LAW &
ECONOMICS
CENTER

Program on Economics & Privacy

Balancing Privacy and Public Health in the COVID-19 Era

Thursday, May 14, 2020
11:00 AM to 12:00 PM EDT

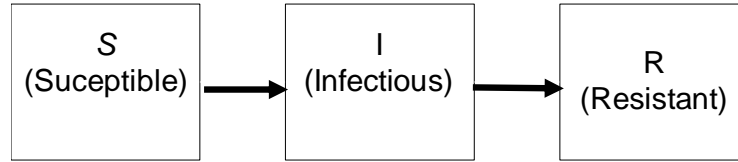**Program on Economics & Privacy Webinar**

Balancing Privacy and Public Health in the COVID-19 Era

Jane Bambauer
Woodrow Hartzog
Daniel Barth-Jones
Berin Szoka
Moderator: James Cooper

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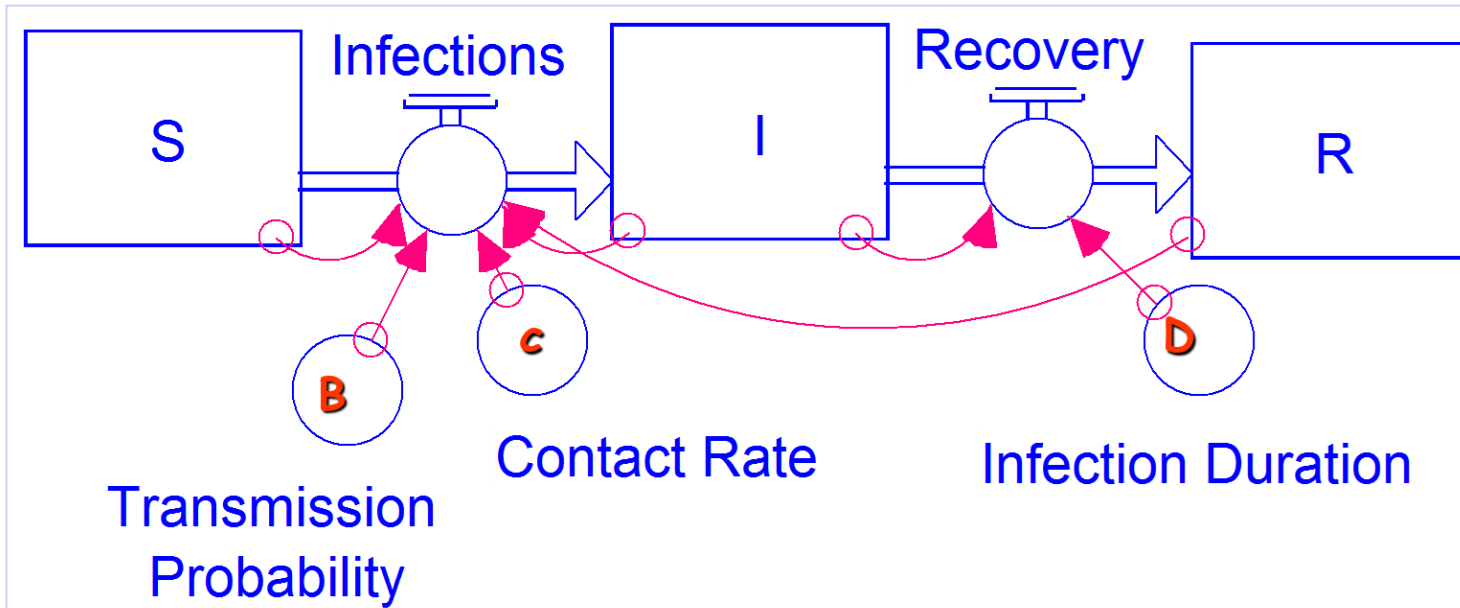
SIR Model
(Suceptible, Infectious, Resistant)

| S (Suceptible) | → | I (Infectious) | → | R (Resistant) |

$$\mathrm{d}S/\mathrm{d}t = -Sc(I/N)B$$

$$\mathrm{d}I/\mathrm{d}t = Sc(I/N)B - I/D$$

$$\mathrm{d}R/\mathrm{d}t = I/D$$
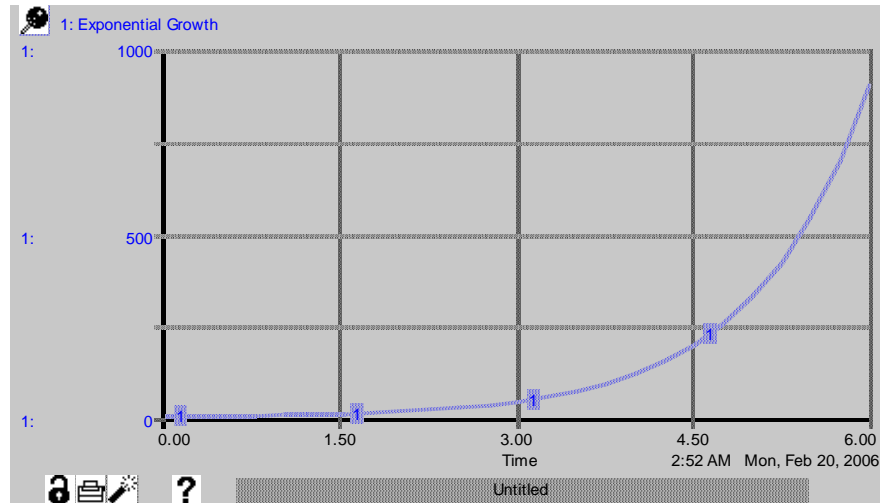
The Reproduction Number, R₀

Ro: The average number of persons infected by one infectious individual who is introduced into a population where everyone is susceptible.

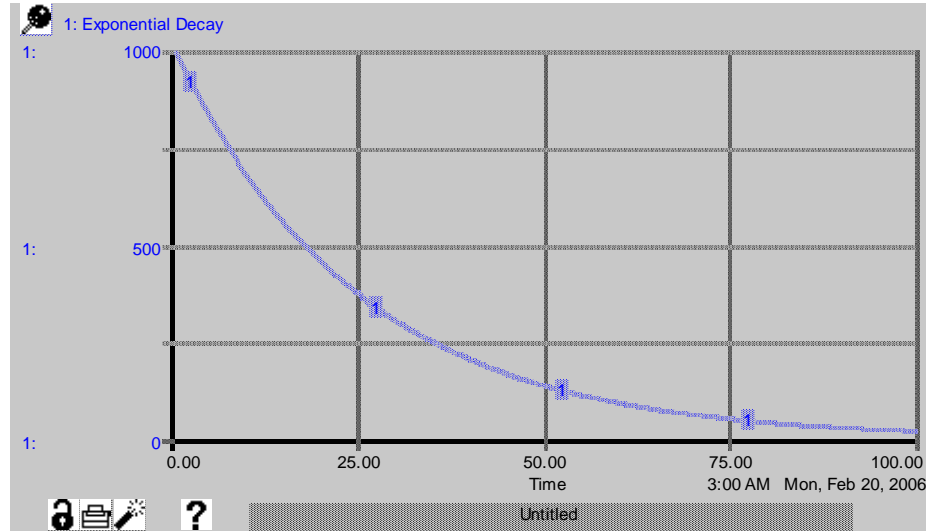# Basic Reproduction Number (R$_0$)

When R$_0$ is greater than one, epidemic infectious disease transmission results.

Each infected person generates more than one infected persons, who each, in turn, generate more than one infected persons - resulting in exponential epidemic growth

Basic Reproduction Number (R$_0$)

When R$_0$ is less than one, transmission can not be sustained and disease transmission declines.

Reproduction Number, R_0

R_0 for the SIR model is the product of:

$\beta,$ the Transmission Probability,

c, the Contact Rate, and

D, the Infectiousness Duration.

$R_0 = \beta\ c\ D$

Reproduction Number at time t, R_t

R_t is the average number of persons being infected by an infectious person <u>at a point in time</u> during the epidemic.
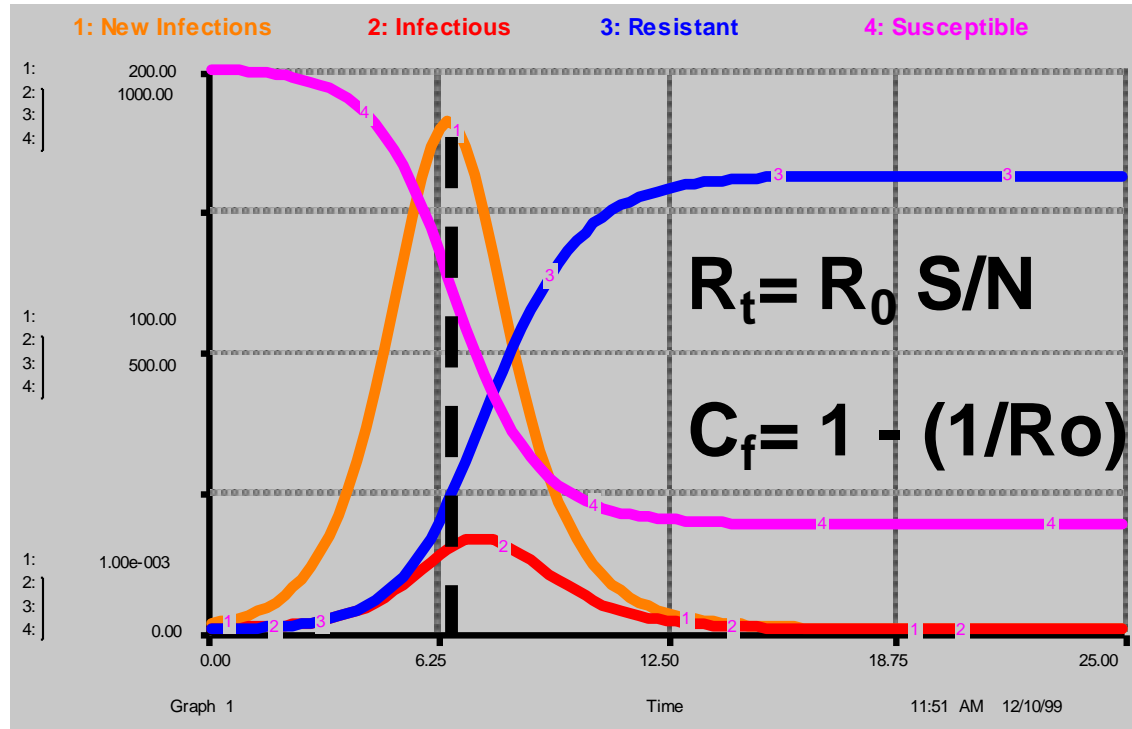
As an epidemic begins the proportion of susceptibles in the population will fall.

R_0 indicates the epidemic potential at the beginning of an epidemic.

$R_t = R_0 (S/N)$,

      where S/N is the proportion of susceptibles.

SIR: Critical Fraction C$_f$

1: New Infections **2: Infectious** **3: Resistant** **4: Susceptible**

$$R_t = R_0 \ S/N$$

$$C_f = 1 - (1/Ro)$$
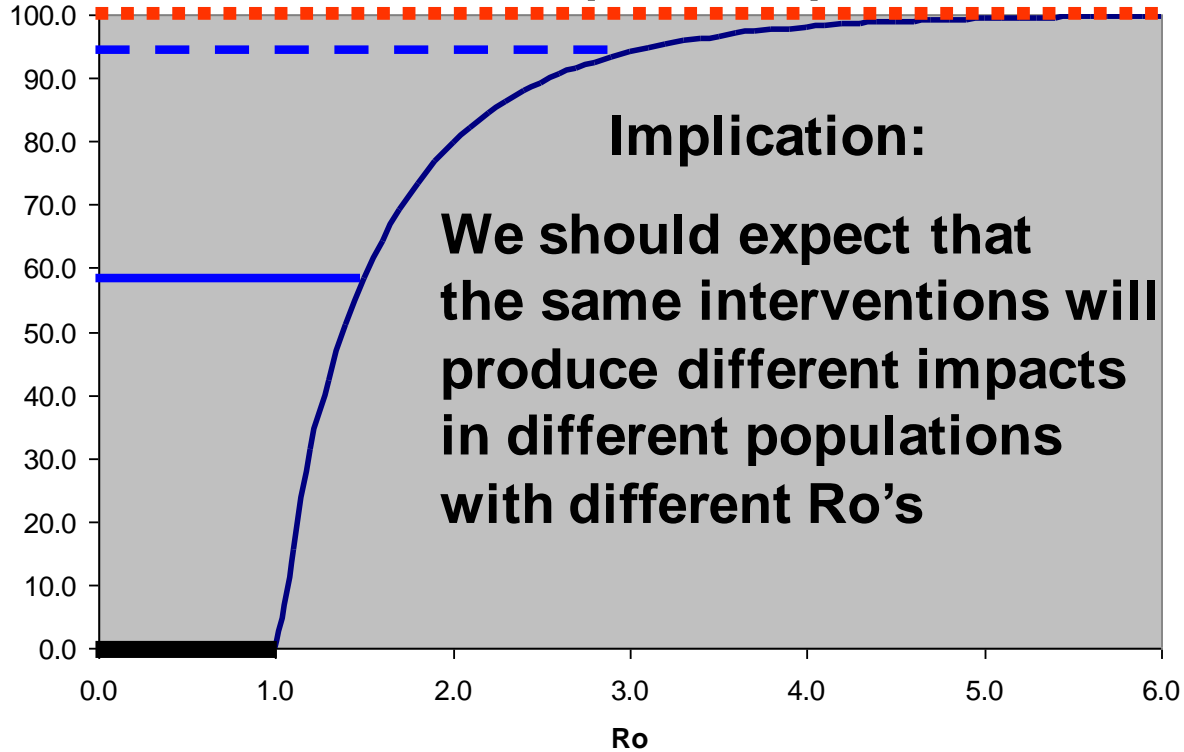
Graph 1   Time   11:51 AM   12/10/99

Relationship between Ro and Endemic Prevalence for Simple SIR Epidemic

Ro

Relationship between Ro and Endemic Prevalence for Simple SIR Epidemic

Implication:

We should expect that the same interventions will produce different impacts in different populations with different Ro's

Relationship between Ro and Endemic Prevalence for Simple SIR Epidemic

Implication:

Joint prevention efforts may appear additive at high Ro's, but at lower Ro's extremely important synergies can be expected.

Ro
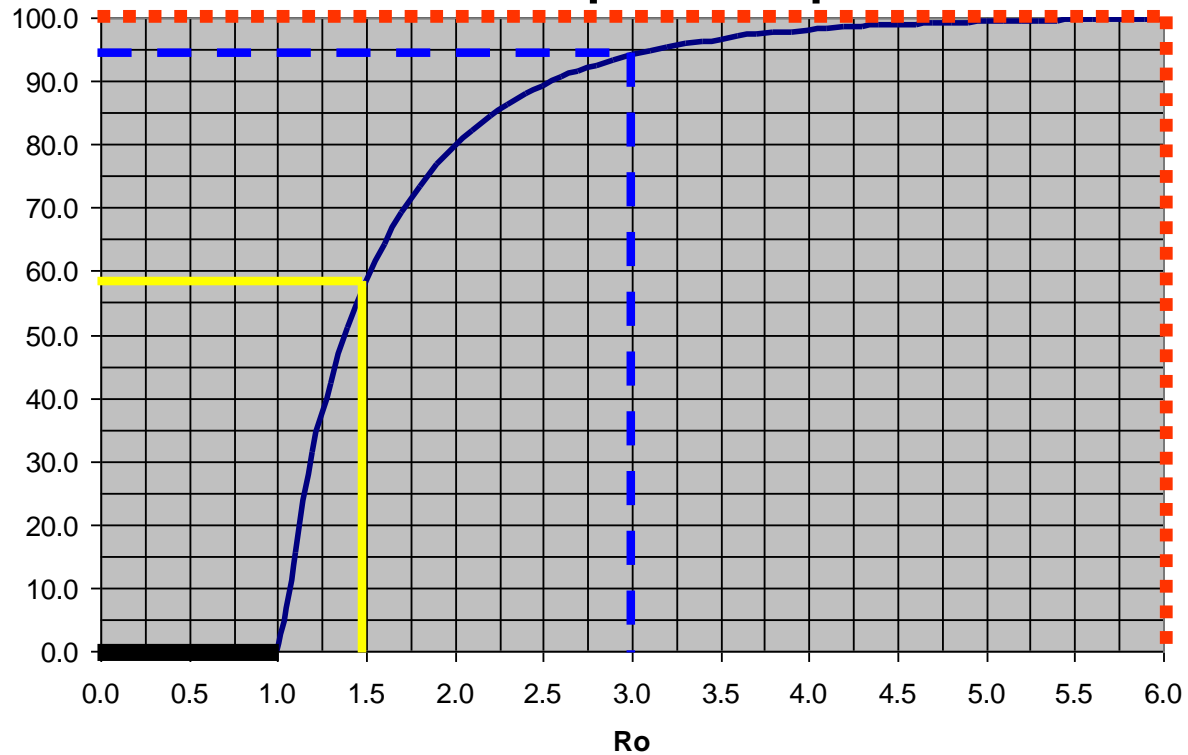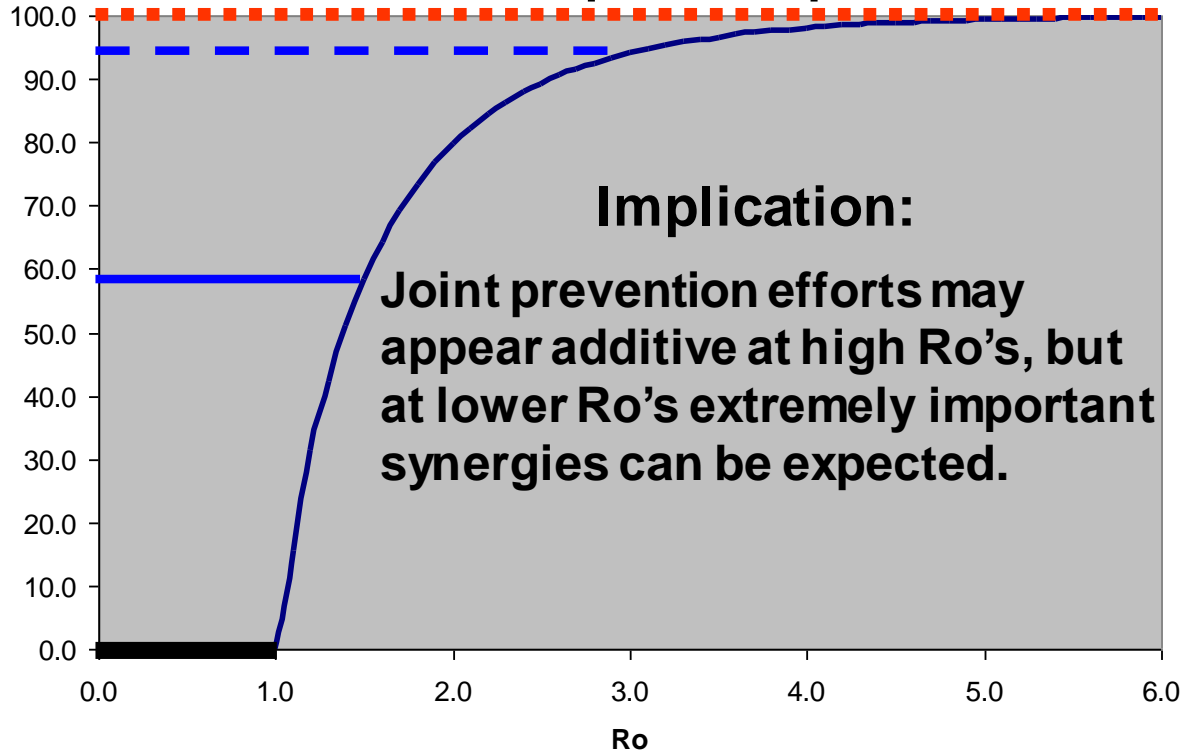
Control Strategies for Reducing Ro

Reduce Transmission Probabilities (β)

Reducing susceptibility of susceptibles
N-95 Masks, Social Distancing

Reducing infectiousness of infectives
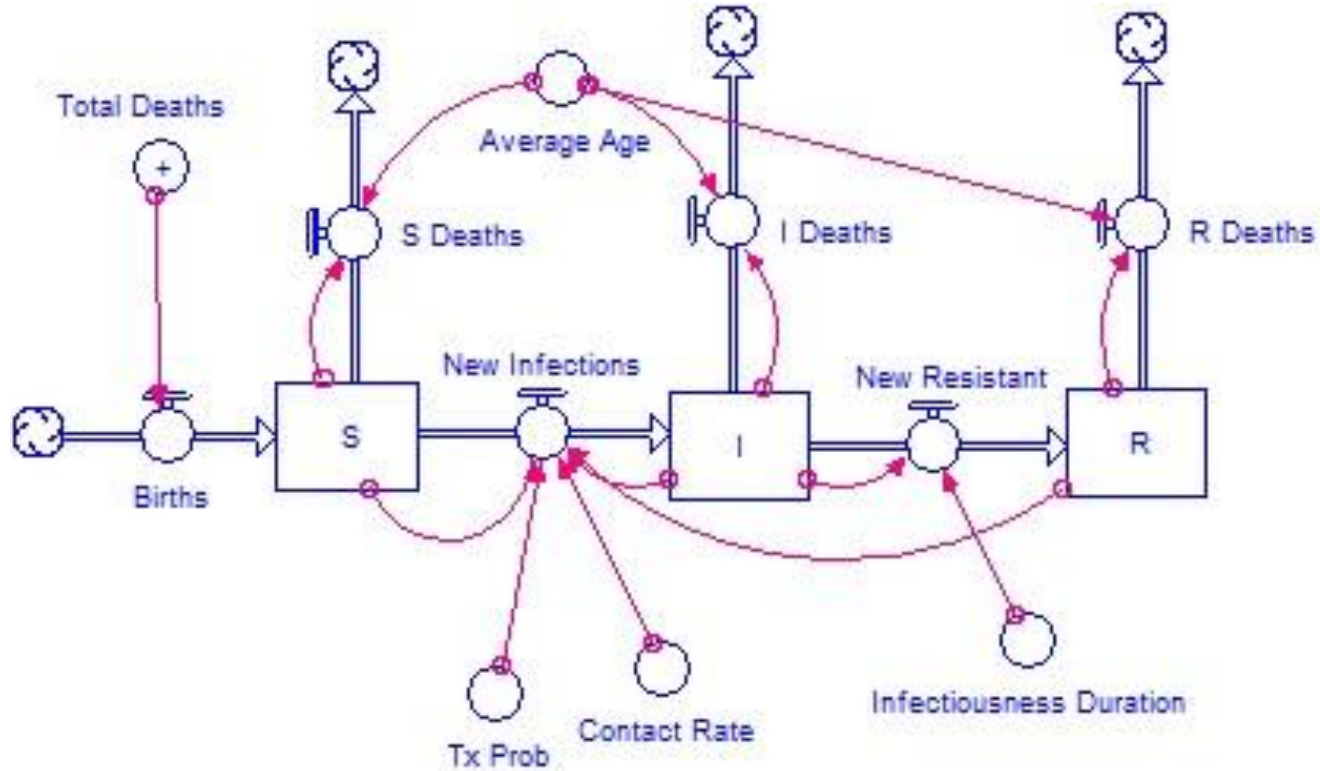Surgical Masks, Social Distancing, Quarantine

Reduce Contact Rates (c)

Quarantine, Closing workplaces, public transportation, etc.

Reduce Infectiousness Duration (D)

Anti-virals: Remdesivir, Favipiravir

SIR with Vital Dynamics

It's Time to Get Real About COVID Apps

{Jane Bambauer, Berin Szoka, Adam Marcus}

Reproduction Rate

Early in Wuhan: close to 6.0

Mid-crisis Italy: between 2.5-3.0

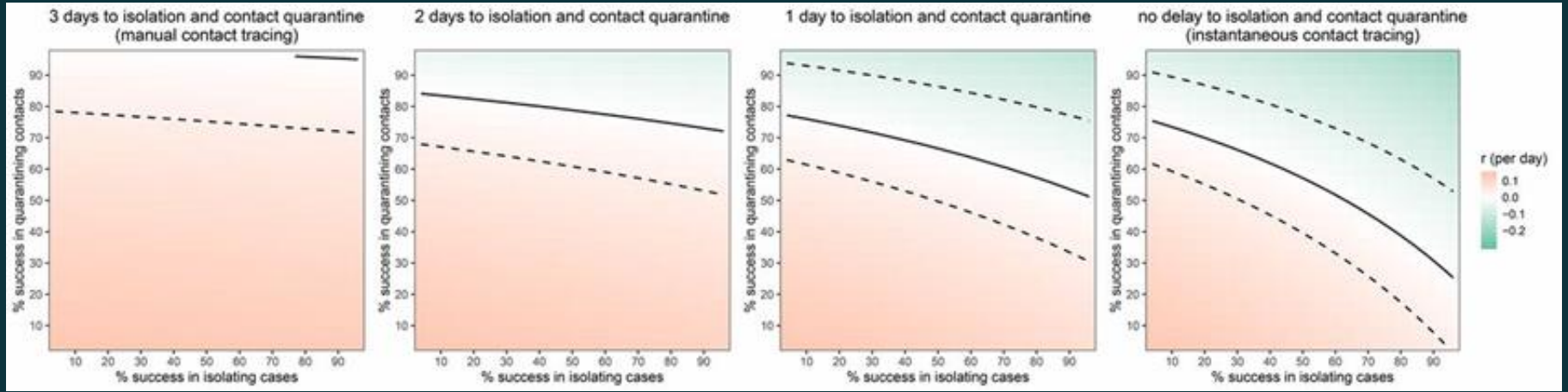U.S. after 6 weeks of lockdowns: 0.8-1.2

Our Options

Even accounting for masks and physical distancing guidelines, we will operate with some combination of:

- Cases/Hospitalizations/Deaths
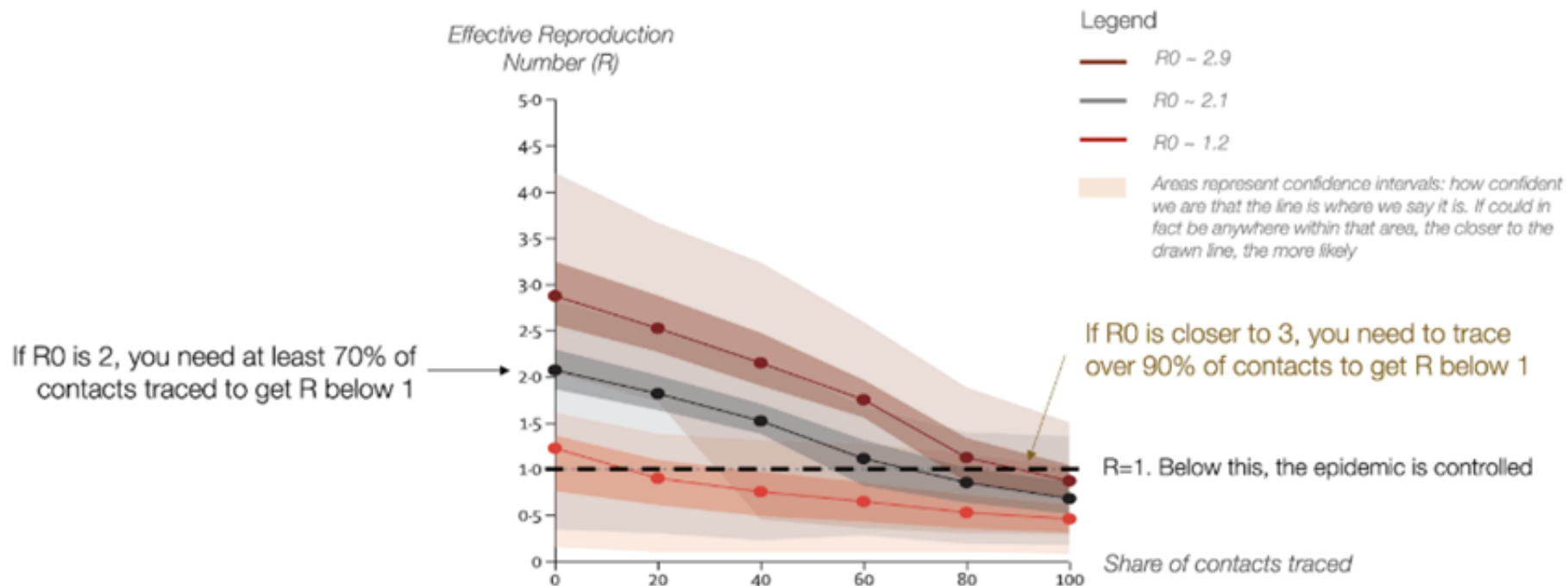- Mass Quarantines (Lockdowns)
- Tracing and Targeted Quarantines

(Until good treatment, herd immunity, or mass routine testing)

What We're Up Against

Dotted lines represent uncertainty in effective reproduction rate

Chart 23: What Share of Contacts Do We Need to Trace to Get the Transmission Rate Below 1?

Effective Reproduction Number (R)

Legend

— R0 ~ 2.9
— R0 ~ 2.1
— R0 ~ 1.2

Areas represent confidence intervals: how confident we are that the line is where we say it is. It could in fact be anywhere within that area, the closer to the drawn line, the more likely

If R0 is 2, you need at least 70% of contacts traced to get R below 1

If R0 is closer to 3, you need to trace over 90% of contacts to get R below 1

R=1. Below this, the epidemic is controlled

Share of contacts traced

Source: Tomas Pueyo annotations based on chart from "Feasibility of controlling COVID-19 outbreaks by isolation of cases and contacts", Joel Hellewell, Sam Abbott*, Amy Gimma*, Nikos I Bosse, Christopher I Jarvis, Timothy W Russell, James D Munday, Adam J Kucharski, W John Edmunds, Centre for the Mathematical Modelling of Infectious Diseases COVID-19 Working Group, Sebastian Funk, Rosalind M Eggo, Link:

Humans are Necessary but Not Sufficient

During lockdowns

    60% of contacts were family and friends

    Potentially can be managed by post hoc contact tracing
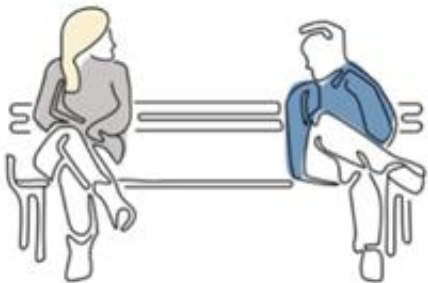
As lockdowns ease

    Greater proportion of contacts are strangers

    More "superspreaders"

Apple/Google Plan Won't Work on Its Own

Alice and Bob don't know each other, but have a lengthy conversation sitting a few feet apart

Bob is positively diagnosed for COVID-19 and enters the test result in an app from his public health authority

A few days later...

Their phones exchange beacons with random Bluetooth identifiers (which change frequently)

~15 min

Key

Key
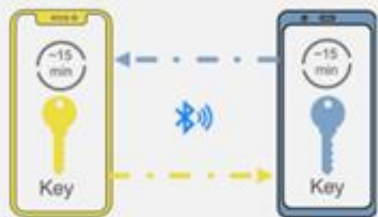
With Bob's consent, his phone uploads the last 14 days of keys for his Bluetooth beacons to the server

Apps can only get more information via user consent

Positive Test

Submit

~14 day temporary store

 Google

Apple/Google Plan Won't Work on Its Own

Participation will be a big problem

- Requires two levels of opt-in
  - Participation rates: Singapore (20%) Australia (10%)
- 19% of American adults do not have a smartphone
  - Disproportionately elderly or low income
- To be effective, *both* parties to a contact need to participate
  - 50% participation catches 25% of proximity contacts

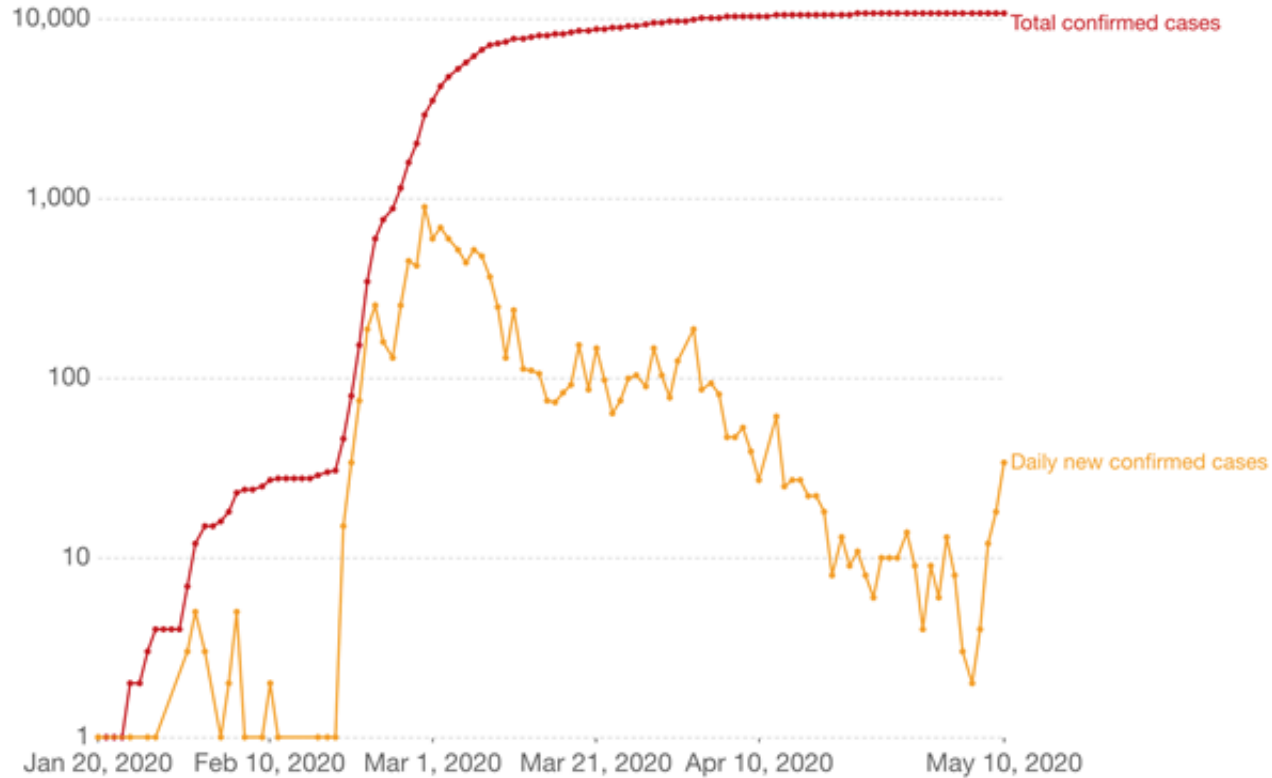# Apple/Google Plan Won't Work on Its Own

- Poor measures of proximity > high false positive rate
- Won't identify places > No opportunity to decontaminate
- Ineffective notice
  - No context (place or time) for users to assess risk when they receive an exposure notification
  - No notice until positive test is reported by user
  - Either too many or too few notifications based on duration and proximity alone

Learning from South Korea

Total and daily confirmed COVID-19 cases, South Korea

The number of confirmed cases is lower than the number of total cases. The main reason for this is limited testing.

Our World in Data

Total confirmed cases

Daily new confirmed cases

10,000

1,000

100

10

1

Jan 20, 2020   Feb 10, 2020   Mar 1, 2020   Mar 21, 2020   Apr 10, 2020   May 10, 2020

Source: European CDC – Situation Update Worldwide – Last updated 10th May, 11:00 (London time)   OurWorldInData.org/coronavirus · CC BY

Learning from South Korea

Total and daily confirmed COVID-19 cases, United States
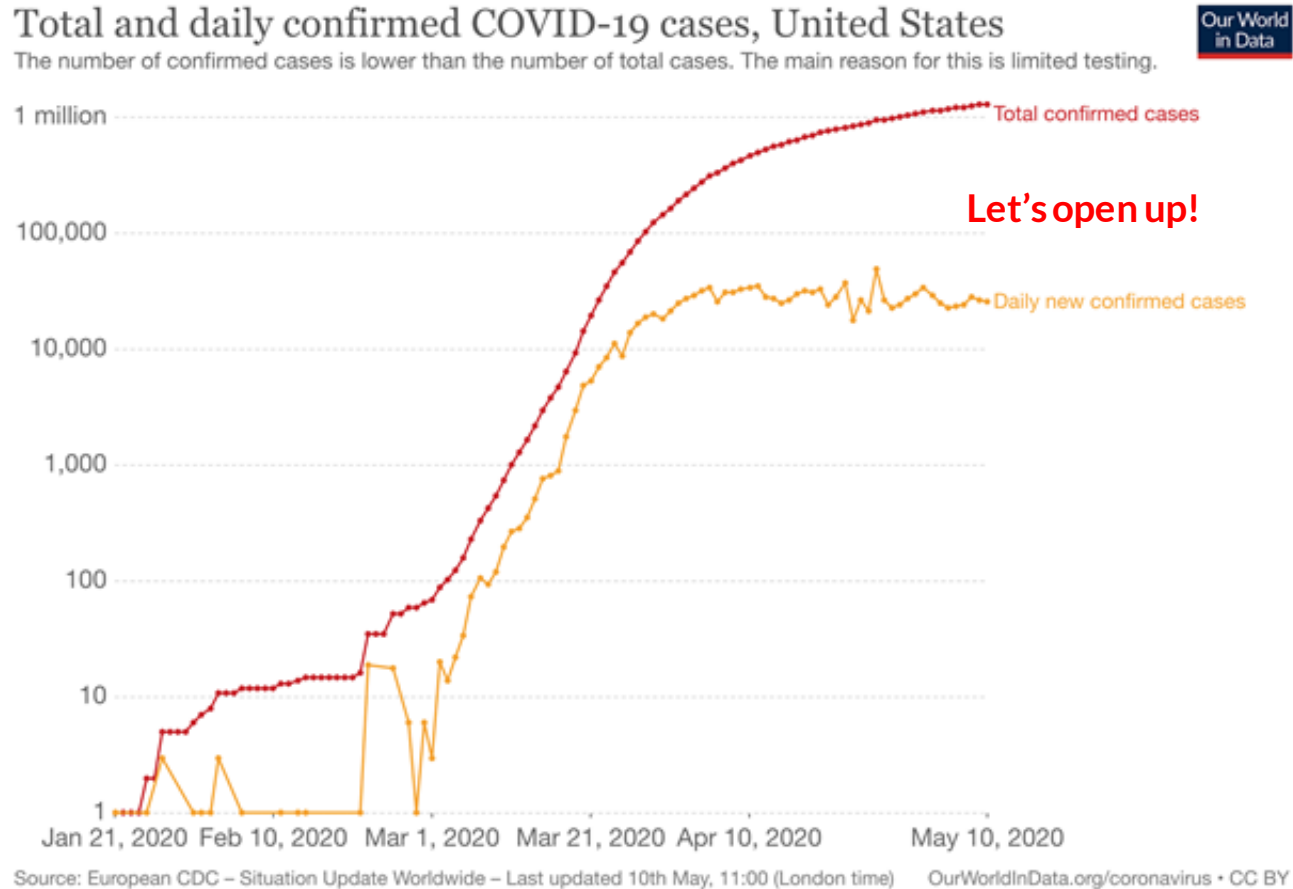The number of confirmed cases is lower than the number of total cases. The main reason for this is limited testing.

Let's open up!
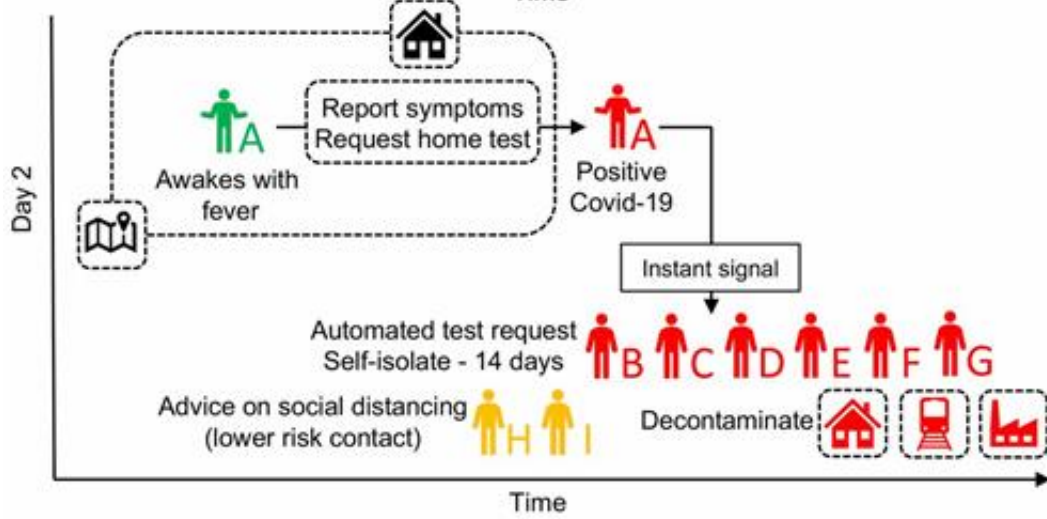
A Smart Test & Trace Program

WHAT:

- Reliable, individualized measures of risk
- Smart recommendations based on that risk
- Near-instantaneous tracing of high-risk or COVID+ users
- Swift updating of individualized risks and recommendations

Day 1

Subject A has COVID-19 infection. No symptoms

Home — A, B

Train — A, C, D

Work — E, A, F, G, H, I — Close Nearby

Home — A, B

Time

Day 2

Awakes with fever — A

Report symptoms
Request home test

Positive Covid-19 — A

Instant signal

Automated test request
Self-isolate - 14 days — B, C, D, E, F, G

Advice on social distancing
(lower risk contact) — H, I

Decontaminate

Time
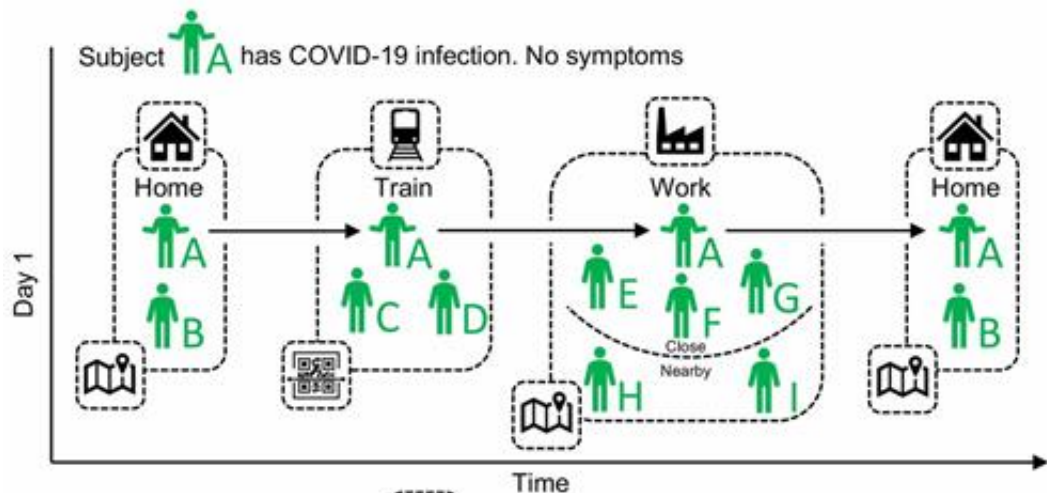
South Korea's System: The Good & Bad

Good:

- Universal participation
- Reasonably effective thus far

Bad:

- Not smart enough: worked well for churches, not nightclub
- Broadcasts location histories of all infected persons
- Doesn't automate tailoring of recommendations enough

A Smart Test & Trace Program

HOW:

- Both GPS *and* Proximity Data
- Centralized database run by the Centers for Disease Control
- Informative, automated, *targeted* notifications via public health authority app
- Broadest possible participation
- Robust statutory privacy safeguards

Preparing for a Test & Trace Program

- Free smart devices & mobile data service for all who want it (stimulus bill)
- Create a Data Repository at CDC
  - Require Apple/Google to collect and upload GPS and Bluetooth proximity data for all devices
  - Require reporting by COVID test administrators
  - Create an Oversight Board
- Require compliance with data protection*
- Leave everything else to PHAs, states, and private firms

Biggest Obstacle: Privacy as Choice

COVID-19 Consumer Data Protection Act (proposal)

The COVID-19 Consumer Data Protection Act would:

> Require companies under the jurisdiction of the Federal Trade Commission to obtain affirmative express consent from individuals to collect, process, or transfer their personal health, geolocation, or proximity information for the purposes of tracking the spread of COVID-19

California Consumer Privacy Act §1798.105

(a) A consumer shall have the right to request that a business delete any personal information about the consumer which the business has collected from the consumer.

Biggest Obstacle: Privacy as Choice

Biggest Obstacle: Privacy as Choice

Biggest Obstacle: Privacy as Choice

Disproportionate Burdens

- Low-income individuals at greater risk of exposure

- African-Americans at far greater risk of severe and fatal cases

- Pew Report: African-Americans and Hispanics are more likely to support government tracking of smartphone location

Contact Tracing Is *Always* Invasive

- PHAs will still access CCTV footage and, possibly, credit card or GPS data
- Patients might face a moral dilemma about whether to disclose their whereabouts and relations to a contact-tracer
- Private institutions will create their own test and trace systems for entrants and employees *without* privacy safeguards

Moving Away from Choice

Under these circumstances, privacy trade-offs should be made at a collective level rather than an individual one

Recommended Privacy Protections

- Oversight Board
  - Experts in privacy, public health, and economics
  - Representation from the general population
- Data Minimization
  - GPS and proximity data uploaded without identifiers
  - Deleted after a period of time (*e.g.*, 30-60 days)
- Access Restrictions
  - Only Oversight Board, public health authorities and PHA-approved apps

Recommended Privacy Protections

- Use/Purpose Restrictions
  - Modeling individual risk
  - Providing notifications
  - Requesting/ordering quarantine or testing
  - Distributing scarce medical resources (e.g. tests)
  - Aiding PHAs design stratified random samples for testing
  - Generating reasonably de-identified data for statistical study
  - Explicit prohibition on use for criminal investigation

Recommended Privacy Protections

- Transparency
    - Open Source Code
    - Access Logs
    - Oversight Board Reports on efficacy, security, and civil liberties
- Data Security
    - Stored in a form that is difficult to decipher (prox id keys)

Recommended Privacy Protections

- Well-Aligned Incentives
  - Expenses from mobile data service plans will give U.S. government incentive to end the program as quickly as the public health allows
- Semi-automatic Off-ramps
  - Automatic collection ends for each individual who acquires immunity under generally accepted* standards
  - Program ends based on mass testing, herd immunity, decreased severity of the virus, or poor efficacy of the program

Evidence of Efficacy

Compared to comparable outbreaks:

- HEALTH (lower rate of transmission)
- PHYSICAL FREEDOM (less sheltering at home)
- COMBO (less transmission *and* less sheltering)

Flipping the Frame

—

If individual choice reduces the efficacy of a contact tracing program, those who advocate for it must choose between:

- LESS HEALTH (higher rate of transmission)
- LESS PHYSICAL FREEDOM (more sheltering at home)
- COMBO (higher transmission *and* more sheltering)

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