

A stochastic metapopulation model of swine influenza A virus dynamics within a farrow-to-finish farm: factors related to virus enzootic persistence



Cador C.¹, Rose N.¹, Bruckert A.¹, Mahé F.², Andraud M.¹

charlie.cador@anses.fr

¹Anses Ploufragan/Plouzané laboratory, Swine Epidemiology and Welfare unit, Po Box 53, 22440 Ploufragan, France

²Mathematics research institute of Rennes, Campus of Beaulieu, 263 General Leclerc Avenue, Po Box 74205, 35042 Rennes, France

Swine Influenza A Virus (swIAV)



Infect weaned piglets (possibly still having maternally derived antibodies MDA) at a **fixed-age** with recurrent occurrence in **successive batches**

Impact of proximity between breeding sows and growing pigs compartments on the within-herd swIAV persistence and recurrence ?

Objectives

Analyze the persistence and recurrence of swIAV in farrow-tofinish pig herds reared with different batch-rearing systems

Materials & Methods

The stochastic metapopulation model



- Fixed-time events
- Binomial process for the culling-replacement

Results & conclusions

The *swIAV* epidemiological model



> SIR model for piglets and sows Partial protection conferred by MDA ✓ M: pigs with MDA $\checkmark I_m$: infected pigs with MDA \succ Reinfection after immunity waning ✓ *Faster and stronger response* ✓ Gamma distribution for immunity waning \blacktriangleright Parameters from the literature^{1,2}

Sensitivity analysis on uncertain parameters

Simulated dynamics (10-batch-rearing system, $\beta_{air} = 0.5$, 100 simulations)

	<u> </u>	 	 		
10					-

Impact of the airborne between-batch transmission rate



Recurrent swIAV outbreaks in sow & piglet compartments as observed in field conditions²

Survival analysis of swIAV within-herd persistence (100 simulations per scenario)





Impact of the batch-rearing system

- Perspectives
 - Perform a sensitivity analysis on the duration of active immunity (1/ σ) and the memory effect of the immune system δ
 - Taking into account the circulation of several subtypes and the generation of reassortants potentially more pathogen and zoonotic

¹Allerson et al., *Vaccine*, 2013; ²Rose et al., *Vet. Res.*, 2013