

COVID-19 Transmission Dynamics Among Close Contacts



THE UNIVERSITY OF
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Self-Introduction



Yang Ge

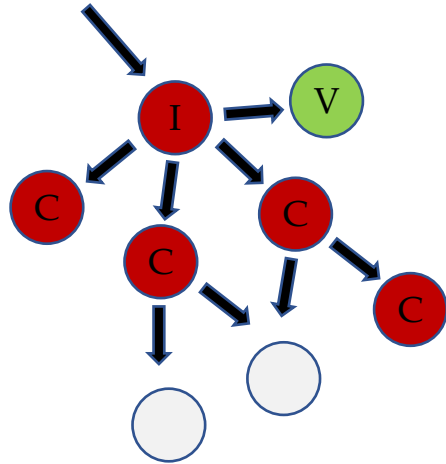
Assistant Professor

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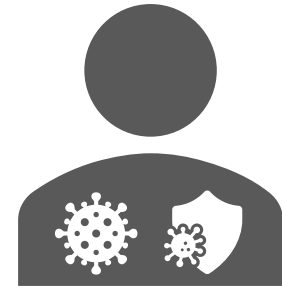
<https://yangepi.github.io/>

My Research

Disease Among Hosts



Disease in the Host



Respiratory
Gastrointestinal
STDs
.....



Data Science + Modeling



Epidemiology



Research Aim

From Data to Comprehension: Empowering Public Health through Data Science Techniques

- Population Study

Ge Y, et al. COVID-19 Transmission Dynamics Among Close Contacts of Index Patients With COVID-19: A Population-Based Cohort Study in Zhejiang Province, China. *JAMA Internal Medicine*. 2021. (2021 IF: 44)

- Clinical Trial Research

Ge Y, et al. Effect of Norovirus Inoculum Dose on Virus Kinetics, Shedding, and Symptoms. *Emerging Infectious Diseases*. 2023. (2021 IF: 16)

- Theoretical Research

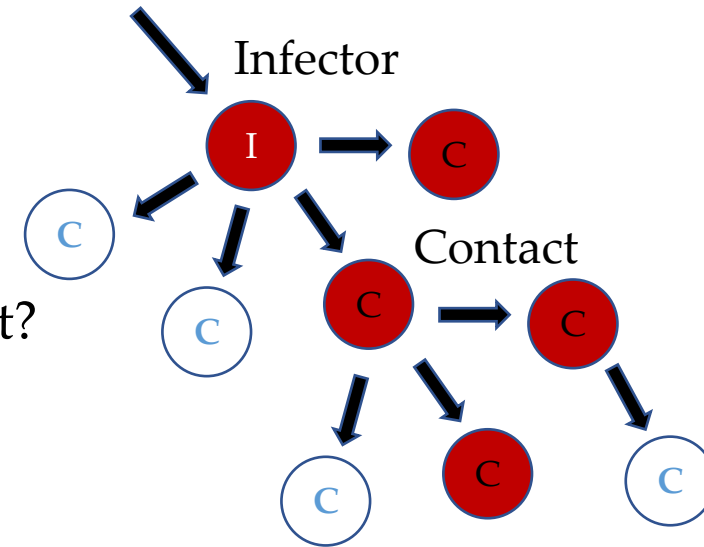
Ge Y, et al. Estimation of Coronavirus Disease Case-Fatality Risk in Real Time. *Emerging Infectious Diseases*. 2020. (2021 IF: 16)

Ge Y, et al. COVID-19. JAMA Internal Medicine

- **Data:** Infectors and their contacts
- **Background:** Susceptible individuals exposed to COVID-19 cases had high infection risk.

- **Questions:**

1. Why not all contacts became infected?
2. Can we estimate the infection risk for each contact?



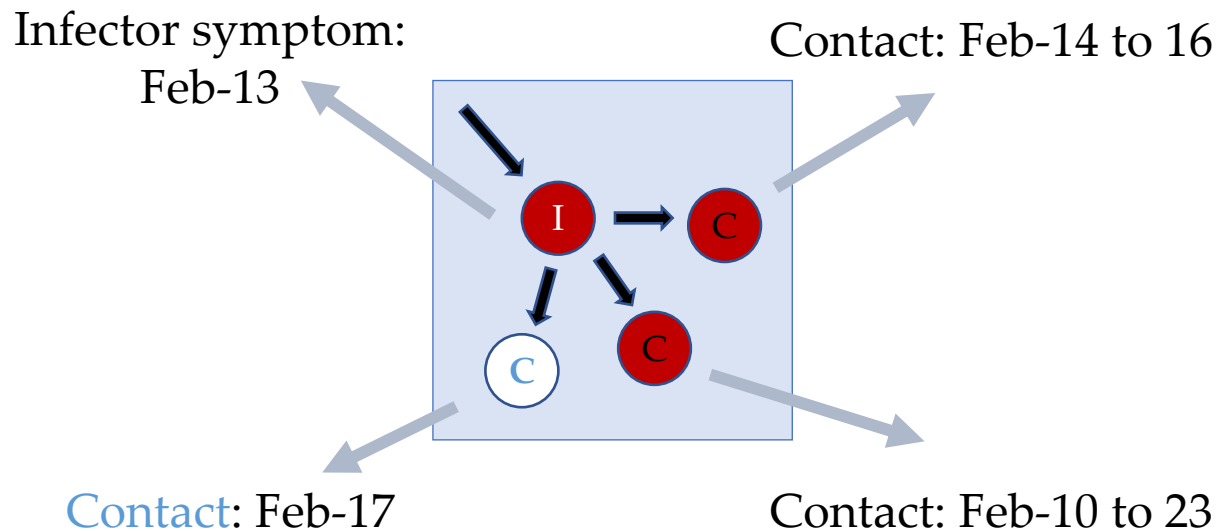
- **Public Health**

1. Help contact tracing decision-making.
2. How big the help would be?
 $0.5 \text{ million/day} * 5 \text{ friends/day} * 14 \text{ days} = 35 \text{ million/day}$

Ge Y, et al. COVID-19. JAMA Internal Medicine

Data Science + Modeling

- Which data variable would be a quick measure of risk?
Host's virus load? Contact's immunity?
- Timing is much easier.

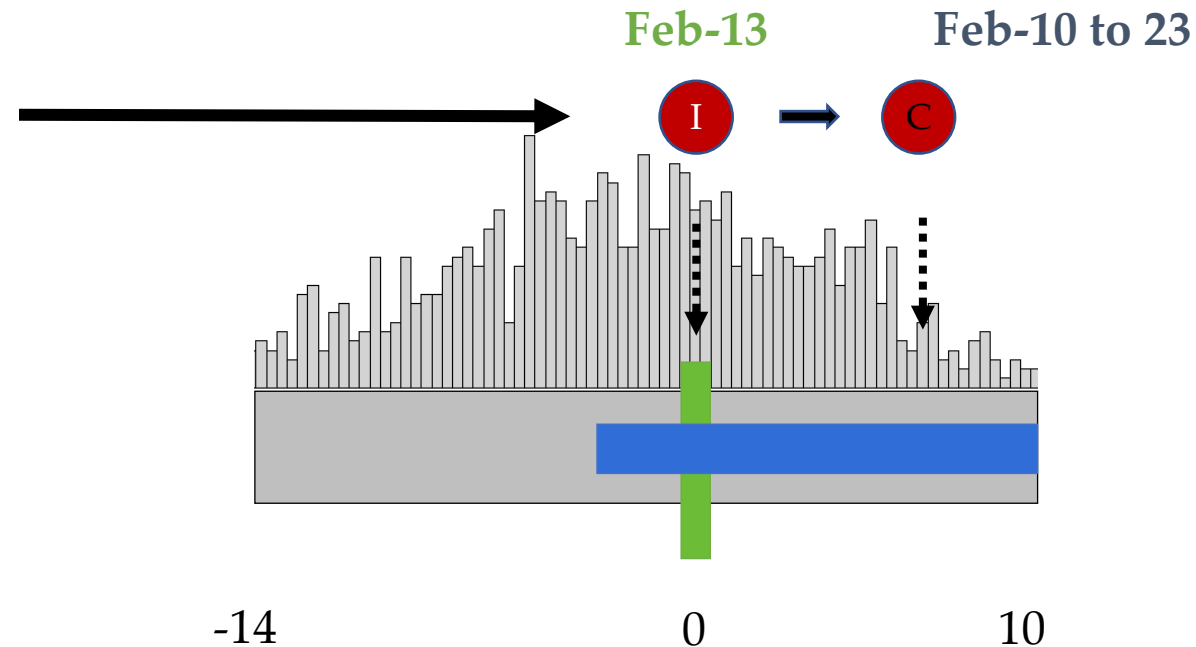
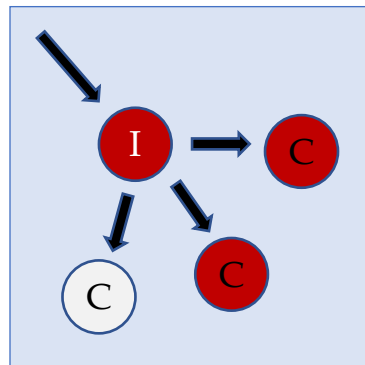


| | | February 2020 | | | | | | | | |
|---|----|---------------|----|----|----|----|----|--|--|--|
| # | MO | TU | WE | TH | FR | SA | SU | | | |
| 5 | 27 | 28 | 29 | 30 | 31 | 1 | 2 | | | |
| 6 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | | | |
| 7 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | | | |
| 8 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | | | |
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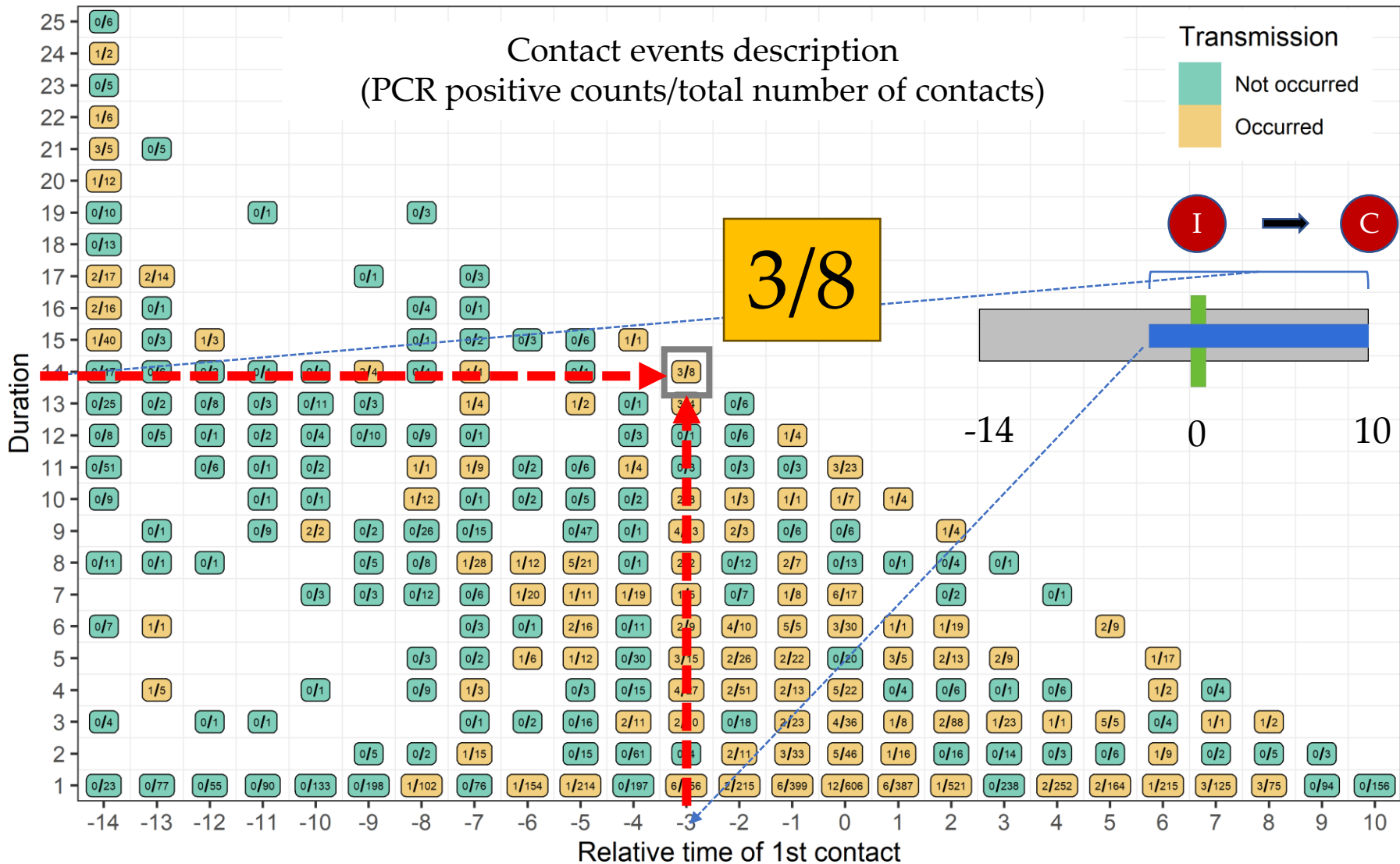
Ge Y, et al. COVID-19. JAMA Internal Medicine

Timing of exposure:

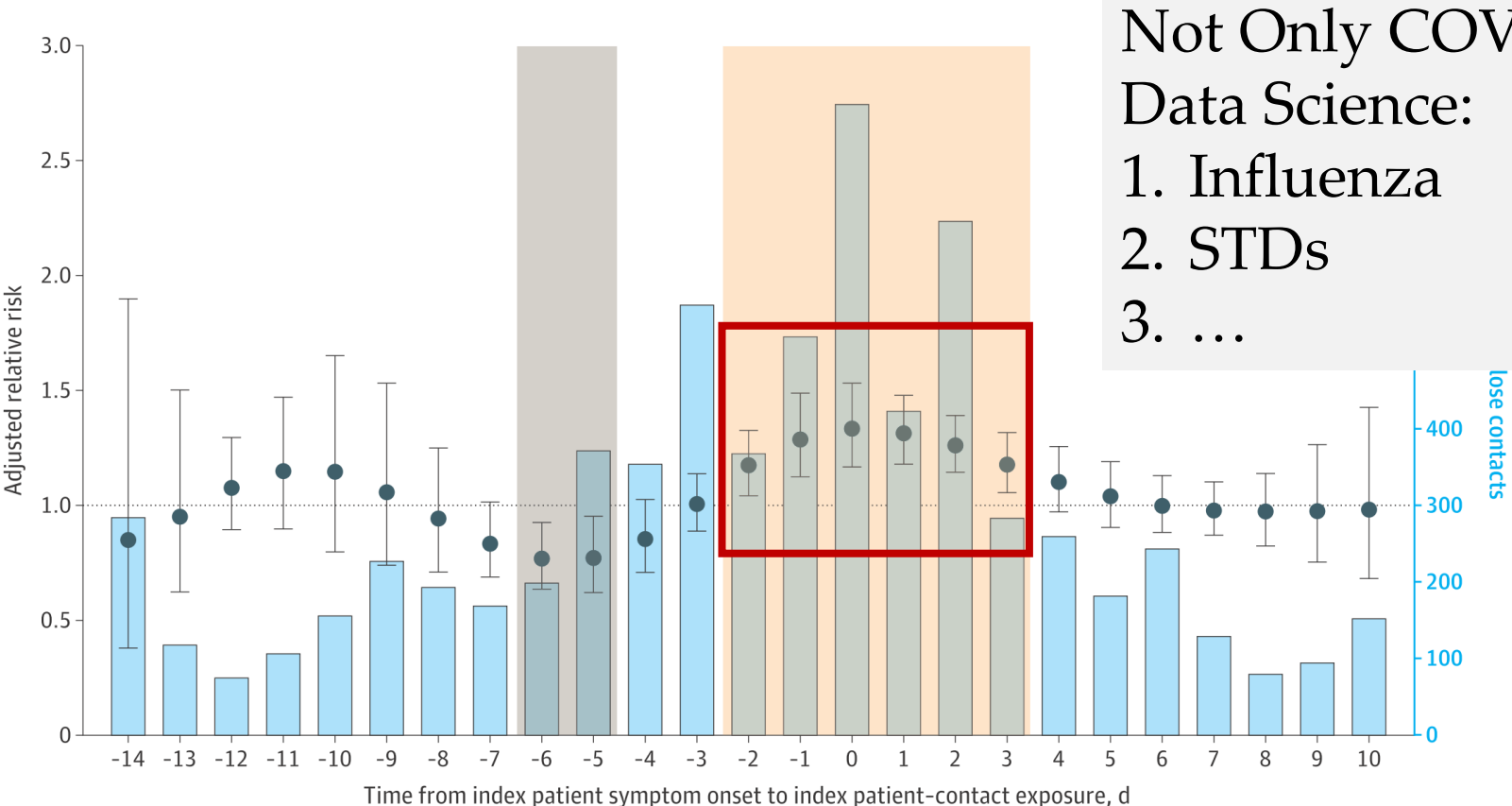
Interest: risk comparison at different exposure days (14 days prior to and 10 days after the index patient's symptom onset date)



Ge Y, et al. COVID-19. JAMA Internal Medicine



Ge Y, et al. COVID-19. JAMA Internal Medicine

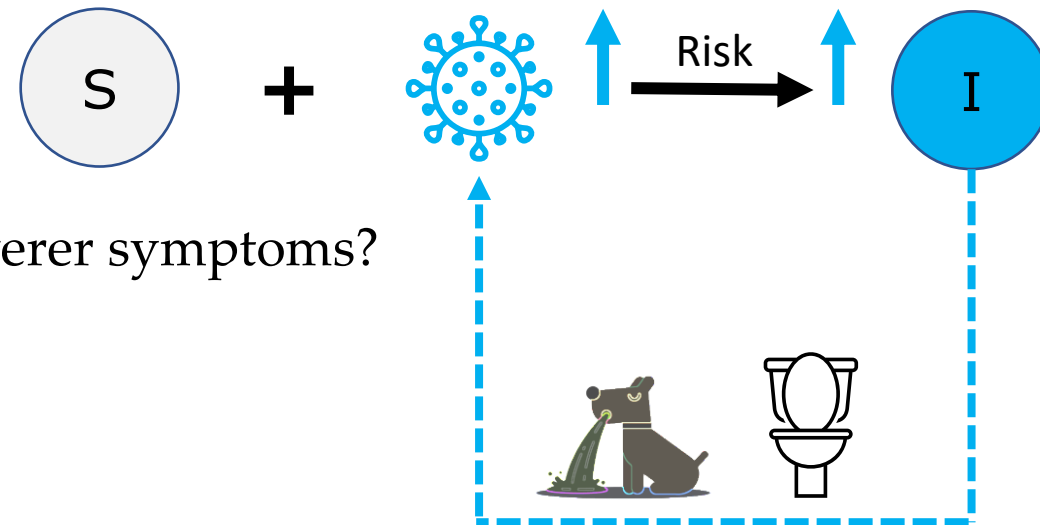


Not Only COVID-19
Data Science:
1. Influenza
2. STDs
3. ...

Contacts were at highest risk of COVID-19 if they were exposed between 2 days before and 3 days after the index patient's symptom onset, peaking at day 0

Ge Y, et al. Norovirus. Emerging Infectious Diseases. 2023.

- **Data:** Participants exposed to norovirus in RCT.
- **Background:** Susceptible individuals exposed to more norovirus led to high infection risk



- **Questions:**

More virus exposure led to severer symptoms?

or led to more transmissions?

- **Public Health**

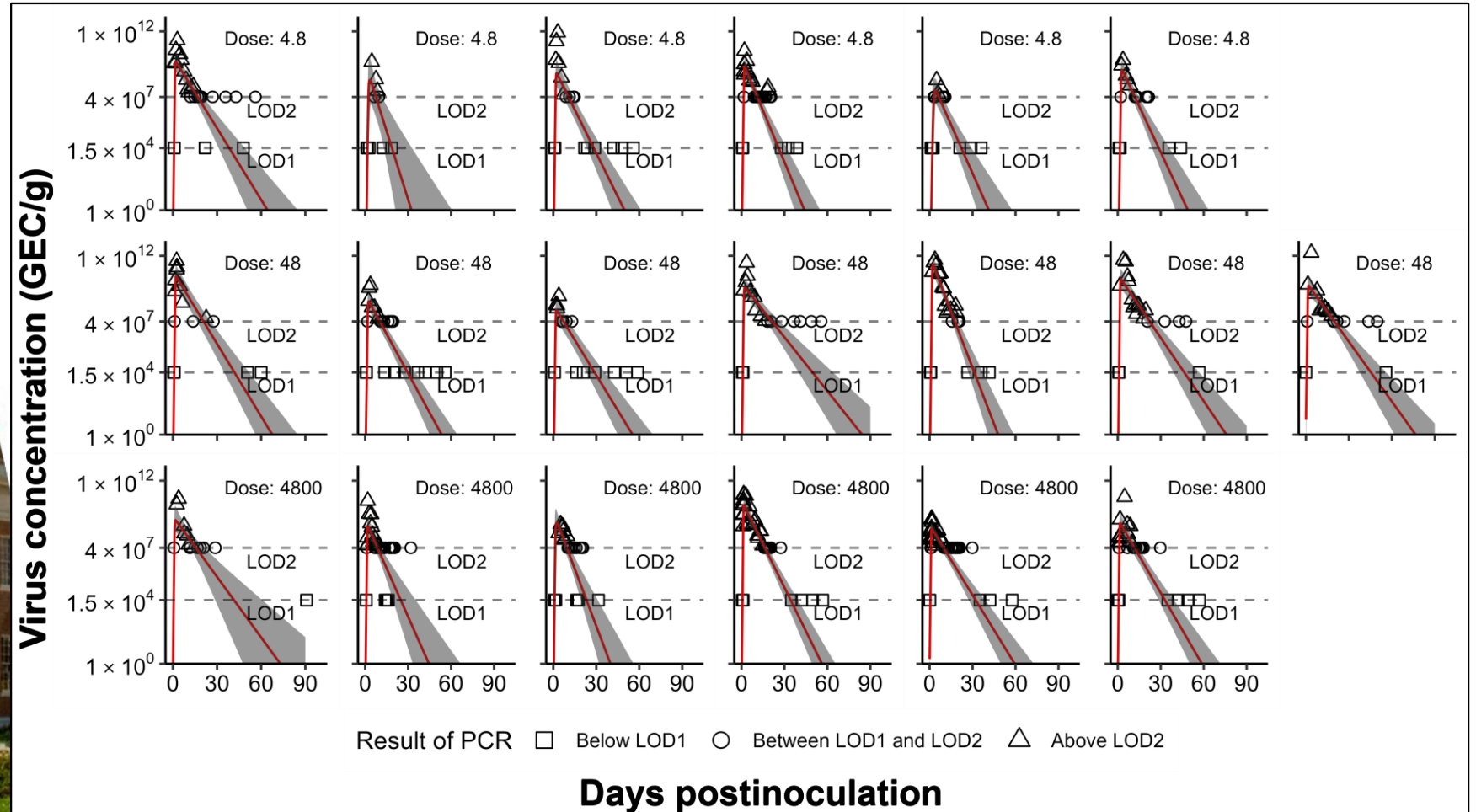
1. Who should receive care first, who should be quarantine first
2. How big the help would be?

Each year in the United States, **900 deaths**, 109,000 hospitalizations, 465,000 emergency department visits.

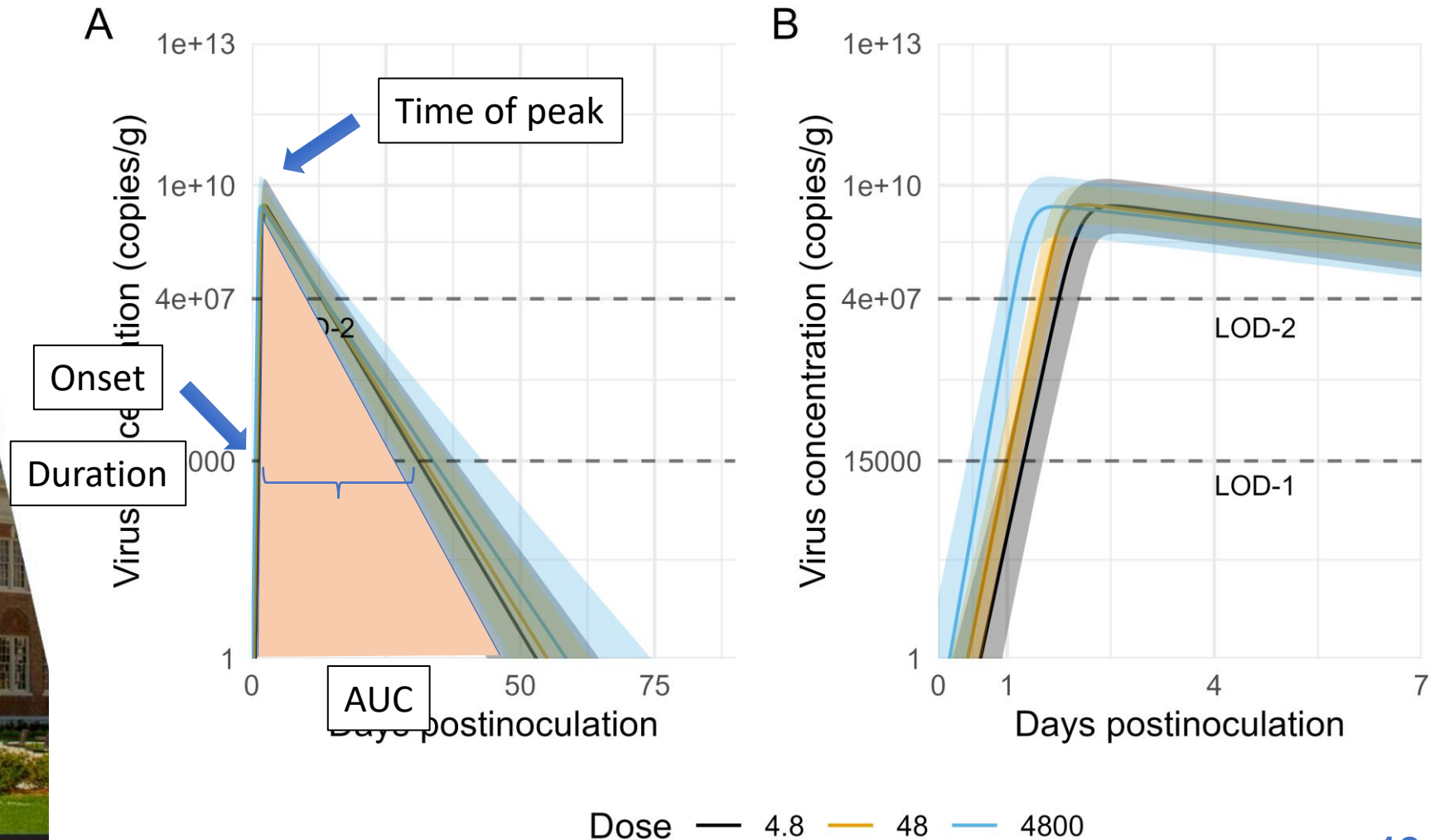
Data Science Modeling

1. Repeated measurements
2. Non-linear
3. Two limited of detections

Ge Y, et al. Norovirus. Emerging Infectious Diseases. 2023.



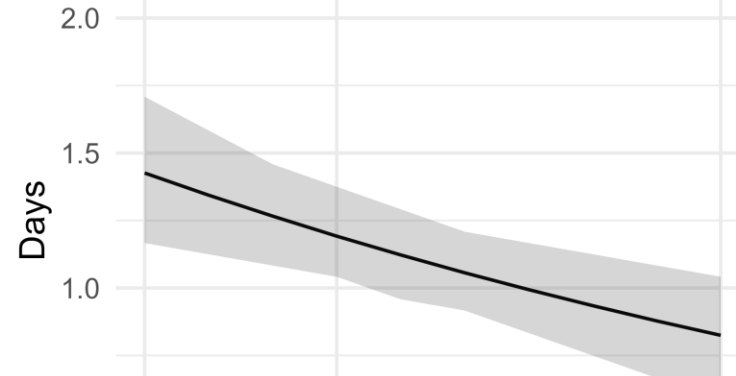
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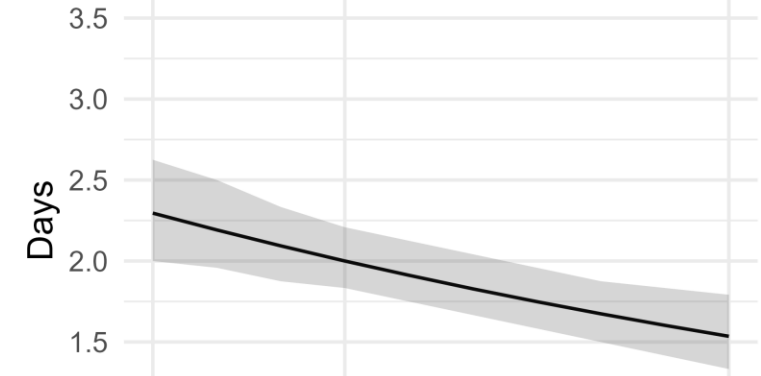
Ge Y, et al. Norovirus. Emerging Infectious Diseases. 2023.



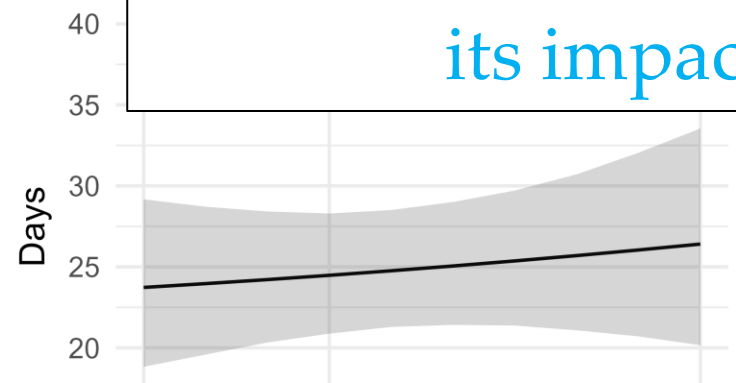
A Time to detection (above 15e3 copies/g)



B Time to peak

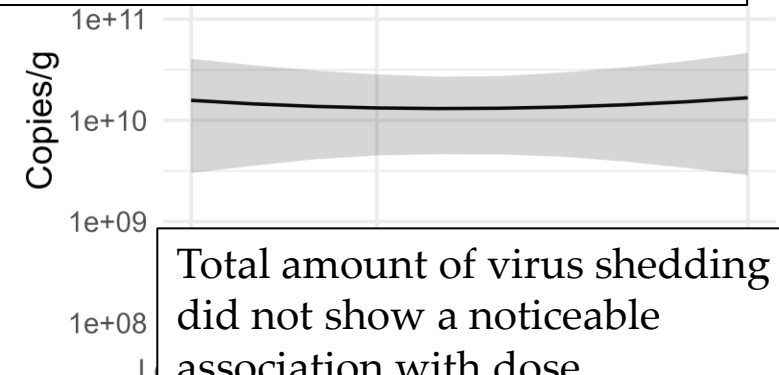


C Shedd



Might have an increased shedding duration

Dose has little impact on shedding (and thus transmission potential), contrast to its impact on infection.



Total amount of virus shedding did not show a noticeable association with dose

In Summary

- Data Science help us better understand observations.
- We can use this approach to conduct research:
 - 1) Theoretical studies,
 - 2) Clinical Trials,
 - 3) Population level studies,
 - ...
- From Data to Comprehension: Empowering Public Health through Data Science Techniques.



Thank you!

Questions?



<https://yangapi.github.io/>



Slides

