



# Supply Chain Continuity in the Age of Covid-19

May 2020

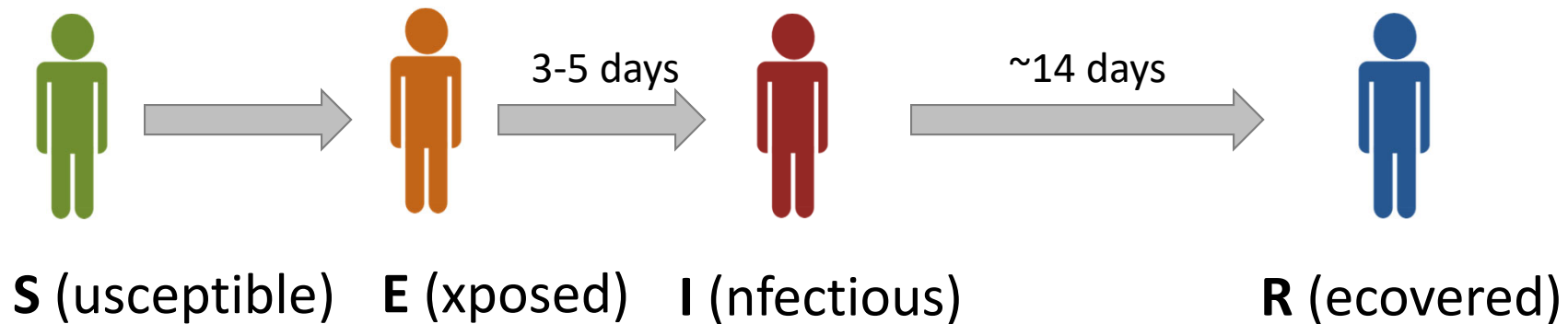
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**DOI: 10.5281/zenodo.3814454 CC BY-NC-ND**

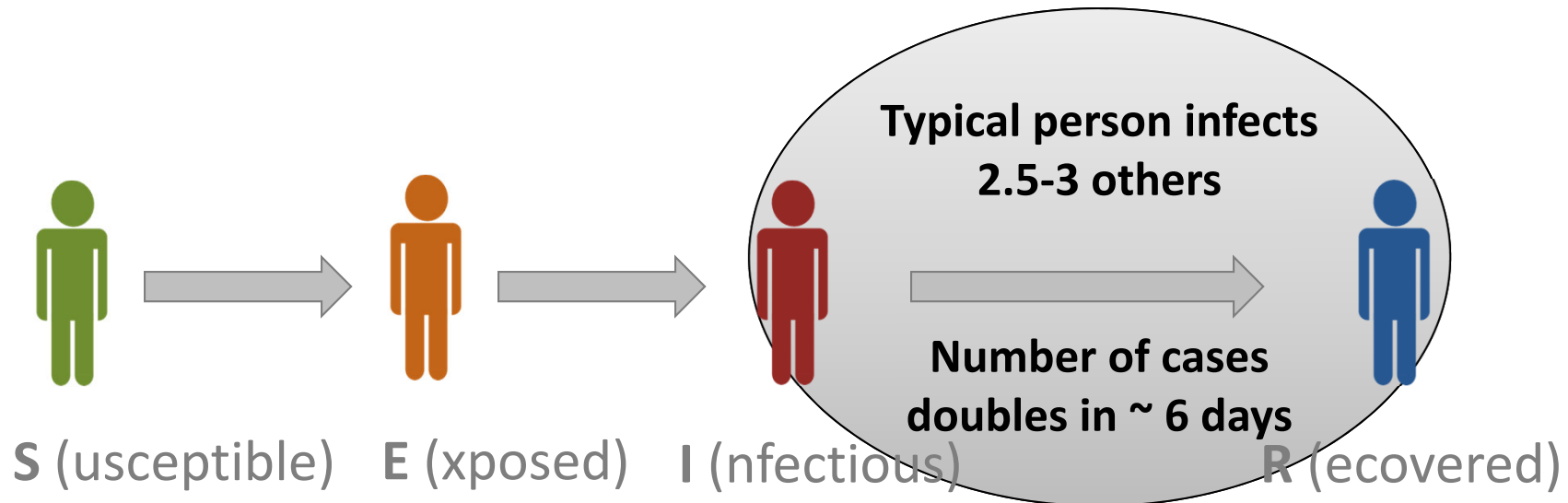
**Video of webinar available: <https://youtu.be/7P8T7A9VDoY?t=53>**

# Foundational Disease Model: SEIR



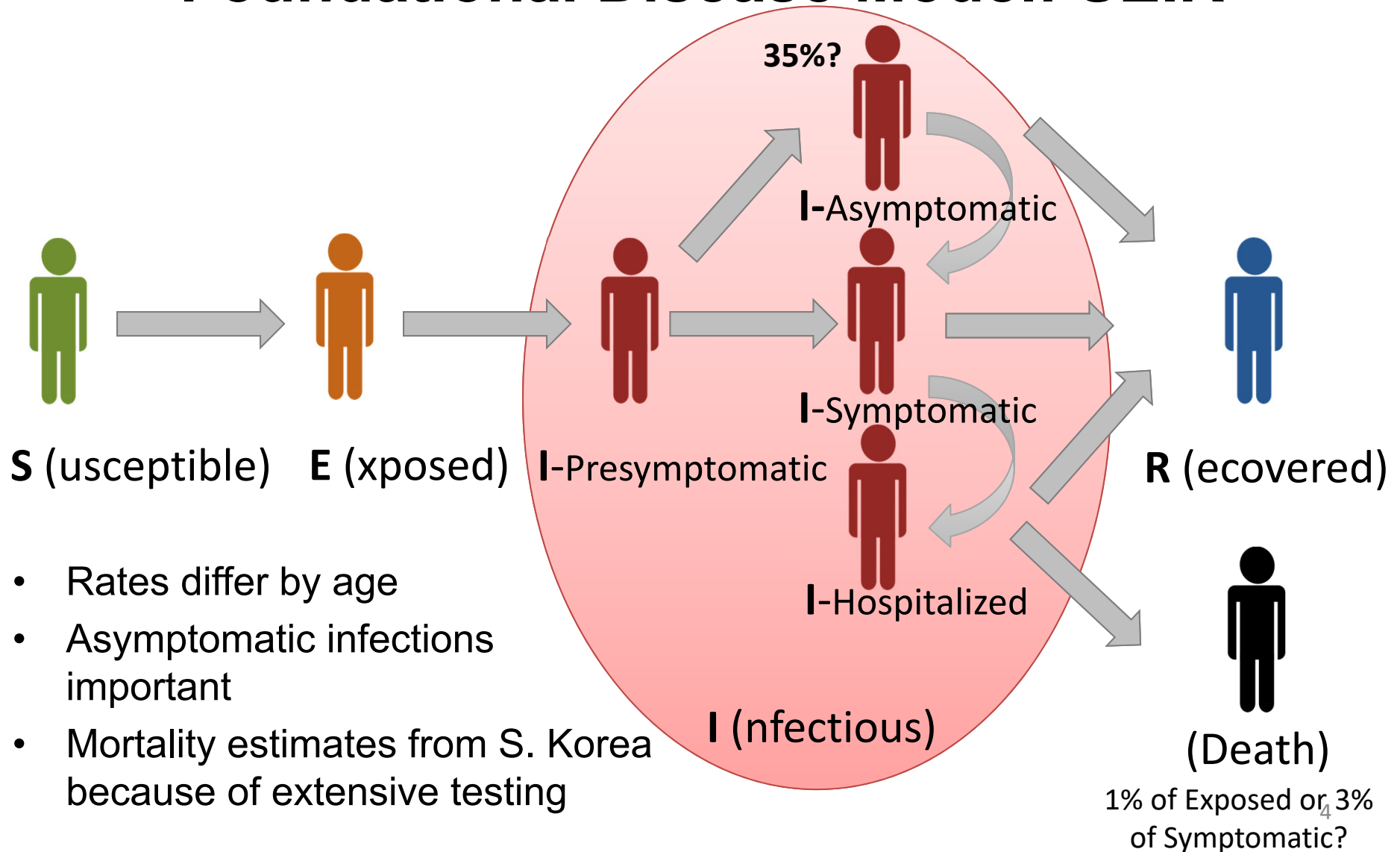
- Values for COVID-19 pulled from multiple references

# Foundational Disease Model: SEIR

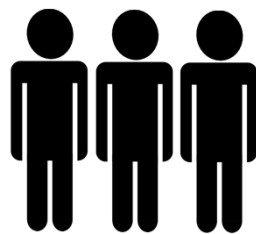
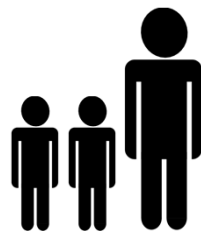
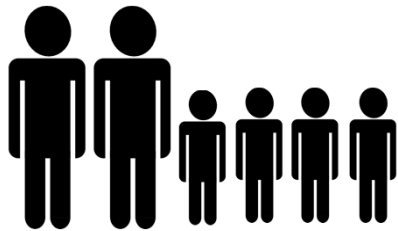
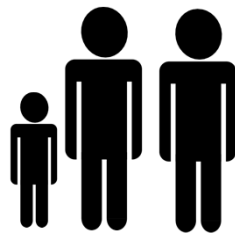
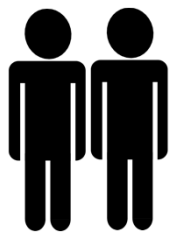


- How infectious is the virus that causes COVID-19?
  - $R_0$  is the average number of people infected by someone who is infectious (at the beginning of the outbreak, without interventions)
  - Doubling rate of cases is a related measure
  - (Values pulled from numerous references)

# Foundational Disease Model: SEIR



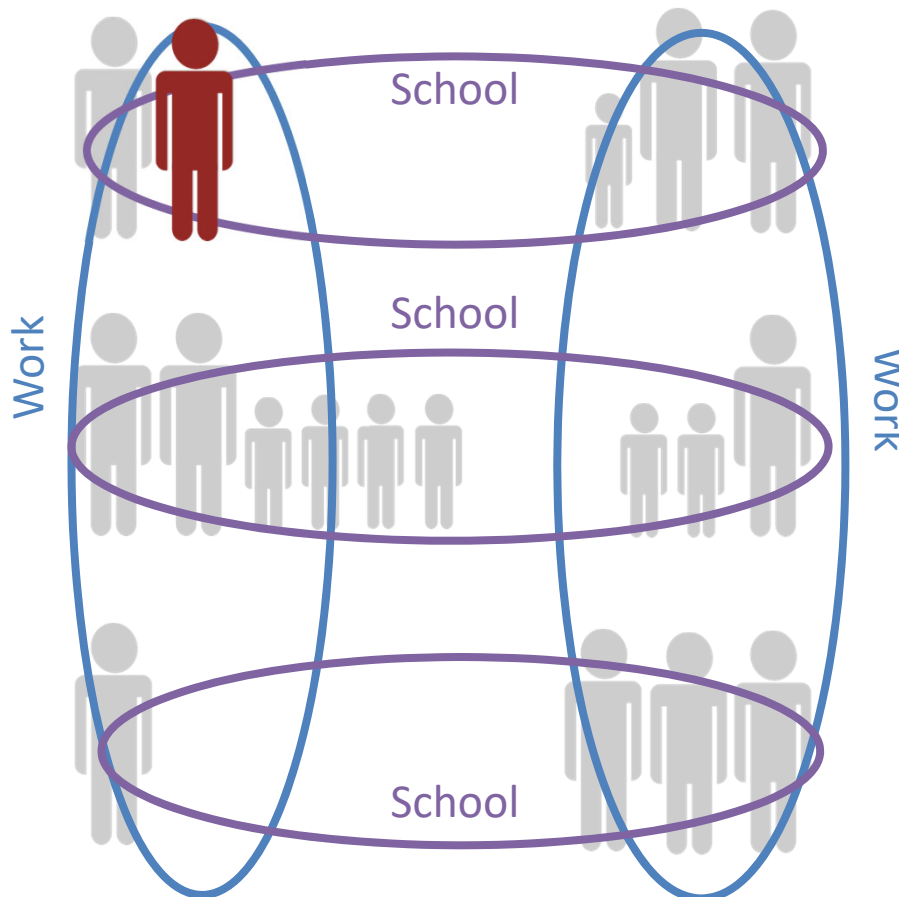
# Community



- Households in each neighborhood
  - Size
  - Family or not
  - Presence of kids
  - Ages

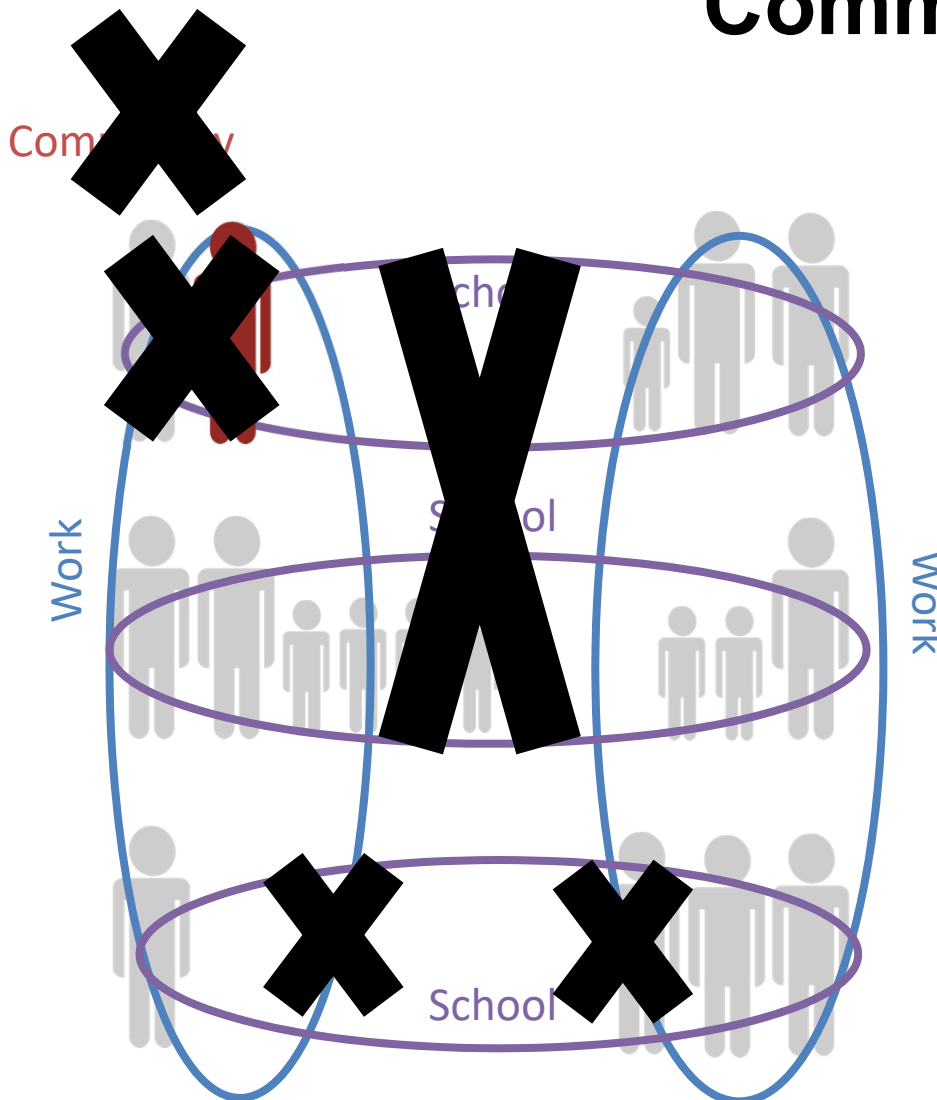
# Community

Community

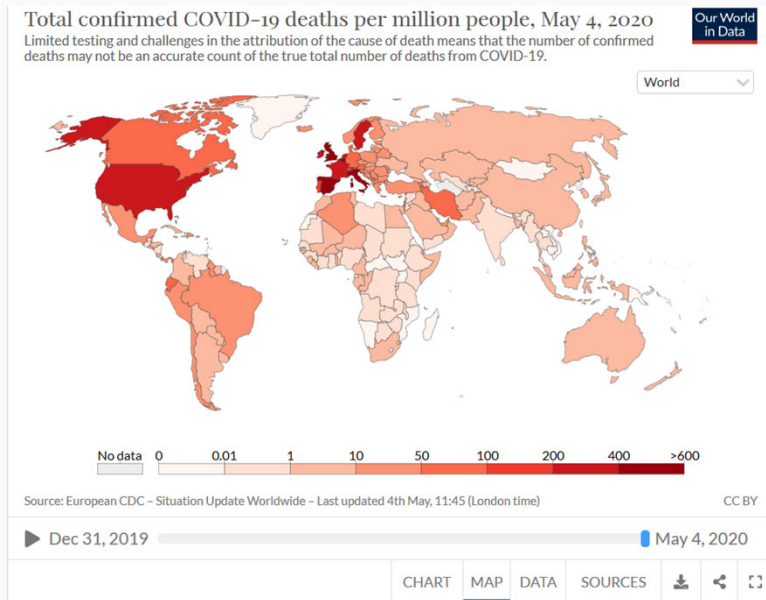
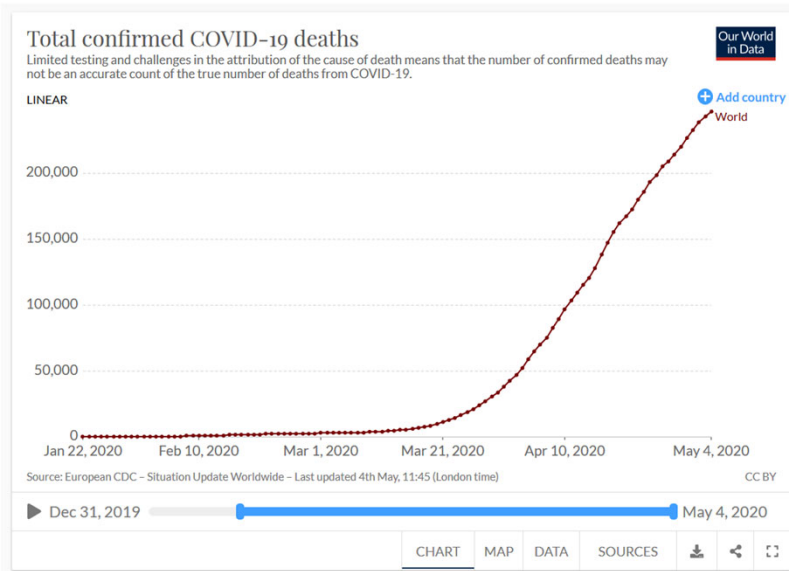


- Households in each census tract
  - Size
  - Family or not
  - Presence of kids
  - Ages
- Infections within
  - Schools (horizontal purple)
  - Workplaces (vertical blue)
  - Community (1 represented)

# Community



- Households
  - Voluntary quarantine
- Schools
  - Closures, distancing, vacating dorms
- Workplaces
  - Telecommuting, essential only, distancing
- Community
  - Sports, churches, non-essential businesses



- Confirmed cases and deaths continue to rise and are undercounted
- Every country will eventually be hit
- There are several current hot spots in Africa

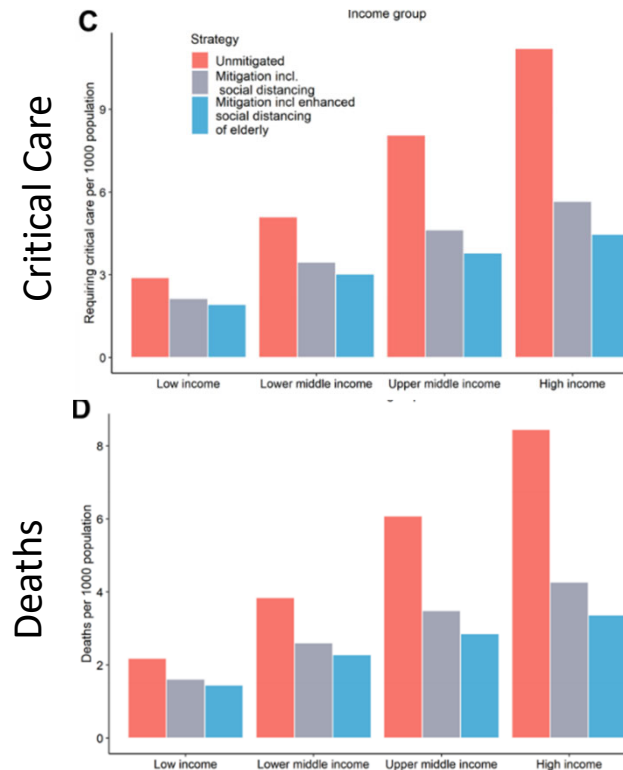
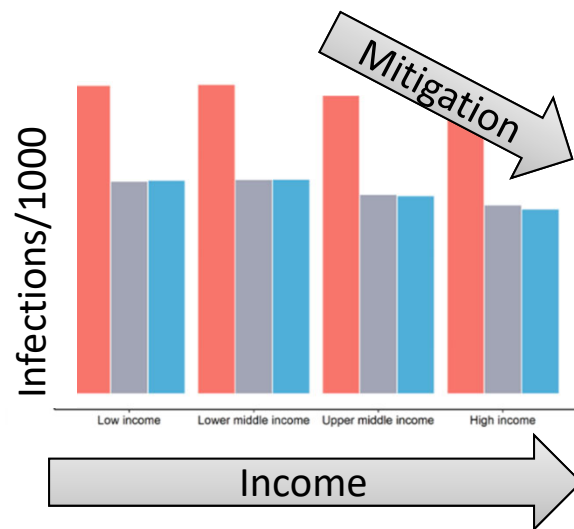
Location	How long did it take for the number of total confirmed deaths to double?	Total confirmed deaths ECDC data. Up to date for 10 AM (CET) on May 4.	Daily new confirmed deaths ECDC data. Up to date for 10 AM (CET) on May 4.
Chad	doubled in <b>2 days</b>	<b>10 total</b> May 4	<b>+0 new</b> May 4
Sierra Leone	doubled in <b>4 days</b>	<b>8 total</b> May 4	<b>+0 new</b> May 4
Ecuador	doubled in <b>6 days</b>	<b>1,564 total</b> May 4	<b>+193 new</b> May 4
Nigeria	doubled in <b>6 days</b>	<b>87 total</b> May 4	<b>+2 new</b> May 4
Sudan	doubled in <b>8 days</b>	<b>41 total</b> May 4	<b>+0 new</b> May 4
Kuwait	doubled in <b>8 days</b>	<b>38 total</b> May 4	<b>+5 new</b> May 4
Liberia	doubled in <b>9 days</b>	<b>18 total</b> May 4	<b>+0 new</b> May 4

Images copied from "ourworldindata.org/coronavirus" on May 4, 2020



# COVID-19 Globally: Future

- Lead modelers predict peak demand
- Lowest income countries
  - Critical care need could outstrip supply 25 times
  - Death rate could be lower



Walker et al: <https://www.imperial.ac.uk/media/imperial-college/medicine/sph/ide/gida-fellowships/Imperial-College-COVID19-Global-Impact-26-03-2020v2.pdf>

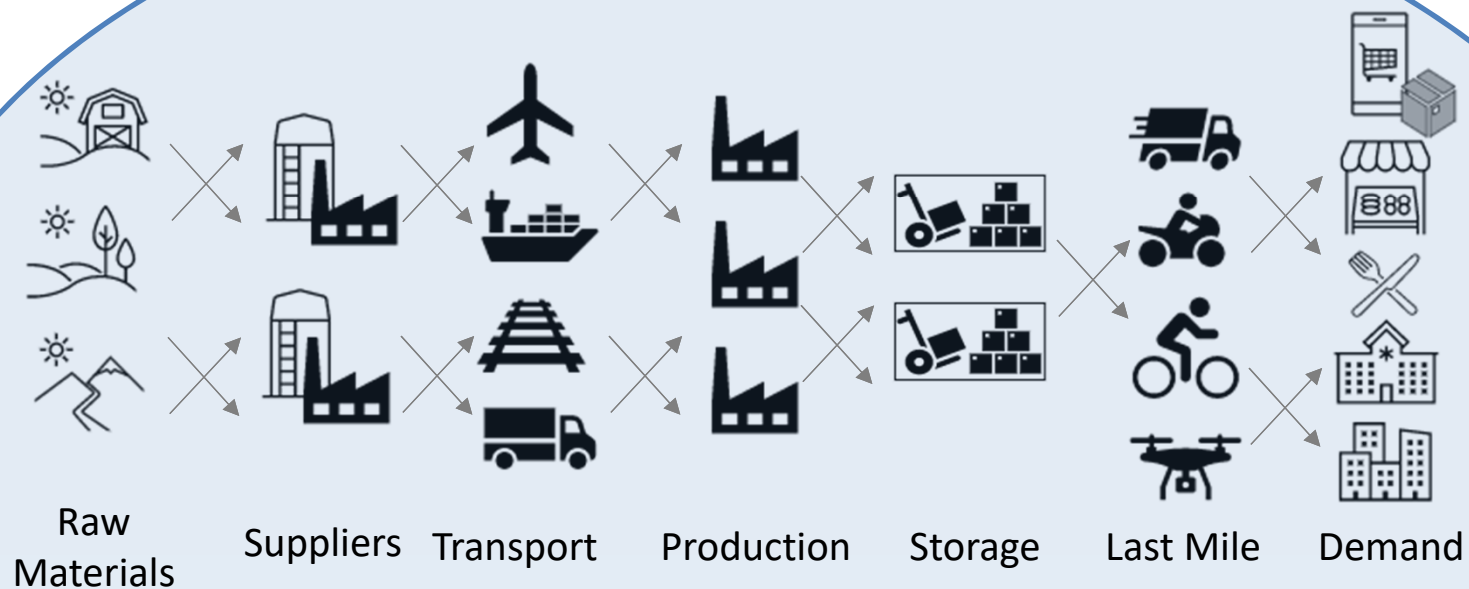
# Future Scenarios

- Do Nothing
  - Epidemics may stop when 60-80% of population has been infected and has immunity
  - Of those infected, 0.5 to 1% (or more) may die
- Mitigation
  - Balance distancing, protection for vulnerable populations, and economics
- Innovation
  - New treatment reduces mortality and hospital stays
  - New vaccine prevents disease; global distribution can be achieved



# SUPPLY CHAIN RISK

# Complex Supply Chains



- **Globally interconnected systems**
- **Optimized, with just-in-time deliveries**



# Disease Impacts Supply Chains

- Disruptions in supply
- Major surges or decreases of demand
- Workforce absenteeism
- Shutting down of operations (e.g., shelter-in-place)
- Return to normalcy
  
- Disruption can lead to innovation

# General Strategy

- Know your risks
- Prioritize
- Prevent or mitigate
- “Triple A” supply chain
  - Agile
  - Adaptable
  - Aligned

**AAA**

Lee, H. L. (2004), “The Triple-A Supply Chain”, Harvard Business Review

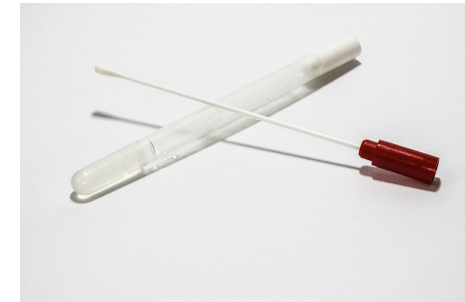
# COVID-19 Example: Masks

- Global shortages of N95 masks and Personal Protective Equipment
- Contributors
  - Over 50% sourced from China
  - Countries have some control over suppliers
  - Long leadtime between manufacturer and consumer
  - Specialized material in mask not widely made
- Solutions:
  - Know your supply chain
  - Produce to satisfy local demand for critical products



# COVID-19 Example: Testing Kits

- In US, some tests for COVID-19 disease or antibodies are difficult to obtain
- Contributors
  - First test built on specialized nasal swab
  - Some tests built on chemical reagent sourced from deep sea ocean vents
- Solution
  - Product commonality can be helpful
  - Consider suppliers in product designs





# COVID-19 Example: Household Products

- Demand from Consumers (and resellers) surged for household items like hand sanitizer and toilet paper
- Contributors
  - Lean supply chains with just-in-time inventory
  - Separate production for industrial and consumer demand
- Solution
  - Flexible production to adjust level of supply
  - Systems that can adapt to demand from different channels



# COVID-19 Example: Ventilators

- Medical ventilators can be in short supply if disease level is high
- Contributors
  - Expensive item with surge demand
  - Complicated medical device
  - Critical components manufactured in China
- Solutions
  - Redesign product or supply chain for it
  - Consider role of and process for regulations



## COVID-19 Example: Food

- Meat is in short supply across the US, including pork, beef, and chicken; other food shortages impending globally
- Contributors
  - Workers at processing plants getting sick
  - Transportation disrupted
  - Markets closed
- Solutions
  - Quantify risks within plant
  - Classify transportation as “essential industry”
  - Mitigate or prevent



# Global Supply Chain Challenges

- Potential shortages in metals (S.A.) and medicines from suppliers (India)
- Challenges in vaccine distribution by UNICEF
  - 70-80% reduction in planned vaccine shipments
- Africa
  - 31+ countries have border closures
    - Countries rely on exports for revenue
  - Collapse in prices for oil and other commodities
  - Some businesses and traders will not survive

## Risk is beyond COVID-19

- Earthquake in Japan (2011) caused “production delays, shortages, and higher prices”, for computers, electronics, or automobiles
  - Add inventory if necessary
  - Agile supply chains can scale up quickly
- Hurricane Maria in Puerto Rico (2017) caused shortages in IV bags and saline throughout the US
  - Ensure suppliers in multiple locations
- Flooding, riots, strikes, fires, embargoes, ...

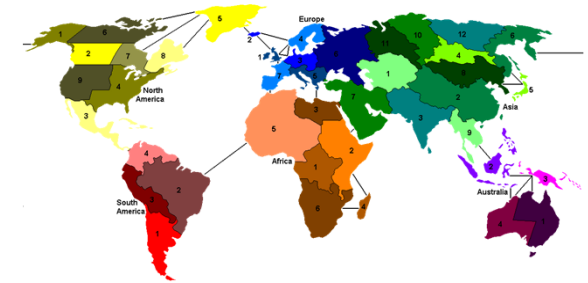


# Know your Risks



- Map the full supply chain
  - Do you know your suppliers' key suppliers?
  - Are they sole or multi-sourced?
  - In what locations are they?
  - What customers are key? Who are their customers?
- Understand the information network
  - Data centers, voice links, IT outsourcing, etc.

# Prioritize Risk



- Identify the **key** suppliers of goods and services
  - How would we be impacted if this one fails?
- Quantify probability of disruption or failure
  - E.g., past data or forecasting, insurance companies
- Understand potential severity of each risk
  - Predictive analytics and scenario analysis
- Challenges: events with low probabilities but high impact

# Prevent and Mitigate Risks



- Prevent risk (e.g., choose suppliers well)
- Evaluate sourcing strategies (sole, multi-, etc.)
- Partner with key suppliers or customers
- Develop detailed communications and emergency plan
- Test, evaluate, and redesign
- Be on guard and act quickly



# Moving Forward with COVID-19



- Protect workforce
- Build relationships and partnerships
- Be prepared for more surges (up or down) in demand or supply
- Disruptions can lead to innovation

# Questions

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