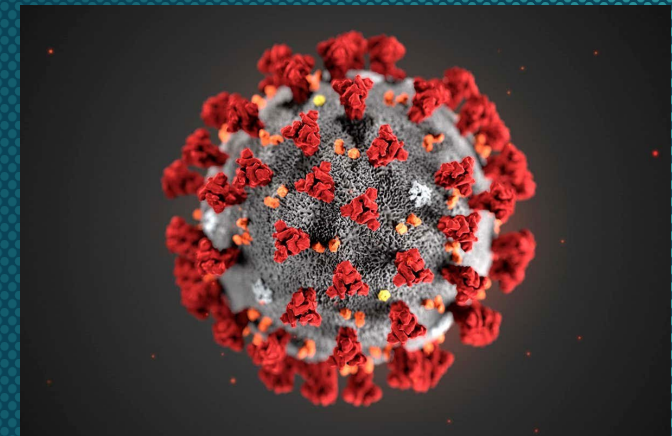# COVID-19 Contact Tracing
I-TECH Videoconference

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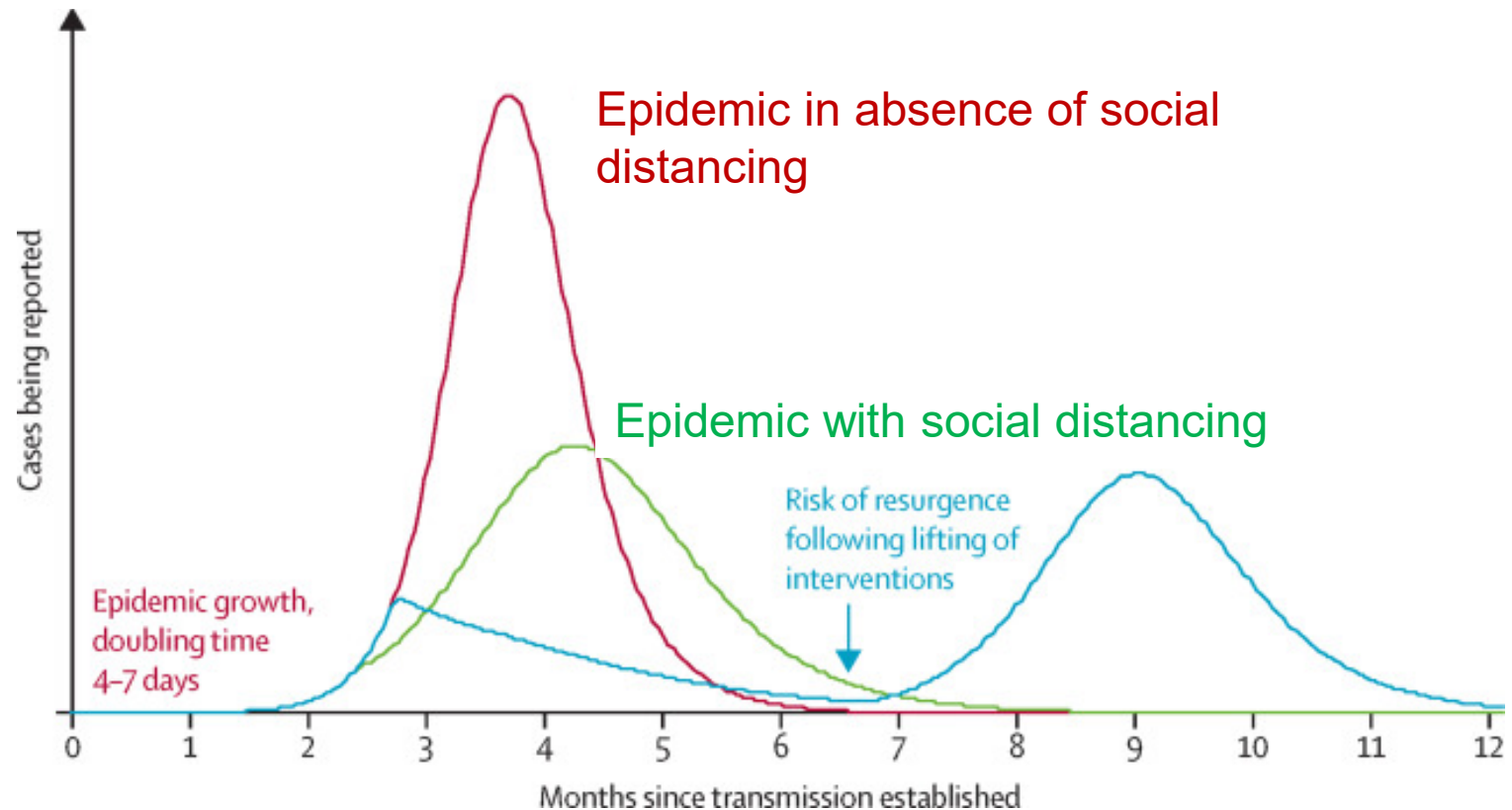Last Updated: May 4, 2020

Overview

- Stage of epidemic and rationale
  - Cluster response
  - Effect in widespread epidemic
- Evidence for effectiveness
- Operational considerations

Contact Tracing in Relationship to Stage of Epidemic

- Outbreak response
  - Early in epidemic – small number of cases
  - Goal is to contain a focal outbreak
  - High intensity investigation
- Contact tracing as large scale epidemic
  - Many people infected
  - Cases exceed the capacity of the system – less intensive response – how to focus
- Declining epidemic
  - Adaptive response – keep the genie from coming back out of the bottle

Mathematical Models: Subsequent Waves of Infection

- Social distancing flattens the curve, decreasing the peak and prolonging the duration of the epidemic
  - Allows healthcare system to manage epidemic
- Relaxation of social distancing may result in new waves of infection
  - Containing these new waves of infection is a central goal of contact tracing
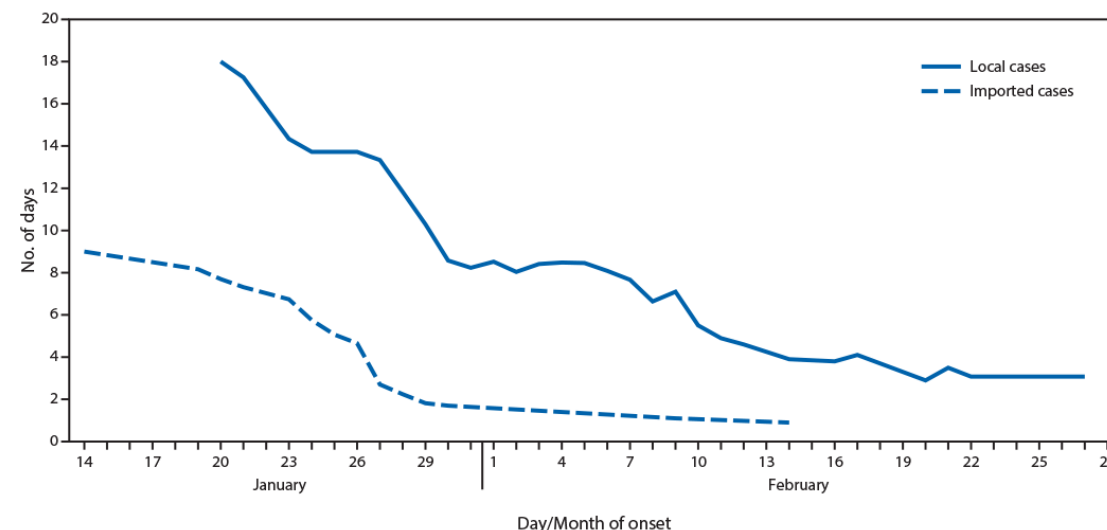

Source: Anderson R. Lancet 2020

Early Outbreak Response: Singapore

- **Early adoption of surveillance & testing**
  - Surveillance – testing hospitalized (later outpatient) pneumonia, ICU, flu-like illness in sentinel clinics, deaths possible infectious cause, clinician discretion
  - Quarantine of close contacts for 14 days
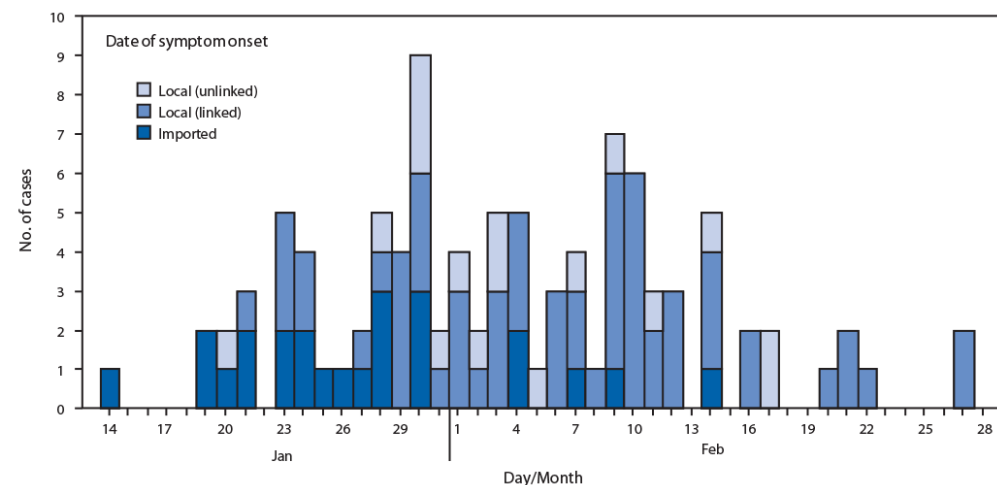
- **Source diagnoses first 100 cases** (Ng Y MMWR 220)

Source	%	
Contact tracing	**53%**	**24.5% before symptom onset**
Clinical case definition	20%	Clinical presentation + travel or exposure
Surveillance	16%	Mostly pneumonia
Provider discretion	11%	

- **3 clusters** (Pung P. Lancet 2020)
  - 36 cases - business/church events with Chinese visitors
  - 2/425 contacts infected

Interval from Symptom Onset to Isolation or Hospitalization

Epidemic Curve: Date of Symptom Onset

Outbreak Response: Many Examples

- Diamond Princess Cruise Ship (Moriarty LF MMWR 2020)
  - 712 (19.2%) of 3711 SAR-CoV-2 positive – 46.5% asymptomatic at time of testing
- Business meetings & church clusters in Singapore (Pung P. Lancet 2020)
  - 36 cases – 2 of 425 contacts infected
- Nursing homes in Seattle (McMichael , NEJM 2020)
  - 167 cases – 35 deaths
- "Youngster" gathering – hotpot and karaoke – 6 (40%) of 15 contact infected by presymptomatic index case (Huang L, J of Inf 2020)
- Engineering congress in Italy – 18 (12.5%) of 143 contacts positive -11 (61%) asymptomatic at time of testing (Valent F. CMI 2020)
- Swiss healthcare workers without PPE caring for an undiagnosed case (Vera C SMW 2020)
  - 21 healthcare workers – 10 >15 minutes exposure – none tested positive for SARS-CoV-2

Outbreak Response: Conclusions

- Early adoption of aggressive surveillance and testing can work
  - Success depended on very organized system of surveillance, testing, and quarantine – complemented by travel restrictions and screening
  - Uncertain whether this translates into long-term containment
- Risk of COVID-19 among "close contacts" in the context of outbreaks is highly variable
- In some instances, a relatively large number of cases are linked to discrete events or places
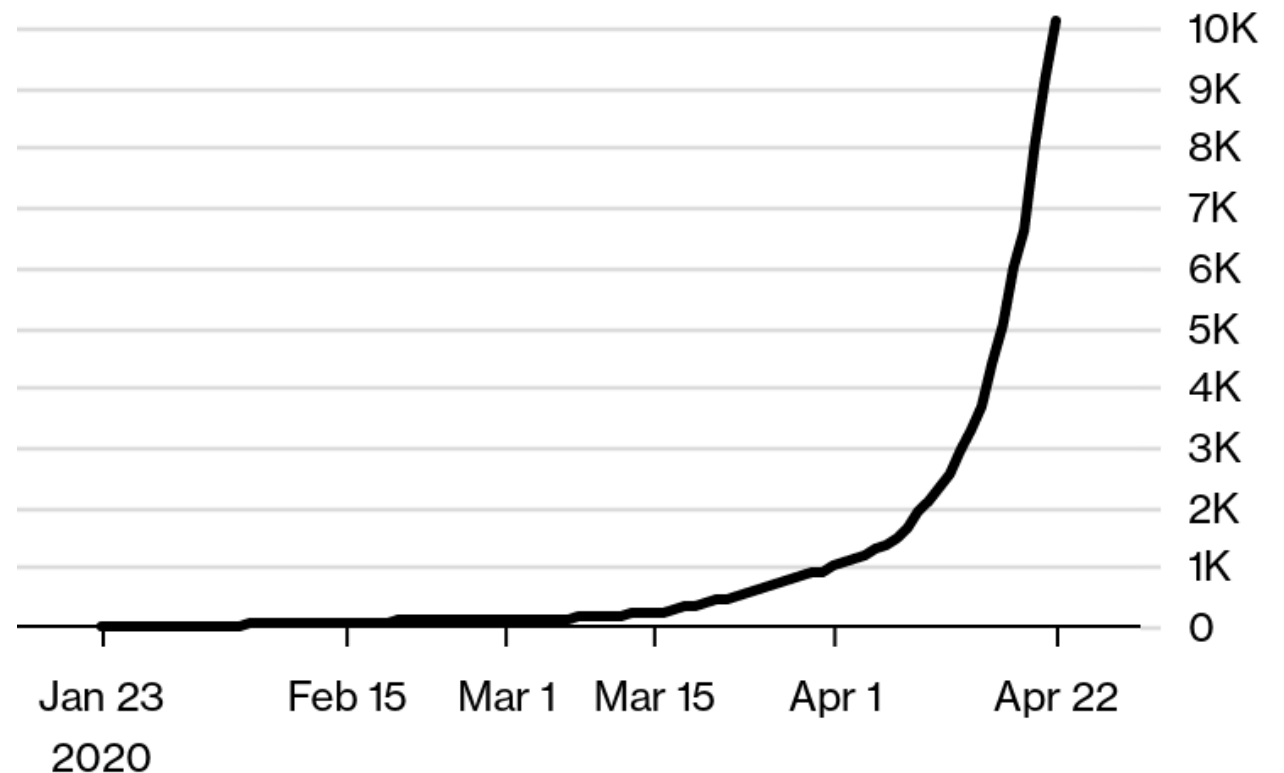
COVID-19 Singapore

- Initial success containing an outbreak did not result in long-term control
- ~17,000 cases by end of April
- Infections concentrated in migrant workers living in crowded conditions

Covid-19 in Singapore

Total cases cross the 10,000 mark on April 22

✎ Cumulative Covid-19 cases

Source: Singapore Ministry of Health

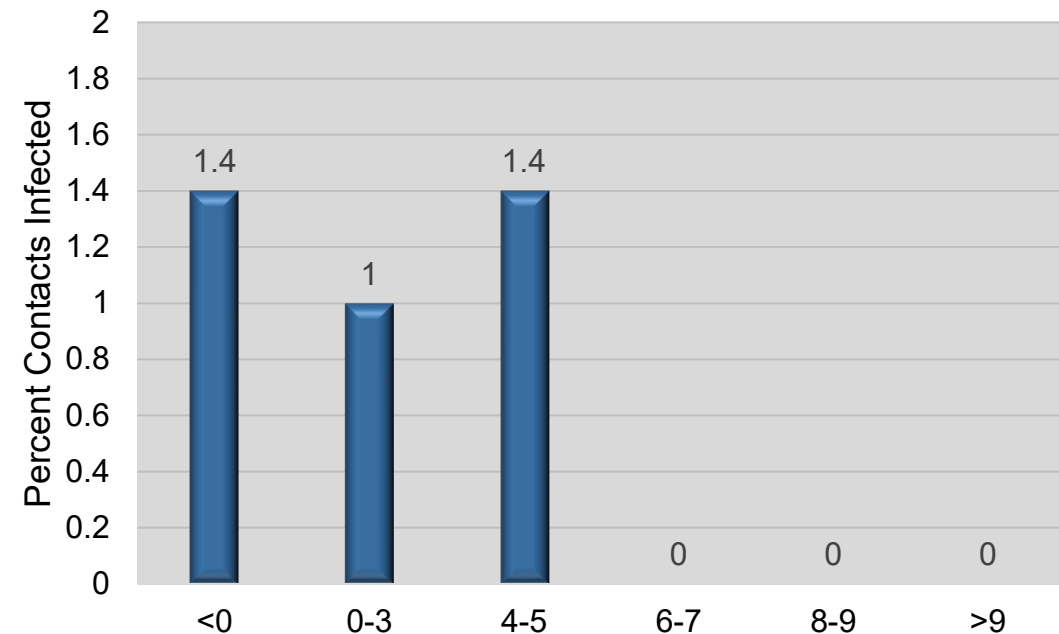Bloomberg

Transmission: Risk in Contacts

	Index Cases	Contacts Tested	Positivity	Subgroups
China Shenzhen Sichuan Guangdong	?	2,240 25,347 7,765	"Close Contacts" 2.8% 0.9% 0.55%	
Shenzhen	391	1,286	6.6%	Household-11.2% - No Assoc. with Age
Wuhan	105	392	Household 16%	Age <18 – 4% Adult not spouse – 20% Spouse – 28%
Korea	30	2,370	0.55% Household 7.6%	
US	10	445	0.45% Household 10%	
Taiwan	100	2761	0.79%	

Sources: Report of WHO-China Joint Mission on COVID2019; Bi Q. Lancet 2020; Li W. CID 2020 (epub); Osong Pub Health & Research Perspectives 2020; Burke RM MMWR 2020; Chang H, JAMA 2020..

Relationship Symptom Onset in Case to Transmission

- 0.8% of contacts SARS-CoV-2 positive – 4 (18%) of 22 asymptomatic
- All 22 secondary cases had an exposure <6 days after symptom onset of index case (vs. 68% among uninfected contacts)
- Higher risk in household contacts and non-household family members vs. healthcare or other persons
  - No cases identified in non-household, family or heathcare contacts

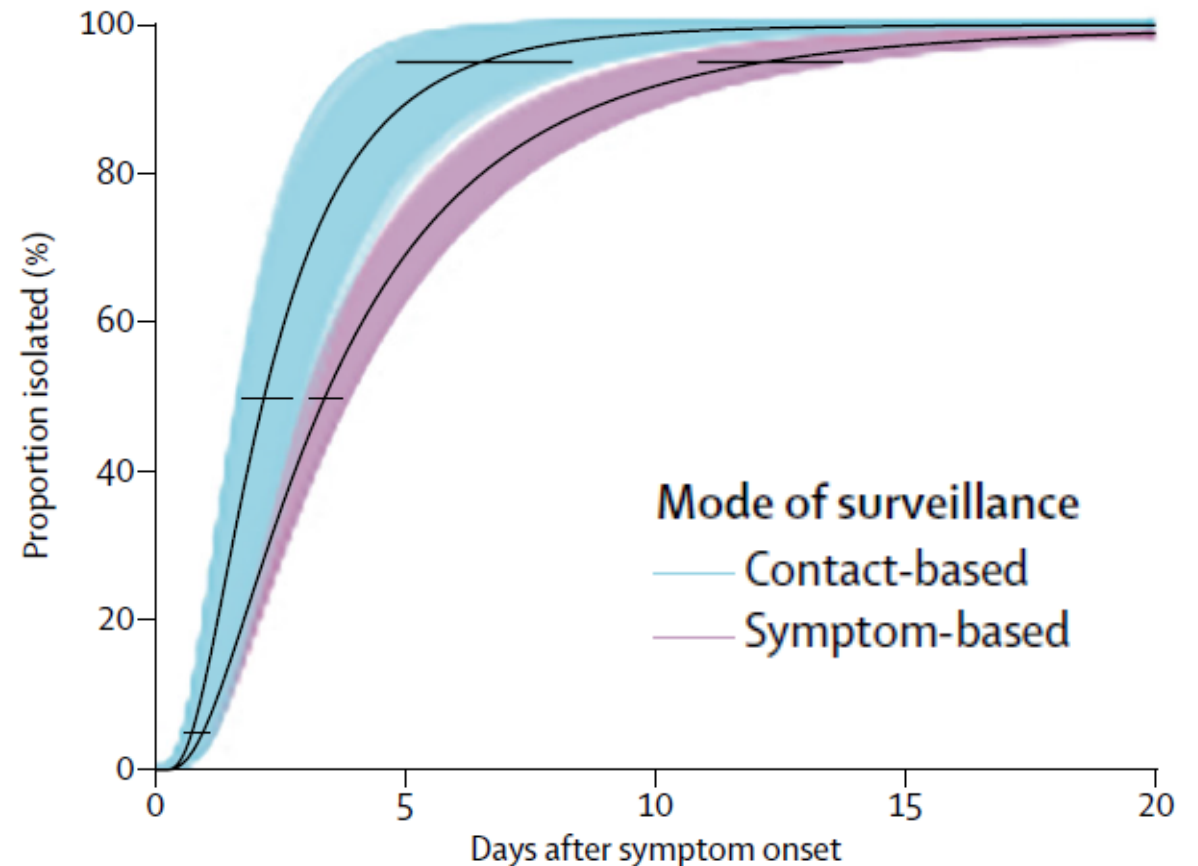Percentage of Contacts with COVID-19 Based on Time from Index Case Symptom Onset to First Exposure

| Number Contacts | 735 | 867 | 216 | 119 | 449 | 284 |

Source: Cheng H. JAMA 2020
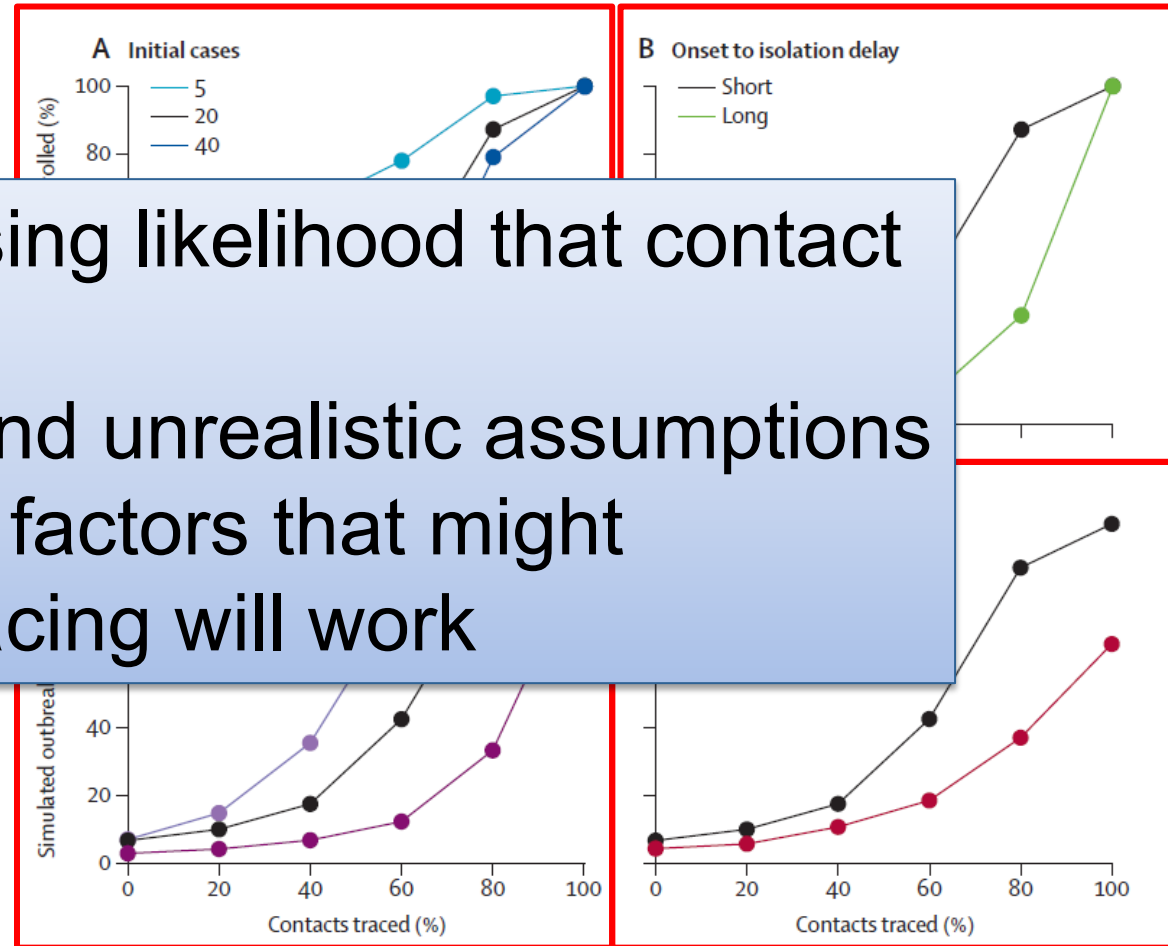
Impact of Contact Tracing

- Analysis of 391 cases in Shenzhen and 1286 contacts – 6.6% contacts had COVID-19
- 80% of cases caused by 8.9% of cases
- Cases identified via contact tracing more likely to be asymptomatic than cases identified via other means (20% vs. 2.6%)
- Among symptomatic cases, those identified through contact tracing had shorter time from onset of symptoms to isolation (3.2 vs. 5.5 days)

Time from Symptom Onset to Isolation, Cases Identified via Contract Tracing (n=87) vs. Other Means (n=304)

Mode of surveillance
— Contact-based
— Symptom-based

Proportion isolated (%)

Days after symptom onset

Source: Bi Q. Lancet 2020

Population Impact Contact Tracing

- Stochastic simulation model
- Isolation prevents further transmission
- 90-100% of cases are identified and isolated (va~~
  - ~~
- Qua~~
- No ~~ hou~~
- Fac~~ effectiveness
  - Smaller initial outbreak
  - Shorter delay symptom onset to isolation
  - Less transmission by asymptomatic persons
  - Absence of subclinical

- **Model is not helpful in assessing likelihood that contact tracing will work**
  - **Too many simplifications and unrealistic assumptions**
- **Provide some insight into the factors that might influence how well contact tracing will work**

A Initial cases
— 5
— 20
— 40

B Onset to isolation delay
— Short
— Long

Contacts traced (%)
Contacts traced (%)
Simulated outbrea~~

Source: Hellwell J. Lancet 2020

Goals of Contact Tracing

- Epidemiologic data to monitor and direct public health response
- Identify people who need medical services and link them to care
- Promote adherence to I&Q guidance
  - Identify people who need support services to sustain social distancing and link those persons to services
- Arrange testing of contacts

Isolation & Quarantine: Brief Summary US

Isolation - Cases

- **Symptomatic cases (include presumptive cases)**
  - Minimum of 10 days since onset of symptoms
  - AND >72 hours without fever in absence of fever-reducing medications
  - AND improvement in respiratory symptoms (e.g., cough, shortness of breath)
- **Asymptomatic cases**
  - Minimum of 10 days since collection of specimen

Quarantine – Contacts

- Household - 14 days after contact completes their time in isolation
- Non-household – 14 days after last contact with case
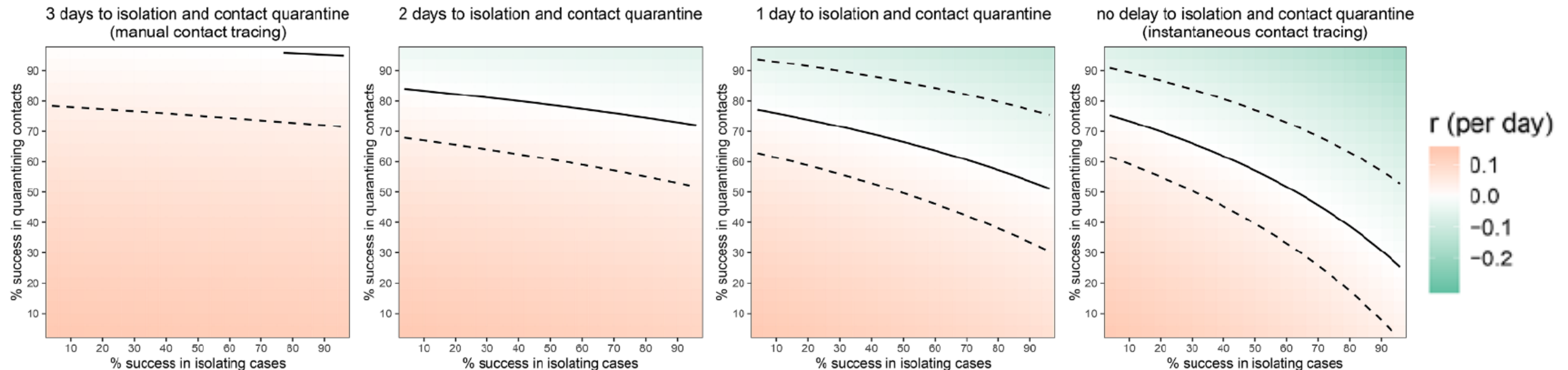
Operational Challenge #1: Identifying Cases

- If you can't identify cases through testing, you can't really do contact tracing

- Requires testing infrastructure

- Contact tracing is a part of a larger control program
  - Role varies depending on stage of epidemic

- Is there any way to do this syndromically? Syndrome is pretty non-specific

Operational Challenge #2: What is a contact?

- Close Contact – Lots of controversy in definition
  - Positivity usually low outside of households
  - Definitions
    - CDC - Within 6ft of a case for $\geq$10 minutes during the 2 days before illness onset through the case's isolation period
    - Singapore - 2m $\geq$30 min
    - Taiwan - Face to face contact >15 minutes without PP
- Interviews needs to integrate people and place
- Interview prompts
  - Household – How many people live in your house?
  - Workplace – Where do you work? What do you do?
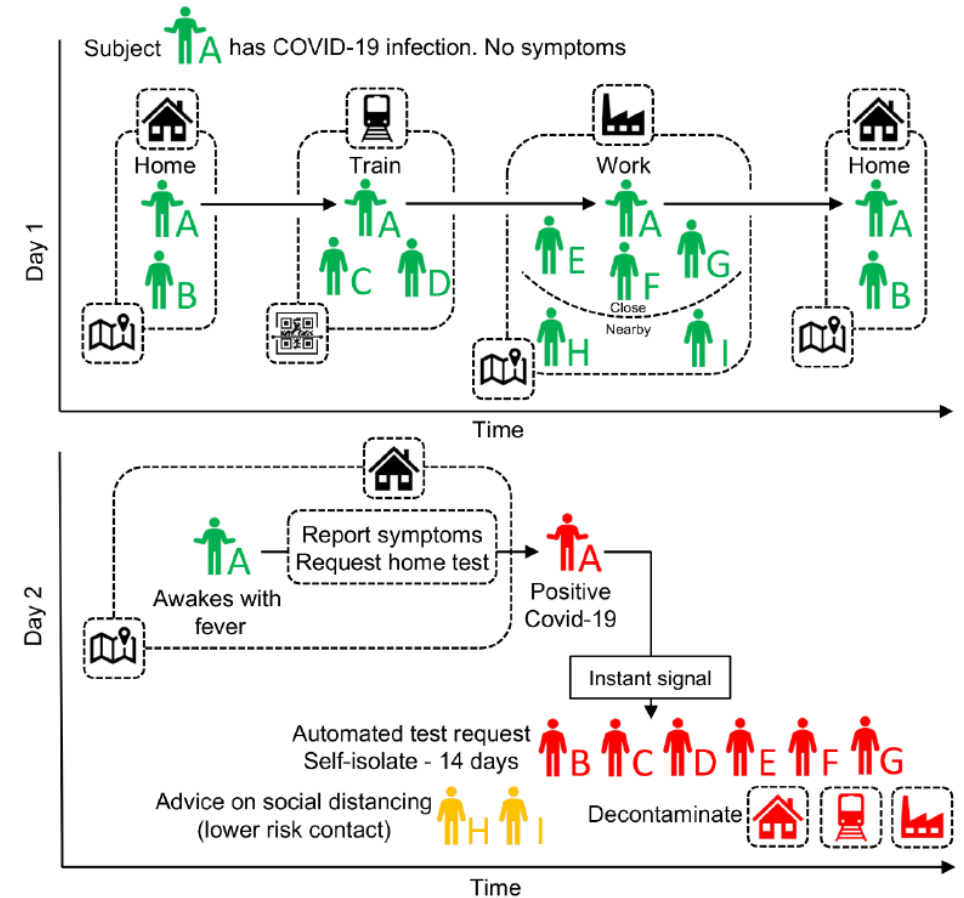 - Places with lots of people – long-term care facilities, events

Contact Tracing via Apps

- Rationale: Resource requirements and need to act very quickly limit the feasibility and utility of manual contact tracing
  - Model assumes 1/3 to ½ transmission occurs before symptom onset
  - Reducing the reproductive number (R – red in figure) below 1 requires immediate isolation and quarantine of contacts

Contact Tracing via Apps

- App records position relative to others using cell phones
  - Direct position vs. location matching
- Requires that large number of people have the App on their phone
  - $1/n$ adoptions = $1/n^2$ exposures recorded
    50% adoption = 25% exposures recorded
  - ~85 groups developing Apps in US

- Very limited data
- Taiwan – Diamond Princess Cruise
- GPS – 3000 passengers disembark-> 627,386 contacts in location >5 minutes
- Many privacy considerations

Source: Ferretti L. Science 2020; Chen C JMIR 2020

Operational Challenge #3: Can People Isolate and Quarantine?

- Advising people to do something they cannot do is not helpful
- Space
  - Is there a space to be by yourself – how much is enough
  - Can you stay home
- Food and money

Operational Consideration #3: Testing

- Testing infrastructure often lacking
- Rationale for testing is strong
  - Identify contacts who are infected
    - Defines isolation period & drives home need for isolation
    - Greater vigilance in symptom monitoring
    - Allows people to isolate or not isolate from household members
    - Identify additional exposed contacts (contacts become cases)
  - Contacts who test negative
    - Still need to remain in quarantine & monitor for symptoms
    - Avoid infected household contacts – probably will not avoid uninfected contacts
  - People will want to be tested!

Overview of Contact Tracing for COVID-19

Case Reported to DOH and Assigned to PHSKC for Follow-up

↓

Investigator Calls Index Case
Confirms Identity and Ability to Speak English or Links to Interpreter Services

↓

REDCap Interview
Demographics, Clinical Status & History Locations of Exposure/Possible Transmission

↓

Medical Assessment

Assessment of Social Support Service Needs

Contact Follow-up & Testing

On-Call CT Provider
-No PCP
-Case has severe symptoms
-High-risk severe disease with no PCP

Contact PCP
No or Mild Symptoms in Person with PCP

Call Center
Mild Symptoms in Persons at Low Risk for Severe Disease

Refer

Household
Arrange Testing as Part of Index Case Call

Non-Household

Call Contacts

Call Contacts with Results