Transmission dynamics of H9N2 Avian Influenza virus in a Live-Bird market in Chattogram, Bangladesh

Pinotti F[1], Kohnle L[2,3], Lourenço J[1,4], Pfeiffer D[2,5], Hoque MA[6], Biswas PK[6], Fournié G[5]

[1] University of Oxford, Oxford, United Kingdom
[2] City University of Hong Kong, Hong Kong
[3] European Food Safety Authority, Parma, Italy
[4] Biosystems and Integrative Sciences Institute, Lisbon, Portugal
[5] Royal Veterinary College, University of London, London, United Kingdom
[6] Chattogram Veterinary and Animal Sciences University, Chattogram, Bangladesh

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Introduction

- H9N2 Avian Influenza virus (AIV) negatively affects poultry industry and human health (*Sun et al, Protein & Cell, 2015*).
- H9N2 AIV is prevalent in Live-Bird Markets (LBMs) in Bangladesh (*Turner et al, Emerging Microbes & Infections, 2017; Kim et al, Emerging Infectious Disease, 2018*).

Our aim:

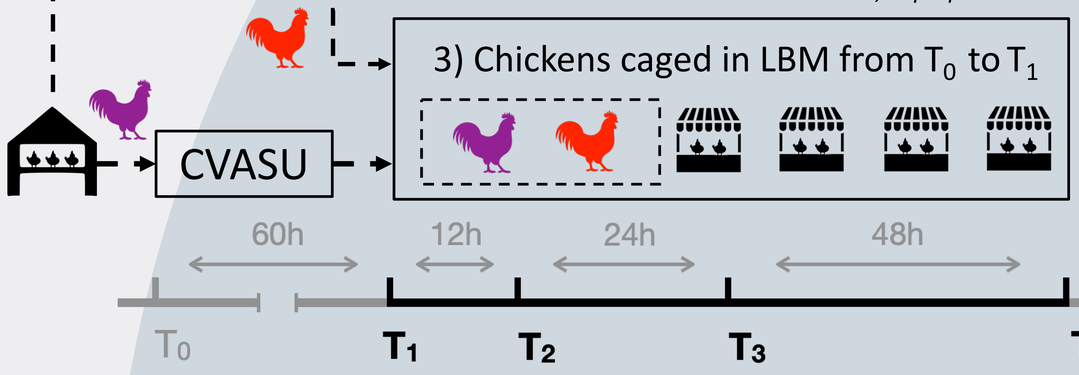
- Investigate H9N2 transmission in an LBM in Chattogram.
- Infer relevant epidemiological parameters.
- Assess impact of interventions to reduce H9N2 burden.

Field experiment

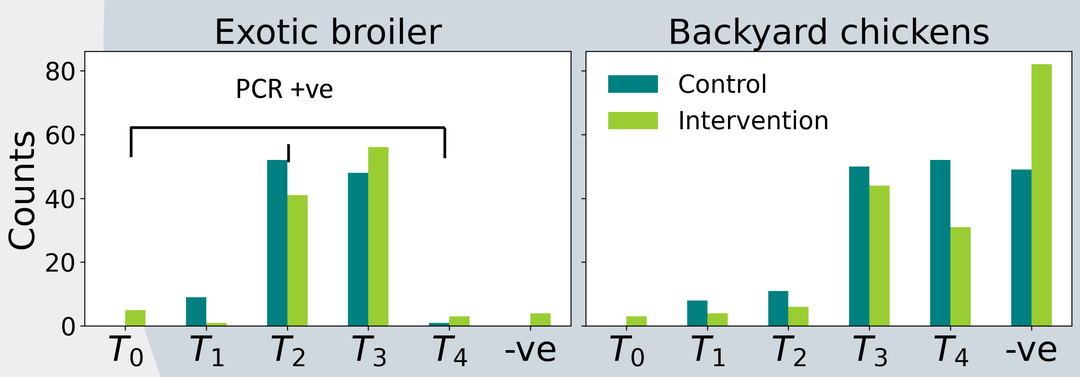
1) Intervention arm: 5 chickens recruited at T_0 from farm and stored at CVASU until T_1

2) Control arm: 5 chickens recruited at T_1 from LBM vendor

Kohnle et al, in preparation

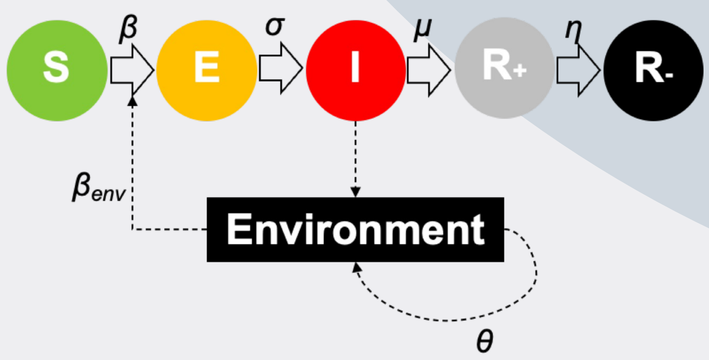


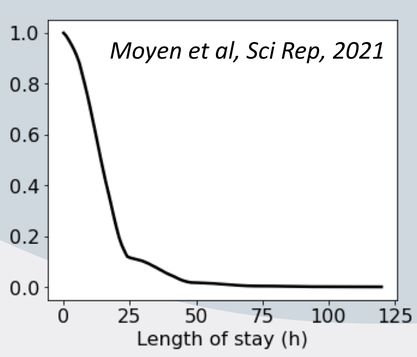
- Chickens PCR-tested at recruitment ($T_{0,1}$) and at LBM ($T_{1\text{-}4}$).
- Repeat many times with broiler and backyard chickens.



Epidemic Model

Susceptible-Exposed-Infectious-Recovered (SEIR) model with direct (β) or environmental (β_{env}) transmission. Marketed chickens' length of stay given by empirical distribution (right).

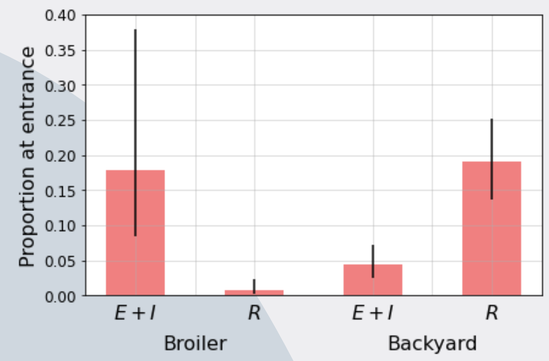


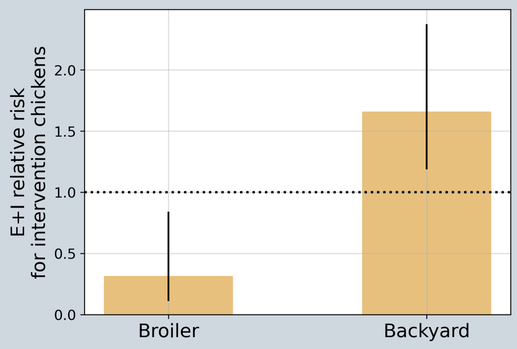


- σ: infectiousness onset rate
- μ: recovery rate
- η: undetectability rate
- θ: environment decay rate

Results

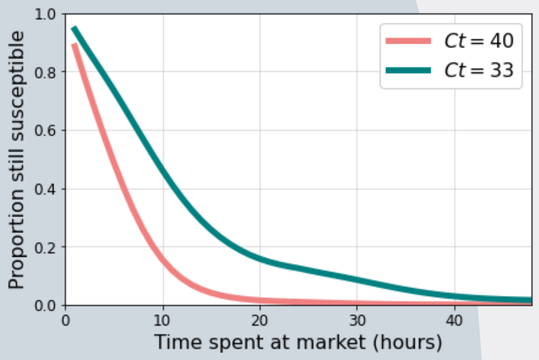
- 18% incoming broilers are latent or infectious (E+I)
- 19% incoming backyard chickens are recovered (R)





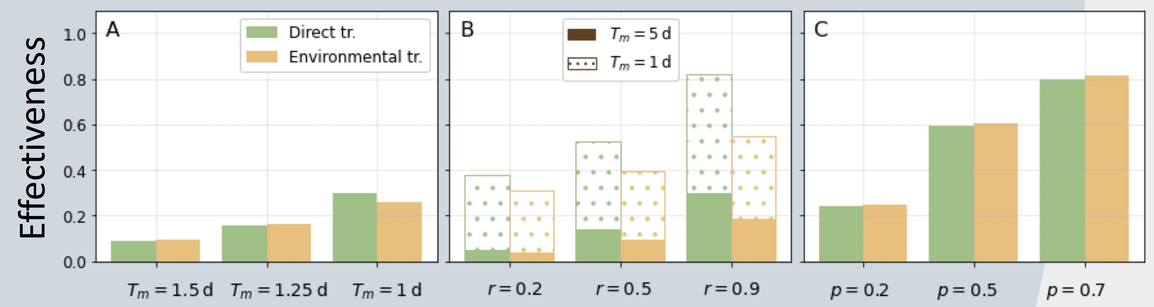
Smaller (larger) odds of recruiting E+I broiler (backyard) chickens in intervention group.

More than 80% of chickens become infected within 1 day.

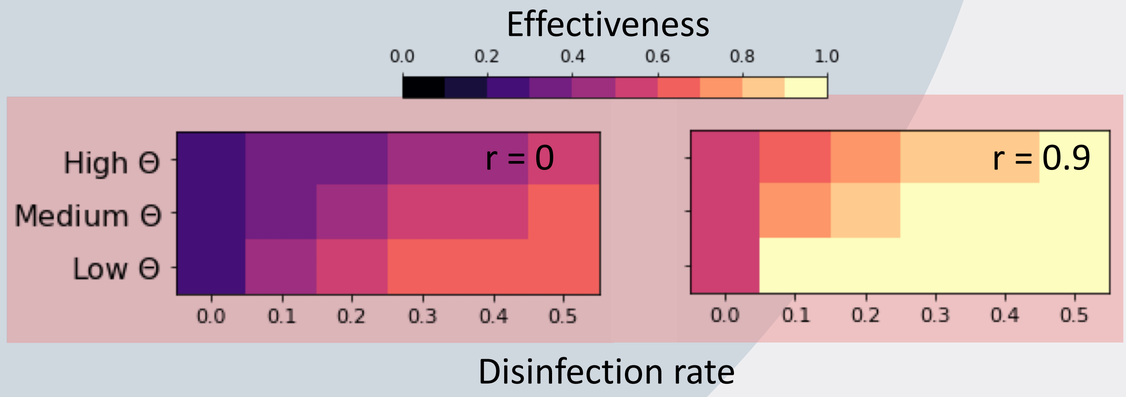


Interventions

- Reducing length of stay T_m (A) or preventing infected chickens from entering the market (B) not much effective unless combined together.
- Widespread vaccination appears effective (C) .



LBM disinfection is also valuable if environmental dynamics is slow (low θ).



Conclusions

- LBMs amplify H9N2 transmission.
- Transport contributes to viral amplification.
- Multi-pronged approach needed to reduce H9N2 burden.
- Next: investigate role of LBMs in the context of production and distribution systems.

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