Towards a better understanding of Highly Pathogenic Avian Influenza (HPAI) transmission in France

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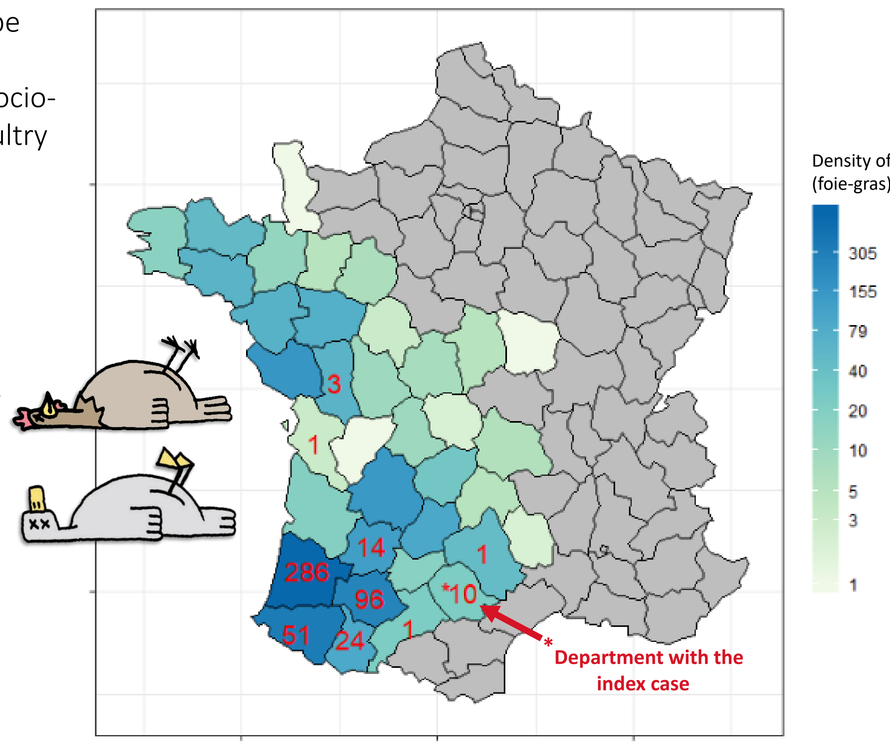
Background

- During the winter of 2016-17, Europe experienced **an unprecedented epidemic of H5N8** that had severe socio-economic consequences for the poultry sector…

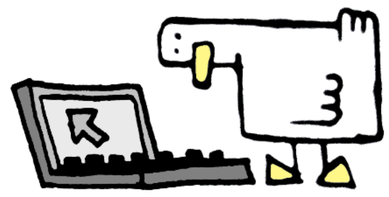
- The southwest of France was the most affected with **484 reported infected premises**
- Approx. **7 million of poultry were culled.**
- **HPAI** has caused severe perturbations to poultry production…

→ So there is a need to determine all the most important transmission routes as well as optimal control strategies that can stop avian influenza virus (AIV) transmission on its track.

Frequency of reported HPAI H5N8 cases in *red* (2016– 2017)



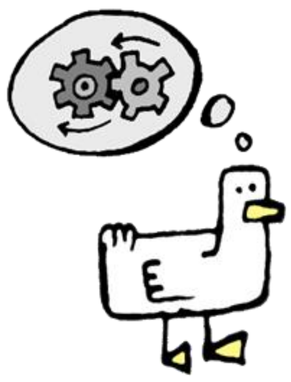
" All hands on board… I don't want to die before my time. ***One world, one health!"***



Ph.D. objective: Assess the use of mathematical models to define, adapt surveillance and intervention strategies in the situation of an animal disease emergence in real-time.

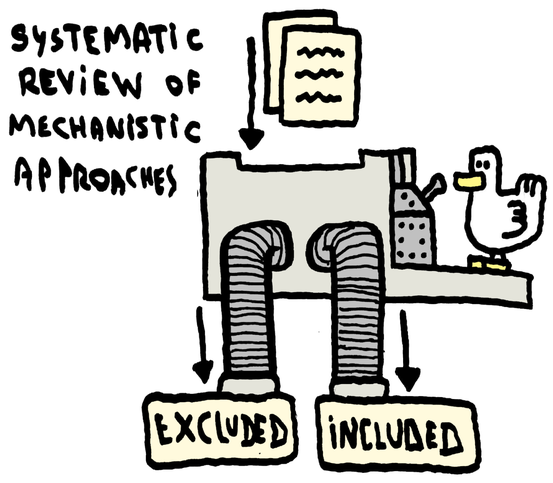
Research questions

- What are the **most important transmission routes**?
- What are the **control strategies** that can be implemented to facilitate effectives mitigation strategies?
- Can we **predict** the trajectory of the spread and determine **the best control strategies in REAL-TIME** (which, where, when) ?



Preliminary work: Systematic review of mechanistic approaches to study AI epidemics

- What are the **mathematical modeling** approaches (including or not control strategies) that have been used to study **Avian Influenza (AI)** epidemics?



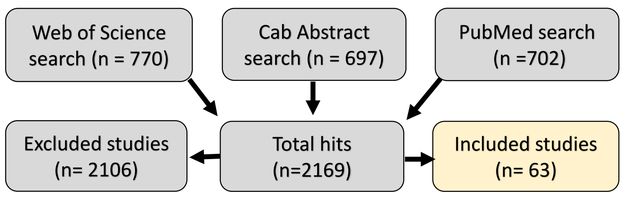
Objectives:

1. Describe the **epidemiological contexts** in which mathematical models have been applied to AIV
2. Provide an **overview** of the different **mechanistic modeling** approaches that have been used to study AIV transmission
3. Identify and discuss the **epidemiological insights** gained from the models
4. Identify **gaps** and future **challenges** for modeling

Data extracted:
Modeling approaches: Stochastic, Deterministic
Models' paradigms: Compartmental, Metapopulation, Network, IBMs
Epidemiological unit: bird, flock, farm, market, city,…
Subtypes: H5N1, H5N2, H7N9, etc.…
Control strategies: Culling, vaccination, zoning, disinfection, …

Main results of the systematic review

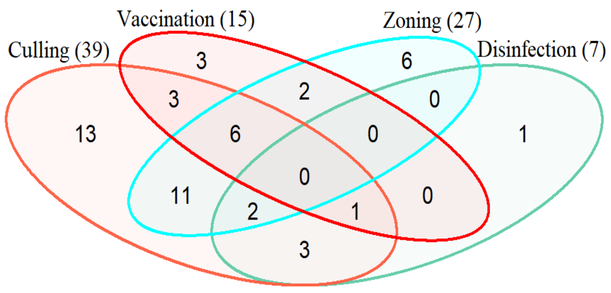
Flow diagram of the selection process for including studies in the review



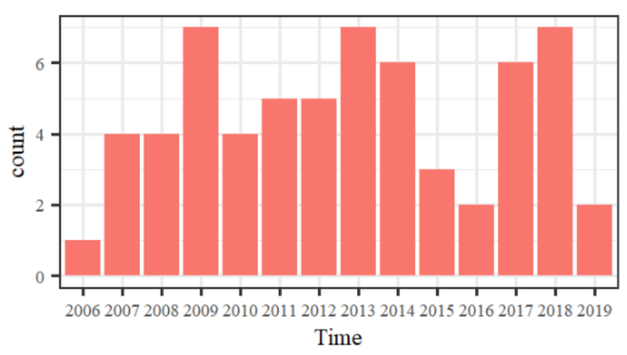
Most commonly AIV subtype found in the review

H5N1	H7N7	H7N9
35	5	4

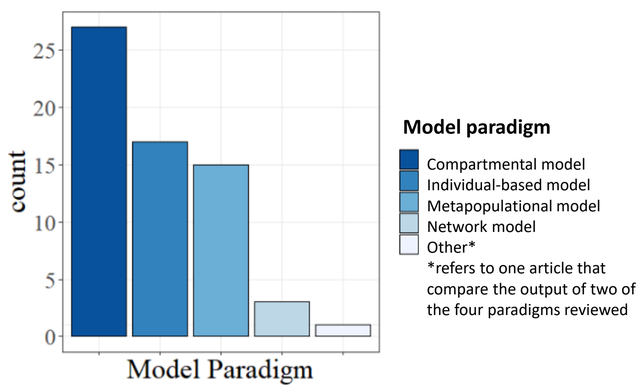
Control strategies most frequently found in the included papers.



Publication trend of Avian Influenza modeling papers

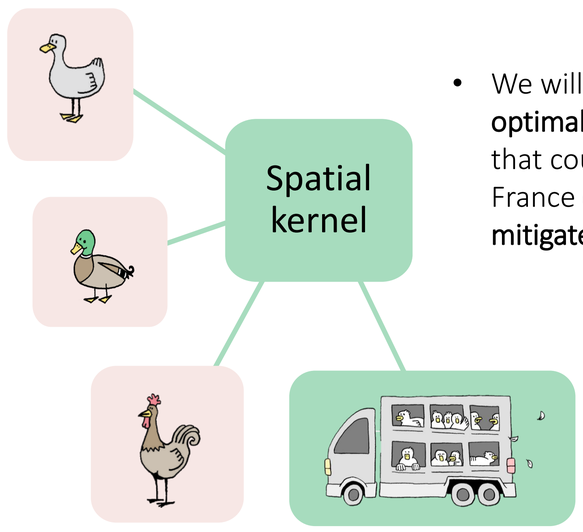


Frequency of mechanistic modeling paradigms that were used to study AI propagation.



Perspective: Modeling the spread and determine the optimal control measures

- We will create a model that incorporate various transmission routes (e.g. movement of live and dead birds) to estimate the **parameters of a variety of transmission kernels** and assess the importance of the included **transmission routes.**



- We will also identify the **optimal control strategies** that could be used in France or elsewhere to **mitigate AIV spread.**

- Finally, with a well-defined model at the national-level, we will use retrospective epidemic data to **predict "in real-time" where and when the virus is most likely to spread and the optimal control strategies that are expected to be the most effective.**

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