Transmission mode determines contact structure and drives pathogen characteristics

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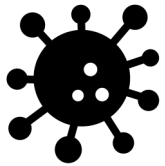
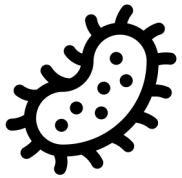
Introduction and Hypothesis



What we know:



The traits of pathogens vary! For example:

- ✓ Virulence
- ✓ Infectivity
- ✓ Duration of infection

These traits can determine their ability to persist and infect a population.

In addition, pathogens can transmit via a range of contact events, facilitated by different host behaviors:

Respiration

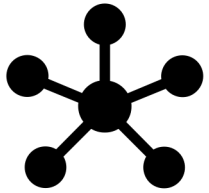
Physical Touch

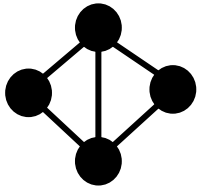
Mating

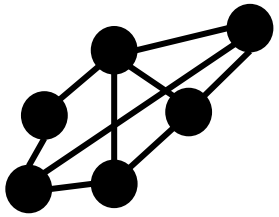
Hypothesis: Different host behaviors give rise to differences in contact network structure, constraining the space over which pathogen traits can evolve to maximize fitness.

Data and Methods

We analyzed 207 contact networks of 55 animal species to investigate the impact of behavior type on contact structure







Grouped networks into 3 transmission categories based on the behavior that described the network:

1. Sexual/Fluid Contact (13 species)
2. Physical Contact (25 species)
3. Non-physical Contact (17 species)

Used a multivariate generalized linear mixed model to examine how network structure is predicted by transmission behavior:

Network Structure ~ Transmission Behavior

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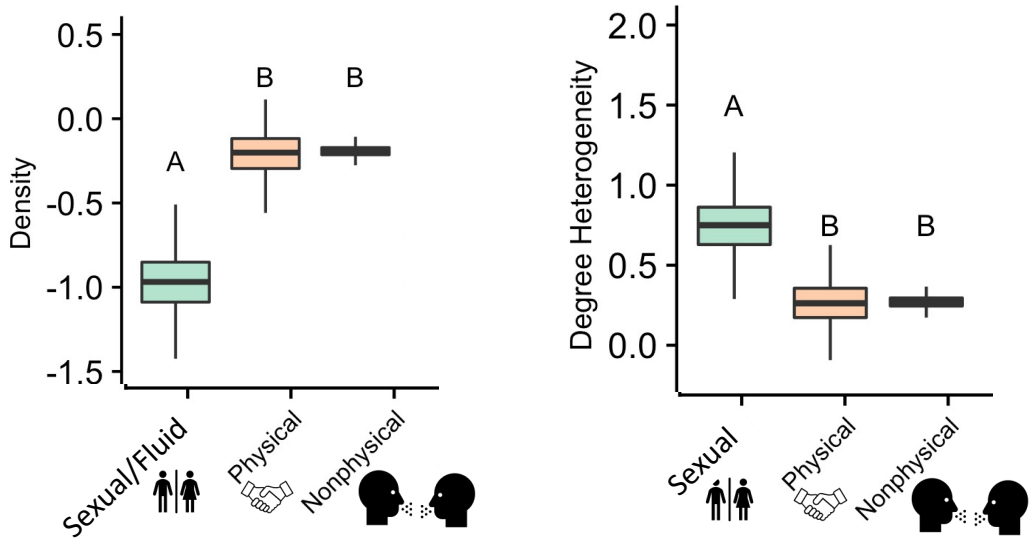
Network structure is unique to sexual/fluid exchange transmission behaviors

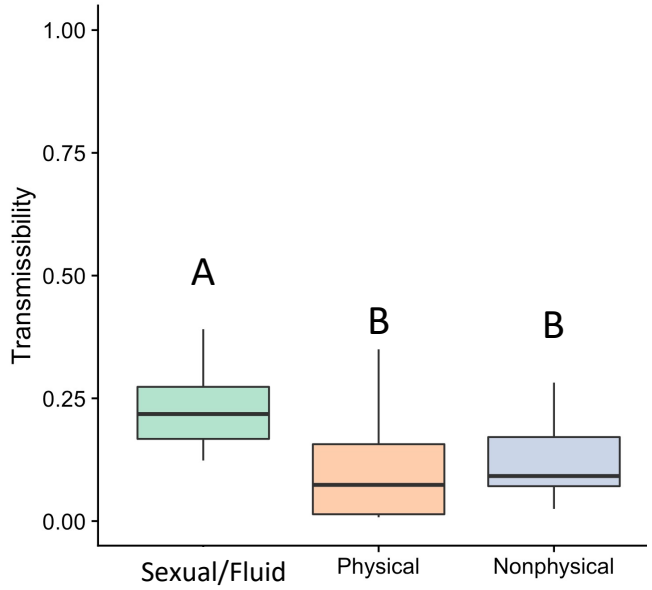


Sexual/Fluid Exchange Networks have **LOW Density** and **HIGH Degree Heterogeneity**

So, when compared to networks representative of physical and nonphysical contact, these networks are:

- Less Connected
- More varied in between-individual number of contacts

Pathogens must be more transmissible to persist on sexual/fluid exchange networks



$$Transmissibility\ (T) = \frac{\beta}{\beta + \frac{1}{G}}$$

β = Risk of Transmission (i.e. contagiousness)
G = Infectious Period

When a pathogen is mathematically simulated to transmit on each contact network, it must have a higher T value to persist ($R_0 \geq 1$ for the simulation) on the sexual/fluid exchange networks.

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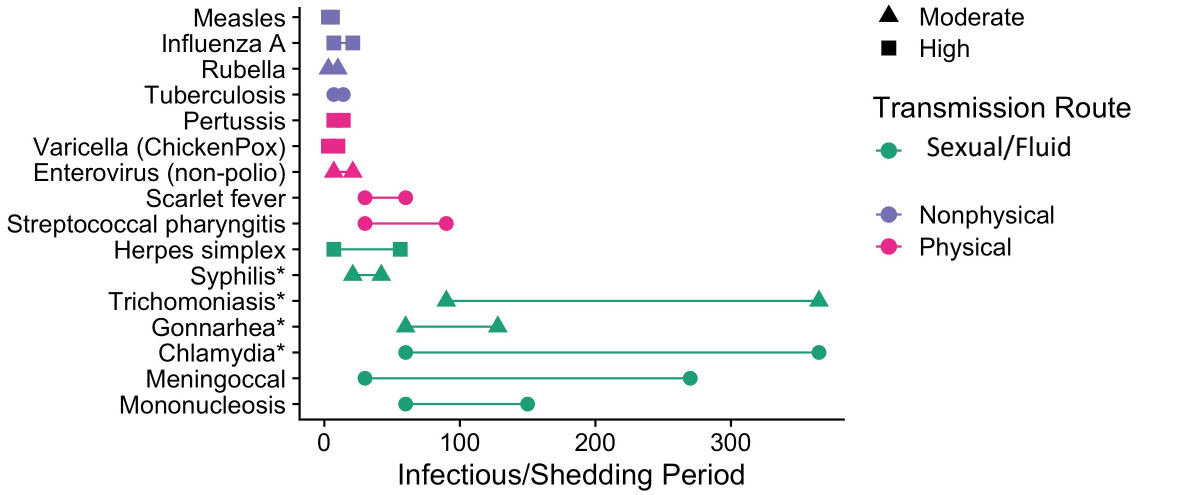
Sexually transmitted pathogens have evolved longer infectious periods relative to other pathogens

T is a function of β and Infectious Period.

- Evolutionary tradeoff between the two
- Maximize one or the other



Through a literature review of some common pathogens' traits, we suggest that **pathogens transmitted sexually or through fluid exchange** have **evolved longer infectious periods** relative to other pathogens traveling on less sparse contact networks.

Conclusions and Acknowledgements

Our work demonstrates that contact network structures can drive the evolution of compensatory pathogen traits according to transmission strategy, providing essential context for understanding pathogen evolution and ecology.

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