Contact Tracing during COVID-19

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MAAETC Webinar

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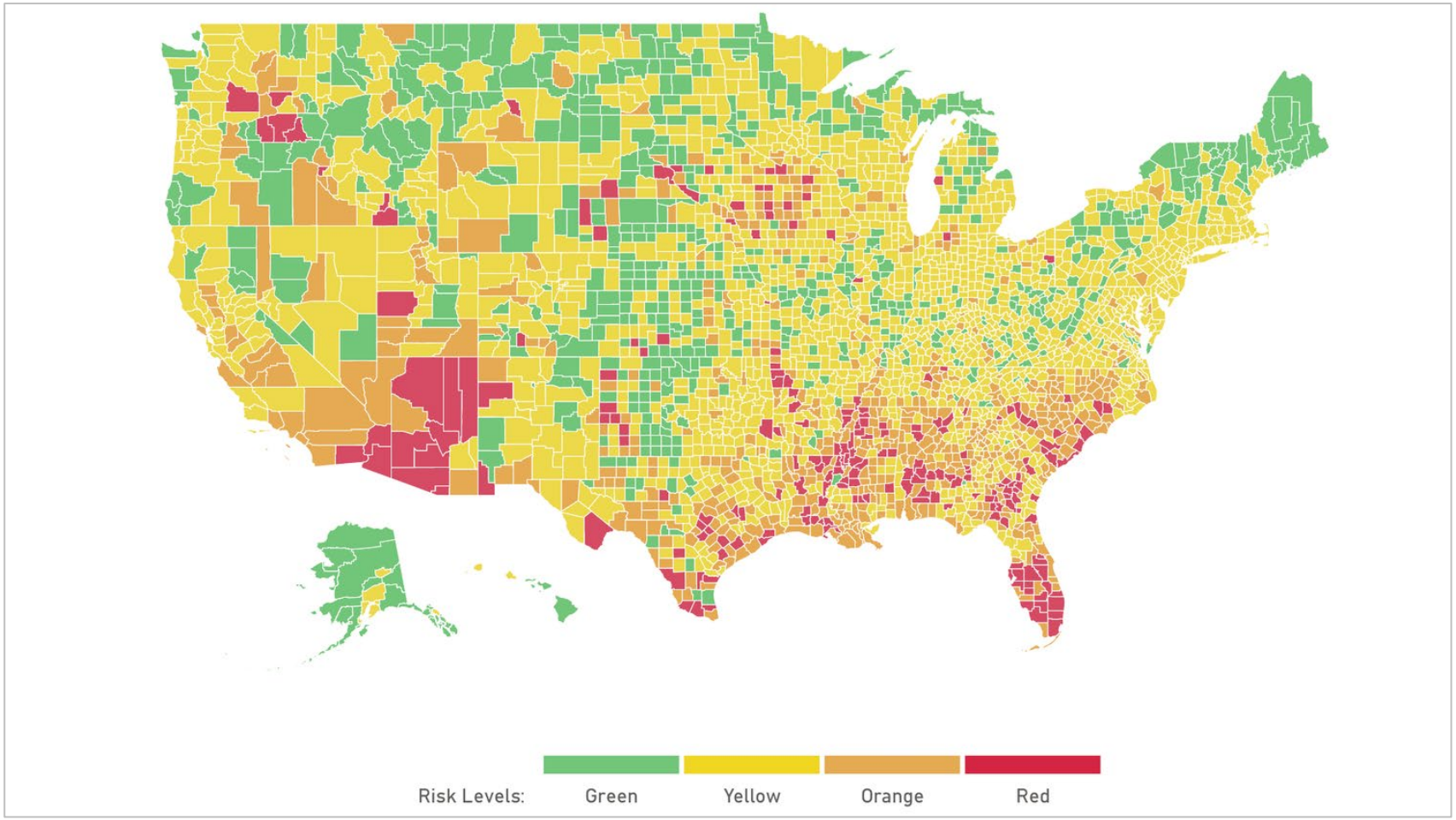
Speaker Disclosure

Speakers are required to disclose any commercial relationships before today's presentation.

HIV and SARS-CoV-2 parallels

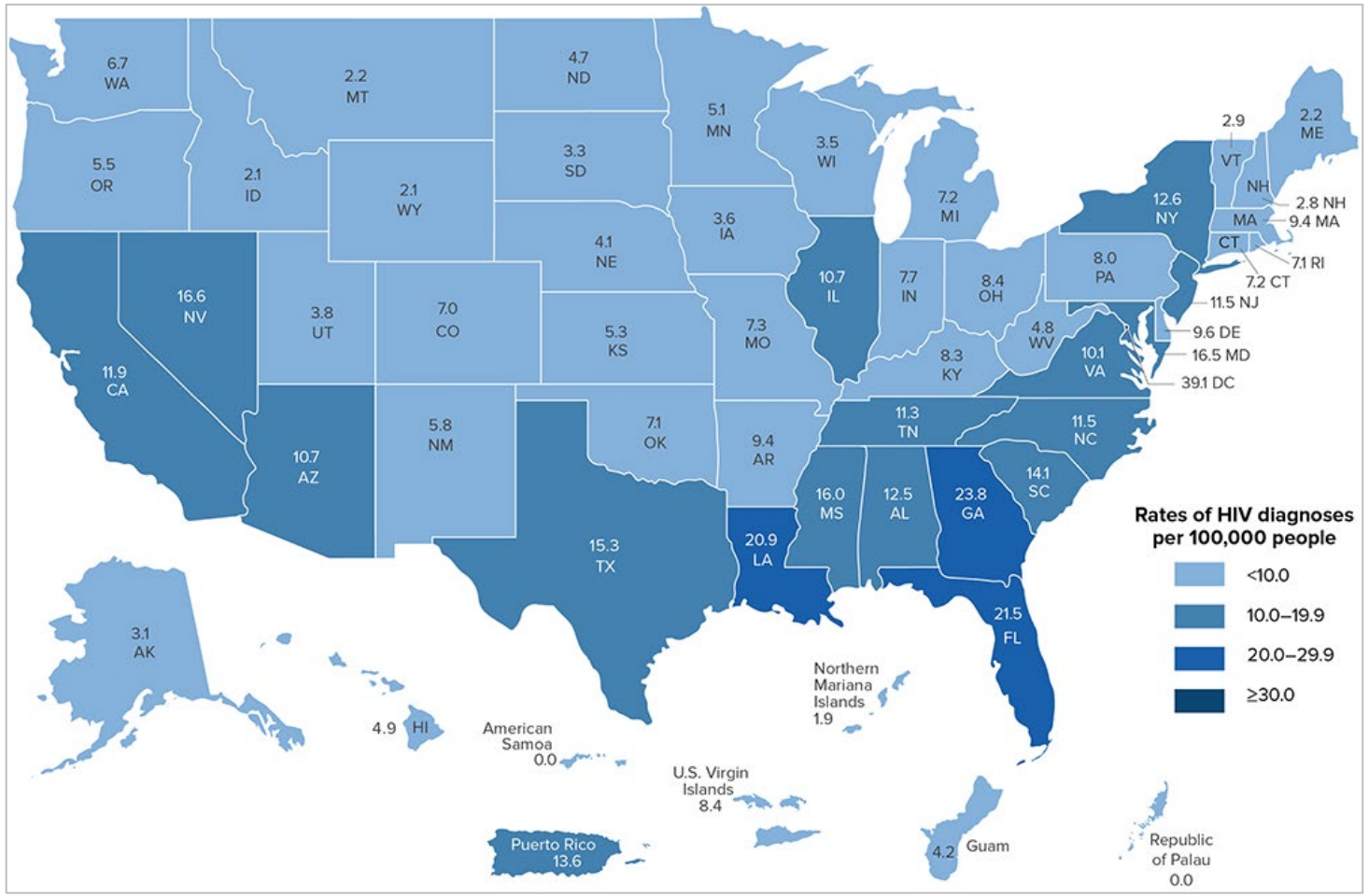
- Pandemics resulting from zoonotic transmission from wildlife
- Take advantage of our social connections to propagate
- Successful control requires global coordination and intensely local focus
- Social networks and ‘connectedness’ drive patterns over space and time
- Lay bare the disparities in access to healthcare, public health interventions, and ability to mitigate risk for infection

Risk of COVID-19 in July 2020



NPR: https://www.npr.org/sections/health-shots/2020/07/01/885263658/green-yellow-orange-or-red-this-new-tool-shows-covid-19-risk-your-county

Rates of HIV in US, 2018



US CDC: https://www.cdc.gov/hiv/statistics/overview/geographicdistribution.html

Objectives for the talk

1. Describe the process of contact tracing for COVID-19 and how it prevents transmission
2. Describe how contact tracing for COVID-19 fits within a comprehensive strategy to control COVID-19 transmission and how we measure impact
3. Discuss major barriers to effective contact tracing and strategies to overcome them

How contact tracing works

Public Health Prevention for COVID-19

If we can limit contact between people who are infected and others, we can limit opportunities for the virus to be transmitted

Timeline of Infection: Infectious Period

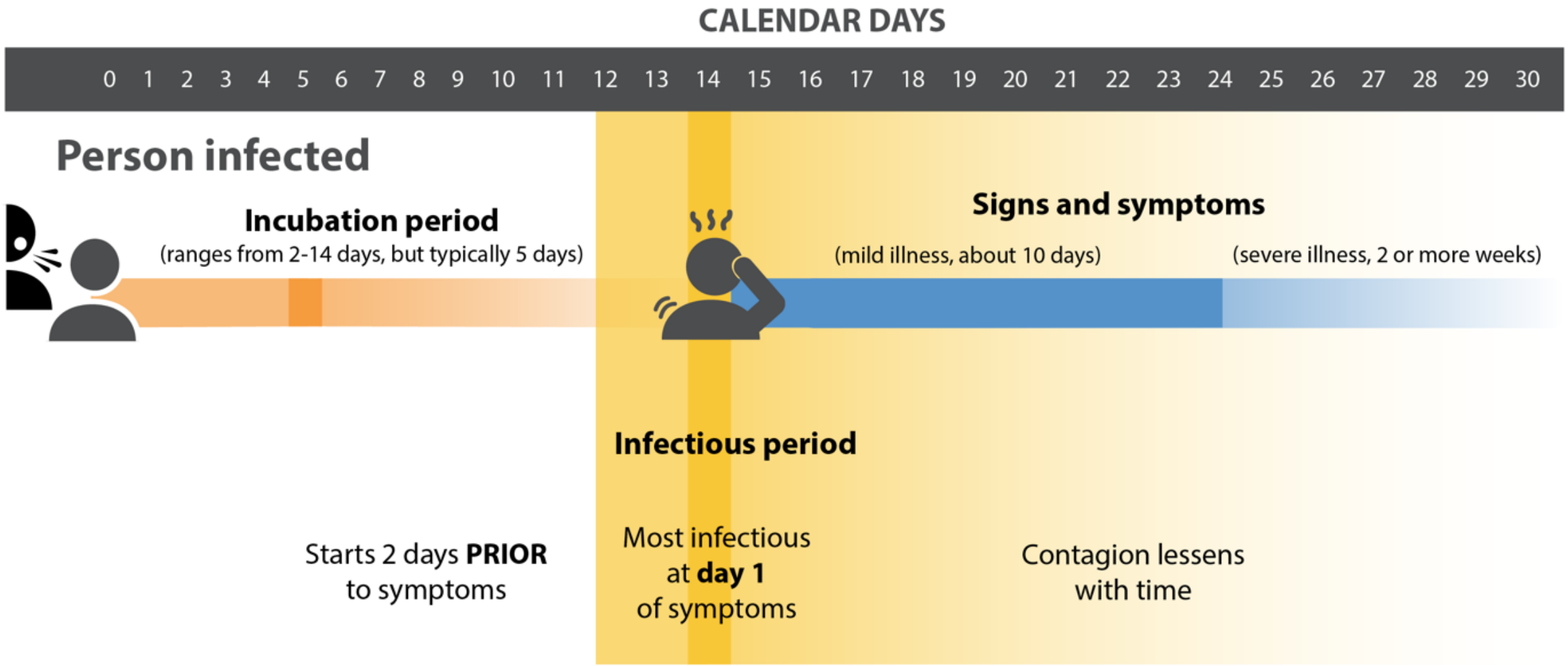
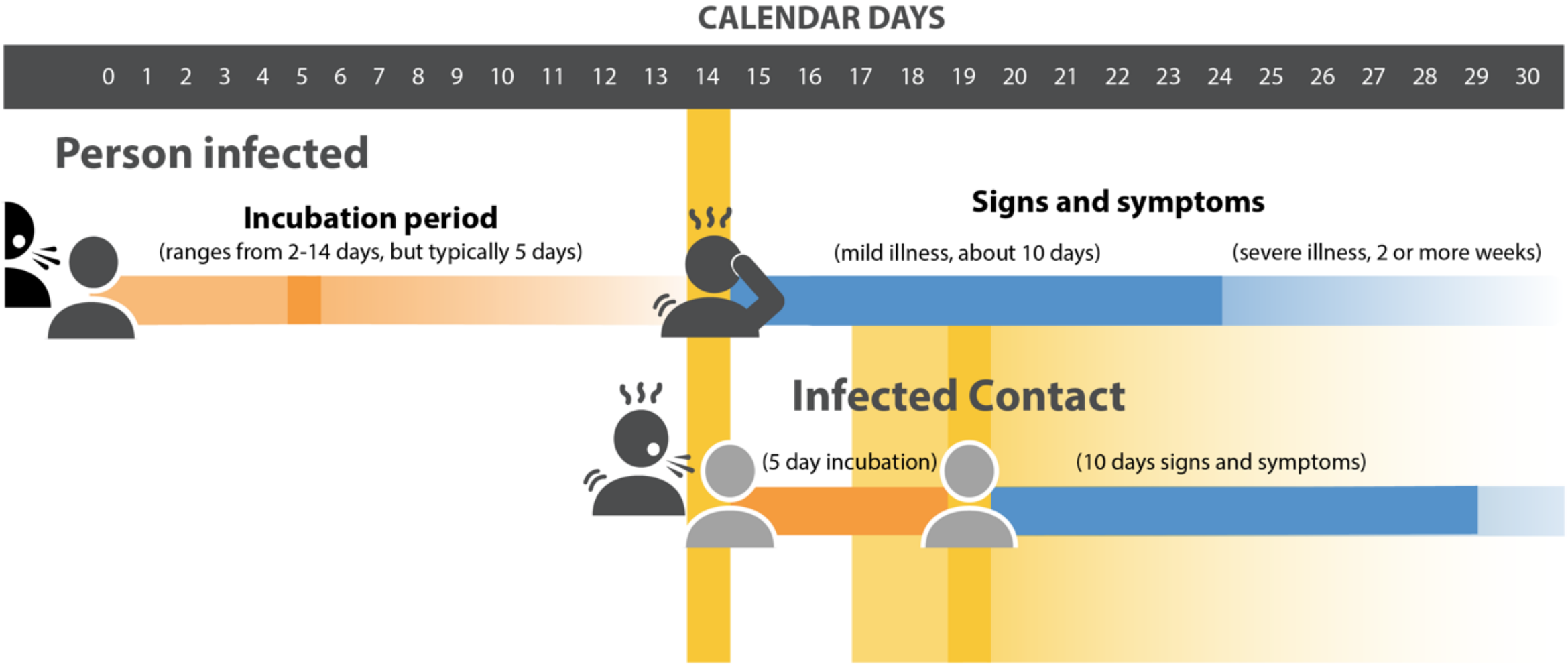


Image source: Center for Teaching and Learning, Johns Hopkins Bloomberg School of Public Health.

Timeline of Infection: Infected Contact



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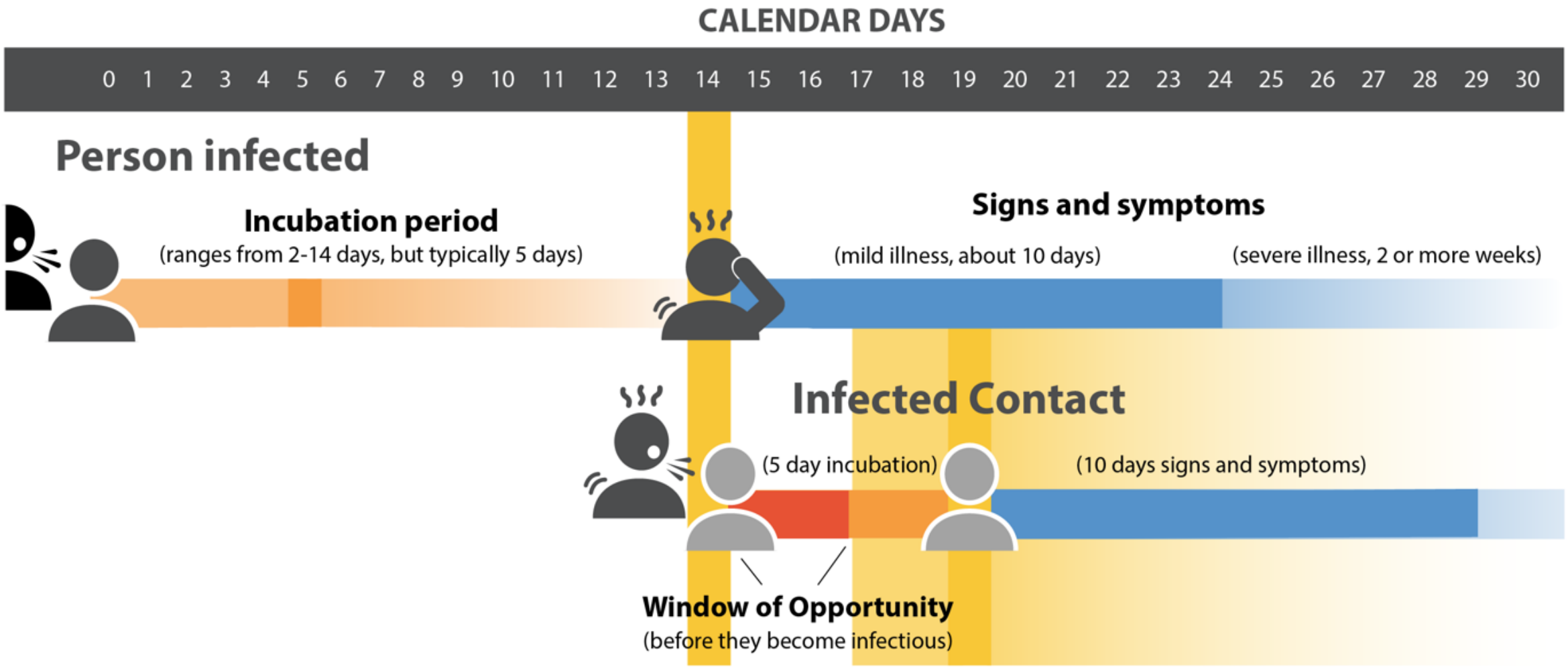
Timeline of Infection: Window of Opportunity



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Cases and Contacts

- **Case**
  - Someone who has COVID-19
  - Usually has a positive laboratory test
- Suspect or probable case
  - Someone exposed to a case who develops symptoms, even if they have not had a test yet

- **Contact**
  - Someone who had contact with a case while they were infectious
    - During their illness
    - 2 days before their illness began
  - Three kinds of contact
    - Physical contact
    - Close contact: within 6 feet for 15+ minutes (10 or 30)
    - Proximate contact: more than 6 feet but in the same room for an extended period

Isolation vs. Quarantine

- **Isolation**
  - Keeps sick people separate from healthy people
  - Restricted to home or hotel
  - Separate space in hospital to limit contact
  - For duration of infectiousness
    - 2 days before onset
    - At least 10 days after onset of illness; symptoms must be improving ***and*** no fever within the past 24 hours

- **Quarantine**
  - Restricts movement and contact of healthy people who have been exposed
  - For 14 days since the last contact with the person who is infected

Six Steps to Investigate Cases and Trace Their Contacts

Introduce	Inquire	Identify contacts	Isolate	Initiate contact tracing	Implement regular check-ins
					
Introduce yourself to the case and get their basic information	Figure out the case's likely infectious period	Ask the case about contacts during their infectious period	Provide isolation instructions to the case, identify challenges, and provide support	Call case's contacts to inform about their exposure, ask about symptoms, and give quarantine instructions	Check in with the case and their contacts until their isolation or quarantine ends

Image source: Center for Teaching and Learning, Johns Hopkins Bloomberg School of Public Health.

Balance Between the Public Health Good and Individual Rights

- Contact tracing programs are a public good because they reduce the risk to the public from COVID-19
- We must balance this good for society with rights of privacy, confidentiality, and autonomy

The Three Legal "Tests" for a Public Health Intervention

- For a public health intervention to be able to limit the rights of individuals to privacy or autonomy, it must meet three "tests" or criteria:

1. The intervention must be respectful of individuals and their rights
2. It must be a benefit to society that is balanced with the limits on individuals
3. It must benefit all members of society

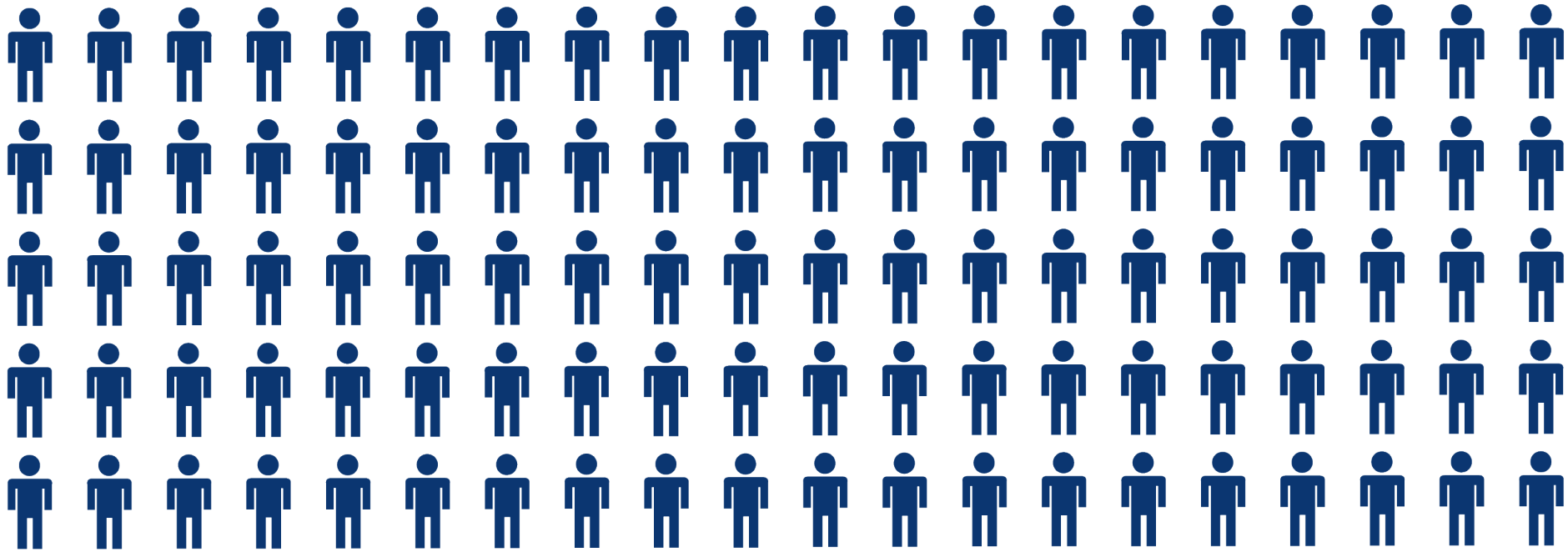
Measuring impact of contact tracing

Impact of contact tracing depends on completeness and timing

- Does contact tracing work? → What level of impact does this contact program have?
- Is it worth doing? → Is contact tracing enough to keep transmission under control?
- Not an all or nothing strategy
- Effectiveness of the program determined by how complete and how quick it is

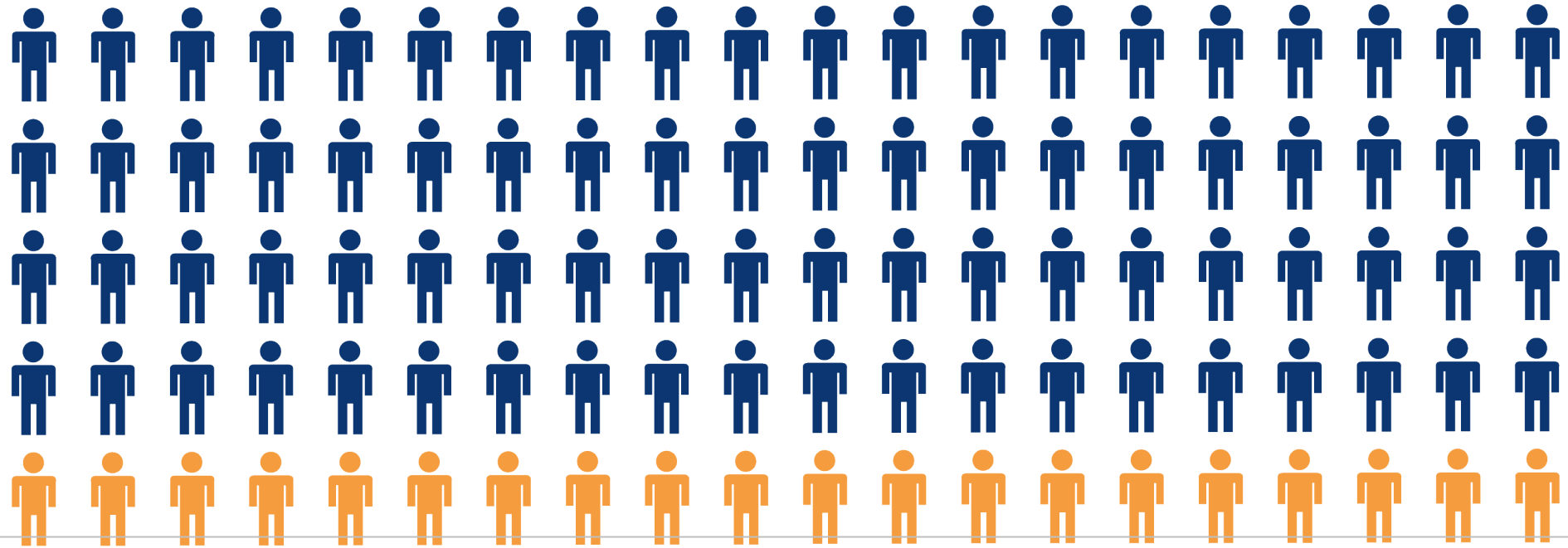
The *proportion of infections* that your surveillance system detects affects the impact of your contact tracing program

These Are All the Infected People in Your Population …



- Image source: Center for Teaching and Learning, Johns Hopkins Bloomberg School of Public Health.

Some May Never Develop Symptoms and So Will Be Harder to Find



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80%
Symptomatic

20%
Asymptomatic

Proportion of All Infected People Detected by Surveillance—1

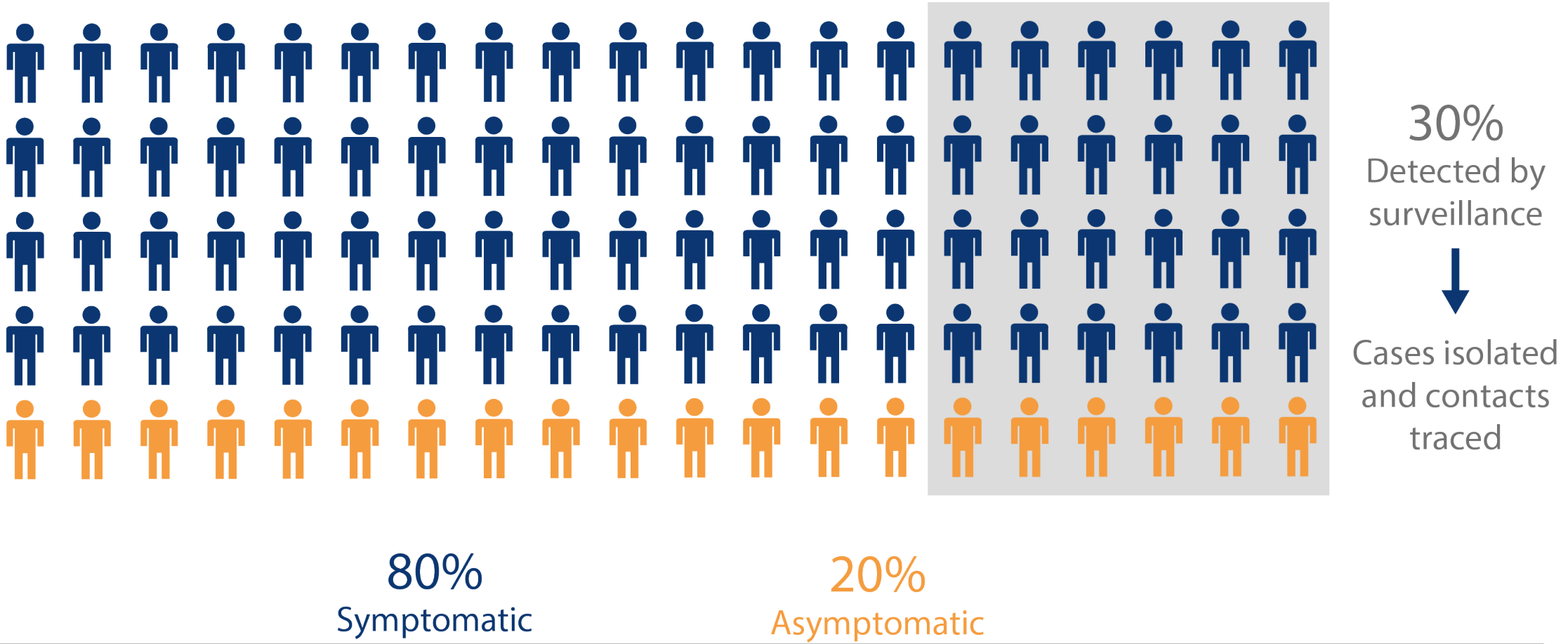
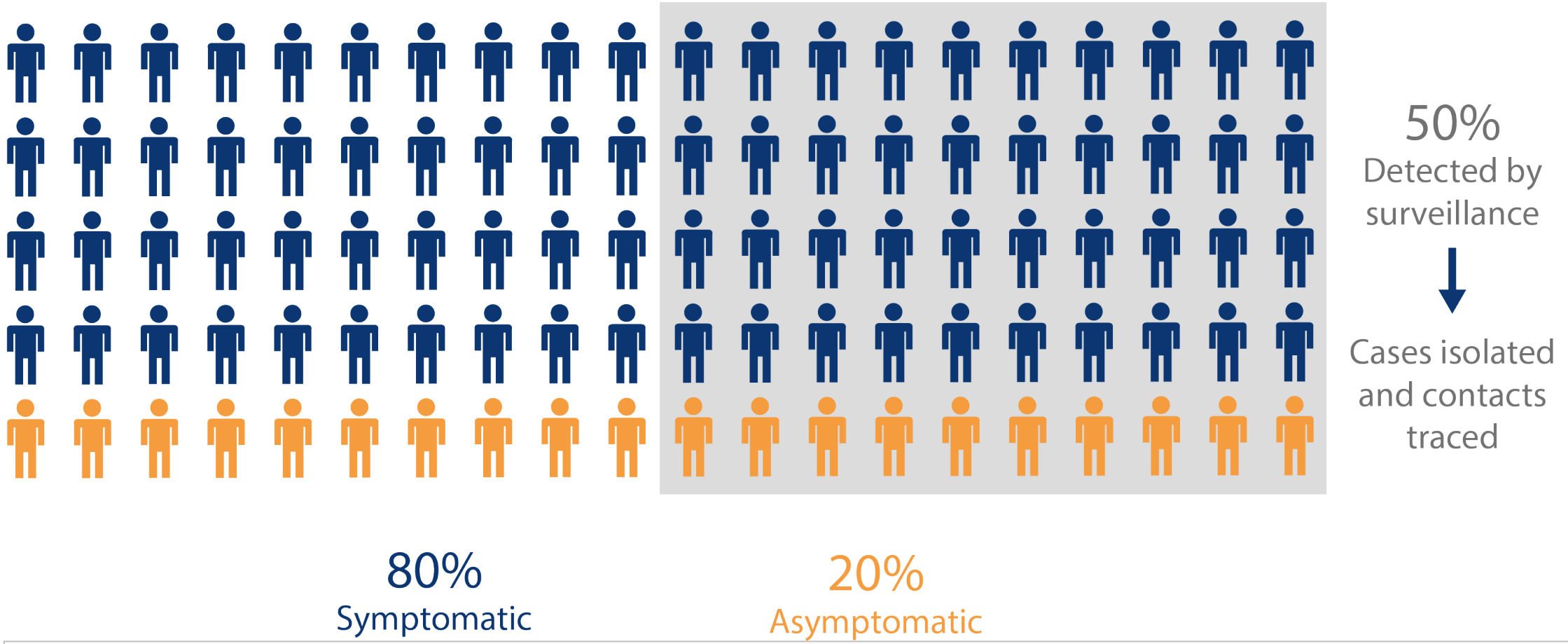


Image source: Center for Teaching and Learning, Johns Hopkins Bloomberg School of Public Health.

Proportion of All Infected People Detected by Surveillance—2



- Image source: Center for Teaching and Learning, Johns Hopkins Bloomberg School of Public Health.

The *timing* of contact notification and quarantine affects the impact of your contact tracing program

SARS-CoV-2: Infectiousness Over Time

- ***Onset of infectiousness*** is, on average, 3 days after infection

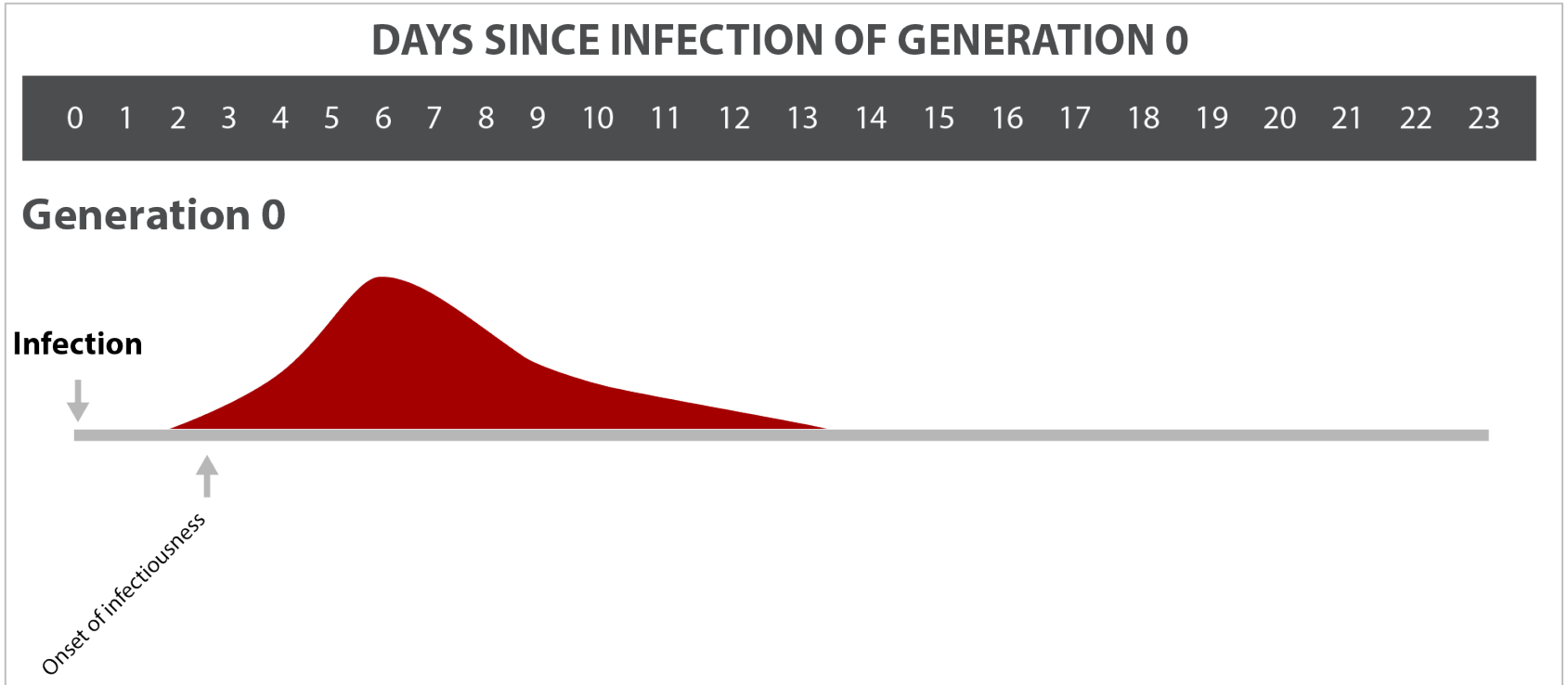
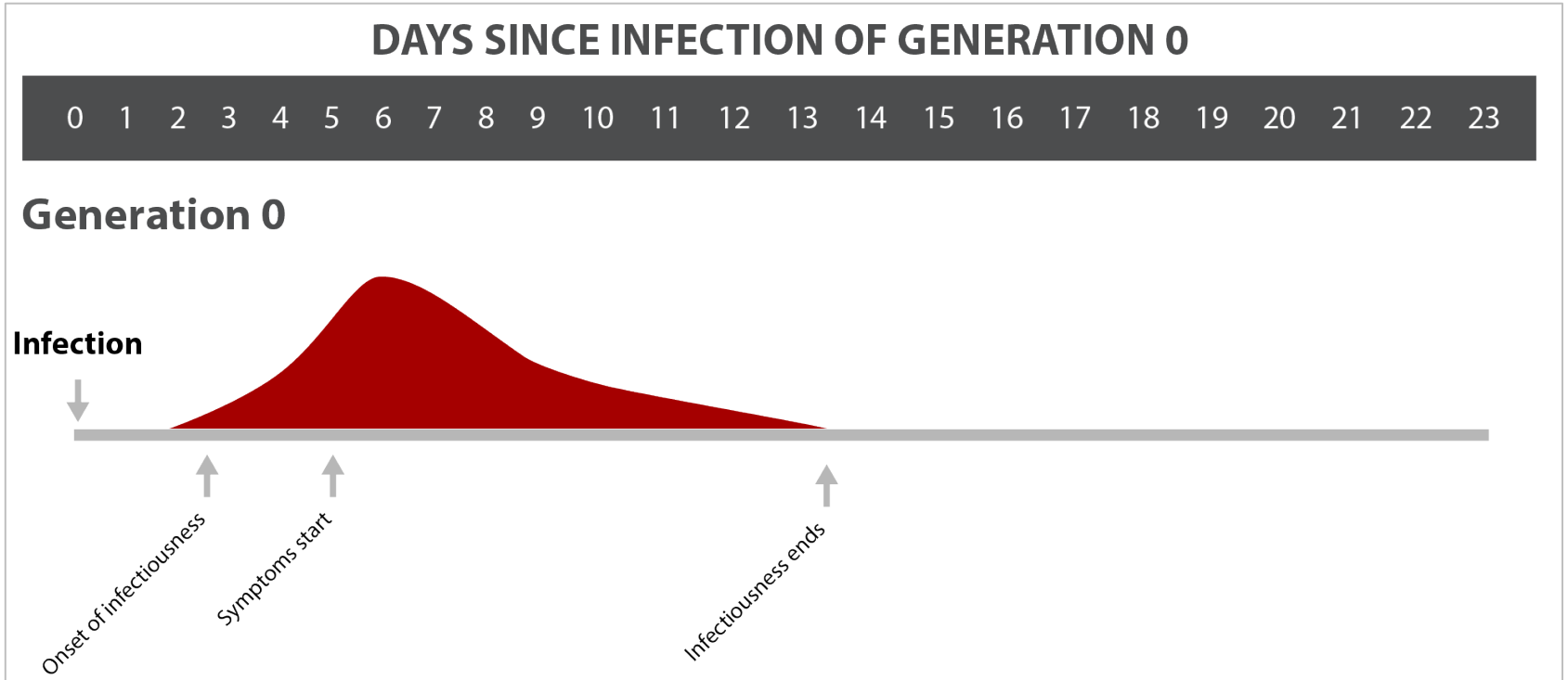


Image source: Center for Teaching and Learning, Johns Hopkins Bloomberg School of Public Health.

SARS-CoV-2: Infectiousness Over Time—Duration

- ***Duration of infectiousness*** is about 8 to 9 days after illness onset (but can be longer for those who are severely ill)
- Asymptomatic people likely have a similar duration of infectiousness (but are less infectious than people who develop symptoms)



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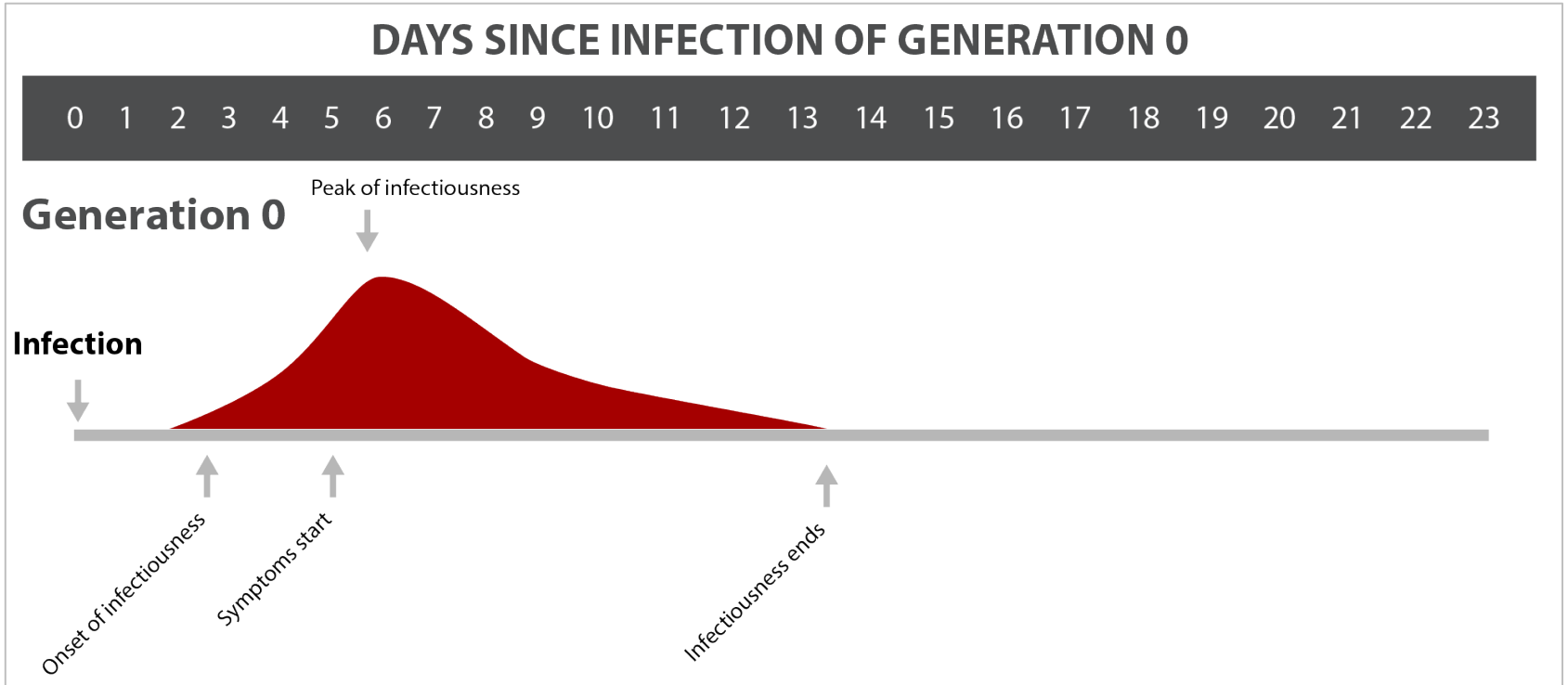
SARS-CoV-2: Infectiousness Over Time—Peak

- Infectiousness ***peaks*** around time of onset of symptoms



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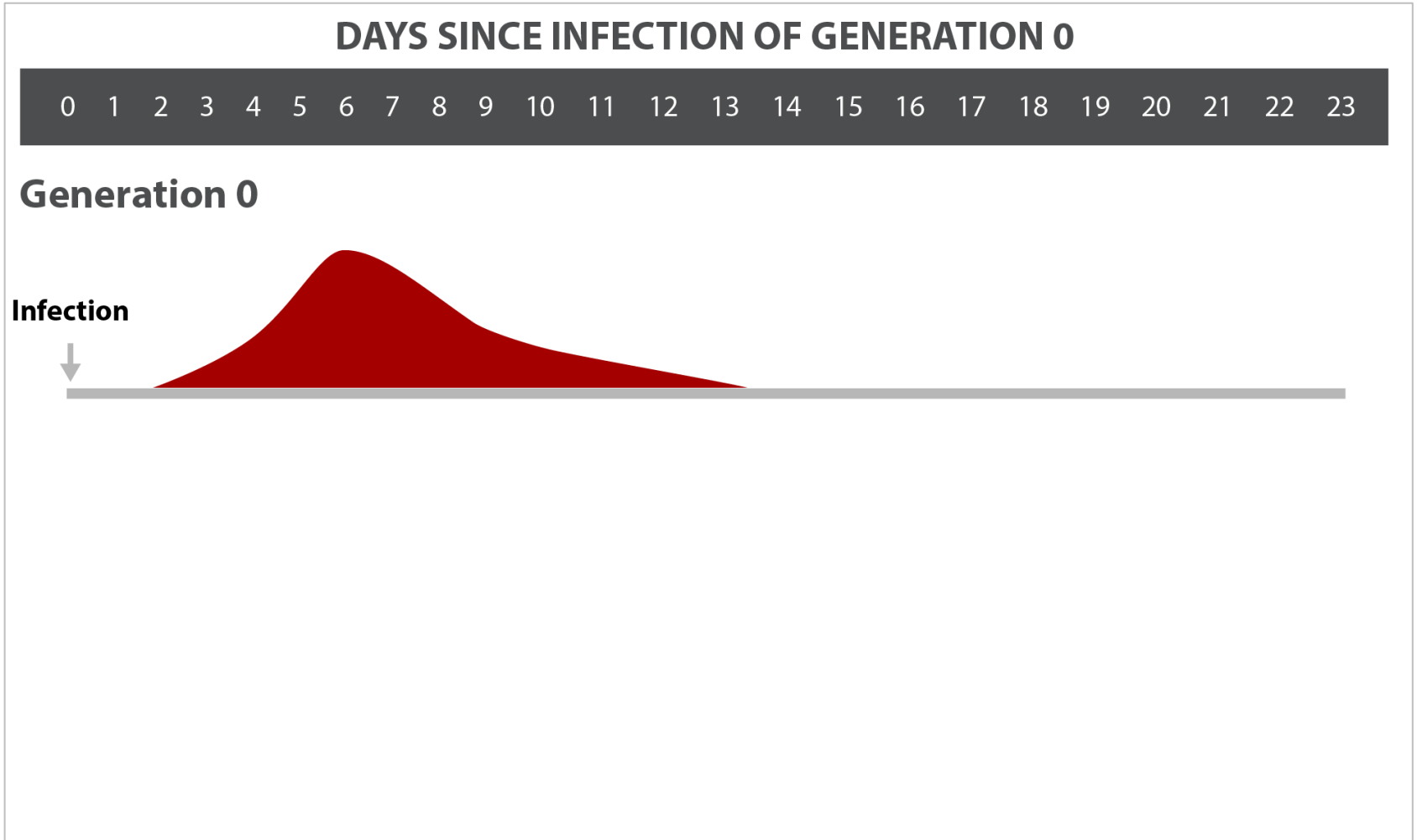
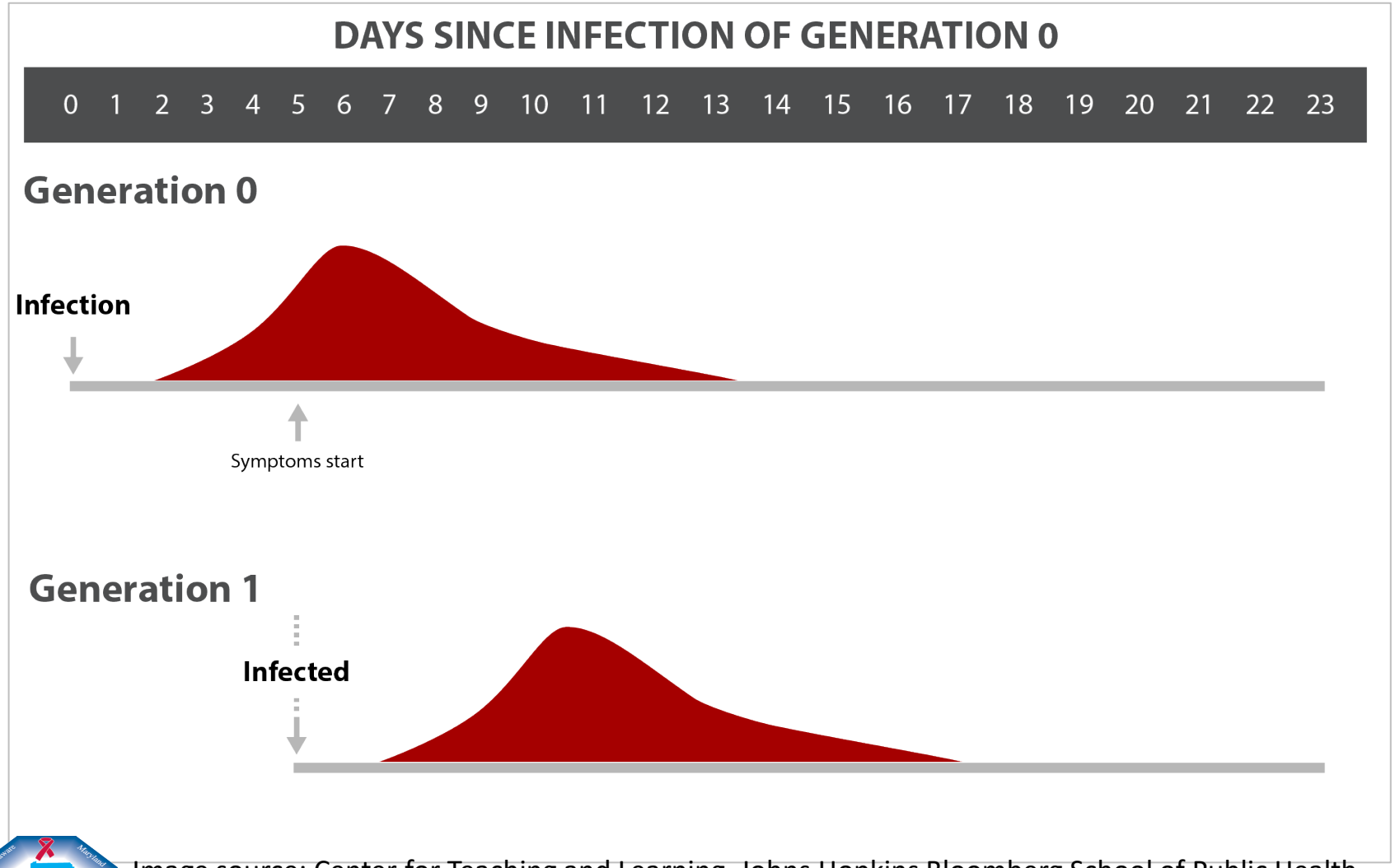
Infectious Period and Transmission



- Curve represents the infectious period of a case identified in surveillance
- This case is called Generation 0
- Subsequent generations will be Generation 1, 2, and so on

Image source: Center for Teaching and Learning, Johns Hopkins Bloomberg School of Public Health.

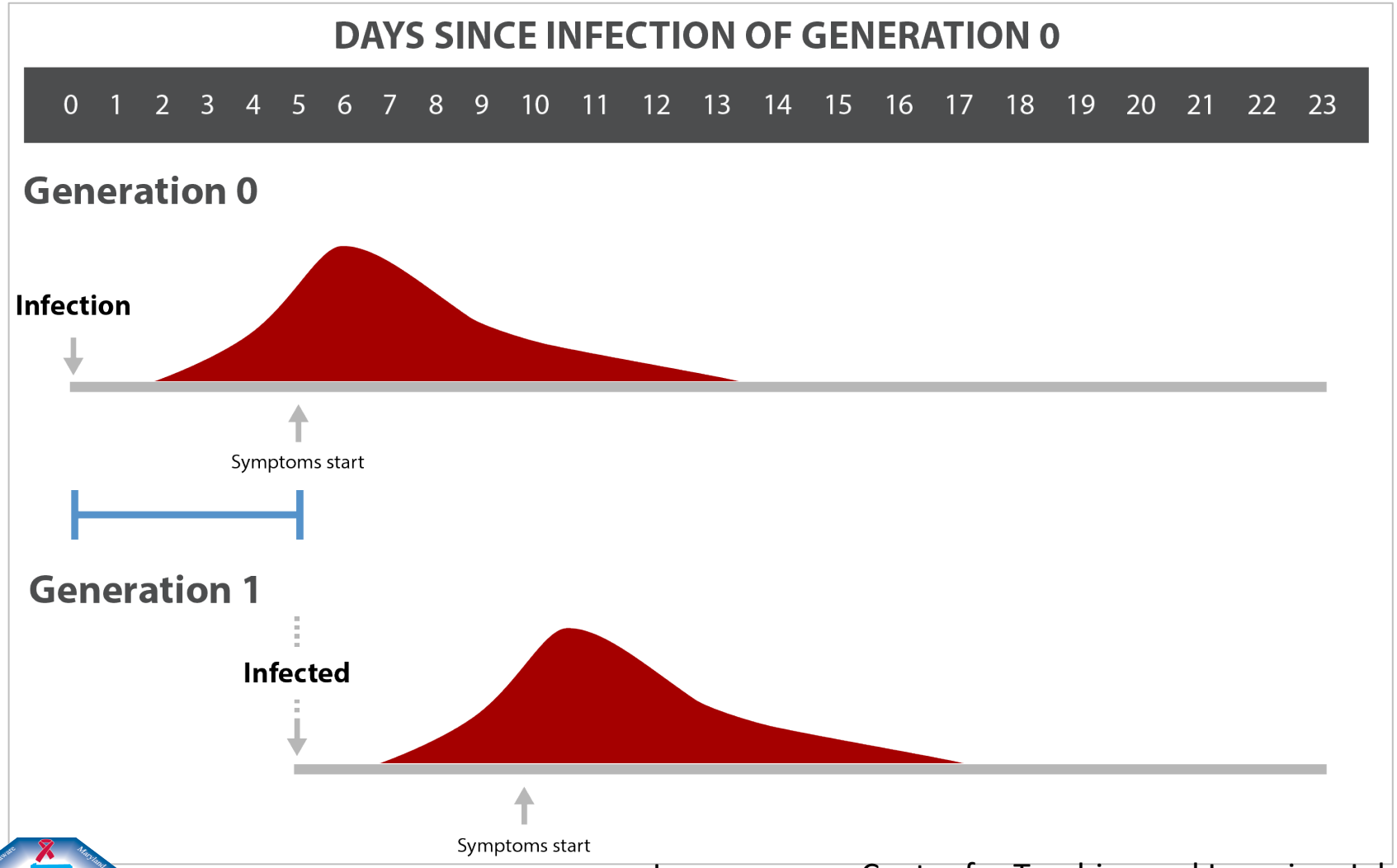
Infectious Period and Transmission—Generation 0 to 1



- Curve represents the infectious period of a case identified in surveillance
- This case is called Generation 0
- Subsequent generations will be Generation 1, 2, and so on
- We want a measure of how quickly each successive generation occurs

Image source: Center for Teaching and Learning, Johns Hopkins Bloomberg School of Public Health.

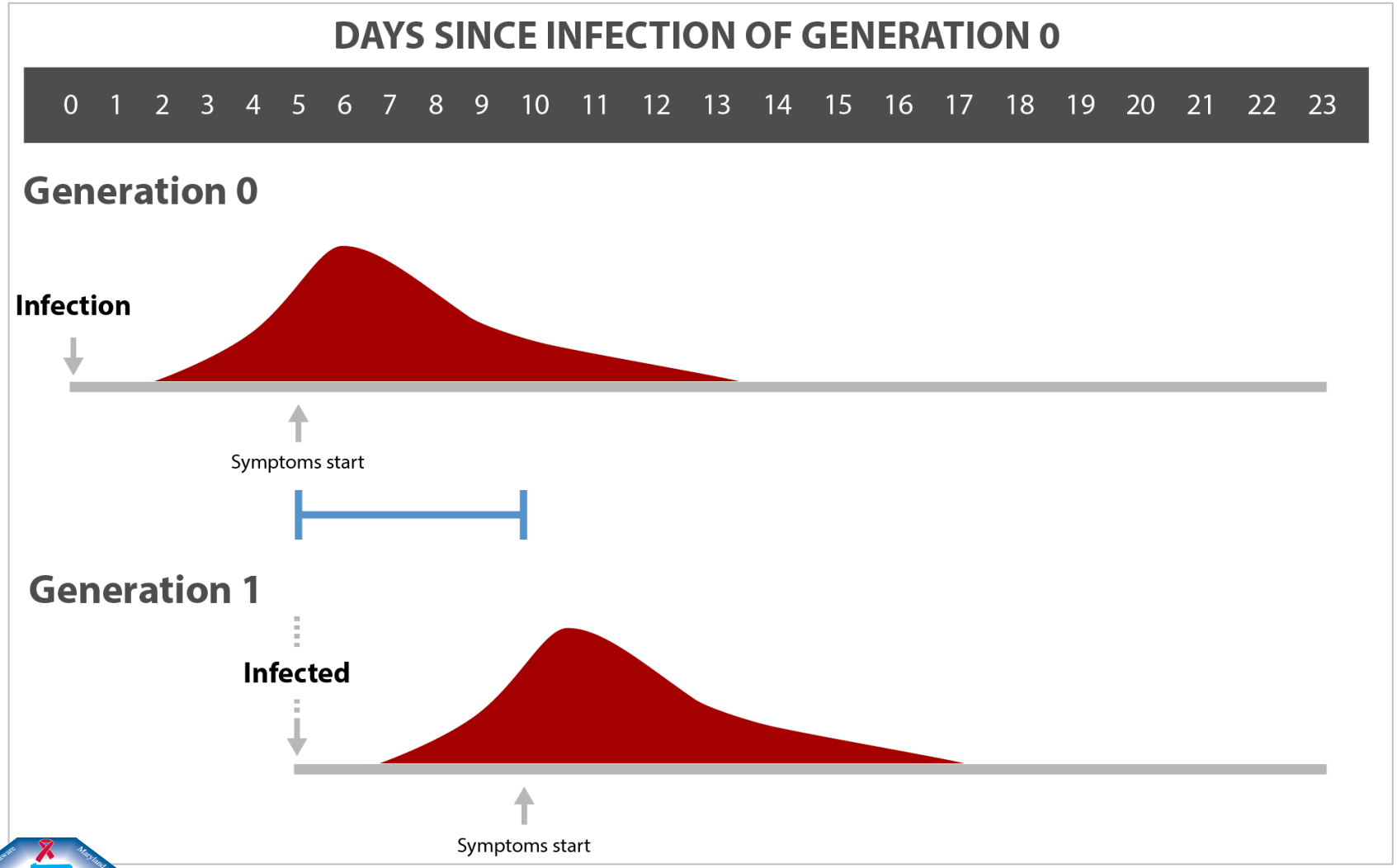
Serial Interval as an Approximation of Generation Time



- ***Generation time*** is the time from the infection in one generation to the time of infection in the next generation (5 days)
- This is a measure of how quickly the outbreak will grow

Image source: Center for Teaching and Learning, Johns Hopkins Bloomberg School of Public Health.

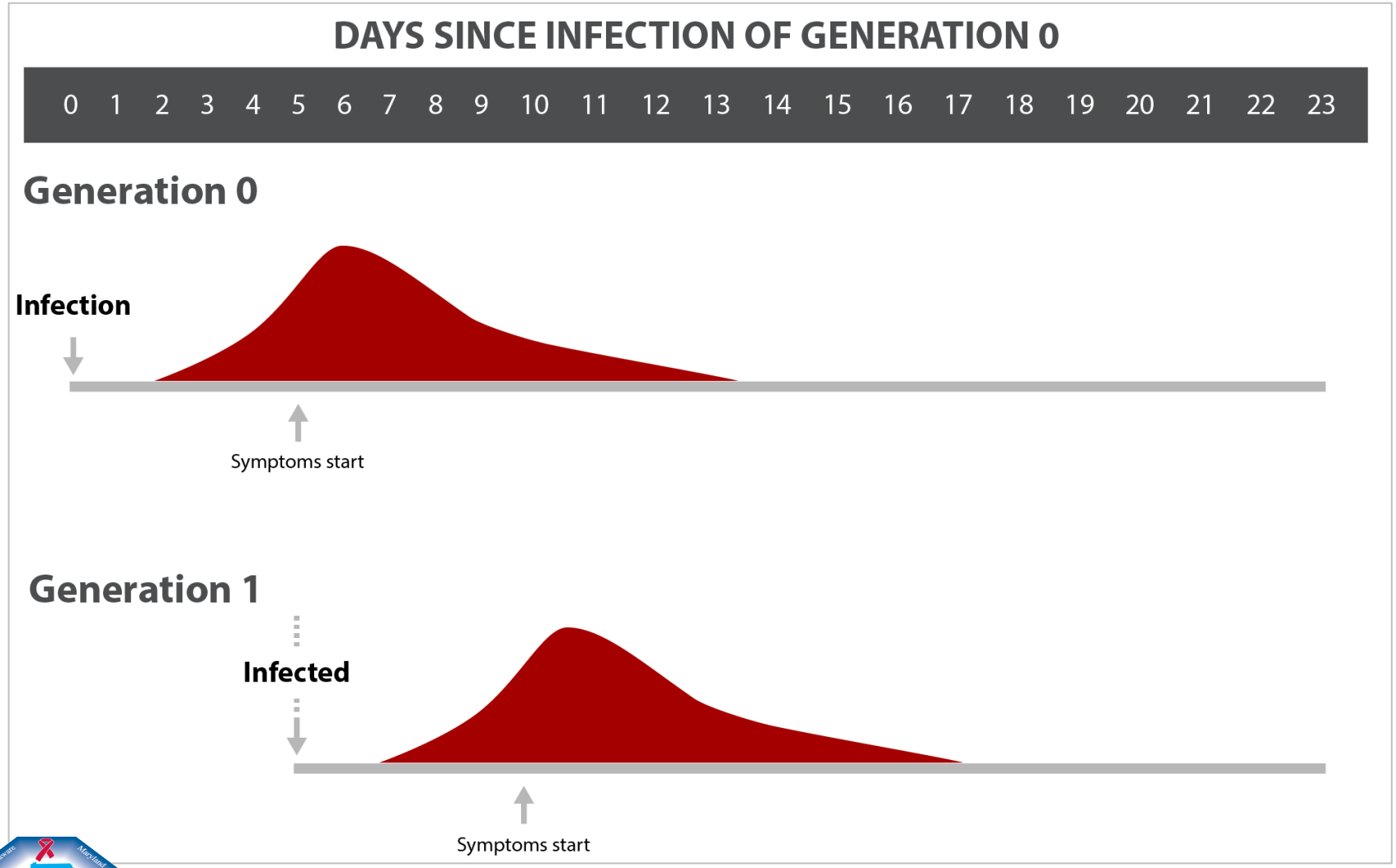
Serial Interval as an Approximation of Generation Time



- ***Generation time*** is the time from the infection in one generation to the time of infection in the next generation (5 days)
- This is a measure of how quickly the outbreak will grow
- ***Serial interval*** is the time between onset of symptoms in one generation to the next

Image source: Center for Teaching and Learning, Johns Hopkins Bloomberg School of Public Health.

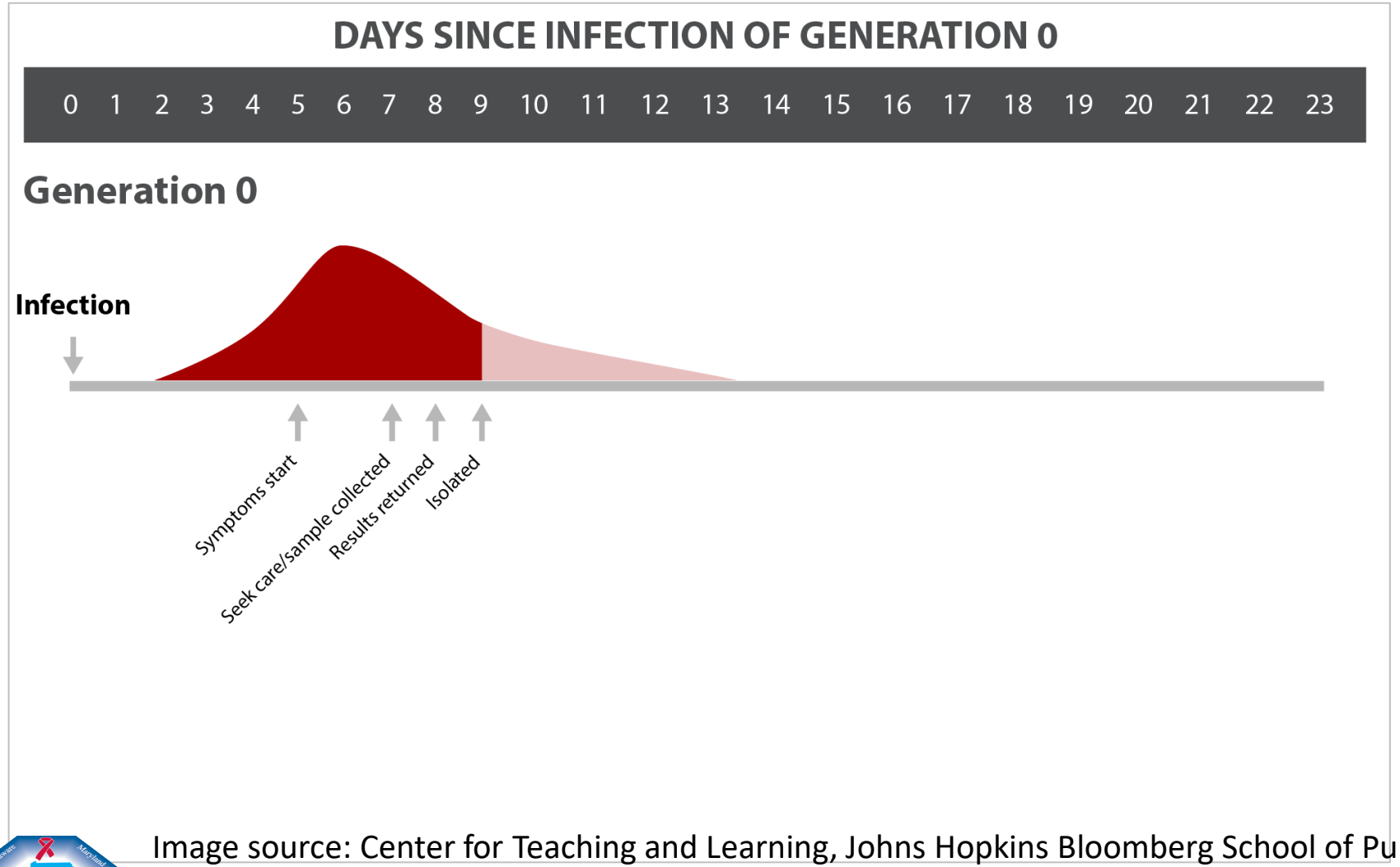
Timing of Contact Tracing Matters Because of Generation Time



- Think about if, how, and when contact tracing happens
- What will be the effect on transmission?

Image source: Center for Teaching and Learning, Johns Hopkins Bloomberg School of Public Health.

Timing of Contact Notification and Quarantine Linked to Case Detection



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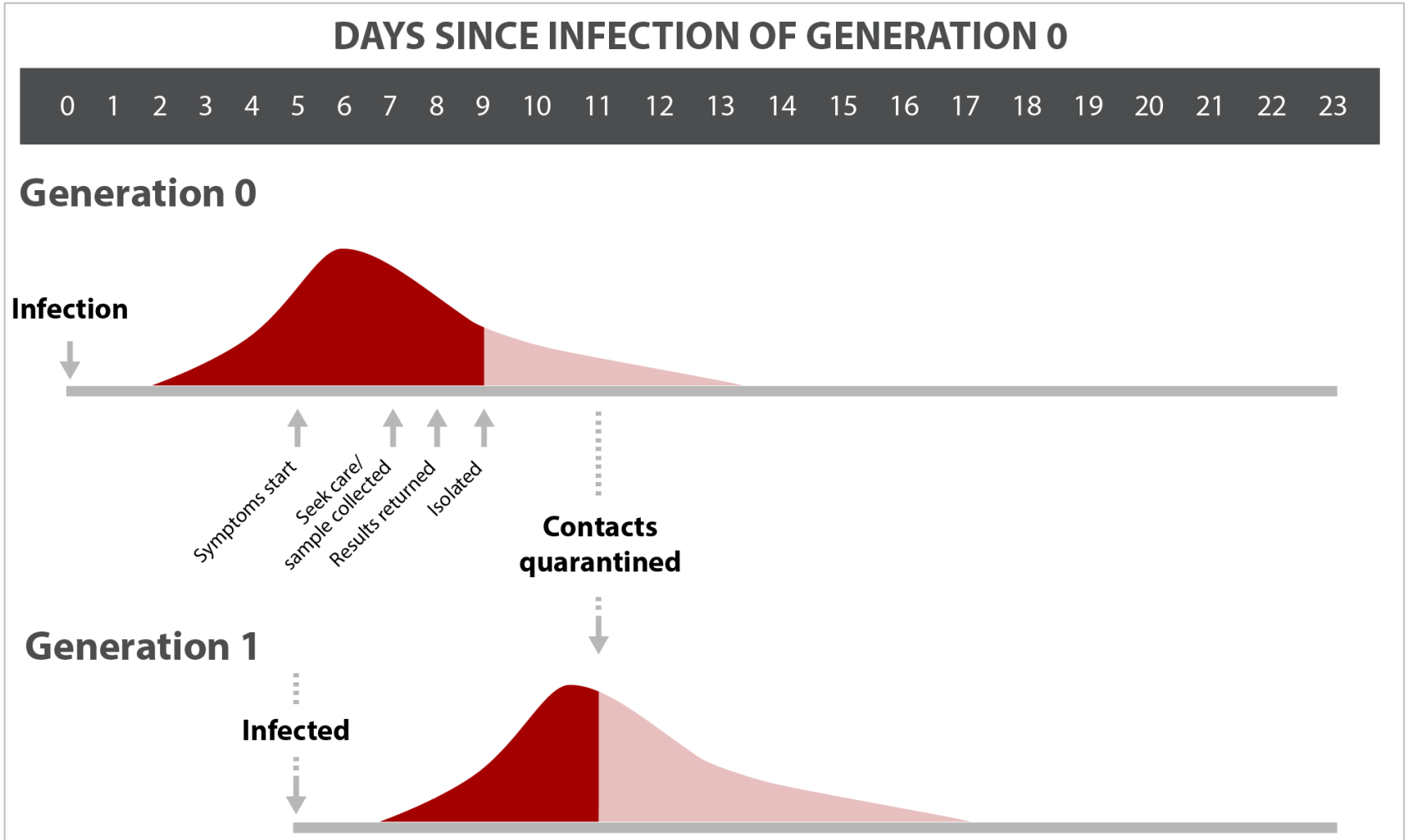
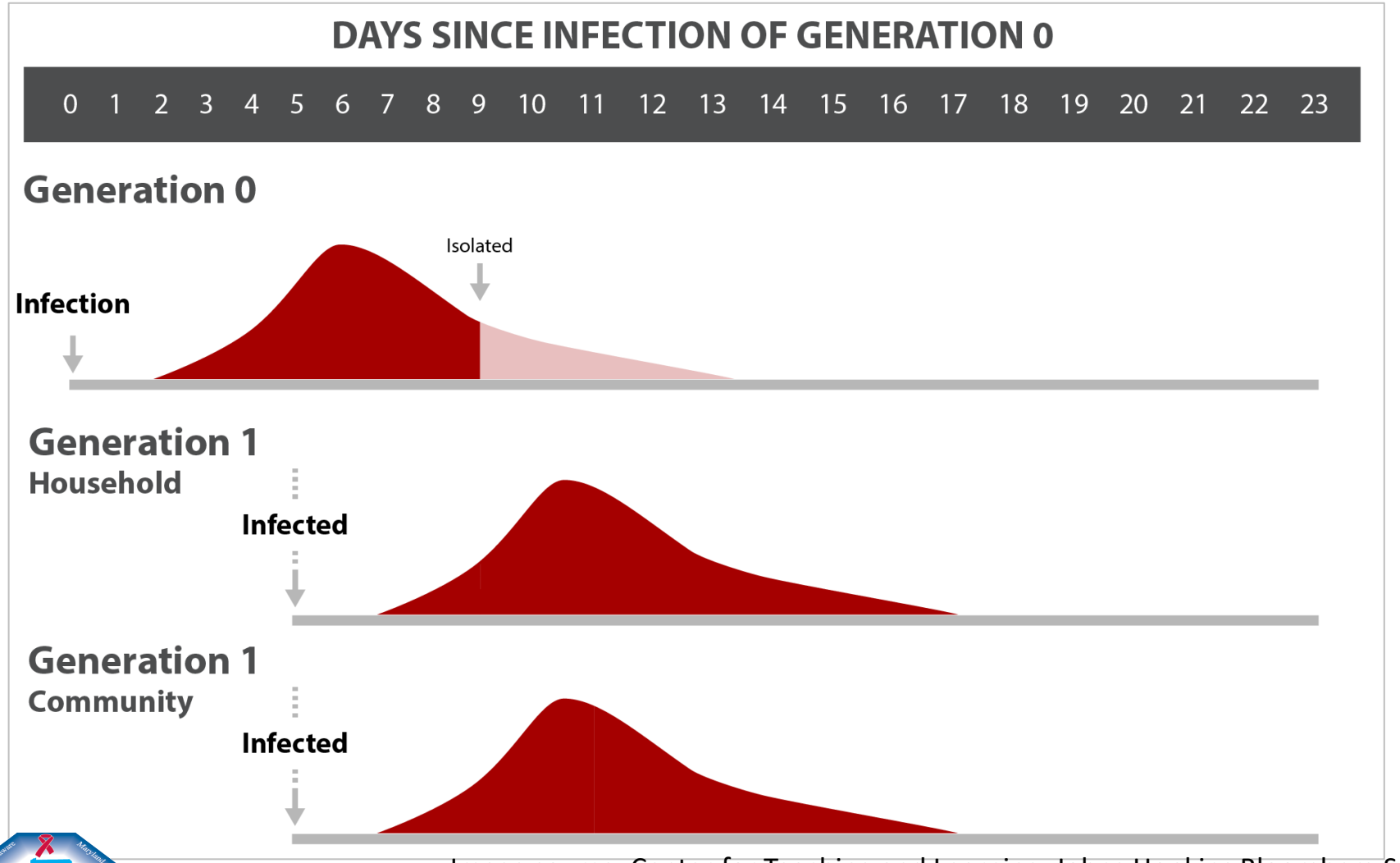


Image source: Center for Teaching and Learning, Johns Hopkins Bloomberg School of Public Health.

Separate Household and Community Contacts



- Closest contacts at higher risk than others
- Closest contacts easier to find than others

Image source: Center for Teaching and Learning, Johns Hopkins Bloomberg School of Public Health.

High-Risk Contacts Can Be Identified More Quickly

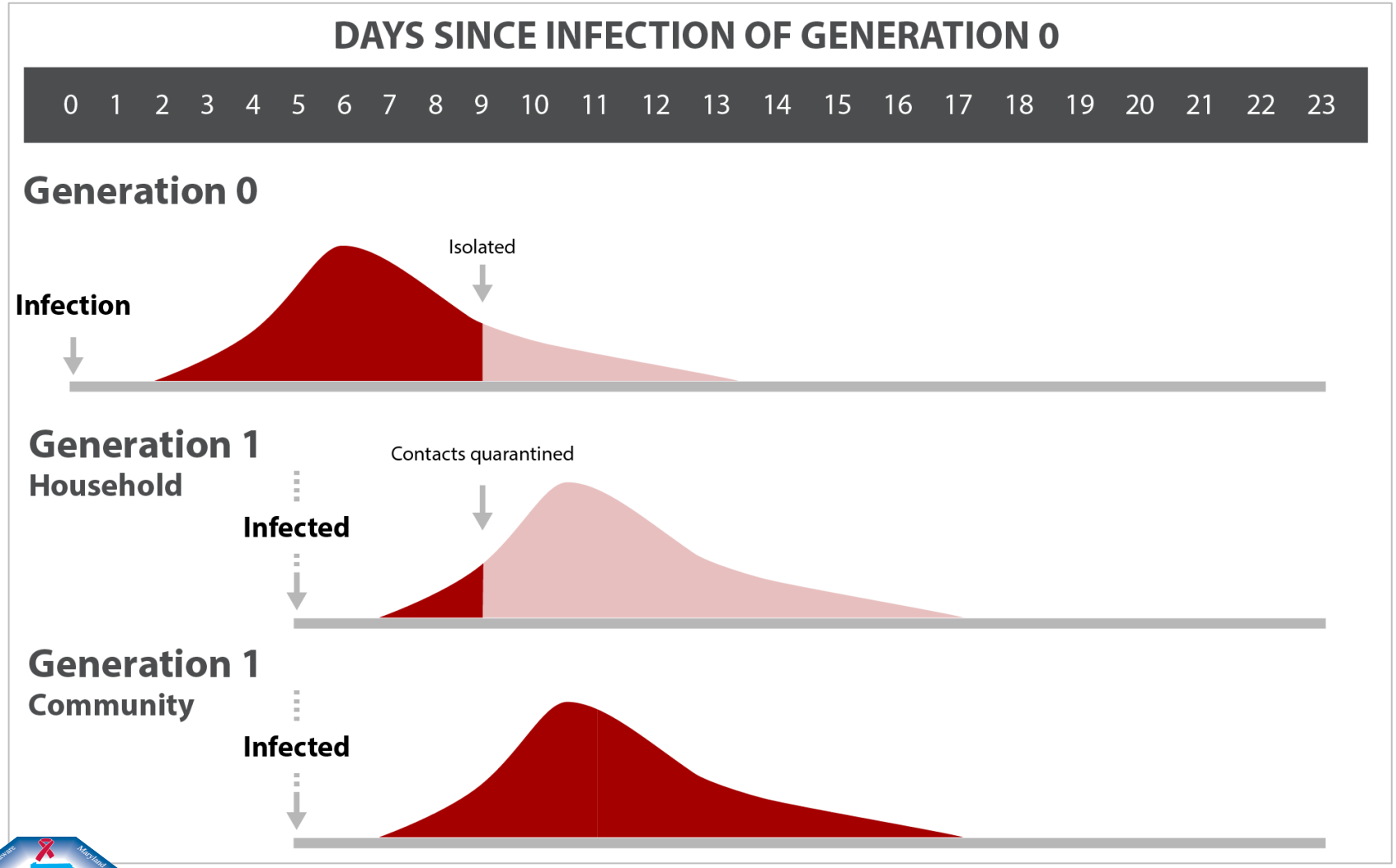


Image source: Center for Teaching and Learning, Johns Hopkins Bloomberg School of Public Health.

Delayed Quarantine of Community Contacts Still Has Impact

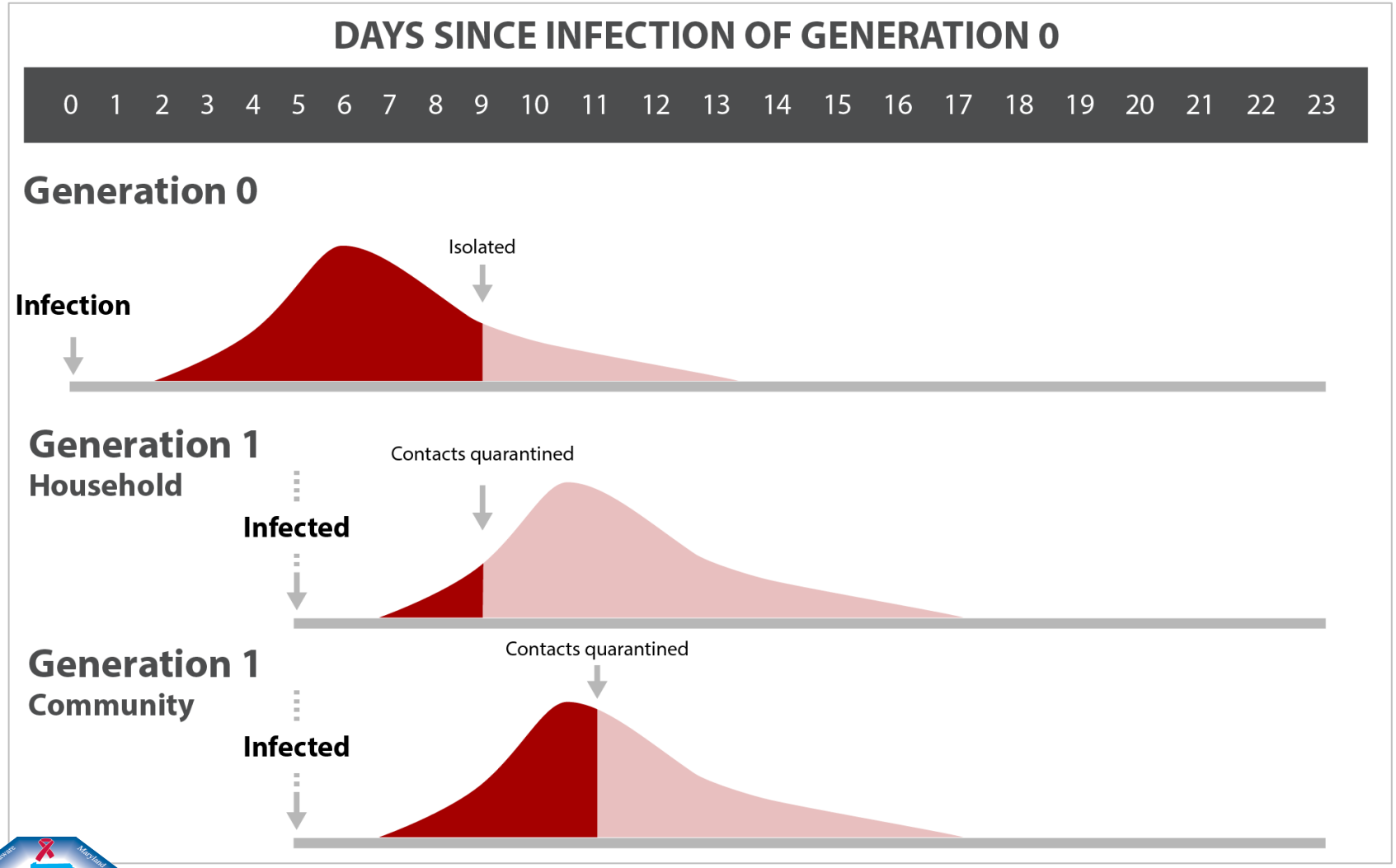


Image source: Center for Teaching and Learning, Johns Hopkins Bloomberg School of Public Health.

Decreased Delay at Each Step = Big Impact on Transmission

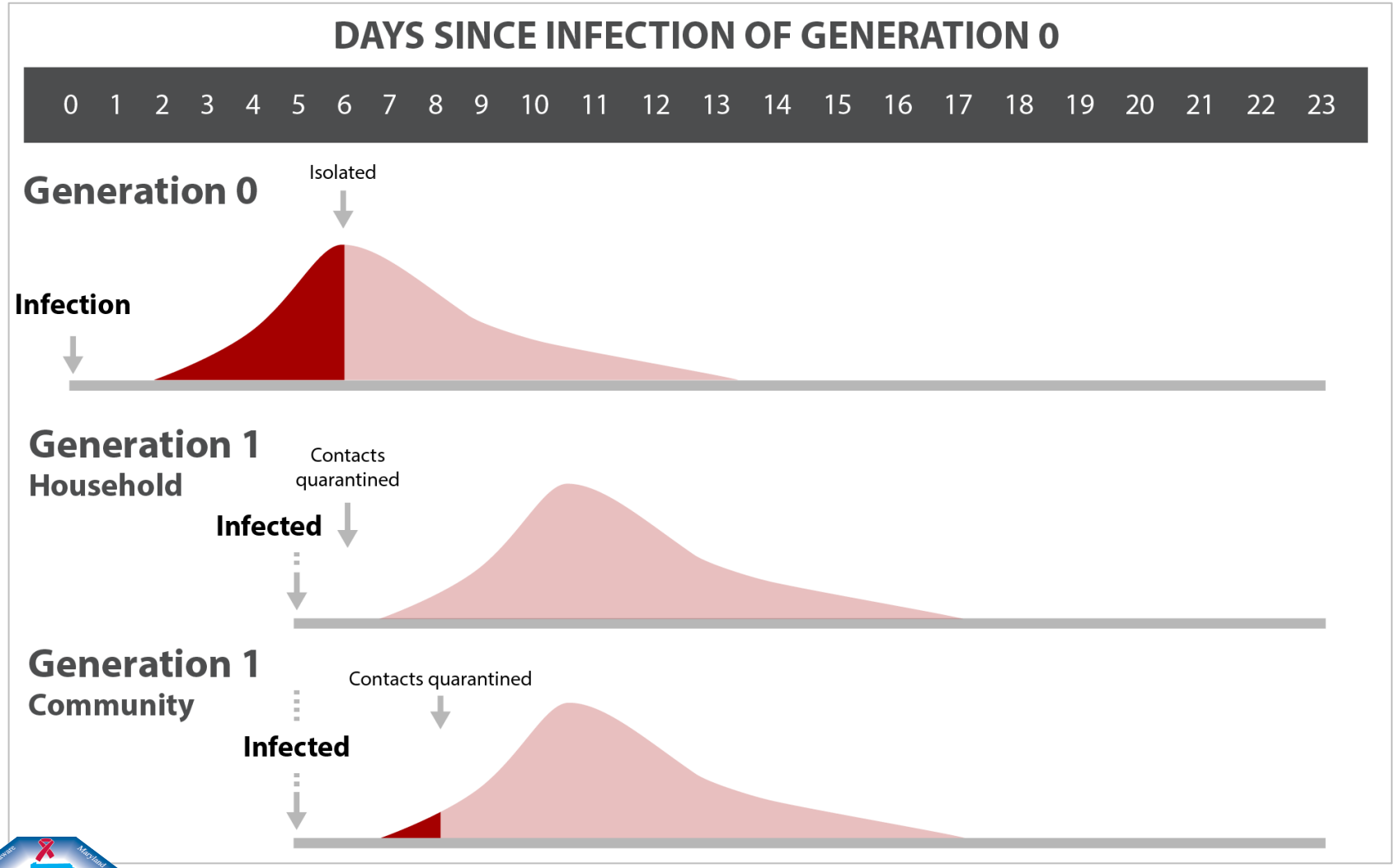


Image source: Center for Teaching and Learning, Johns Hopkins Bloomberg School of Public Health.

Basic Reproductive Number (R0 or R-Naught)

- ***Basic reproductive number*—**the number of people one infectious person will infect if everyone that person has contact with is susceptible
- The higher the basic reproductive number, the more people will be infected
- R0 of 1 means new cases stay constant

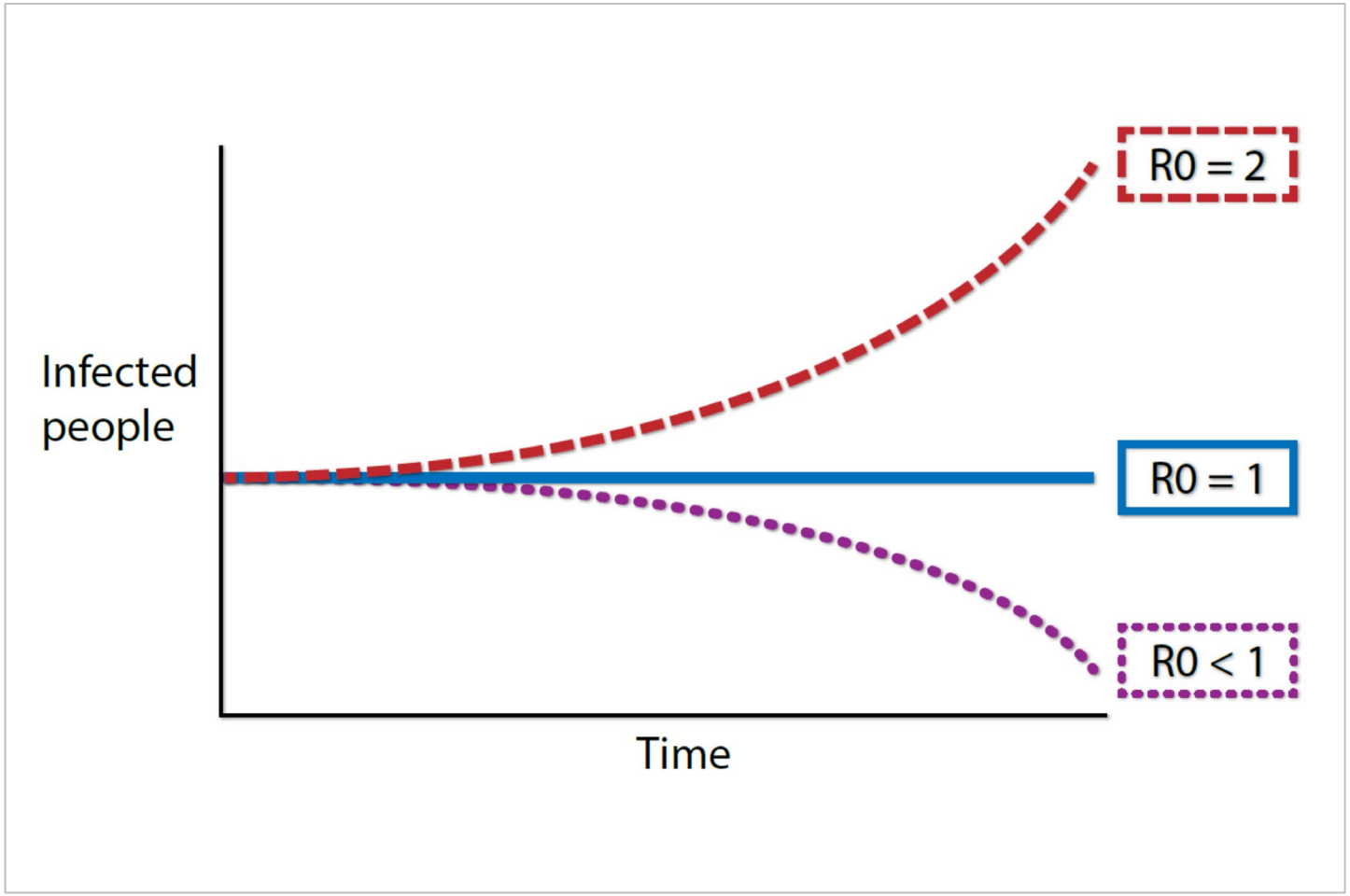


Image source: Johns Hopkins University.

Basic Reproductive Number (R0) vs. Reproductive Number (R)

Basic reproductive number (R0)	Reproductive number (R)
▶ R0 is the average number infected if all contacts are susceptible ▶ It is determined by the pathogen and the context	▶ R is an indicator of transmission *after* interventions ▶ If not everyone is susceptible, it will bring down R ▶ Interventions like contact tracing or social distancing will bring down R

The difference between R0 and R is a good way to measure impact of contact tracing programs

Change From R0 to R as a Measure of Impact—1

- Interventions can reduce reproductive number
- Let's assume that each person infects 2 more, on average

R0 = 2

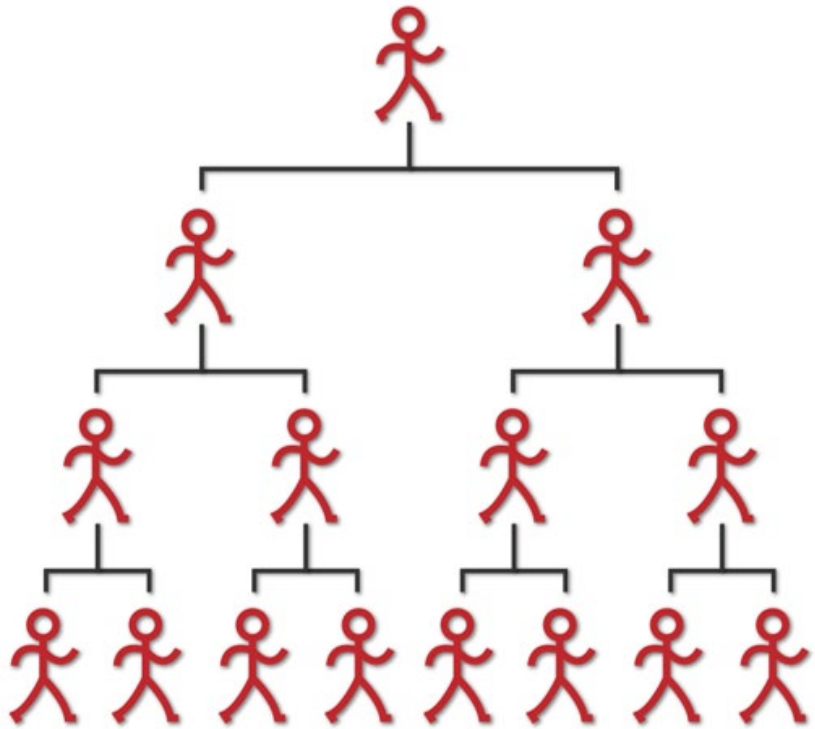


Image source: Johns Hopkins University.

Change From R0 to R as a Measure of Impact—2

- Interventions can reduce reproductive number
- Let's assume that each person infects 2 more, on average
- Intervention can reduce 1 new infection at each step
- This changes the overall size of outbreak

R = 1

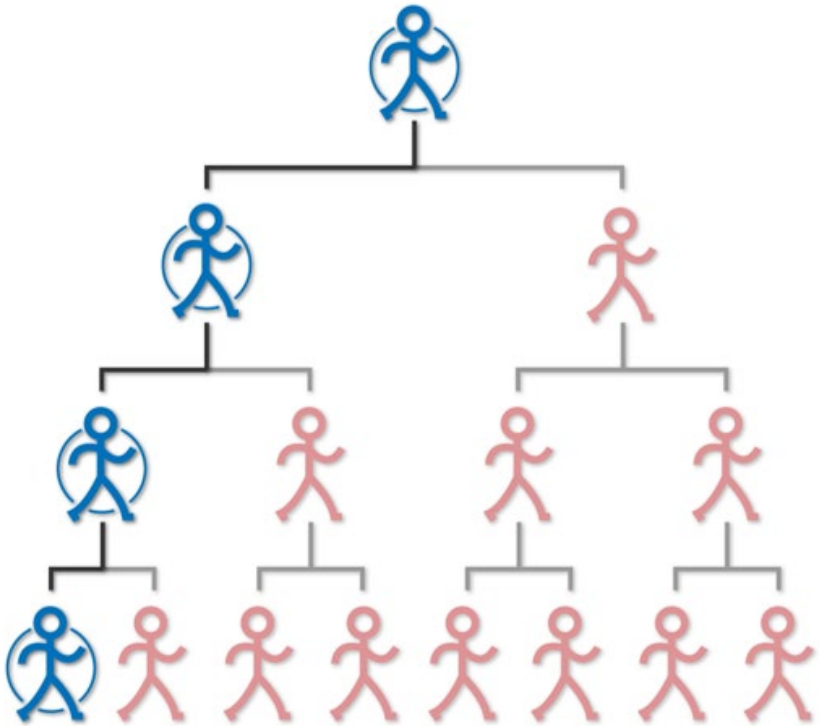
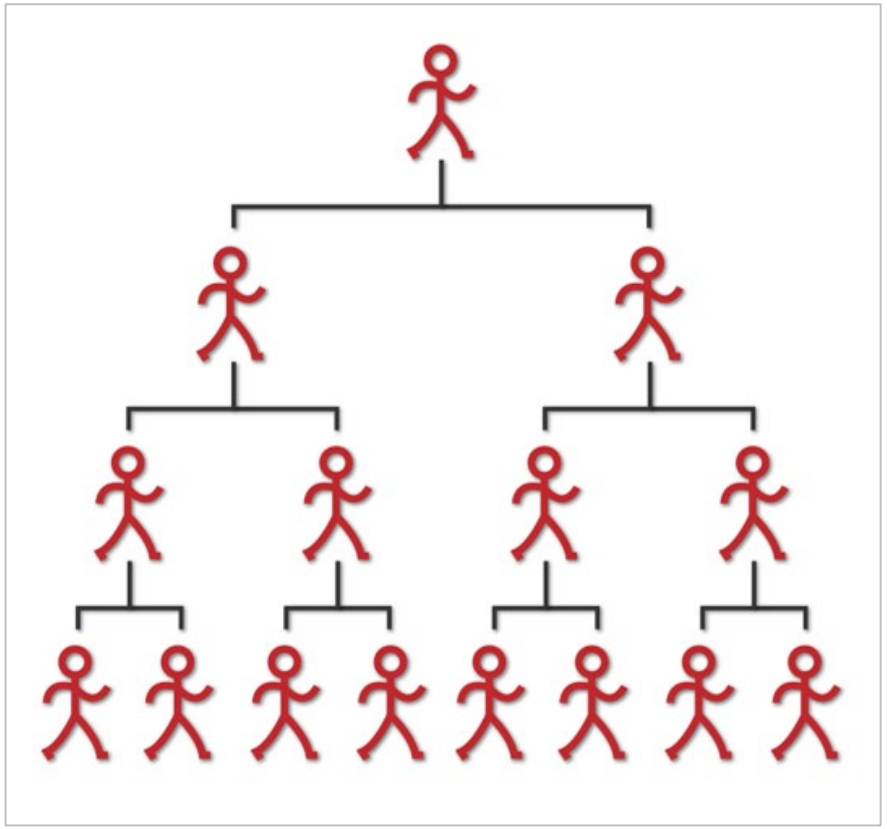


Image source: Johns Hopkins University.

Impact of Contact Tracing Measured as Change From R0 to R

R0 = 2



INTERVENTION

R = 1

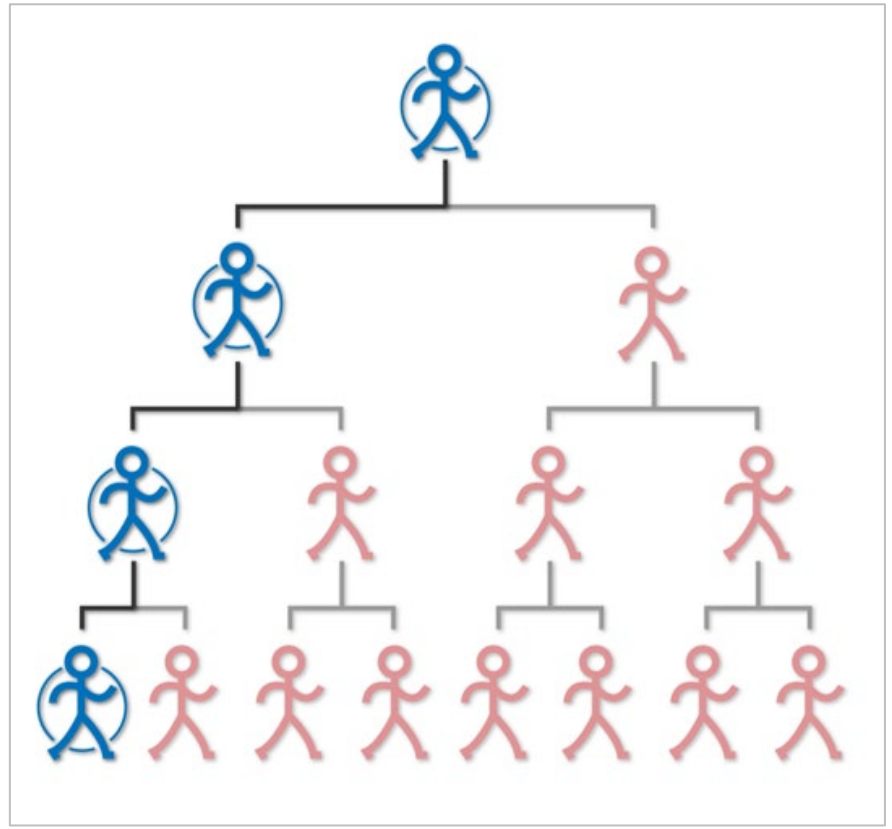


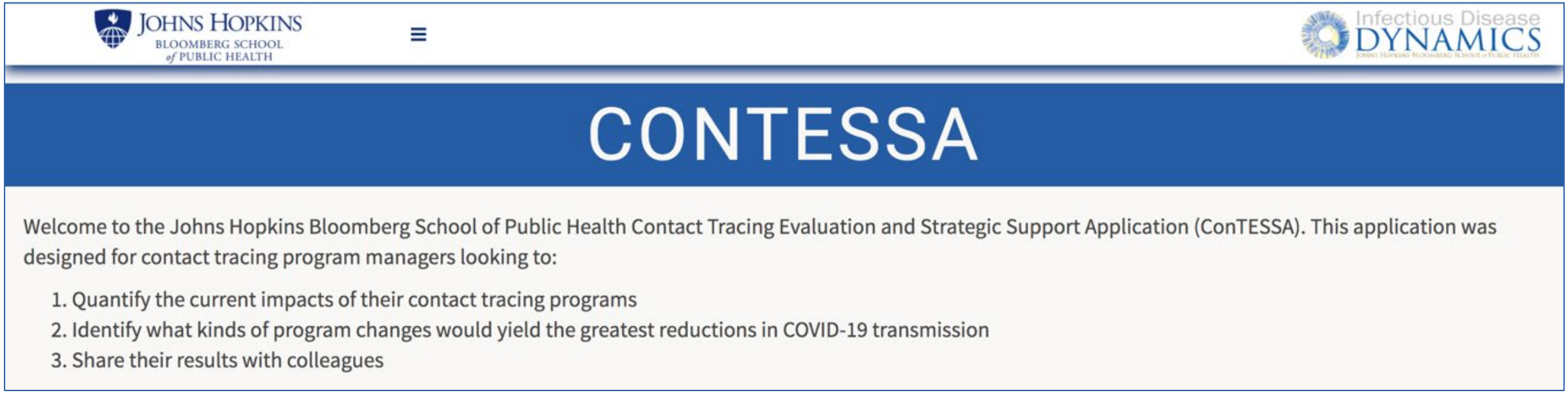
Image source: Johns Hopkins University.

Indicators Needed to Estimate Impact on R0

Completeness	Timing

▶ What proportion of all infectious people does surveillance identify?
▶ What proportion of infected people are isolated?
▶ What proportion of contacts are quarantined?
	▶ Average duration rather than proportion
	  ▶ What is the average time between symptom onset and isolation?
	  ▶ What is the average time between exposure and quarantine among contacts?
	  ● Does this duration differ for household contacts?

ConTESSA



- https://iddynamicsjhu.shinyapps.io/contessa/

ConTESSA Overview

- What this application ***can provide***:
  - Decision support tool
  - Custom estimates of possible impact of given contact tracing strategy
  - Direct comparison of two strategies

- What this application ***does not provide***:
  - Exact calculation
  - Forecast of future disease burden

The metrics customize a dynamic infection model

Barriers to success

Not isolating enough people with infections quickly

Cause	Possible remedies
► Surveillance insufficient ► Not enough people with symptoms tested ● Lack of access ● Fear ● Stigma ► People exposed not systematically tested ● Lack of access and bandwidth in testing systems ● Misguided policy ► Time from onset of infectiousness to isolation too slow ► Delays in seeking a test ► Delays in returning test results ► Delays in isolation	► Improve access ► Analyses to identify gaps ► Community outreach ► Hold test providers accountable for reasonable timelines ► Make use of rapid antigen tests

Insufficient support for isolation and quarantine

Cause	Possible remedies

▶ Risk of job loss
▶ Risk of income loss
▶ Inability to isolate safely at home
  ▶ No way to isolate
  ▶ Home not safe
	▶ Changes to workplace policy for sick leave
	▶ Government support to promote isolation and quarantine
	▶ Safe housing for isolation and quarantine

Lack of trust

Cause	Possible remedy
▶ Chronic public health issue ▶ Part of the lack of access cycle ▶ Public health responses politicized ▶ Misinformation about government tracking citizens	▶ Community outreach and shared decision-making ▶ Improved communication and efforts to get people the right information ▶ Building as many bridges as possible with all communities

Summary

Contact tracing is an important tool to control COVID-19

- Completeness and timing are important
- Facilitated by programs, but relies on public trust and ability to act
- Question isn't *if* programs work, but *how well* they work
  - Not an all or nothing endeavor
- Very important to reach marginalized communities
  - Public good
  - Most at-need

Resources

- Free courses on Coursera
  - COVID-19 Contact Tracing
  - Measuring and Maximizing Impact of COVID-19 Contact Tracing

- Contact Tracing Evaluation and Strategic Support Application (ConTESSA) https://iddynamicsjhu.shinyapps.io/contessa/

- Maximizing and evaluating the impact of test-trace-isolate programs. https://medrxiv.org/cgi/content/short/2020.09.02.20186916v1

MidAtlantic AIDS Education and Training Center - Contact Information

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