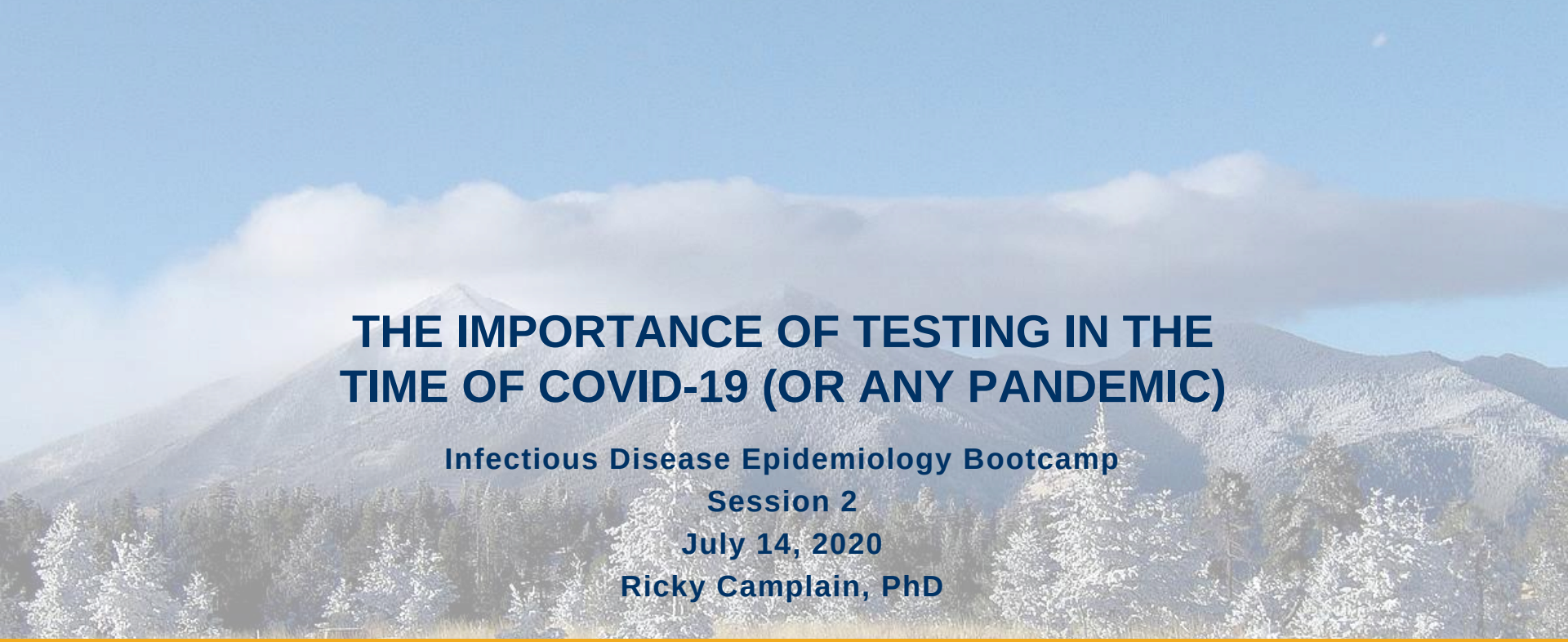

THE IMPORTANCE OF TESTING IN THE TIME OF COVID-19 (OR ANY PANDEMIC)

Infectious Disease Epidemiology Bootcamp

Session 2

July 14, 2020

Ricky Camplain, PhD

NAU NORTHERN ARIZONA UNIVERSITY

INFECTIOUS DISEASE EPIDEMIOLOGY BOOTCAMPS OBJECTIVES

1. Explain the basics of infectious disease epidemiology, including transmission and conceptual model
2. Evaluate infectious disease measures (e.g., R-naught, case fatality, incidence).
3. Explain the importance of control infectious disease spread
4. Describe the process of testing, case investigation, and contact tracing for infectious diseases
5. Compare sensitivity, specificity, and positive and negative predictive value of diagnostic tests
6. Understand the concepts of database construction and data entry for quality data reporting
7. Interpret data tables and charts related to infectious disease measures

REMEMBER TO JOIN US FOR THE OTHER BOOTCAMPS!

- Tuesday, July 21 at 11:30 AM PDT – Measures of Frequency and Associations
  - **Risk and rates**
  - **How are the calculated?**
  - **How to interpret them when you encounter them in reports and news stories!**

- Tuesday, July 28 at 11:30 AM PDT – Getting the Most Out of Your Data
  - **Data interpretation**
  - **Data visualization**

OBJECTIVES

- Types of testing
- Importance of testing for disease prevention
  - **“Box It In”**
- Validity and accuracy of diagnostic tests
- When is testing appropriate for disease mitigation?

TYPES OF TESTING

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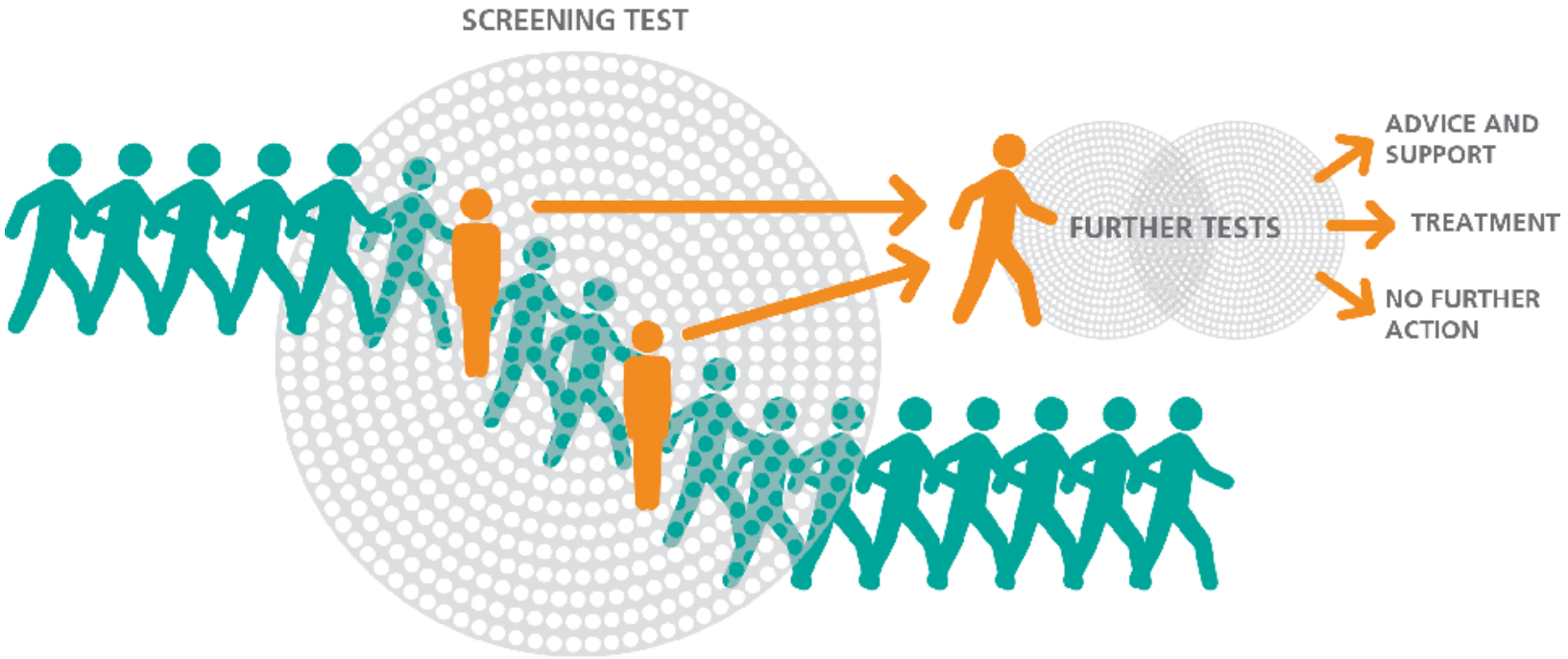
SCREENING



Source: https://support.pods-online.org.uk/screening-tools

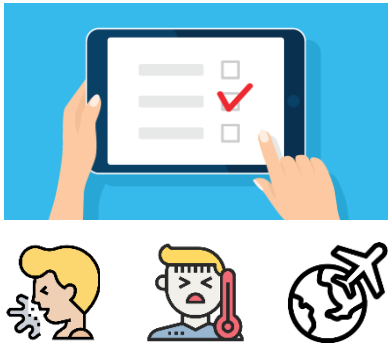
SCREENING

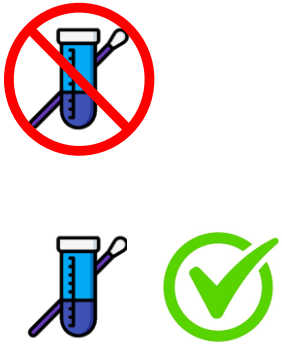
- The best screenings have:
  - **Few false positives**
  - **Few false negatives**
- Those with positive screening test may be referred to diagnostic test

SCREENING FOR COVID-19

- Series of questions asked to determine a person's risk for COVID-19
  - **Symptoms being experienced**
  - **Travel history in recent weeks (less important when community spread is high)**
  - **Exposure to someone who has been confirmed to have COVID-19**

- After screening, a health professional will decide on whether a person should be tested



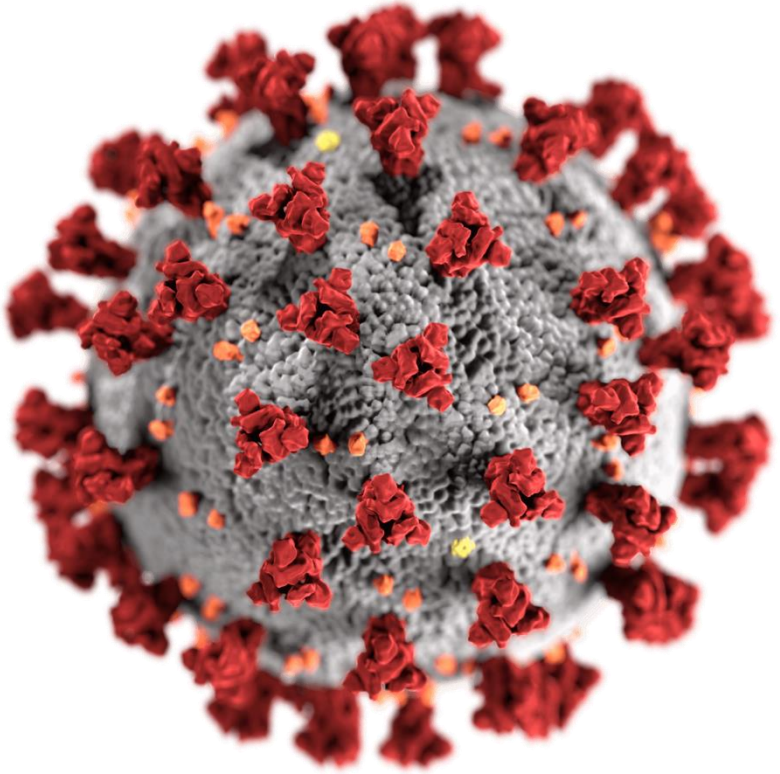


DIAGNOSTIC (VIRAL) TESTING

- A viral test can confirm if you have a current infection

- CURRENT COVID-19 TESTS
  - **PCR diagnostic testing**
  - **Point-of-care RAPID tests**
    - Results in 15-30 minutes

- TEST RESULTS CAN VARY FROM 10 MINUTES TO OVER A WEEK
  - **Depends on type of test, type of lab, geographical location, availability of lab**



ANTIBODY TESTING

- Help determine whether an individual was previously infected – even if that person never showed symptoms
- Can play an important role in understanding the transmission dynamic of the virus in the general population
- Not recommended as the sole basis for diagnosis of acute infection
  - **Not authorized by FDA for diagnostic purposes**

- HOW LONG DO COVID-19 ANTIBODIES LAST?!
  - **Evidence for short-term immunity**
  - **Antibodies may start to decrease within 2-3 months**

MORE RESEARCH NEEDED!

IMPORTANCE OF TESTING FOR DISEASE PREVENTION

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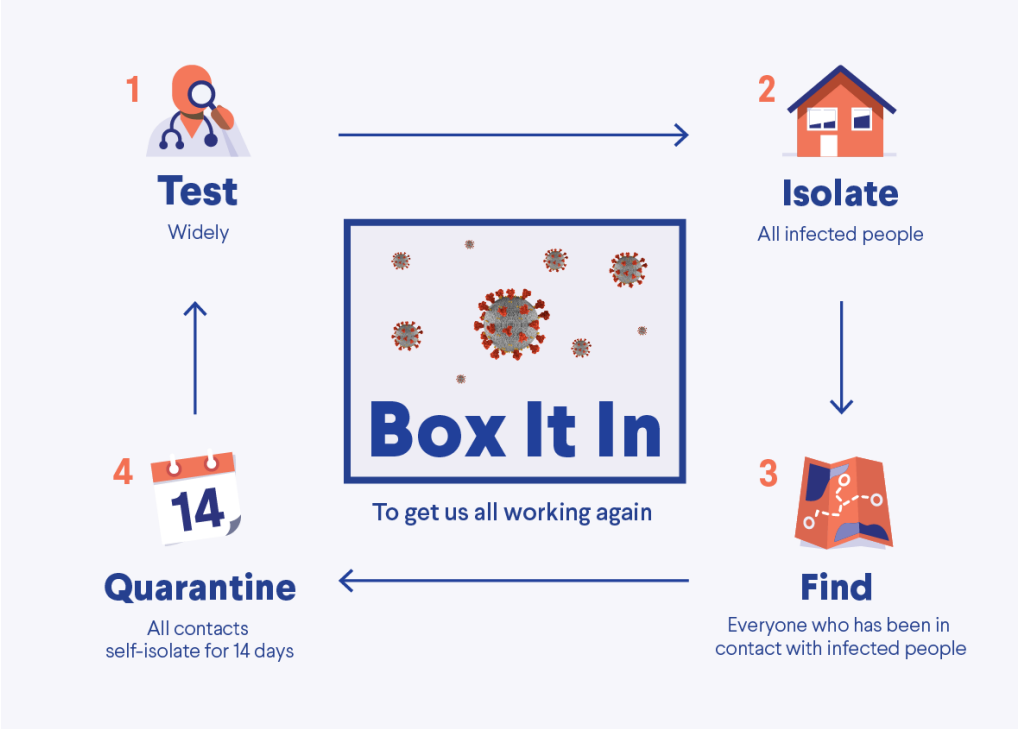
TESTING FOR DISEASE MITIGATION

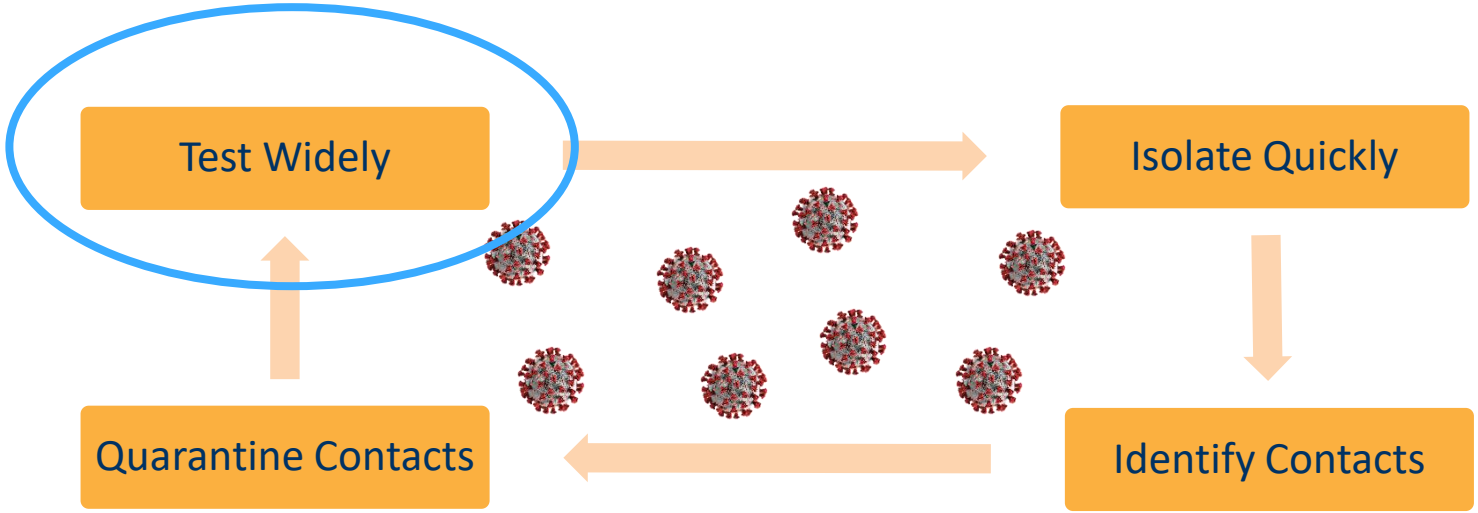
- Testing does not slow the spread of the virus
- Allows you to monitor the outbreak, epidemic, pandemic as it unfolds
- Sets off a chain of events to take action
  - **Isolate infected people so the virus stops with them!**
  - **Contact tracing → quarantine → behavior change**

BOX IT IN!



Source: https://preventepidemics.org/wp-content/uploads/2020/04/COV035_BoxItInBriefingDoc_v9.pdf

BOX IT IN – CHAIN OF EVENTS

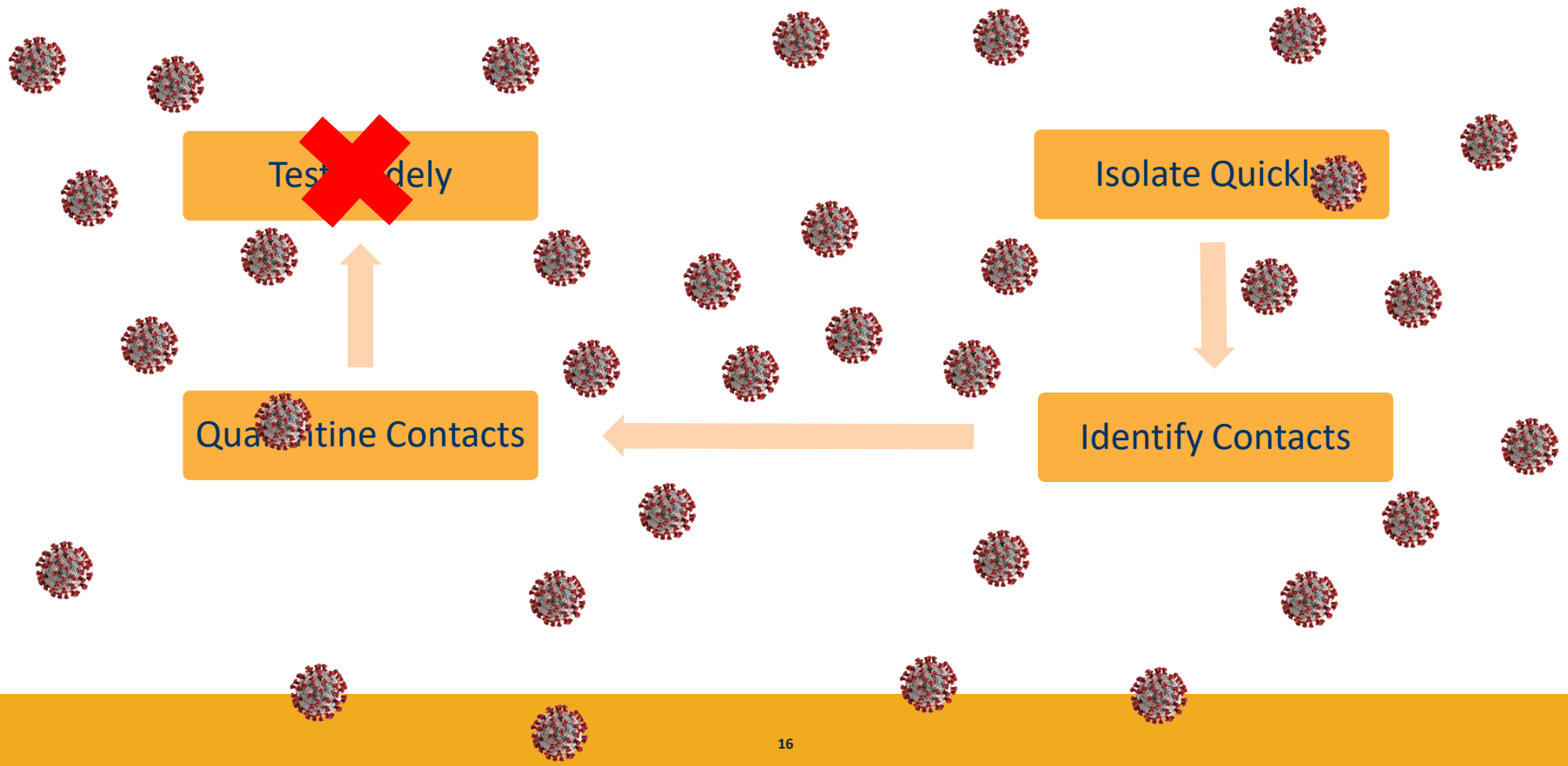


TEST WIDELY AND EFFECTIVELY

- Increase the number of diagnostic tests available
- Increase test processing speed
- Prioritize testing for groups for which testing will make the most difference in improving outcomes
  - **Comprehensive testing among vulnerable populations.**
- Expand serological testing

- Education!

BOX IT IN – CHAIN OF EVENTS



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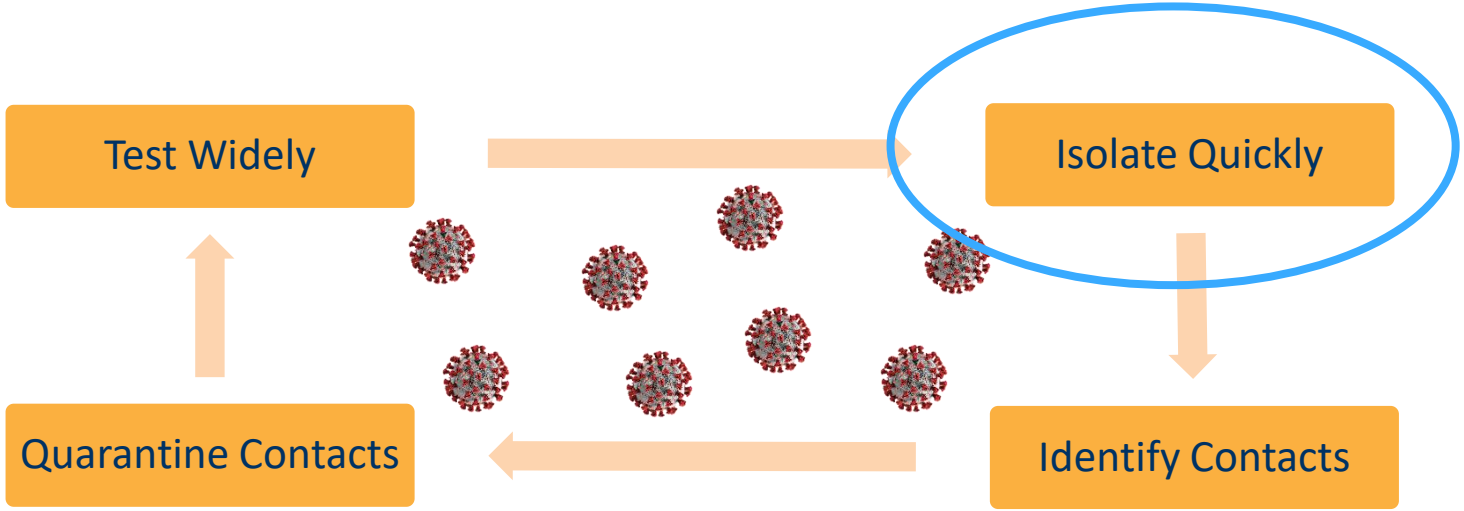
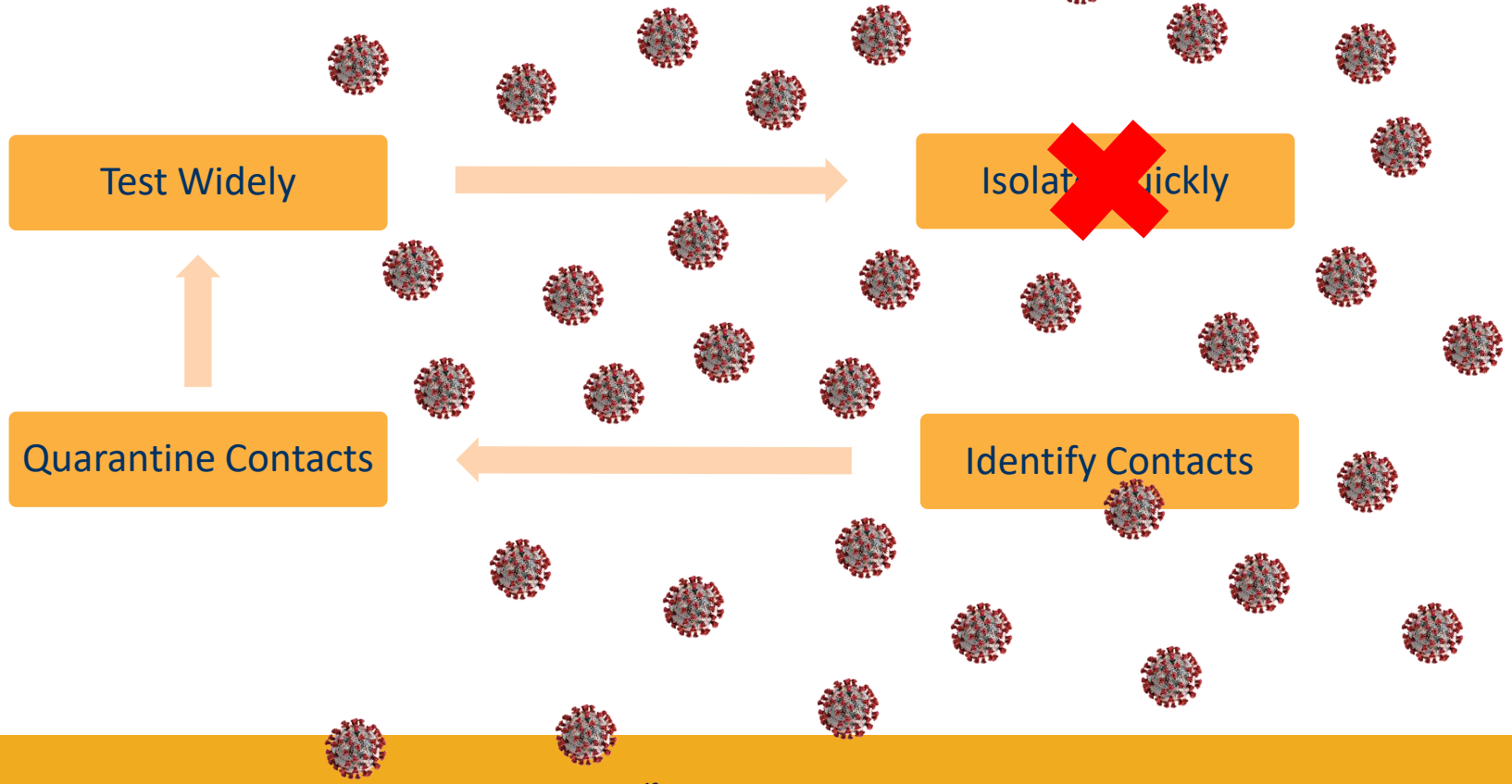


ISOLATE QUICKLY

- Those who do not require hospitalization to isolate at home
- Make facilities (e.g., hotels) that are safe available for people who cannot safely isolate in their homes
- Rapid and effective isolation of all infected patients in hospitals
- Wide-ranging preventive measures in congregate living settings to prevent introduction of the virus and reduce transmission between vulnerable residents and staff
  - **Reducing populations to allow for adequate social distancing**

BOX IT IN – CHAIN OF EVENTS



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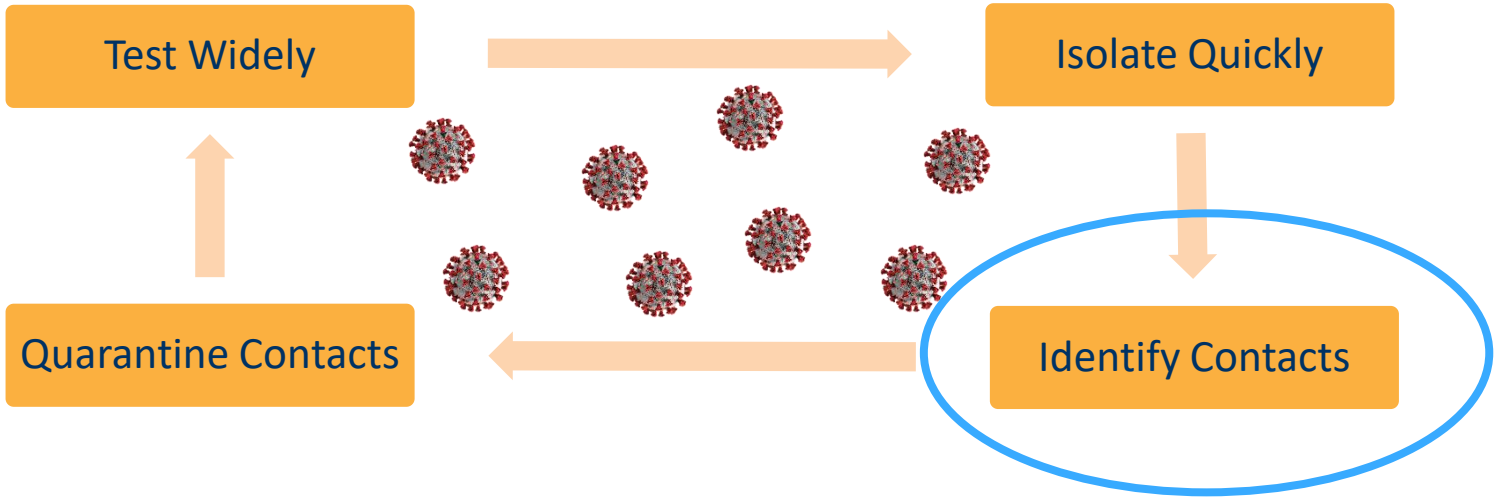
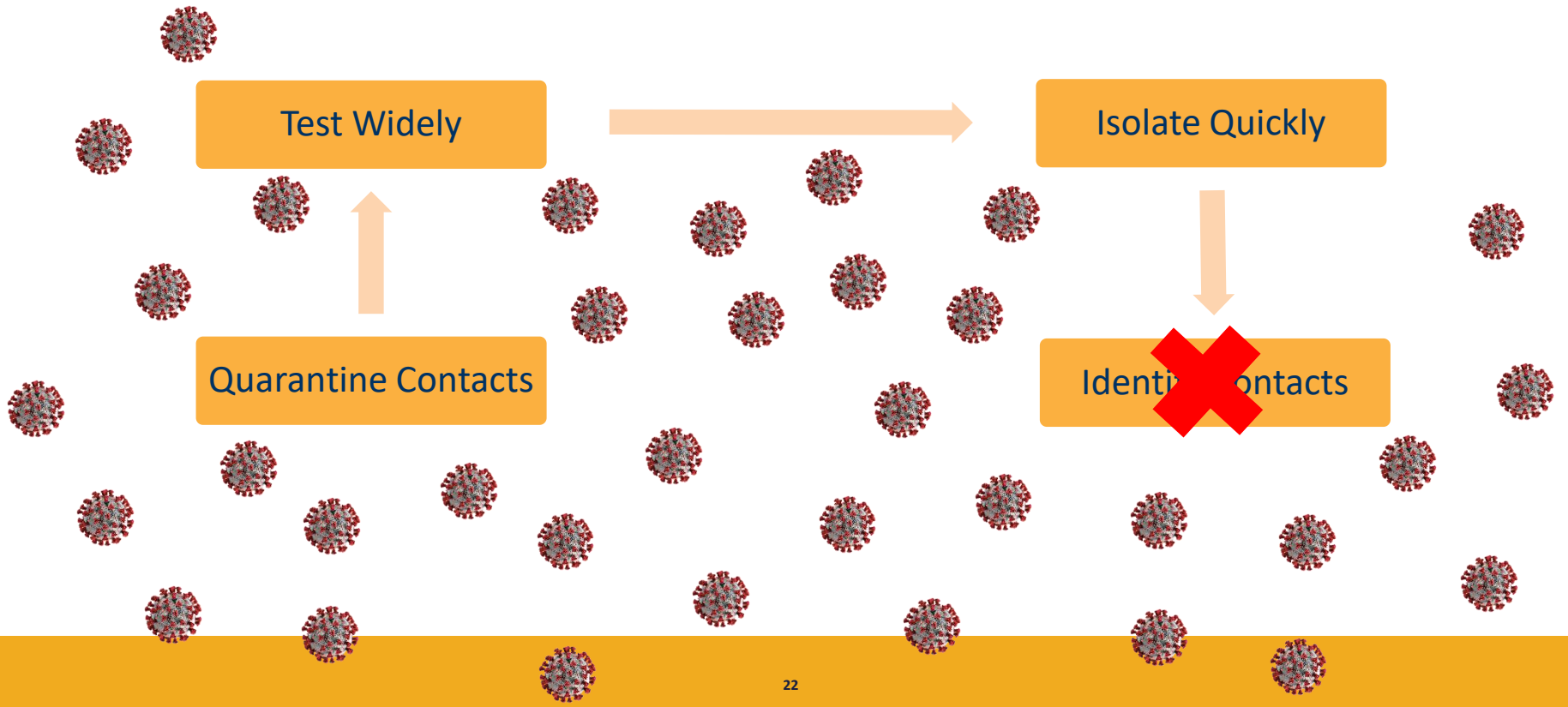


IDENTIFY CONTACTS – CONTACT TRACING

- Massively expand contact tracing capacity at the local, state, and federal levels
- Support person-to-person contact tracing to make it more efficient and effective
- Address concerns about confidentiality and privacy
- Embrace technology

BOX IT IN – CHAIN OF EVENTS



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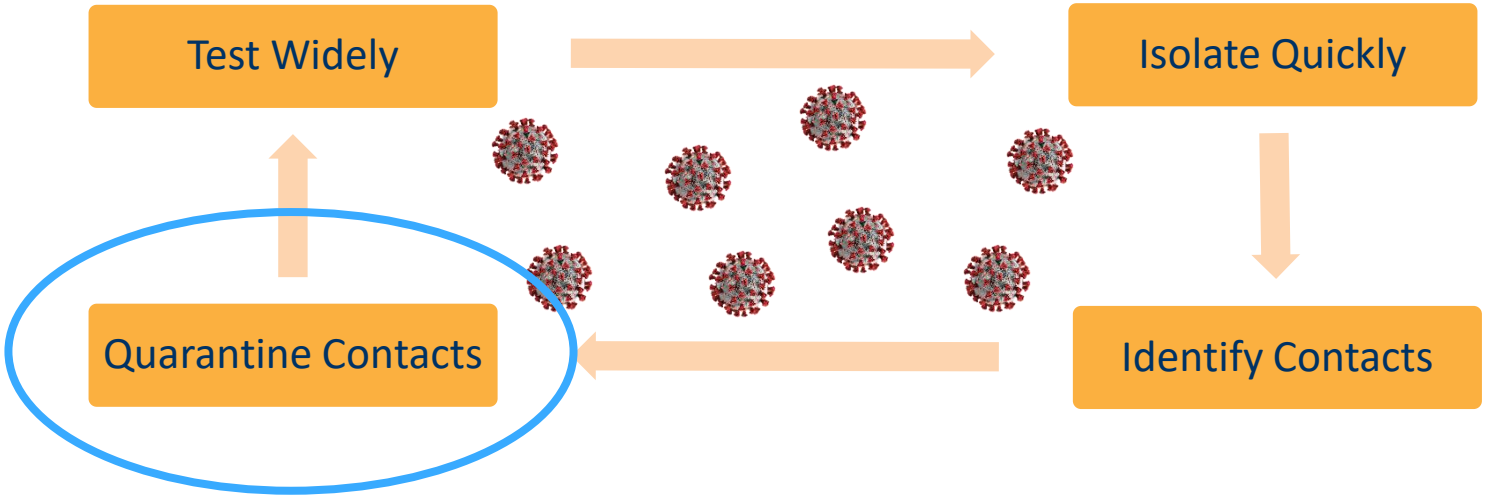
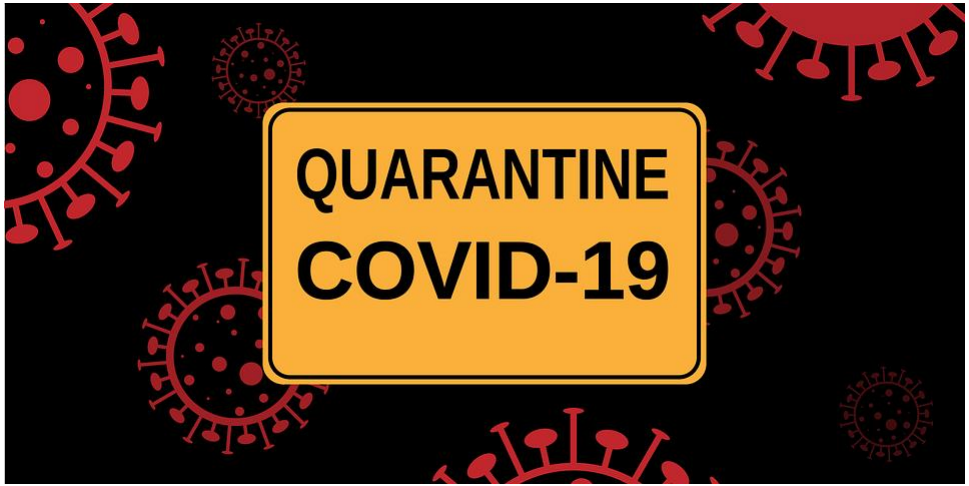


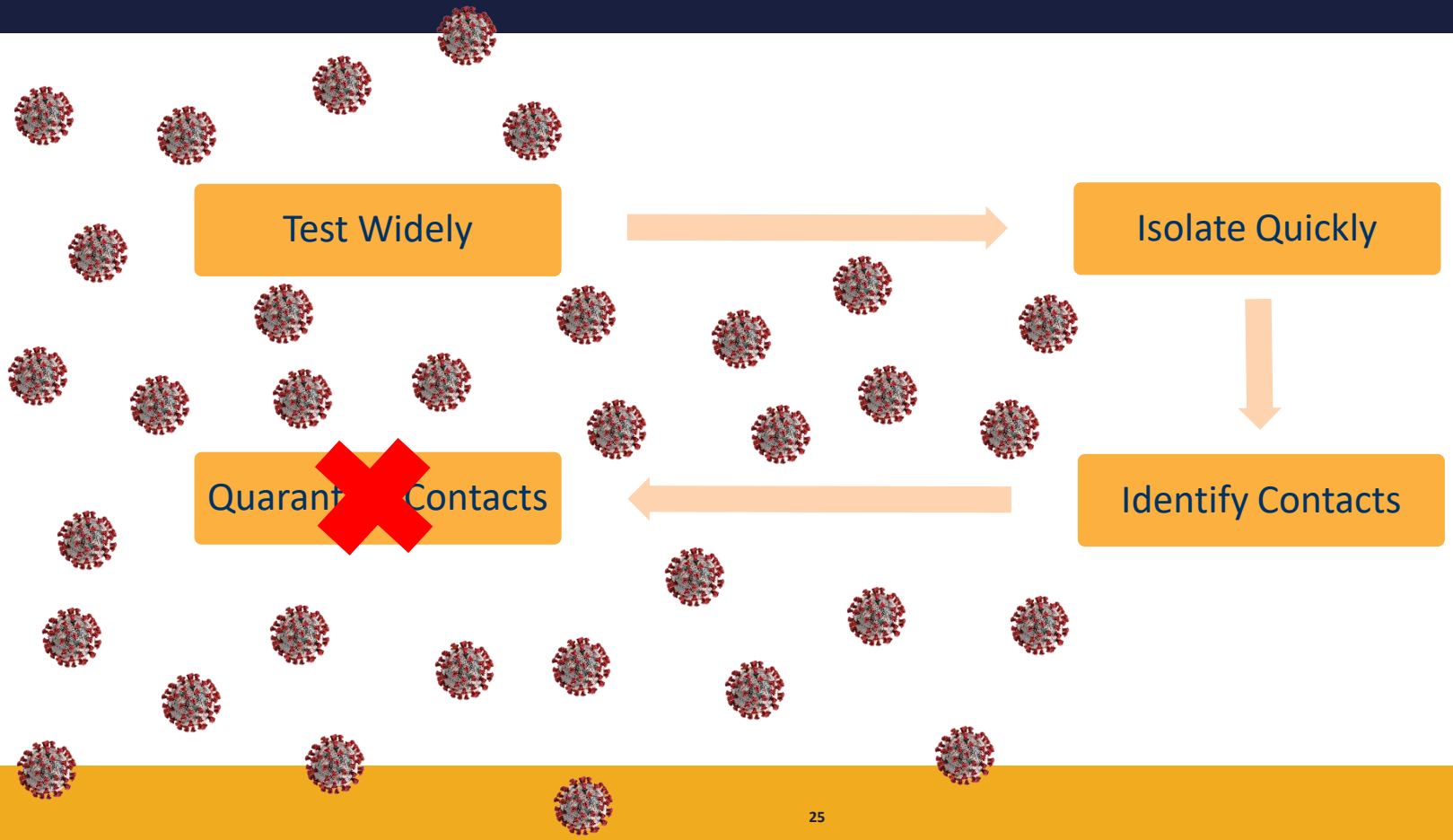
QUARANTINE CONTACTS

- Provide services and support to people so they can quarantine as comfortably as possible

- Provide ready access to telehealth services and care when needed



BOX IT IN – CHAIN OF EVENTS



TESTING: NOT THE END ALL – BE ALL

- Testing and “Box It In” is not our only mitigation strategy
  - **Especially in the current stage of the pandemic**

- In tandem with:
  - **Stay at home orders**
  - **Public health messaging**
  - **Going out for essential things only**
  - **Social distancing**
  - **Wearing masks**
  - **Washing hands**

VALIDITY AND ACCURACY OF DIAGNOSTIC TESTS

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HOW TO MEASURE TEST VALIDITY AND ACCURACY

	Disease Status		
Test Result	(+)	(-)	
(+)	TP	FP	T+
(-)	FN	TN	T-
	D+	D-	

TP = True positive
FP = False positive
TN = True negative
FN = False negative

D+ = Disease positive
D- = Disease negative
T+ = Test positive for disease
T - = Test negative for disease

TERMS YOU MAY HAVE HEARD

- Sensitivity
- Specificity
- Positive Predictive Value
- Negative Predictive Value

SENSITIVITY

Sensitivity = probability of a positive test among persons with a disease

How good is a test for identifying people with disease?

SENSITIVITY

	Disease Status		
Test Result	(+)	(-)	
(+)	TP	FP	T+
(-)	FN	TN	T-
	D+	D-	

$$\textbf{Sensitivity} = \frac{TP}{TP + FN} = \frac{TP}{D+}$$

SPECIFICITY

Specificity = probability of a negative test among persons without disease

How good is a test for identifying people without disease?

SPECIFICITY

	Disease Status		
Test Result	(+)	(-)	
(+)	TP	FP	T+
(-)	FN	TN	T-
	D+	D-	

$$\textbf{Specificity} = \frac{TN}{TN + FP} = \frac{TN}{D-}$$

WHAT ABOUT THESE OTHER QUESTIONS

- If I obtain a positive test result, what is the probability that I actually have the disease?

- If I obtain a negative test result, what is the probability that I do not have the disease?

POSITIVE PREDICTIVE VALUE (PPV)

PPV = probability that a person has the disease given that a positive test has been obtained

If I obtain a positive test result, PPV is the probability that I actually have the disease.

POSITIVE PREDICTIVE VALUE (PPV)

	Disease Status		
Test Result	(+)	(-)	
(+)	TP	FP	T+
(-)	FN	TN	T-
	D+	D-	

$$\text{PPV} = \frac{TP}{TP + FP} = \frac{TP}{T+}$$

NEGATIVE PREDICTIVE VALUE (NPV)

NPV = probability that a person does not have the disease given that a negative test has been obtained

If I obtain a negative test result, NPV is the probability that I actually do NOT have the disease.

NEGATIVE PREDICTIVE VALUE (NPV)

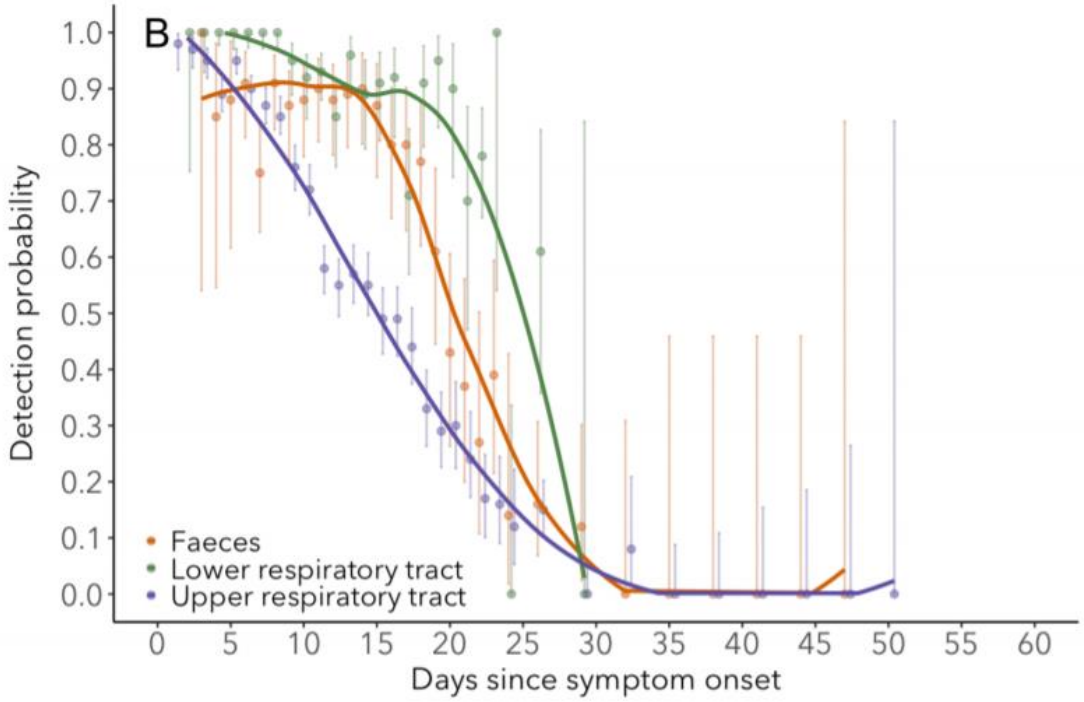
	Disease Status		
Test Result	(+)	(-)	
(+)	TP	FP	T+
(-)	FN	TN	T-
	D+	D-	

$$\textbf{NPV} = \frac{TN}{TN + FN} = \frac{TN}{T-}$$

SO REMEMBER…

- **Sensitivity** = How good a test is for identifying people with disease
- **Specificity** = How good a test is for identifying people without disease
- **Positive Predictive Value** = How likely it is for someone who tests positive to actually have the disease
- **Negative Predictive Value** = How likely it is for someone who tests negative to not have the disease

ACCURACY OF COVID-19 TESTS MAY DEPEND ON TIME!



Source: https://www.medrxiv.org/content/10.1101/2020.05.15.20103275v1.full.pdf

WHEN IS TESTING APPROPRIATE FOR DISEASE MITIGATION?

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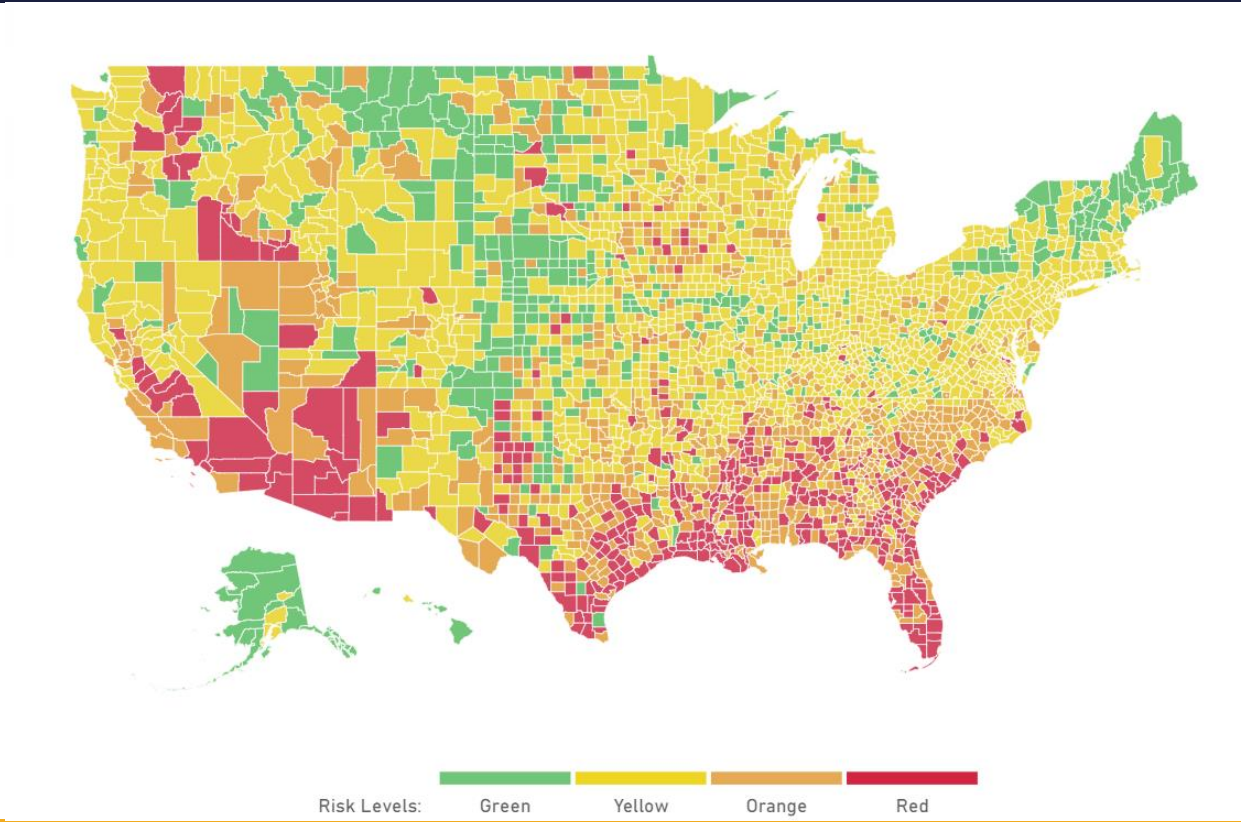
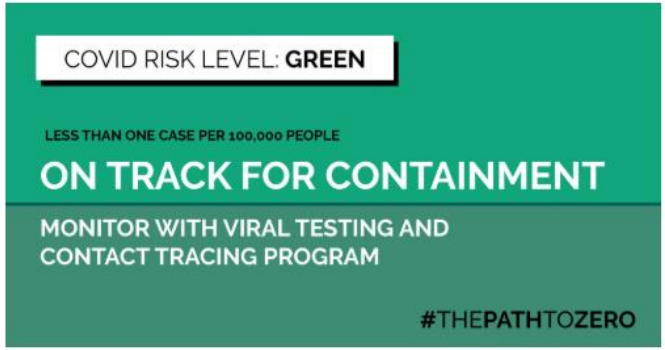
COVID-19 RISK LEVEL IN THE UNITED STATES



Source: https://globalepidemics.org/key-metrics-for-covid-suppression/?fbclid=IwAR0mvYgzE_GsbVRE-2BF_XciztZp5w_JFZjJnFcypSRbSXJFhkKr85mPICo

COVID-19 RISK LEVEL – HARVARD GLOBAL HEALTH INSTITUE



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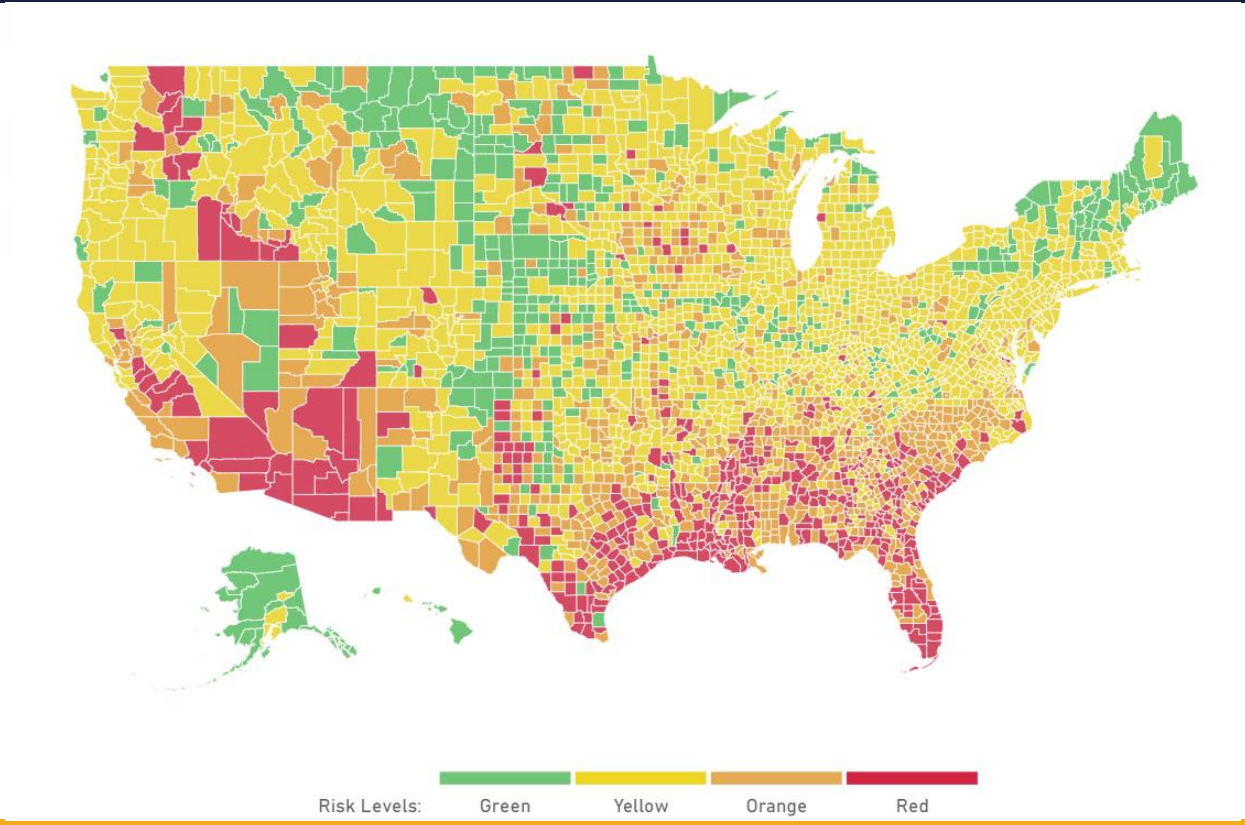
COVID-19 RISK LEVEL IN THE UNITED STATES – BY COUNTY



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COVID-19 RISK LEVEL BY STATE

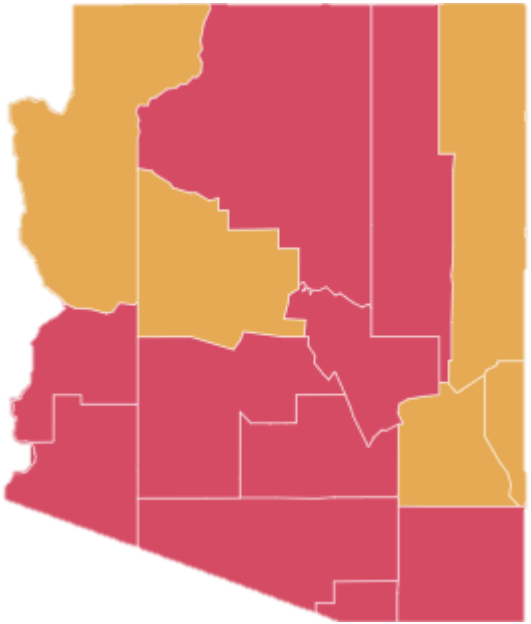
State/County	Daily new cases per 100k people (7d moving avg.)
Arizona	49.1
Florida	43.6
Louisiana	34.9
South Carolina	30.1
Georgia	28.5
Texas	27.9
Alabama	25.2
Nevada	24.1
Mississippi	23.7
Idaho	23.5
Tennessee	22.0
California	21.9
Arkansas	19.8
Utah	19.8
Kansas	17.8
Iowa	16.6
North Carolina	15.1
Oklahoma	14.5
New Mexico	12.1
Wisconsin	10.9

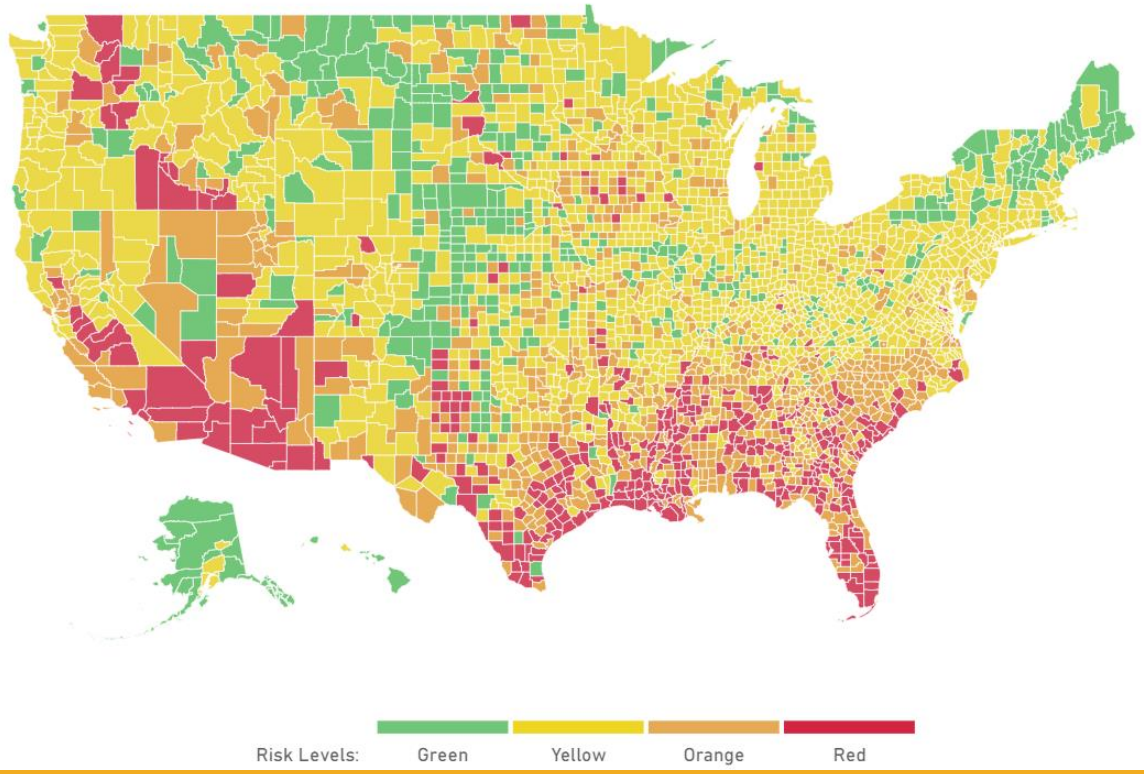
State/County	Daily new cases per 100k people (7d moving avg.)
Delaware	10.7
Ohio	9.3
Missouri	9.0
Virginia	9.0
Washington	8.4
Nebraska	8.4
North Dakota	8.1
Minnesota	8.0
District of Columbia	7.4
Kentucky	7.3
West Virginia	7.2
Indiana	7.2
Maryland	7.0
South Dakota	6.8
Illinois	6.8
Colorado	6.4
Montana	6.3
Oregon	6.2
Pennsylvania	5.7

State/County	Daily new cases per 100k people (7d moving avg.)
Maryland	7.0
South Dakota	6.8
Illinois	6.8
Colorado	6.4
Montana	6.3
Oregon	6.2
Pennsylvania	5.7
Alaska	5.4
Wyoming	5.1
Michigan	5.0
Rhode Island	4.3
New York	3.2
Massachusetts	3.1
New Jersey	3.0
Connecticut	2.3
Hawaii	1.9
New Hampshire	1.4
Maine	1.1
Vermont	0.9

COVID-19 RISK LEVEL BY COUNTY

Arizona





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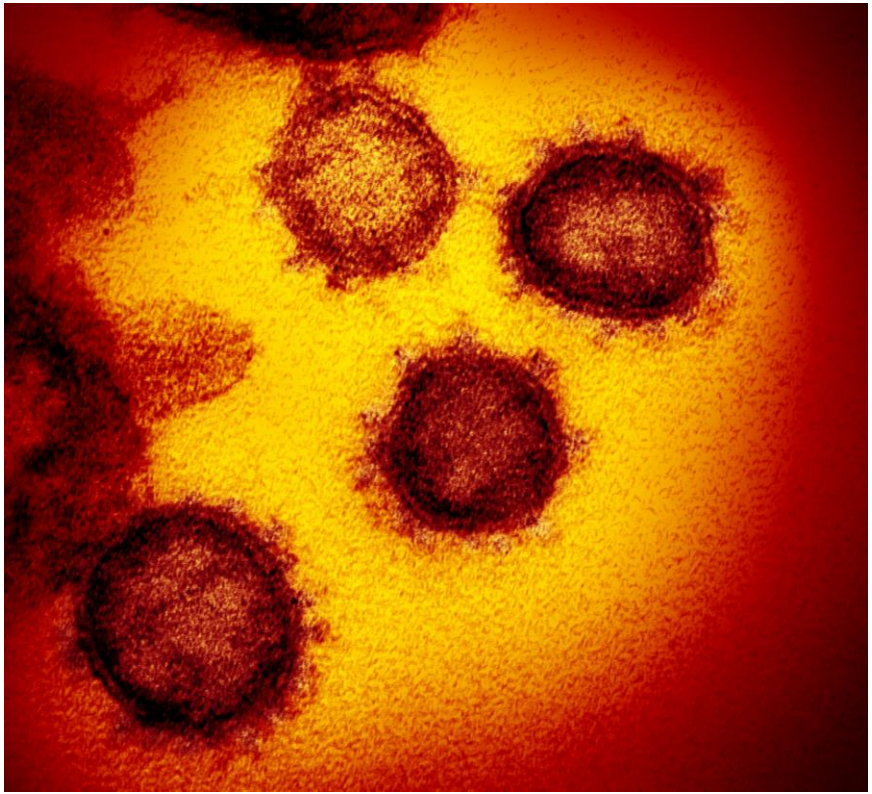
SARS-COV-1 – BOX IT IN SUCCESS

- SARS-CoV-2 (virus that causes COVID-19)
  - **13,000,000 cases**
  - **571,000 deaths**

- SARS-CoV-1
  - **8,000 cases**
  - **700 deaths**
  - **More aggressive than SARS-CoV-2**



SARS-COV-1 – BOX IT IN SUCCESS

- SARS-CoV-1
  - **Easier to identify cases**
  - **Easier to track down contacts**

- EVERYONE HAD SEVERE SYMPTOMS IN TWO TO THREE DAYS

REFLECTION

- Types of testing
- Importance of testing for disease prevention
  - **“Box It In”**
- Validity and accuracy of diagnostic tests
- When is testing appropriate for disease mitigation?

ACKNOWLEDGMENTS

- Drs. Meghan Warren and Brettania O’Connor
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  - **nau.edu/sherc**

THANK YOU!

QUESTIONS?

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