

# Reaction-diffusion spatial modeling of COVID-19 in Chicago

Trent Gerew

Illinois Institute of Technology

August 27, 2021



- ① The COVID Problem
- ② Project Context and Objectives
- ③ Current Work
- ④ Future Goals



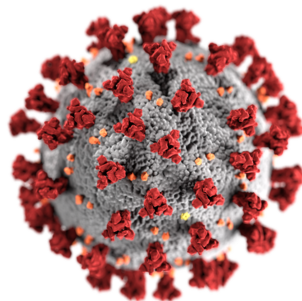
- ① The COVID Problem
- ② Project Context and Objectives
- ③ Current Work
- ④ Future Goals



Identified in Wuhan, China in December 2019.  
Caused by the severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2).

In the United States alone, we currently have

- **37,768,911** total cases
- **626,833** total deaths



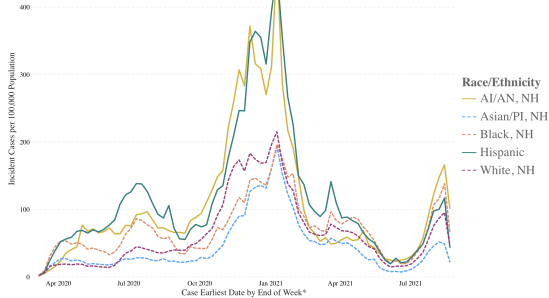


Transmission by exposure to infectious respiratory fluids:

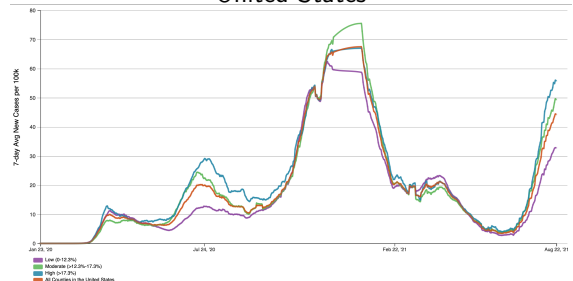
1. Inhalation of virus
2. Deposition of virus on exposed mucus membranes
3. Touching mucous membranes with soiled hands contaminated with virus



COVID-19 weekly cases per 100,000 population by race/ethnicity, United States



COVID-19 weekly case rate per 100,000 population by percentage of county population in poverty, United States





- ① The COVID Problem
- ② Project Context and Objectives
- ③ Current Work
- ④ Future Goals



Why make a mathematical study of COVID-19?

- Predict growth patterns
- Anticipate intervention effects





Models of infectious diseases are usually variations on the **Kermack-McKendrick model** (1927).



Usual assumptions:

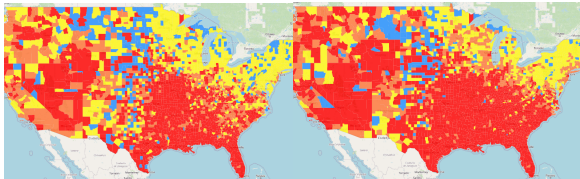
- Population is *homogeneous*
- Transmission is spatially independent

# Project Context and Objectives



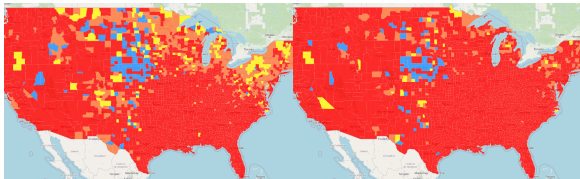
These assumptions don't match reality!

Level of community transmission by county



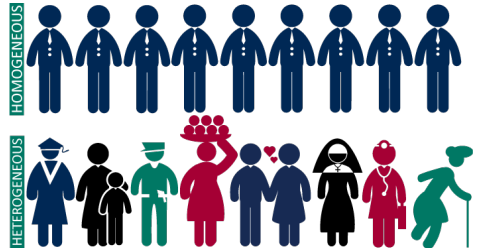
(a) 7/22/2021

(b) 7/29/2021



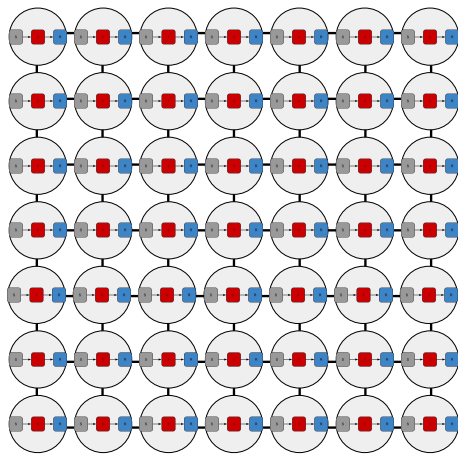
(c) 8/8/2021

(d) 8/21/2021



**Idea:** Use reaction-diffusion to build explicit spatial dependence.

- The data clearly shows a diffusive pattern
- Spatial dependence can approximate demographic differences
- Spatially dependent data exists for many scales and regions





- ① The COVID Problem
- ② Project Context and Objectives
- ③ **Current Work**
- ④ Future Goals



- ① The COVID Problem
- ② Project Context and Objectives
- ③ Current Work
- ④ Future Goals