The relevance of Zika epidemiological modelling studies in informing public health policies during the first wave of the Zika epidemic

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Introduction

- Unusual increase of cases of microcephaly among newborns in the state of Pernambuco (Oct 2015) and Public Health Emergency of International Concern (Feb 2015)
- Outstanding increase of Zika virus disease research : pathogenesis, epidemiology, risk and infectious disease modelling, diagnostics, therapeutics and vaccines
- Challenges for public health to translate scientific knowledge into Zika virus prevention and control

Objectives

- Review epidemiology and especially on infectious disease modelling research published in the "acute phase" of Zika epidemic
- Relevance for public health

Methods: Literature search

Systematic search "Zika" on biomedical literature database (Pubmed and Embase) and preprint servers
Period: Nov 2015 to Jan 2017
n= 3176

Selection on title and abstracts, **n= 157**
Inclusion: epidemiological studies and infectious disease modelling

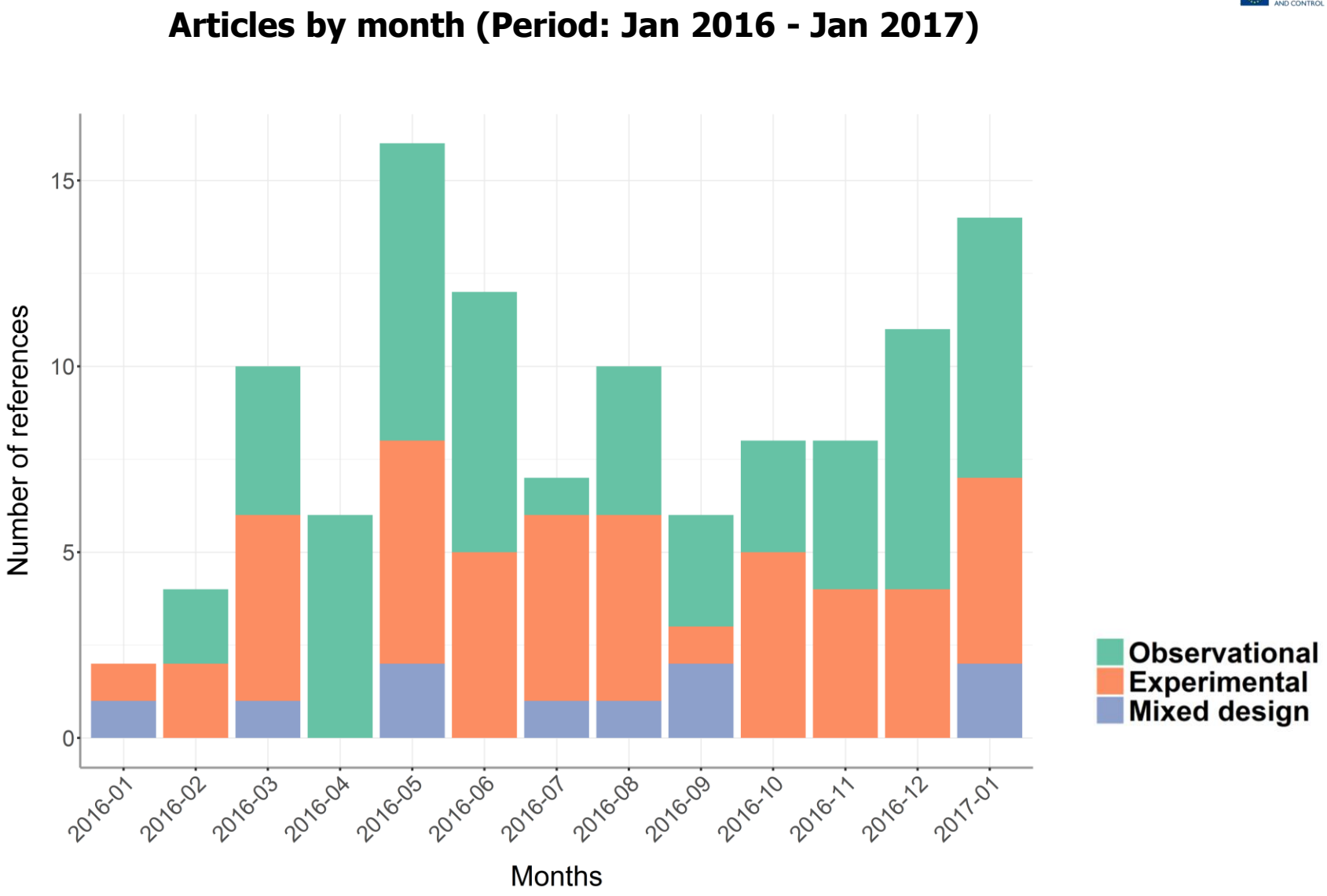
Exclusion: genetic study, literature review, cell biology, laboratory diagnostic and vaccine development

Second review on full text , **n= 114**
Data extraction metadata (study design, publication date, PH relevance)

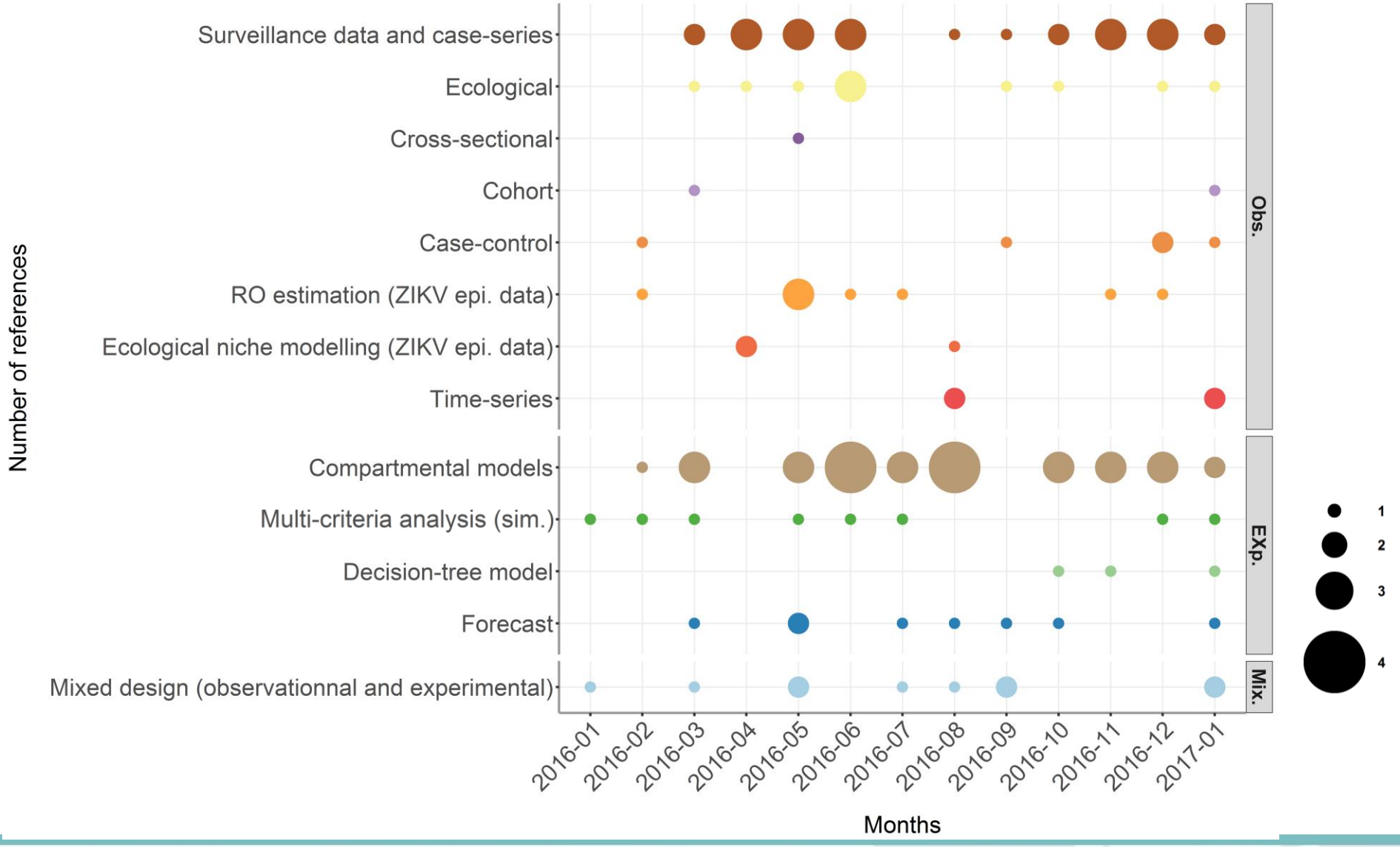
Results: outline of selected studies

Observational studies	
Descriptive	
Surveillance data and case-series	23
Ecological	10
Analytical	
RO estimation (estimated from ZIKV epi. data)	8
Case-control	5
Time-series	4
Ecological niche modelling (using ZIKV epi. data)	3
Cohort	2
Cross-sectional	1
Experimental studies	
Theoritical simulation	
Compartmental models	29
Forecast	8
Multicriteria analysis	8
Decision-tree model	3
Mixed design studies	
Mixed design (observationnal and experimental)	10
Total	114

Results: time trend



Results: time trend by study design



Results

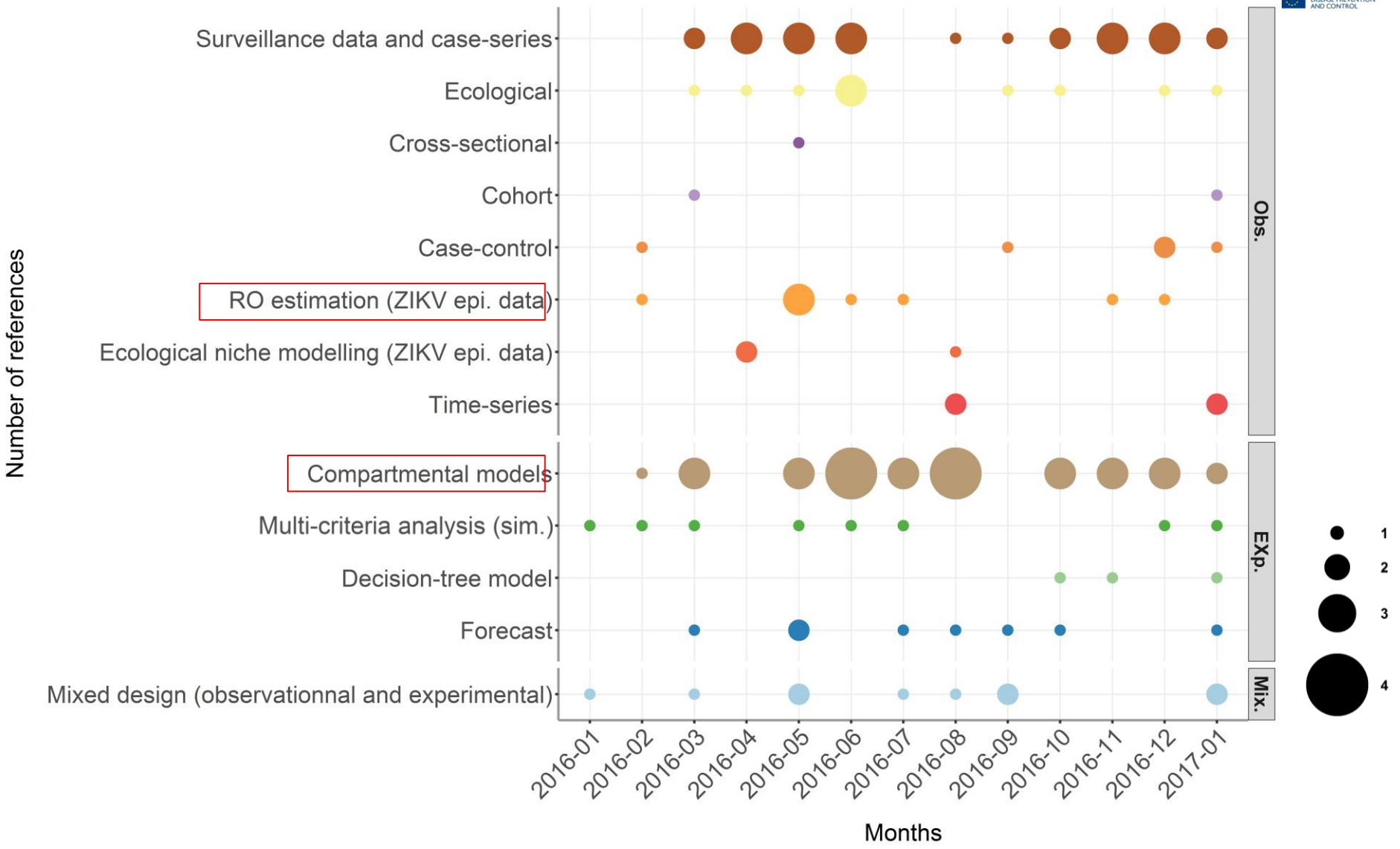
- Descriptive studies: surveillance data
- Observational analytical studies: risk assessment
  - Delays for specific target group (adverse outcomes during pregnancy and neonates follow-up)
  - standardized research protocols[1]
- Ecological studies remains of interest (co-factors)
- Experimental (theoretical simulations)
  - Spread into specific settings/group and epidemic pattern
  - Multi-criteria analysis and comprehensive study with mixed design: relevant but not standardized

Relevance

- Paramount importance for public health early phase of an a PHEIC
- Period at risk and co-factors

1: http://www.who.int/reproductivehealth/zika/en/

Results: reproductive number



Results: reproductive number

- Large number of articles (n=37, 27%): preprint servers and peer-review publications
- Estimated from epi-data vs compartmental models
- Complexity increase over time

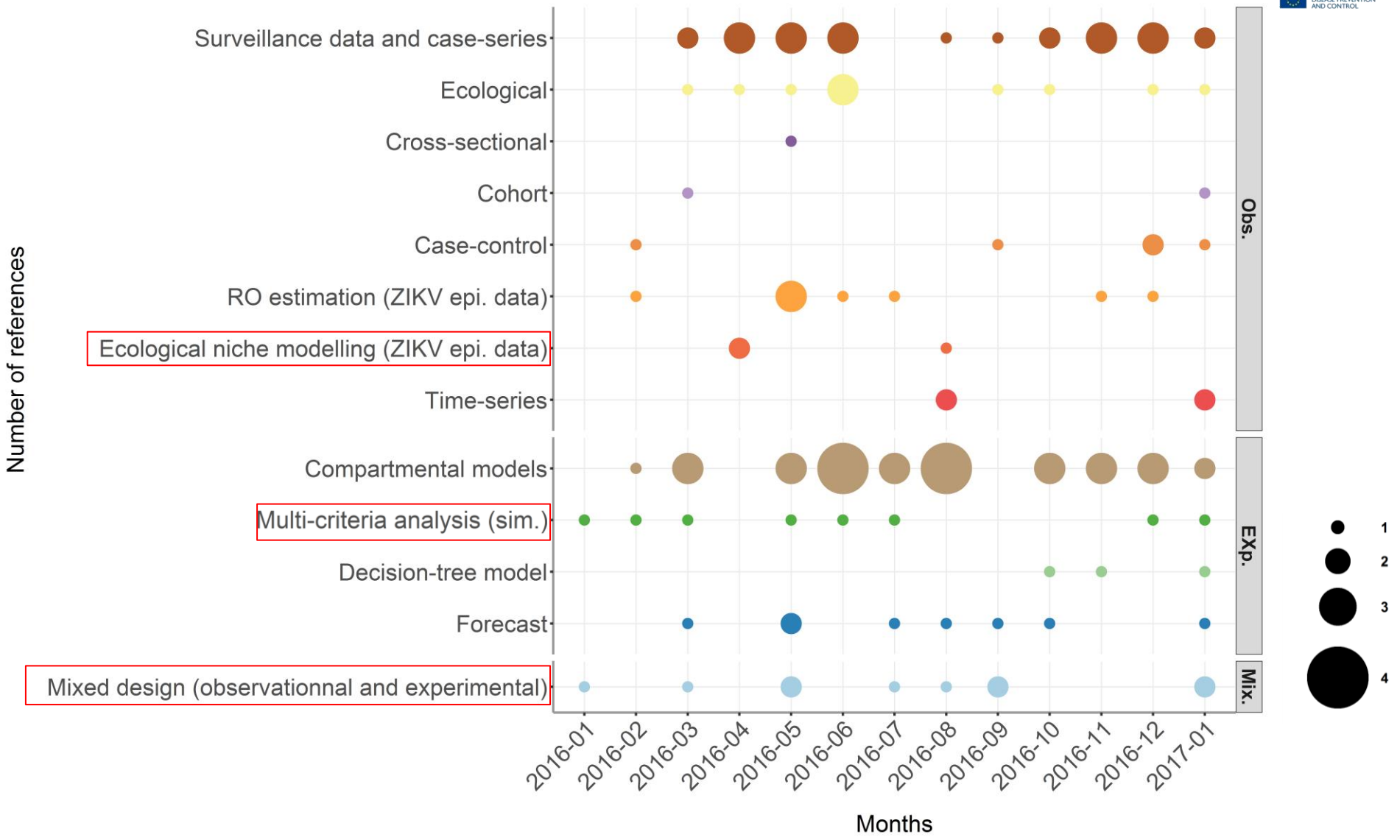
Limitations

- Initially limited knowledge on
  - entomological parameters (EIP, vector competence & vectorial capacity, vertical transmission, temperature dependence)
  - epidemiological parameters (ratio asymptomatic/symptomatic, transmissibility person-to-person …)

Relevance

- Assets for public health in an early phase of any PH emergency
- Challenge in assessing methods used and subsequent limitations
- Still limited number of compartmental models with a comprehensive assessment combining different modes of transmission

Results: ENM, multi-criteria and mixed design



Results: ENM and multi-criteria analysis

- Ecological niche models (ENM): ZIKV disease vs *Aedes* vectors
- Integration of multi-criteria approach (relevant covariates)
- Spatial model with vectorial capacity (expected epidemic behaviour)

Limitations

- Difference with reference to methods among studies: standardization
- Spatial resolution and time variations

Relevance

- Added-value to delineate of area(s): circulation is on-going or can be expected
- Spatially explicit epidemic model: front wave/outbreak forecast under climate forcing

Results: prevention and control

- Few observational and modelling studies on :
  - Cost-effectiveness
  - Vector control strategy effect on health outcomes (vector population)
  - Enzootic cycle and level of transmission modelling after outbreak
  - End-points for disease prevention, outbreak control, and risk assessment

Limitations

- Time to collect data on vector control strategy & health outcomes
- Multidisciplinary approach required
- Limited knowledge in the eco-epidemiology of Zika virus (vector and host)

Relevance

- Optimal vector control
- Integration of uncertainties and scenario

Conclusions

- Outstanding research outcomes replying to Zika virus disease emergence

- "PH priority list" of relevant studies
  - Observational analytical studies
  - Specificity of mosquito-borne disease and infectious disease modelling
    - reliable knowledge on entomological and ecological parameters (e.g. vector competence, reservoir)
    - epidemiological parameters (ratio symptomatic/asymptomatic, herd immunity, sexual transmission)
  - Include assessment of strategies and vector control interventions in outbreak settings
  - Mixed design: theoretical simulation and multi-criteria approach including scenario and uncertainties

Future research topics linked to Zika and public health

Observational studies

- Descriptive: regional ecological studies (additional co-factors at population level)
- Analytical : case-control and pregnancy and newborns follow-up (strength of the association, risk per trimester and risk factor(s))

Experimental studies: infectious disease modelling

- Vector-borne/not vector borne transmission (compartmental and network)
- Future transmission pattern and possible scenario taking into account different potential drivers of endemicity (vector(s), host(s) herd immunity, meta-stability)
- Levels of transmission post-invasion & endemic setting under different scenario