Rewards: 1-rv

1-u(pd rd + pv rv)

Best strategy: the one that maximizes the rewards

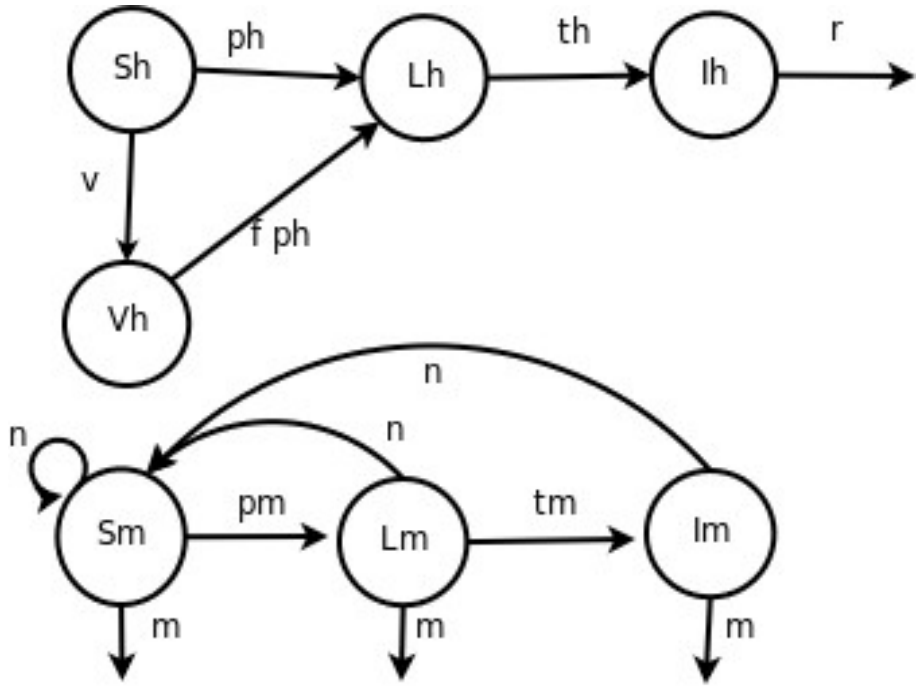
Formalizing the YF problem



Best strategy: the one that maximizes the rewards

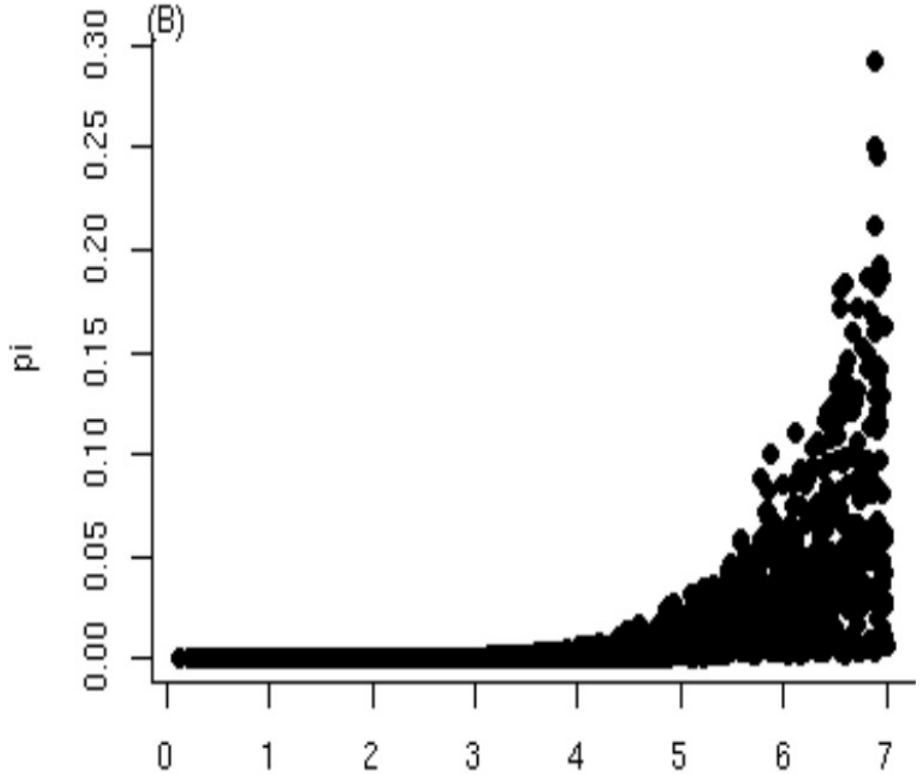
Transmission model

SEIR+V for humans



SEI for mosquitos
With seasonal
Recruitment

Pr(infection) = [0,0.3]

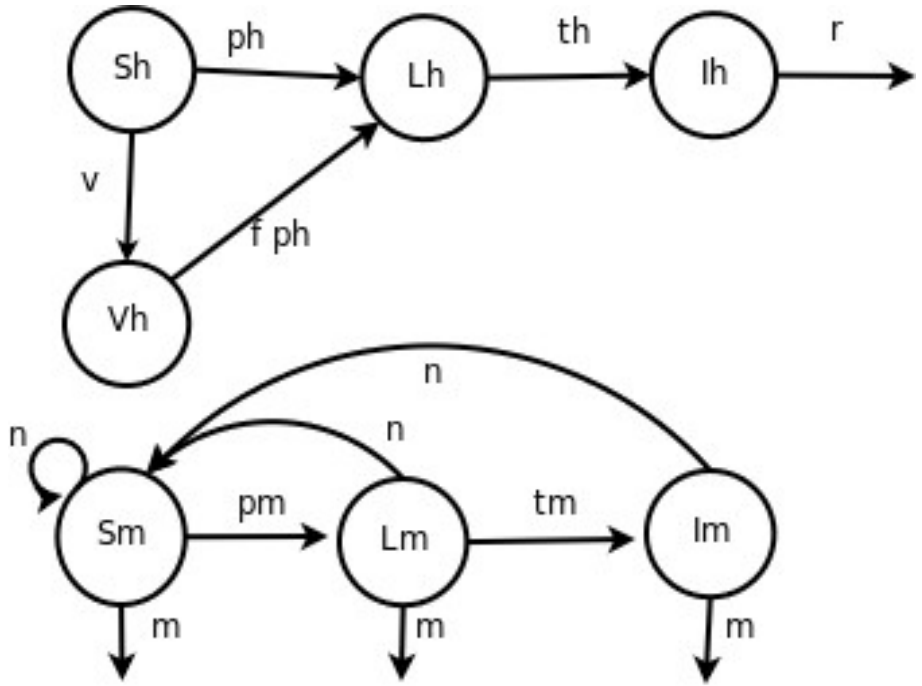


R0

Transmission model

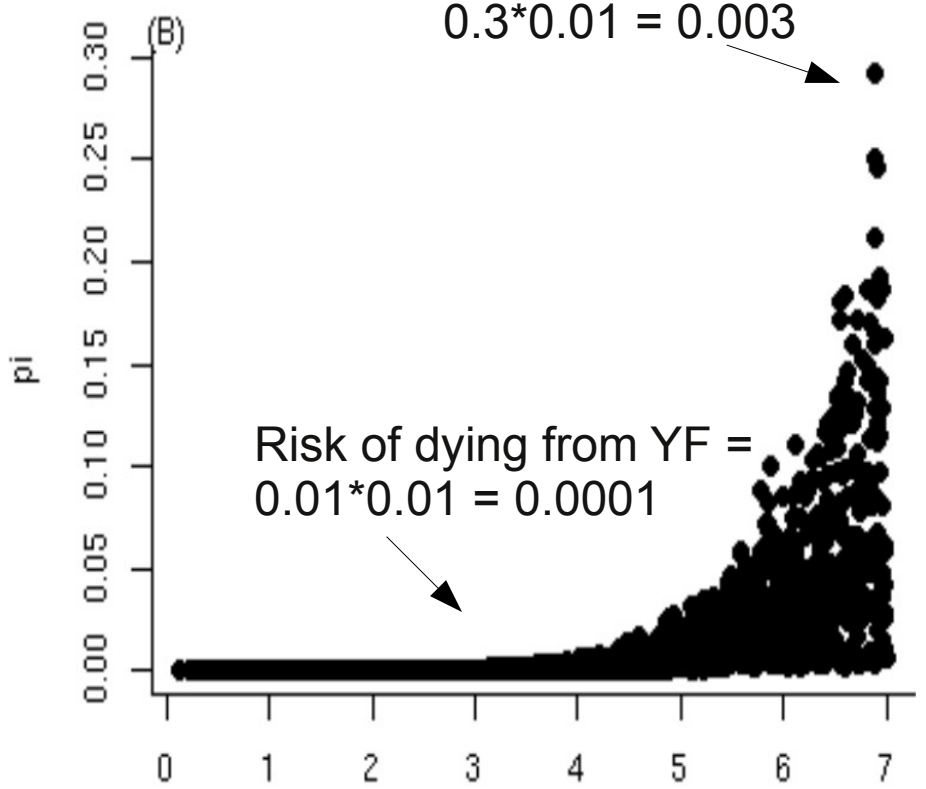
If YF was present:

SEIR+V for humans



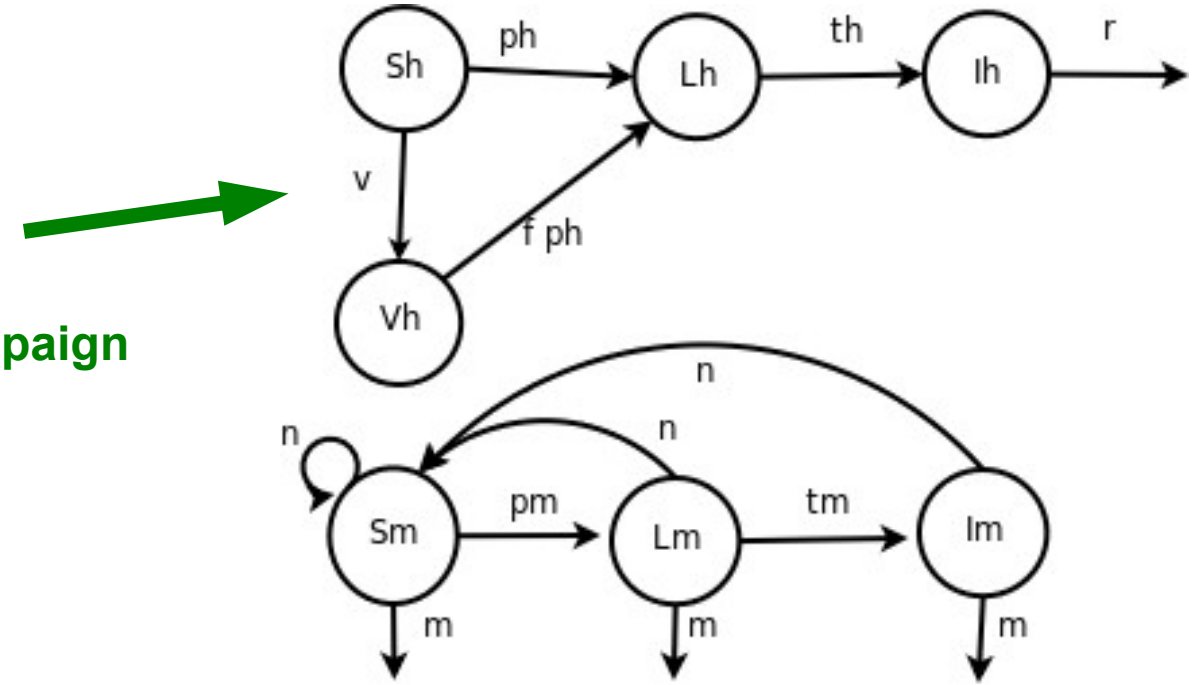
SEI for mosquitos
With seasonal
Recruitment

Risk of dying from YF =
0.3*0.01 = 0.003

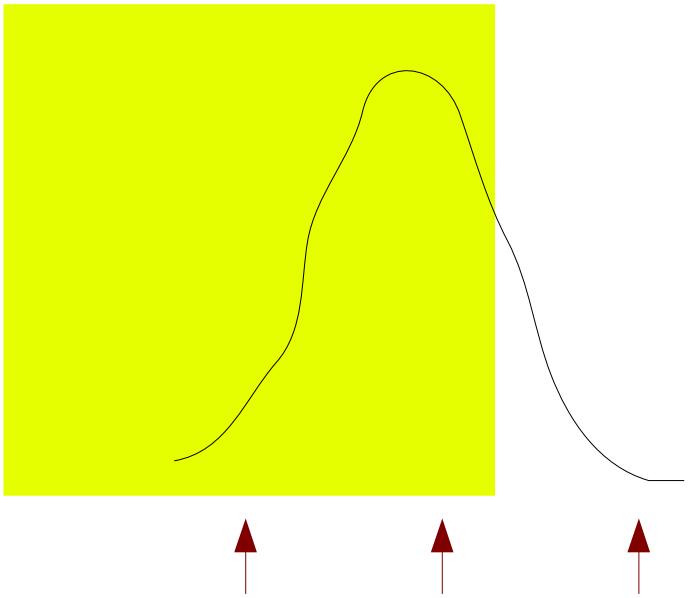


R0

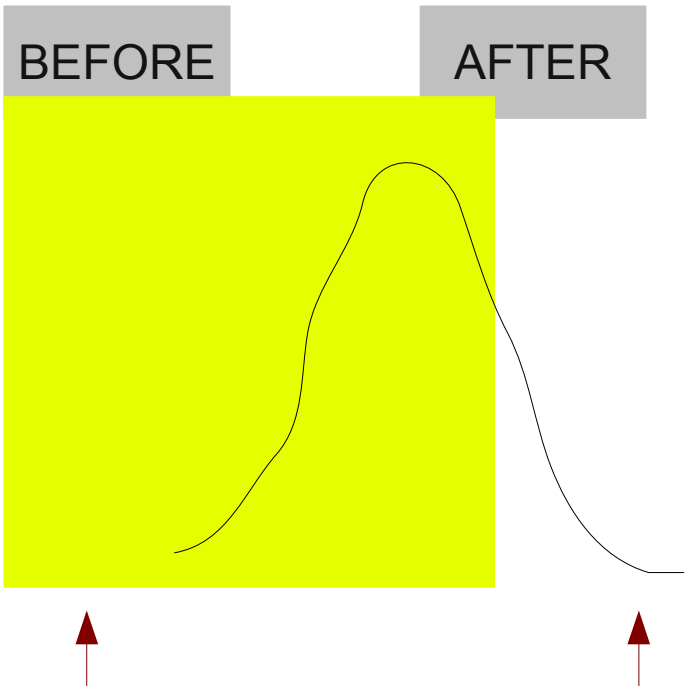
Vaccination campaign



V very small: slow campaign
V large: fast campaign



Results: What if one expects a very slow vaccination campaign?



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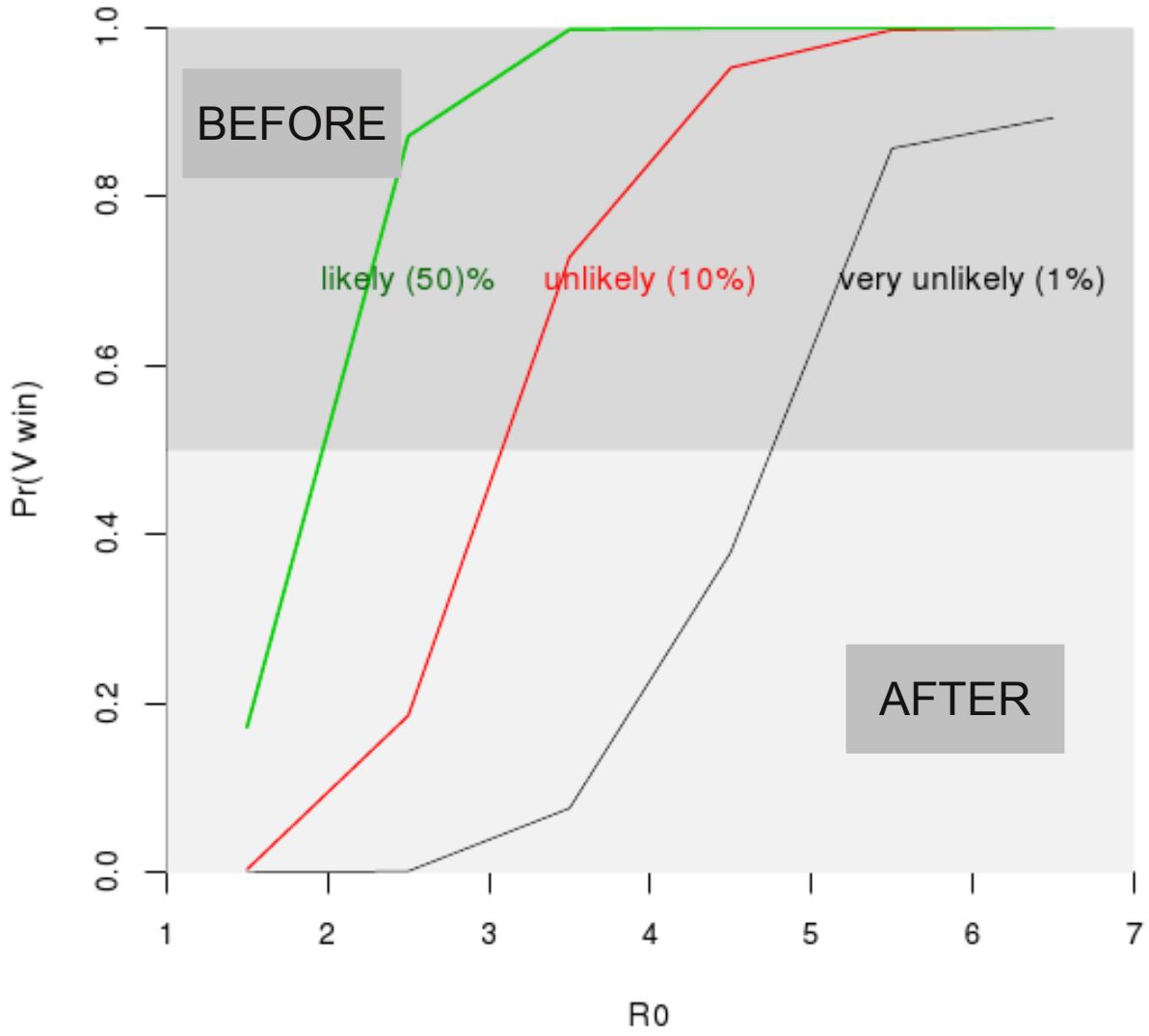
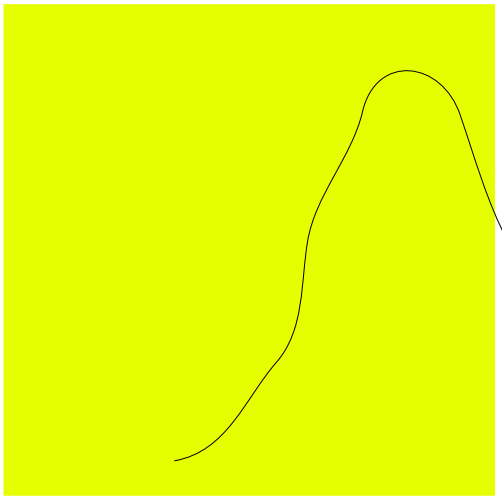
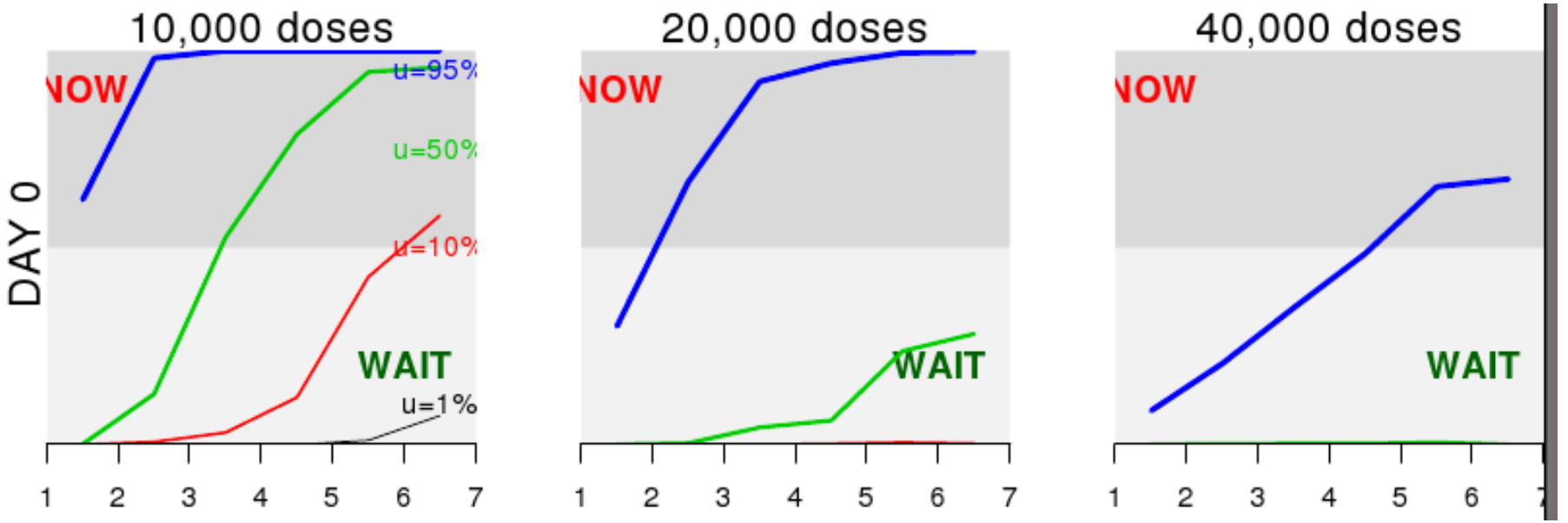
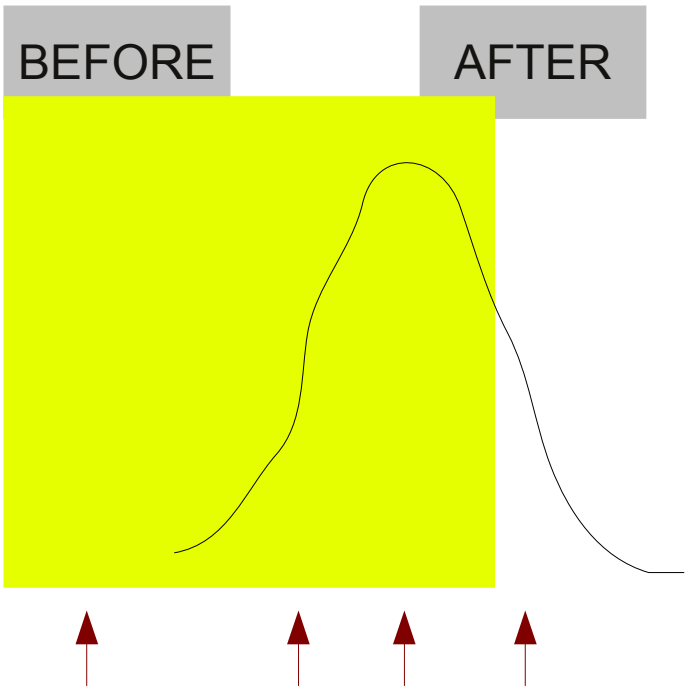




Decision is highly dependent on U
But reductions in R0 brings decision towards „waiting“!

What if one expects a more effective vaccination campaign?





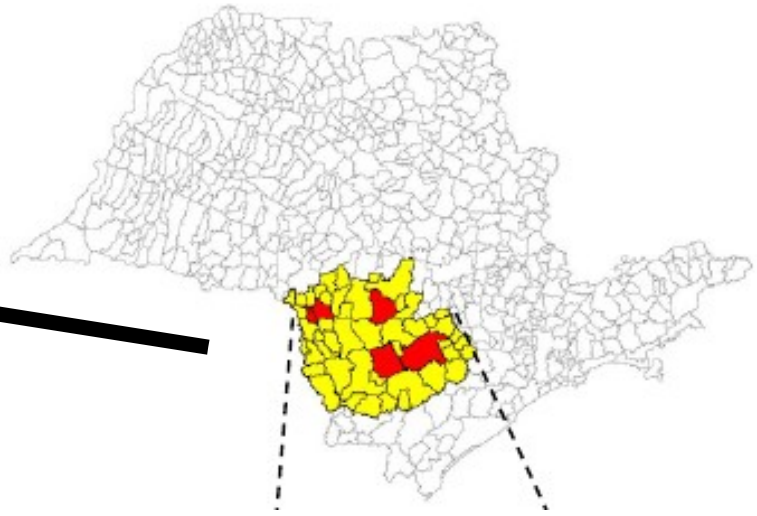
The more effective the response (speed and strength) the best is the strategy of waiting

Our results support The current strategy:

- Surveillance of sylvatic activity
- Localized vaccination campaigns
- Vaccination only in endemic areas And travellers

Problem that remains:

- How to estimate risk of arrival?



Related questions...

- Should we get the influenza shot?
- In what conditions, should we start investing resources in 'not present' diseases?
- What is the benefit of 'specific' versus 'generalist' strategies for mitigating the risk of 'not present' diseases?