How dengue control can affect Zika related mortality and morbidity

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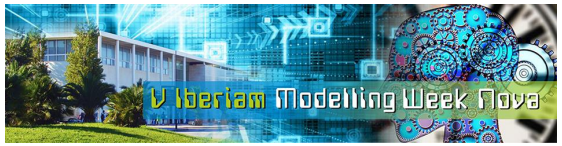
What is Zika vírus infection?

- Zika virus disease is caused by a virus **transmitted** primarily by Aedes mosquitoes.
- **Symptoms** are generally mild and include fever, rash, conjunctivitis, muscle and joint pain, malaise or headache. Symptoms typically last for 2–7 days. Most people with Zika virus infection do not develop symptoms.
- Zika virus infection during pregnancy can cause infants to be born with microcephaly and other congenital malformations, known as **congenital Zika syndrome**.

In http://www.who.int/en/news-room/fact-sheets/detail/zika-virus



Zika Transmission

- Zika virus is primarily transmitted by the bite of an infected mosquito from the ***Aedes* genus**, mainly *Aedes aegypti*, in tropical and subtropical regions.
- *Aedes* mosquitoes usually bite during the day, peaking during early morning and late afternoon/evening.
- It is the same mosquito that transmits **dengue**, chikungunya and yellow fever.
- Zika virus is also transmitted **from mother to fetus during pregnancy**, through sexual contact, transfusion of blood and blood products, and organ transplantation.

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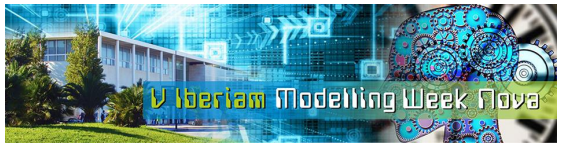

Zika Epidemiology

- It was first identified in Uganda in 1947 in monkeys and later identified in humans in 1952 in Uganda and the United Republic of Tanzania.
- Outbreaks of Zika virus disease have been recorded in Africa, the Americas, Asia and the Pacific.
- From the 1960s to 1980s, **rare sporadic cases** of human infections were found across Africa and Asia, typically accompanied by mild illness.
- The first recorded **outbreak** of Zika virus disease was reported from the Island of Yap (Federated States of Micronesia) in 2007. This was followed by a large outbreak of Zika virus infection in French Polynesia in 2013 and other countries in the **Pacific**.
- In March **2015**, **Brazil** reported a large outbreak of rash illness, soon identified as Zika virus infection.
- In October 2015, Brazil reported an association between Zika virus infection and **microcephaly**.

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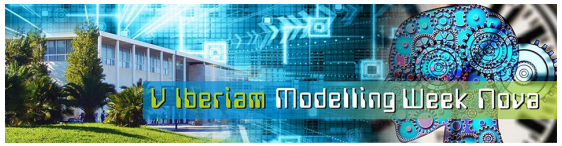


Modelling infectious diseases

How to build a compartmental model ?

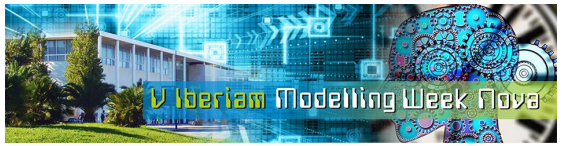
- Population level (human and vector)
- Population is divided depending on transmission status - classes
- Model describes transition between classes
- Model corresponds to a system of differential equations
- Model parameters describe rates of transition

On Dynamics and control of mosquito-transmitted pathogens - historical overview

On Mathematical epidemiology

On Ro definition

On Infectious diseases compartmental models



Propose a mathematical model (assumptions)

Parameterize upon real data

Compare predictions with real data

Predict disease transmission

Include control interventions

Make predictions

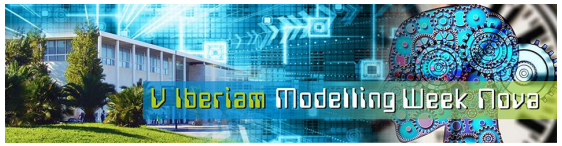
Our model assumptions

Zika and dengue in Brazil

- Recently, an outbreak in Brazil was associated with an unexpected increase of microcephaly in newborns. In fact, a pregnant woman can pass Zika virus to her fetus during pregnancy, causing microcephaly and other severe fetal brain defects.
- Dengue is an endemic disease in Brazil, where the mosquito population has been controlled as a public health measure.

On Zika outbreak in Brazil

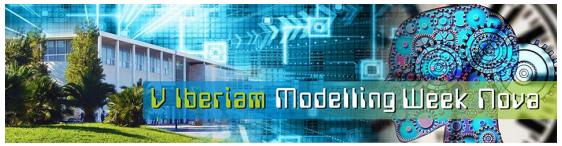
On Zika outbreaks in the Americas



Average age at infection

- Mosquito control impairs both diseases transmission and is expected an increase in the average age of infection in the human population
- This may increase the incidence of Zika in fertile and pregnant women, thus leading to more cases of fetal malformations.
- On the other hand, it is expected a decrease in the total number of Zika infections

On Increased age at infection (rubella in Greece)



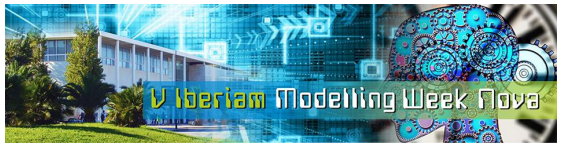
Problem 1

How dengue control can affect Zika related mortality and morbidity

Tasks

Tasks

- Build a model for Zika virus transmission
- Study Disease free and endemic equilibria
- Compute R_0
- Include vector control (for dengue)
- Compare average age at infection with and without vector control at endemic equilibrium
- Analyse impact of vector control for congenital Zika syndrome
- Propose alternative/complementary control measures



Simulation Tools

- GNU Octave