Human Activity Shapes Infectious Disease Dynamics: Social Division, Misinformation, and Climate Change

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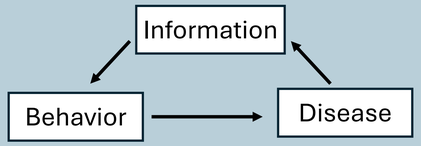
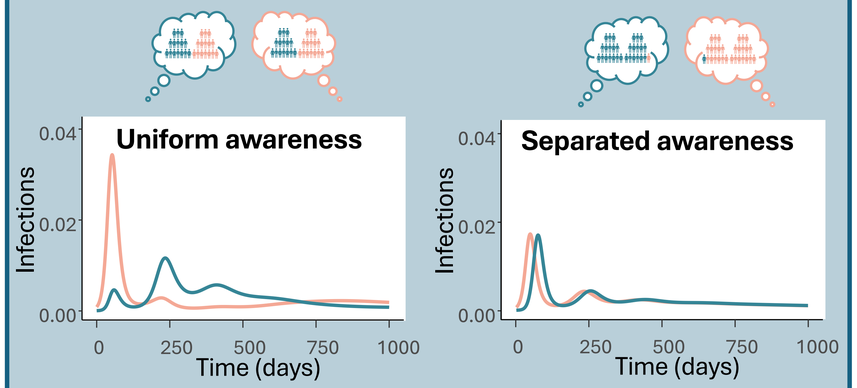
How do **social division** and perceived risk affect epidemic dynamics?

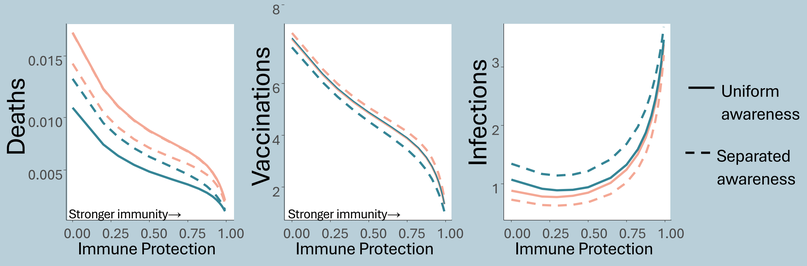


We developed a compartmental **awareness-based** model of disease transmission and behavior in two groups.

Awareness separation is when members of a particular group are more aware of deaths within their own group.



Uniform awareness can lead to large second and third waves.
Separated awareness can reduce between-group differences.



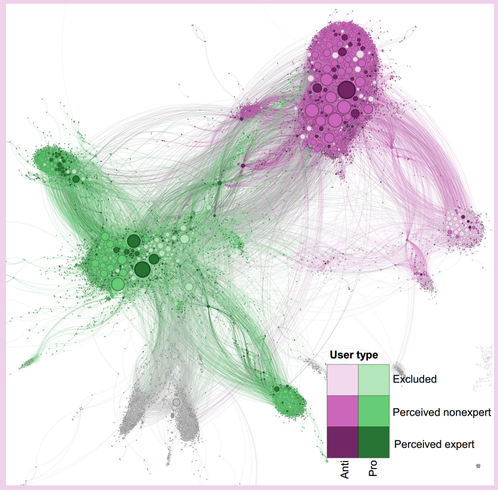
Stronger immune protection can lead to more infections because fewer people get vaccinated with fewer deaths.

Interplay between disease and behavior can produce complicated, counterintuitive dynamics.

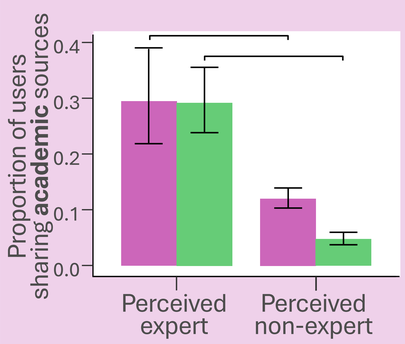
Harris MJ, Cardenas KJ, and Mordecai EA (2023). Social divisions and risk perception drive divergent epidemics and large later waves. *Evolutionary Human Sciences*. doi: 10.1017/ehs.2023.2

How important are perceived experts in the anti-vaccine **misinformation** community?

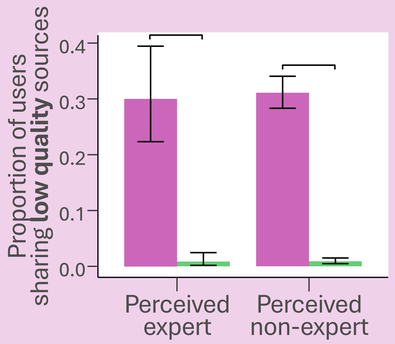
Perceived experts have biomedical credentials in their profiles.
We analyzed 4.2M tweets about Covid vaccines from April 2021.



Perceived experts in the anti-vaccine community are disproportionately central and receive significantly more engagements (retweets, likes) compared to a matched set of perceived non-experts.



Perceived experts share **academic** sources.



Anti-vaccine users share **low quality** sources.

Perceived experts are prevalent and important in the anti-vaccine community on Twitter.

Harris MJ, Murtfeldt R, Wang S, Mordecai EA, and West JD (2024). Perceived experts are prevalent and influential within an antivaccine community on Twitter. *PNAS Nexus*. doi: 10.1093/pnasnexus/pgae007

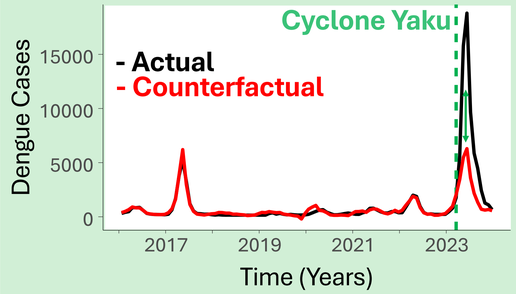
How much is **climate change** contributing to dengue burden in Peru?

Anthropogenic activity → Extreme weather → Disease

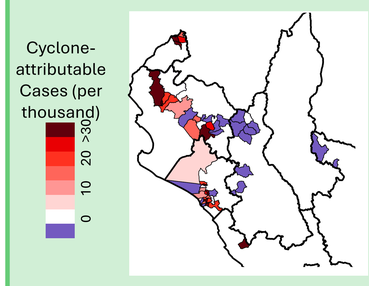
We used a generalized synthetic control model to estimate the causal effect of Cyclone Yaku on dengue cases in Peru.

$$\textbf{Dengue}_{i,t} = \alpha\,\textbf{Rain}_{i,t} + \beta\textbf{Temp}_{i,t} + \lambda_i f_t + \delta_{i,t} D_{i,t} + e_{i,t}$$

Climate covariates; **Interactive fixed effect** (unobserved confounders); **Cyclone effects**; Error



Cyclone Yaku caused **38,209** (17,454 – 49,928) dengue cases across six months (April – Nov. 2023).



Cyclone-attributable incidence was greatest in districts with high flood risk, low-quality housing, and mean temperature above 24°C.

Extreme precipitation in NW Peru is **31.6% more likely** because of anthropogenic forcing according to CMIP-6 climate models.

Cyclone Yaku caused 67% of dengue cases in affected districts in Peru during the 2023 outbreak.

Harris MJ, Trok JT, Martel KS, Munayco CV, Diffenbaugh NS, Lescano AG, Mordecai EA. Quantifying the number of dengue cases attributable to Cyclone Yaku during Peru's 2023 outbreak. In prep. https://purl.stanford.edu/hx183kb6172

The projects above are my dissertation work. I am a new post-doc in the Weitz Group in the Department of Biology working at the interface of human behavior and infectious diseases. I also am interested in initiatives related to science communication, particularly countering misinformation. Please reach out if you are interested in potential collaborations!

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