

COVID-19 Simulation Integrated Model (*COVSIM*) to Inform Local Decision-Making

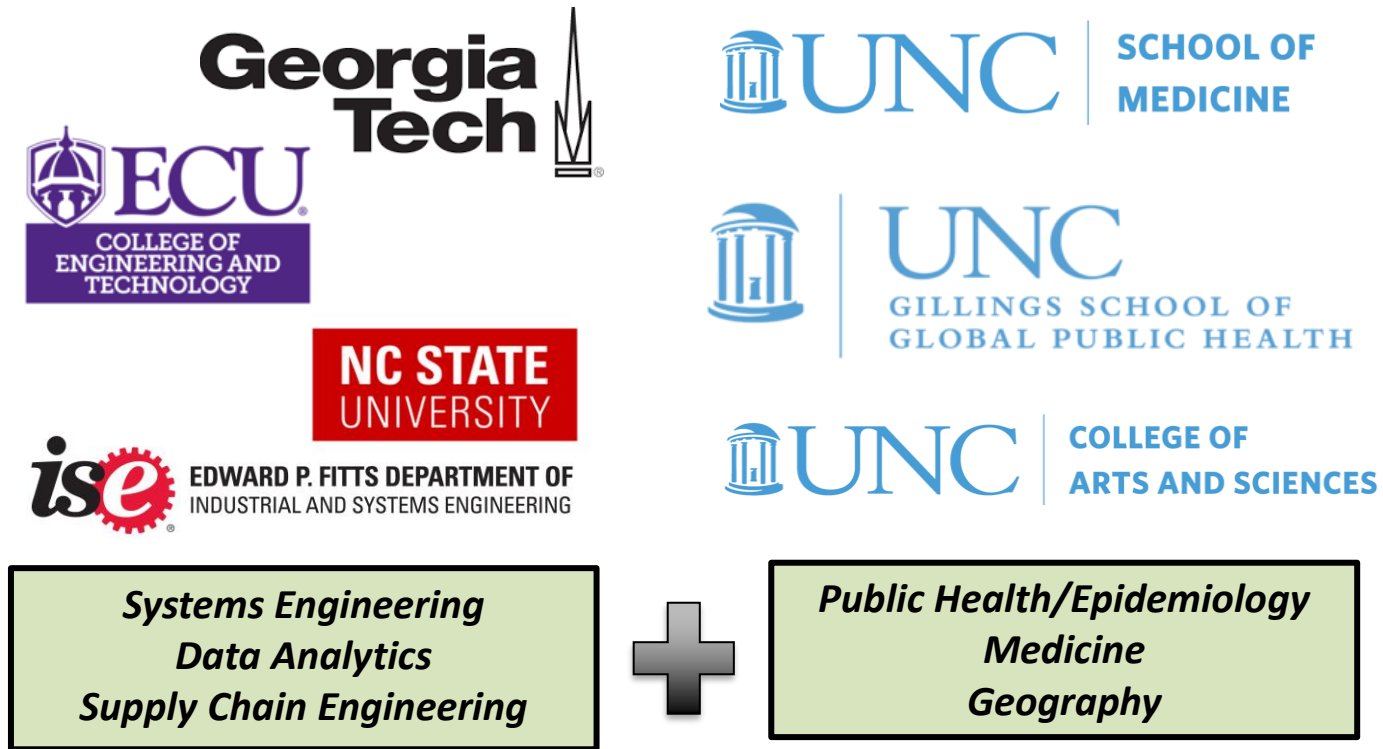
COVID-19 Modeling Projections for Schools Part 1: Model Background



The “COVSIM” Model team

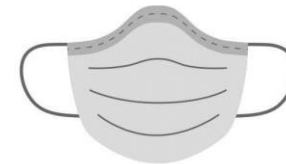
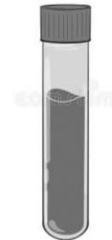
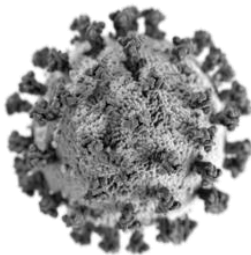
The COVSIM team is one of six modeling teams funded by CDC and the Council for State and Territorial Epidemiologists to:

- (a) forecast SARS CoV-2 infections and outcomes,
- (b) estimate the impact of intervention scenarios, and
- (c) support state and local decision-makers



Our Modeling Objective

To estimate the proportion of susceptible students infected throughout a school semester, depending on incoming protection as well as masking and testing policies.



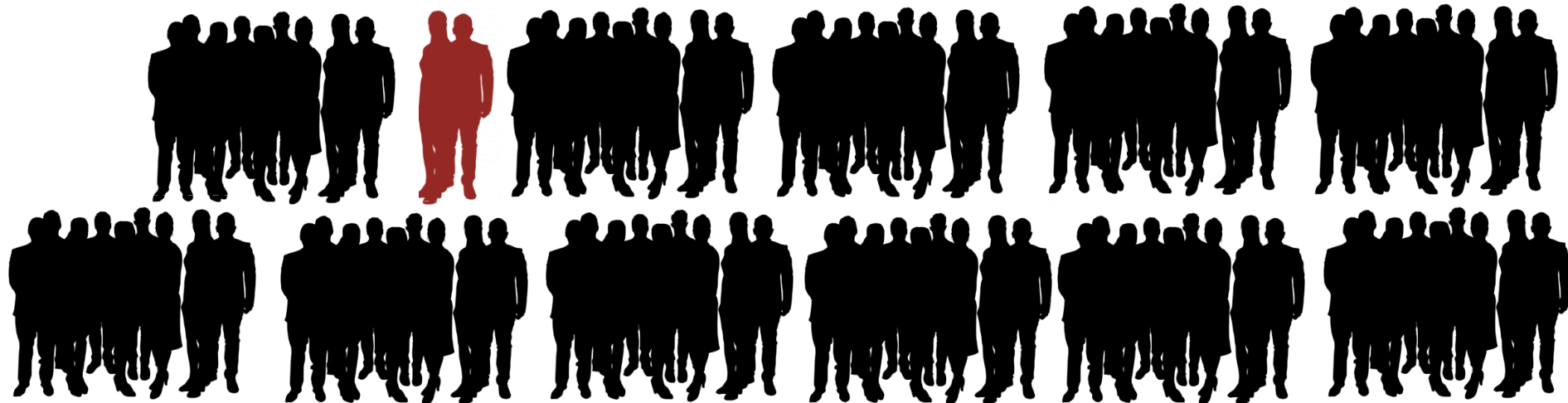
Imagine a school...

- Student population: **500**



Imagine a school...

- Student population: 500
- **2-3 students begin infected with COVID-19** at the start of the semester

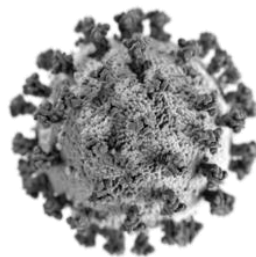


Imagine a school...



- Student population: 500
- 2-3 students begin infected with COVID-19 at the start of the semester
- Some students have either already had COVID-19 or have received the vaccine (“**incoming protection**”), or are susceptible to becoming infected

If **30%**
of students
have had
COVID-19...



...and **20%** of
students have
received the
vaccine.



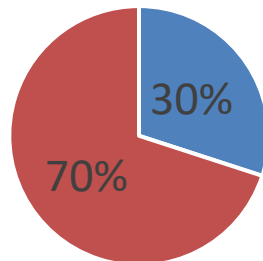
Then incoming
protection:
50%

Imagine a school...

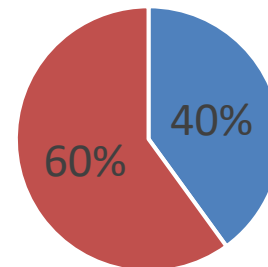


- Student population: 500
- 2-3 students begin infected with COVID-19 at the start of the semester
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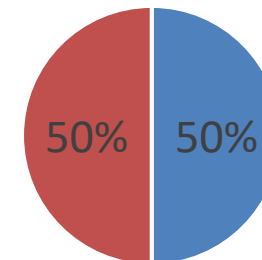
Elementary School Setting



Middle School Setting



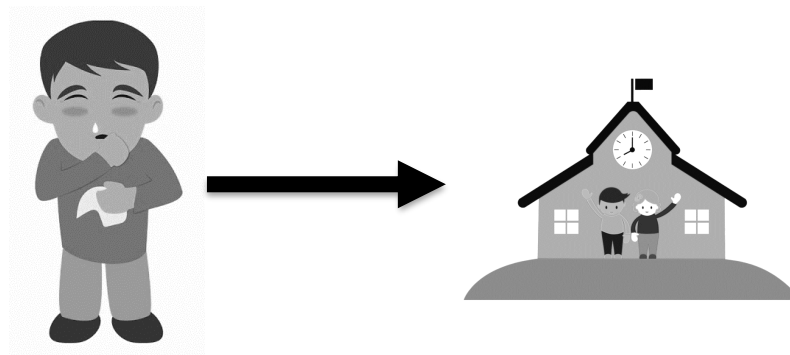
High School School Setting



■ Incoming Protection ■ Susceptible

Imagine a school...

- Student population: 500
- 2-3 students begin infected with COVID-19 at the start of the semester
- Some students have either already had COVID-19 or have received the vaccine (“incoming protection”), or are susceptible to becoming infected
- Every week, **one new student becomes infected** with COVID-19 outside the school



Imagine a school...

- Student population: 500
- 2-3 students begin infected with COVID-19 at the start of the semester
- Some students have either already had COVID-19 or have received the vaccine (“incoming protection”), or are susceptible to becoming infected
- Every week, one new student becomes infected with COVID-19 outside the school
- Availability of **random RT-PCR testing and isolation** among students every week

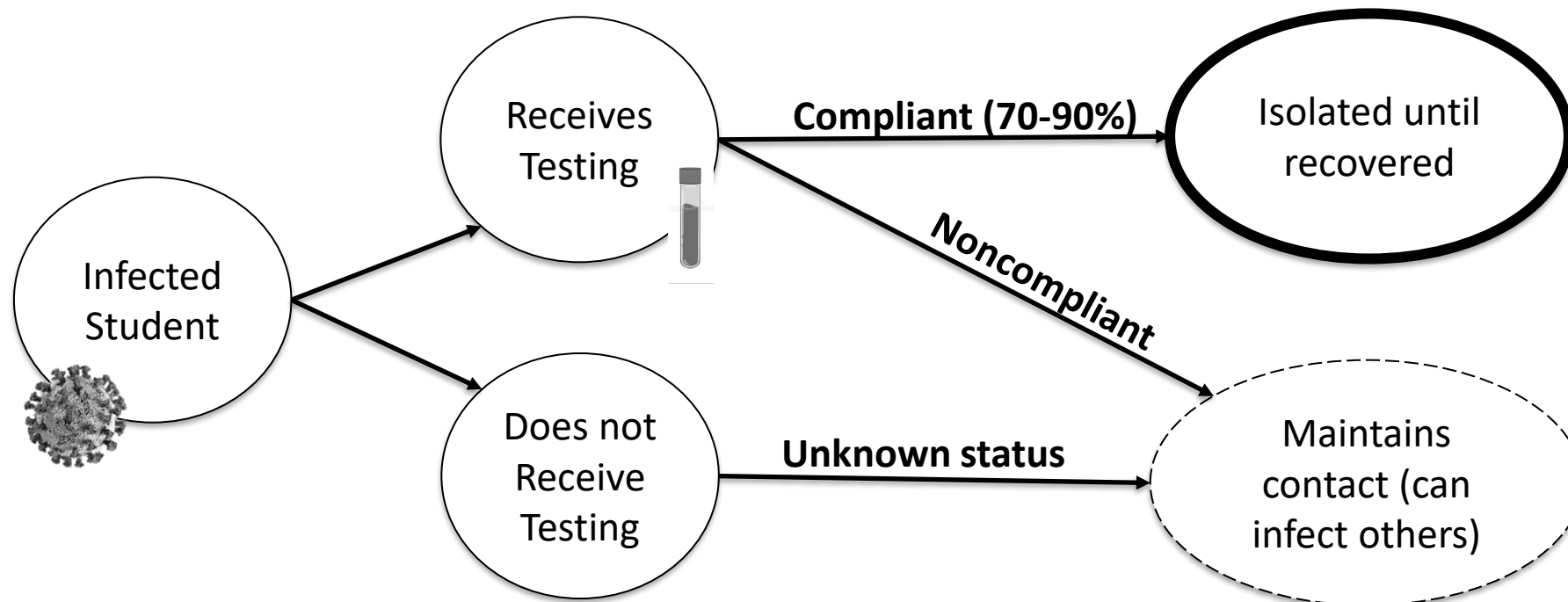


Random testing and
isolation of COVID-19
positive students

Imagine a school...



- Availability of random RT-PCR testing and isolation among students every week



COVID-19 Simulation Integrated Model (*COVSIM*) to Inform Local Decision-Making

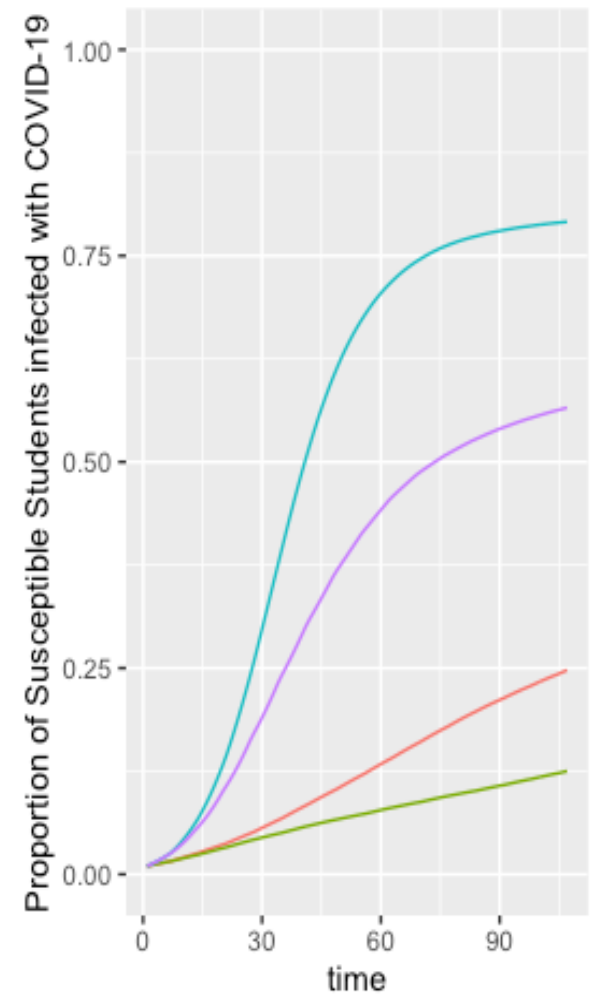
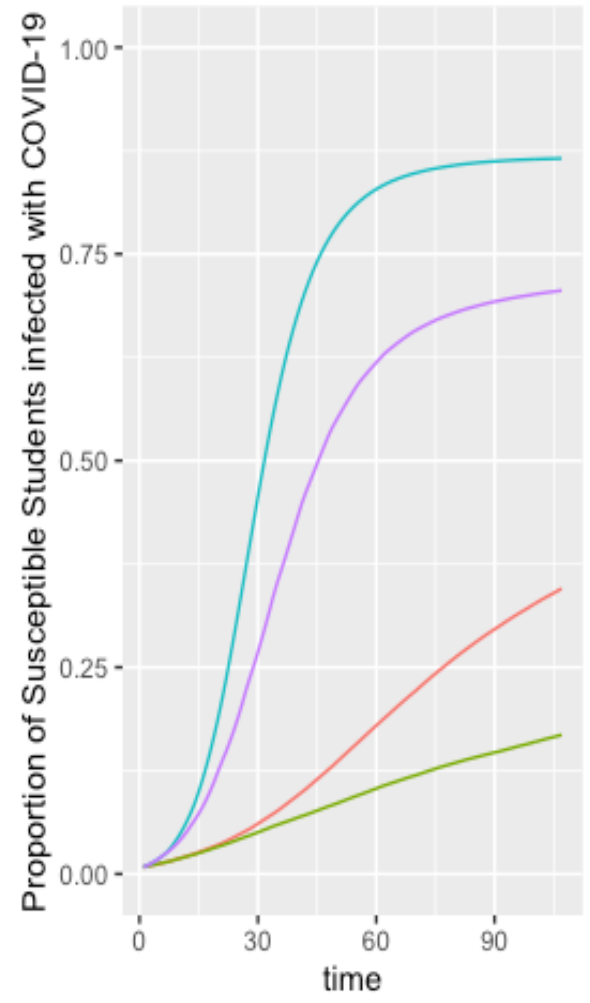
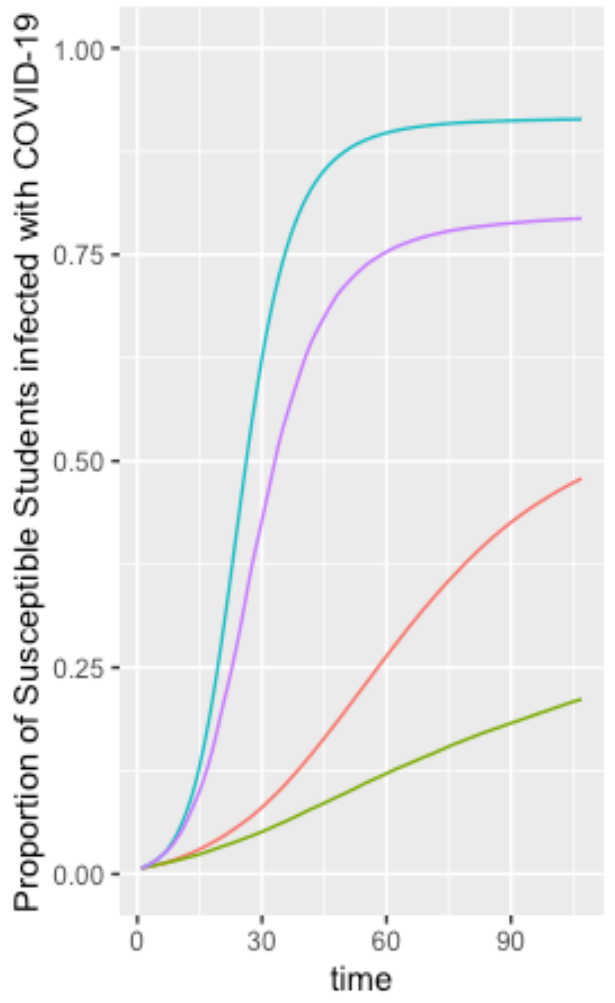
COVID-19 Modeling Projections for Schools Part 2: Model Results



Elementary School Setting
(incoming protection = 30%)

Middle School Setting
(incoming protection = 40%)

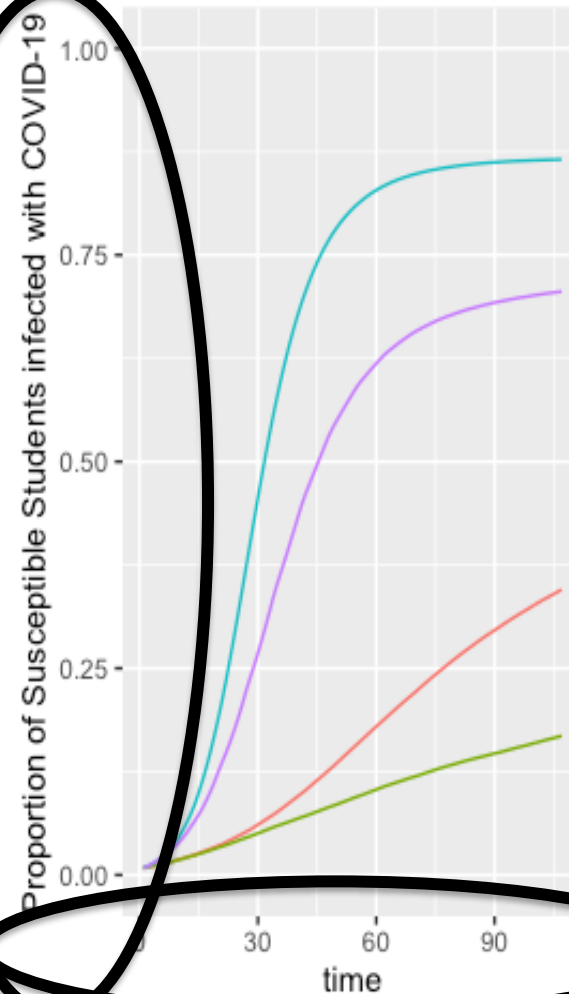
High School Setting
(incoming protection = 50%)



- scenarios
- Universal masking: Baseline
 - Universal masking: PCR_50
 - No masking: Baseline
 - No masking: PCR_50

**Y axis = Percent of
Susceptible Students
who have become
infected**

**Middle School Setting
(incoming protection = 40%)**

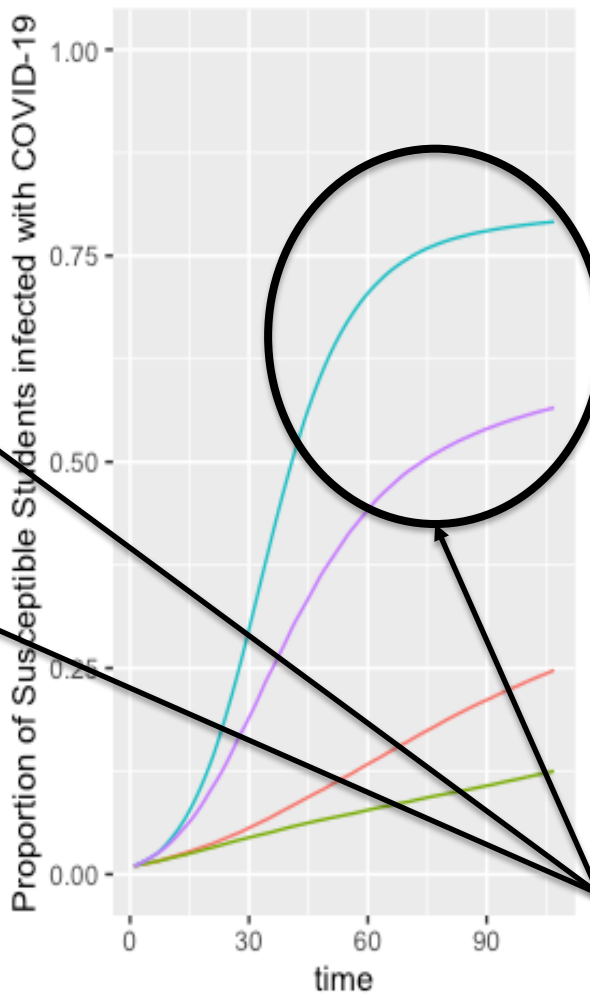
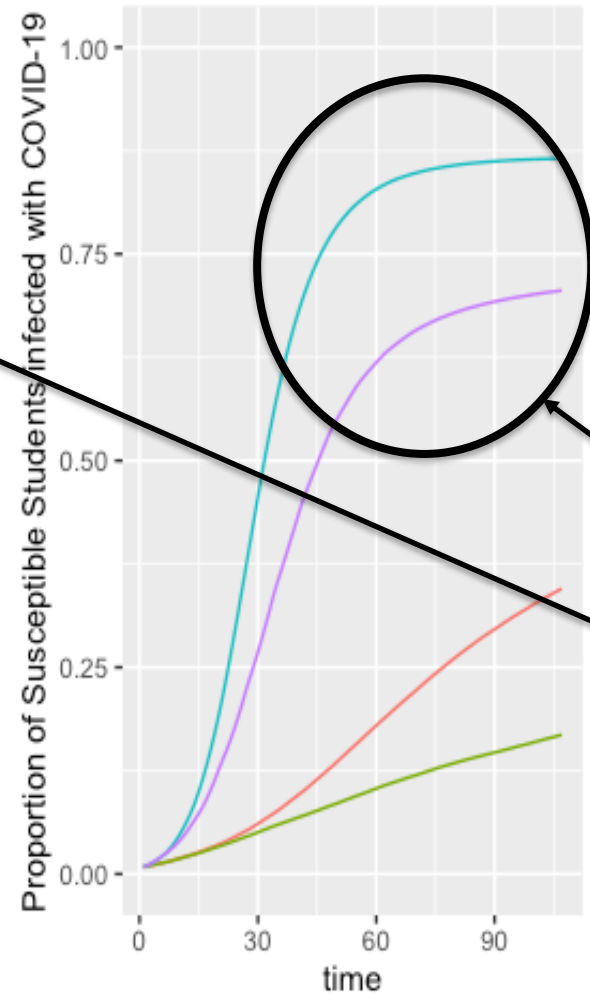
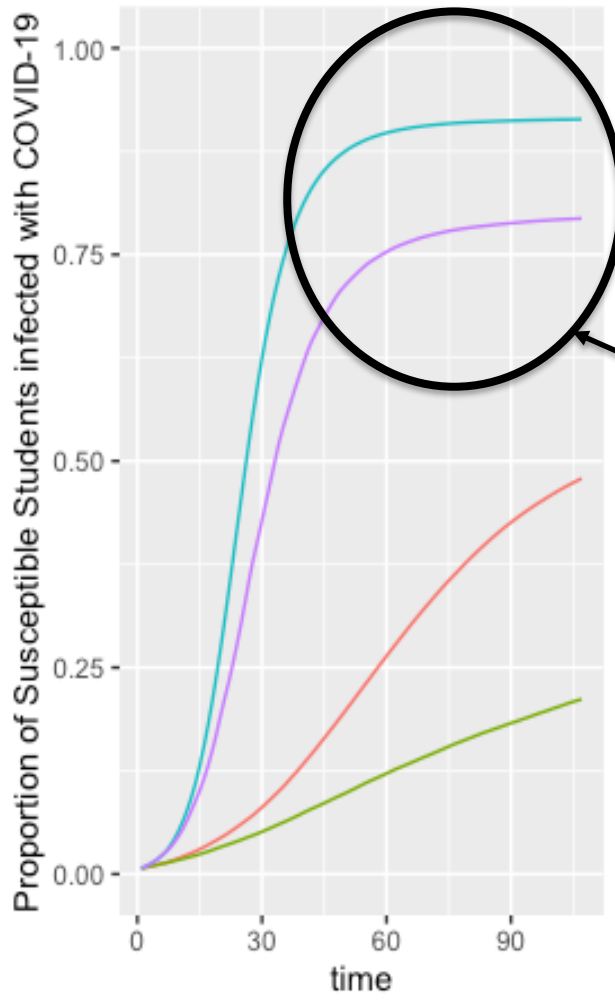


**X axis = days since the
school semester began
(107 total days)**

Elementary School Setting
(incoming protection = 30%)

Middle School Setting
(incoming protection = 40%)

High School Setting
(incoming protection = 50%)



scenarios

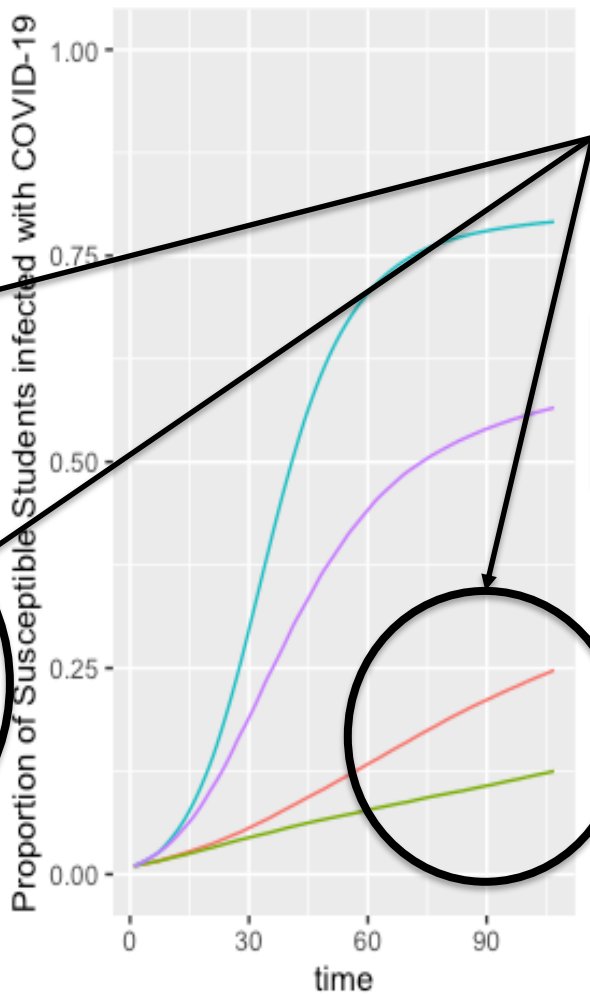
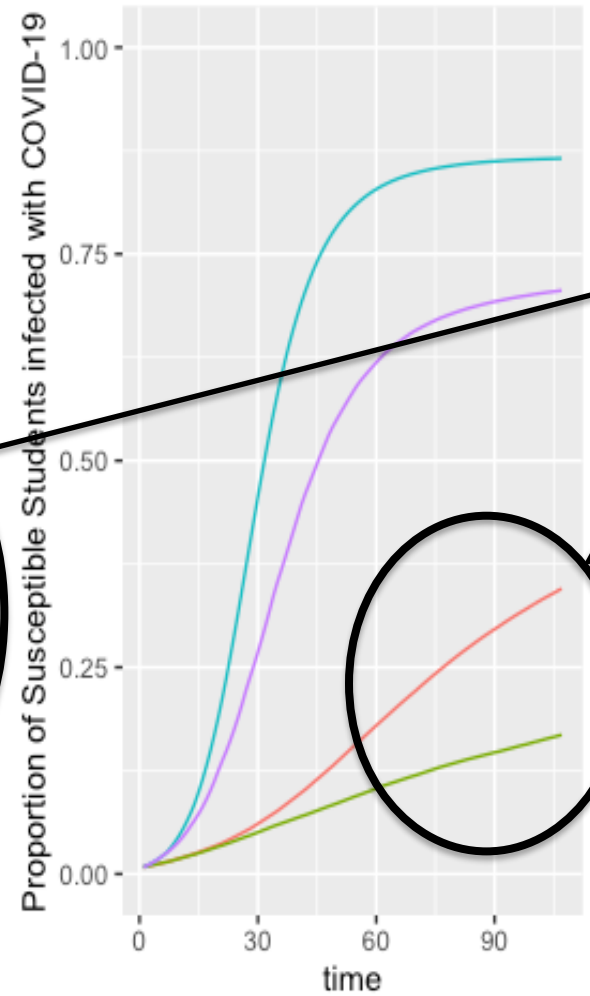
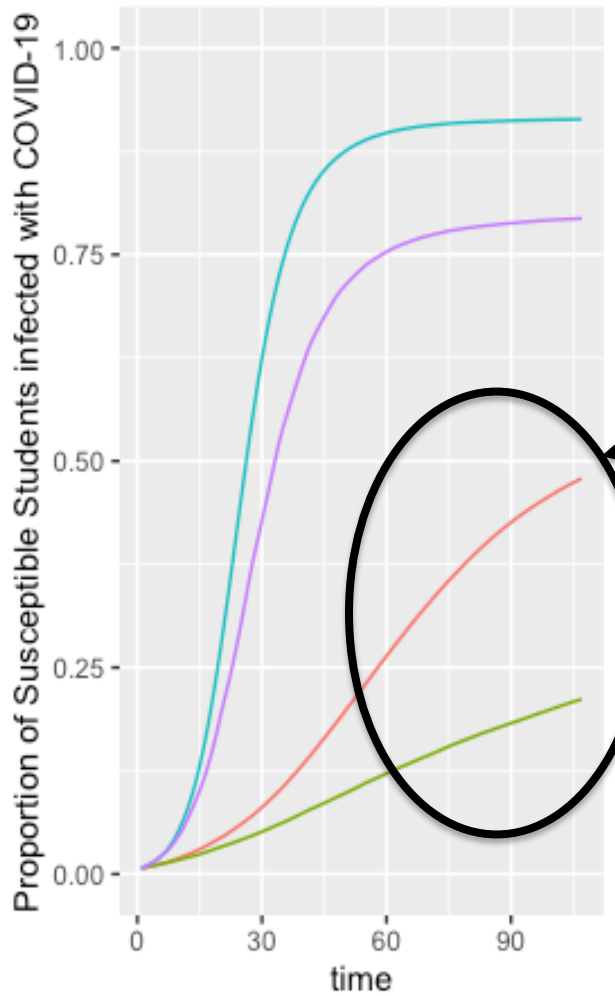
- Universal masking: Baseline
- Universal masking: PCR_50
- No masking: Baseline
- No masking: PCR_50

“No Masking” scenarios:
effective reproductive rate = 4.0
(for every 1 person infected, 4 other students become infected)

Elementary School Setting
(incoming protection = 30%)

Middle School Setting
(incoming protection = 40%)

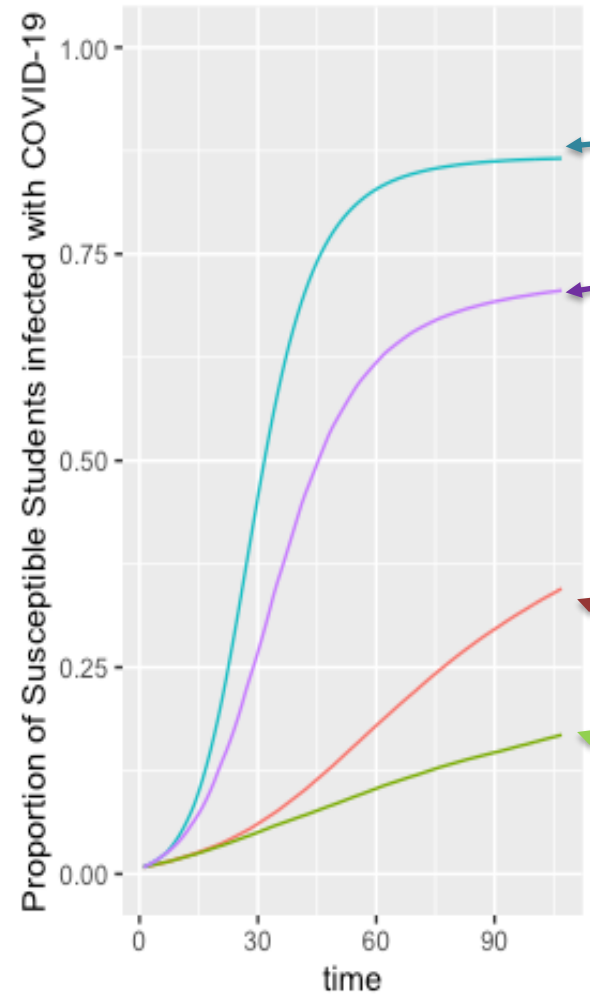
High School Setting
(incoming protection = 50%)



“Universal Masking”
scenarios: **effective reproductive rate = 2.0**
(50% reduction in viral reproducibility from masking)

- scenarios
- Universal masking: Baseline
 - Universal masking: PCR_50
 - No masking: Baseline
 - No masking: PCR_50

Middle School Setting
(incoming protection = 40%)



No Masks

No testing

Testing 1/2 of students

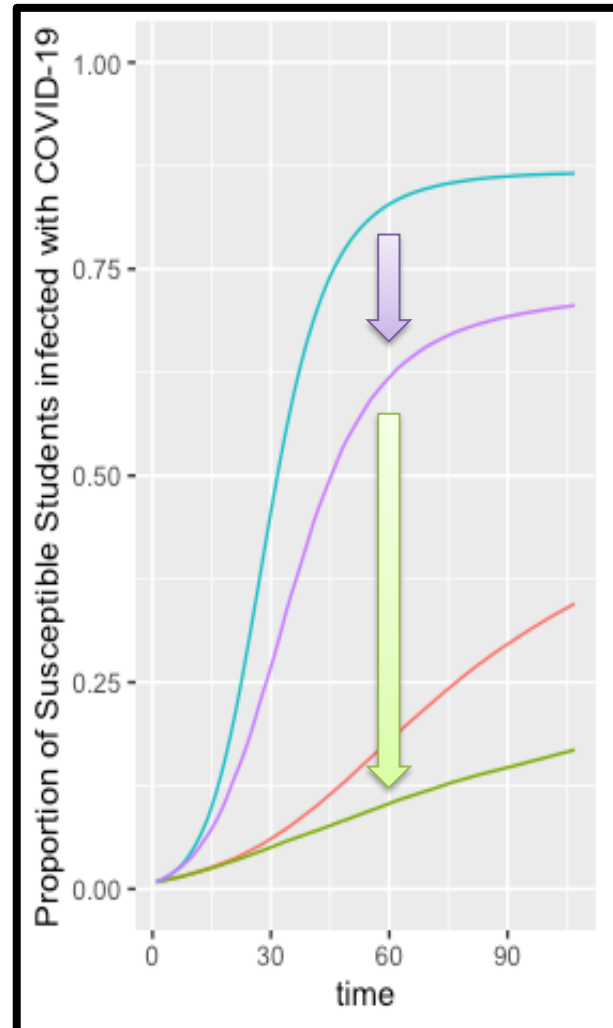
2 Levels of Testing for either masking policy
(no testing OR testing 1/2 of students every week)

Universal Masking

No testing

Testing 1/2 of students

Middle School Setting (incoming protection = 40%)

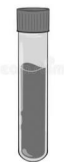
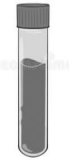


after 60 days....

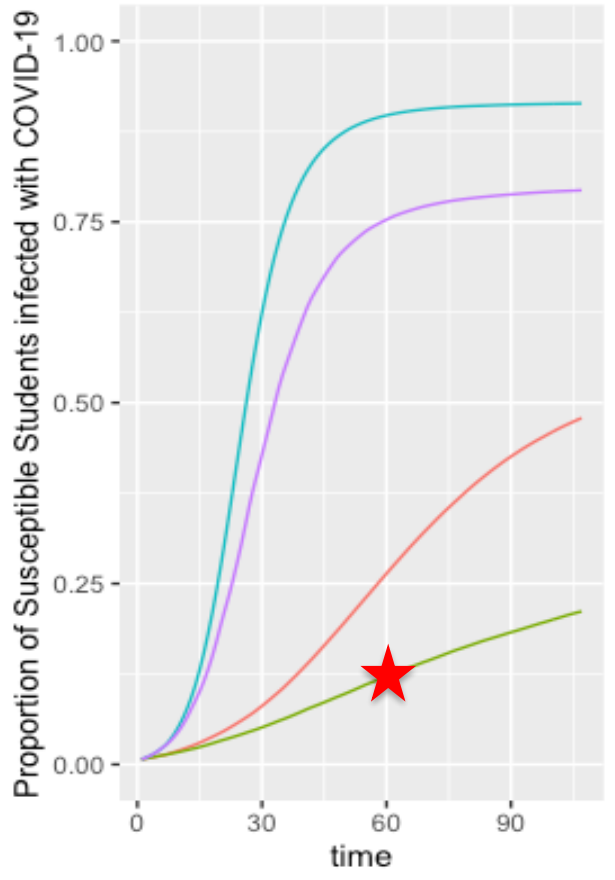
No testing, No masking = ~80% of susceptible students have become infected

Testing students, no masking = ~60% of susceptible students have become infected

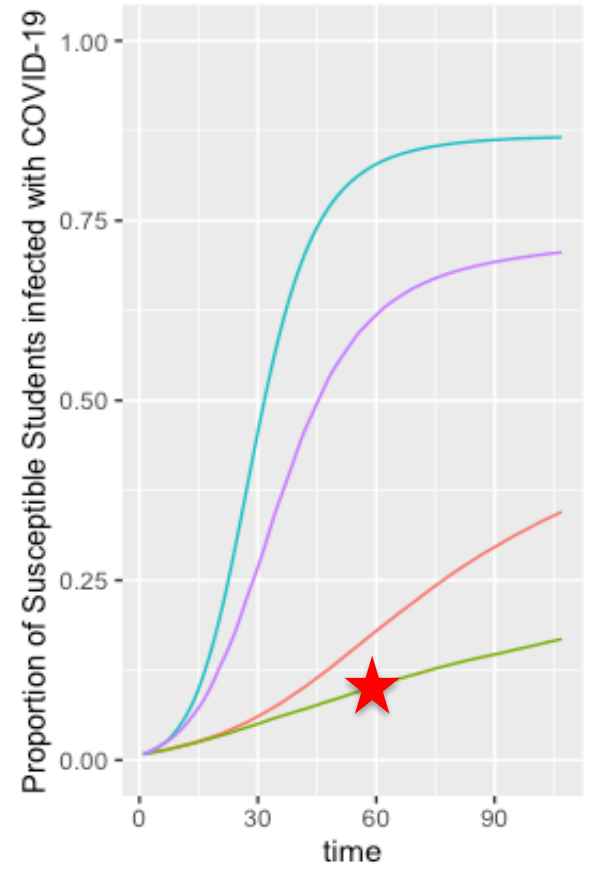
Testing students + universal masking = ~10% of susceptible students have become infected



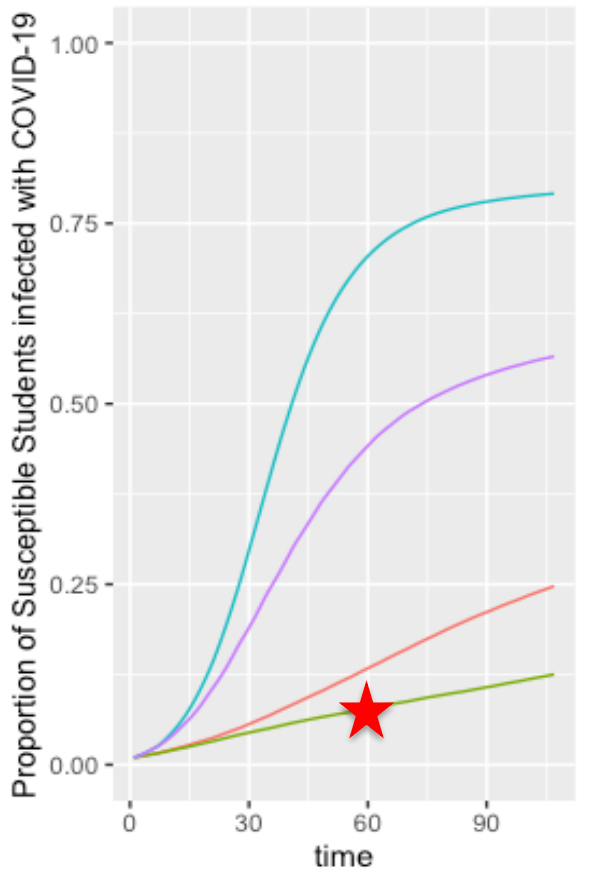
Elementary School Setting
(incoming protection = 30%)



Middle School Setting
(incoming protection = 40%)



High School Setting
(incoming protection = 50%)



- scenarios
- Universal masking: Baseline
 - Universal masking: PCR_50
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after 60 days....

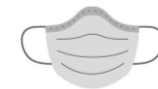
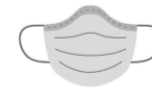
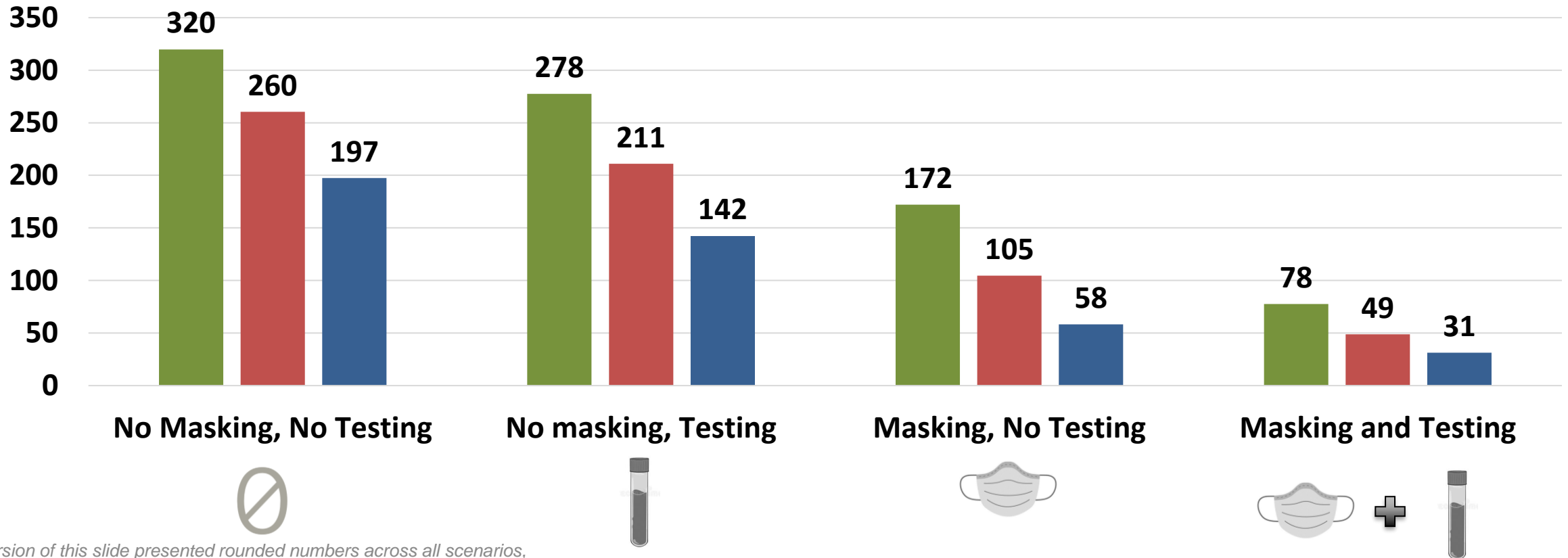
~15% of susceptible students have become infected (30% protection)

~10% of susceptible students have become infected (40% protection)

~7% of susceptible students have become infected (50% protection)

New Infections among 500 Students after 1 semester

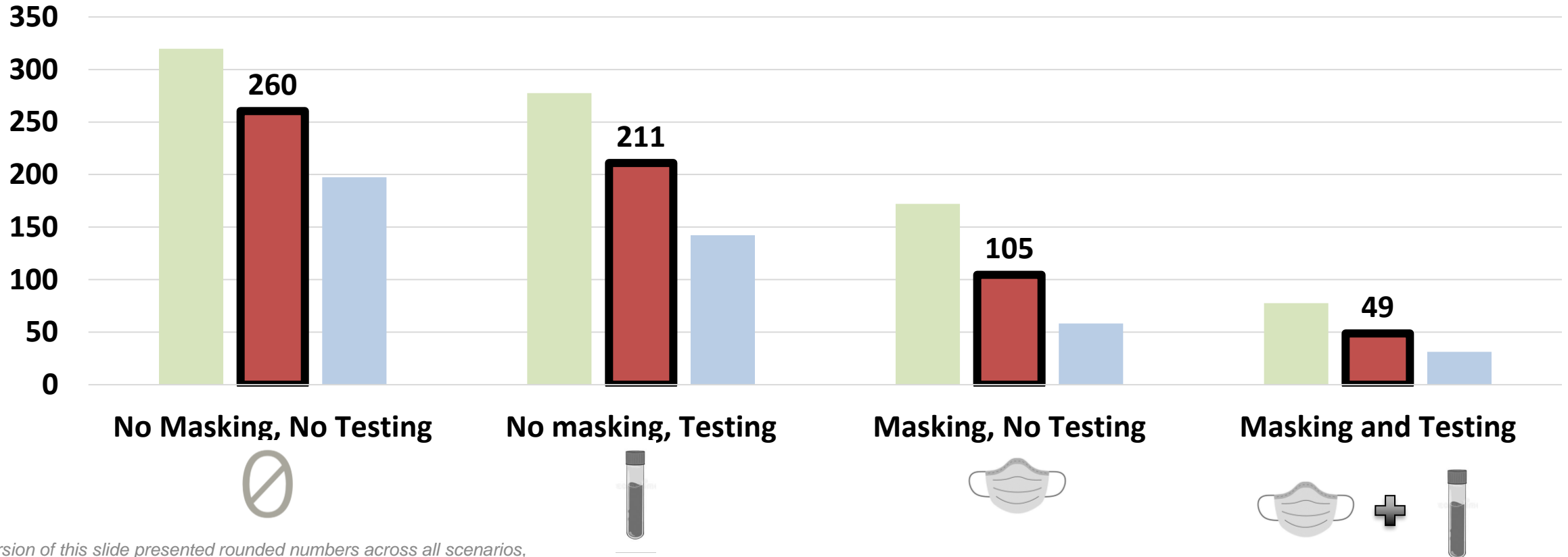
- Elementary School Setting (incoming protection = 30%)
- Middle School Setting (incoming protection = 40%)
- High School Setting (incoming protection = 50%)



A prior version of this slide presented rounded numbers across all scenarios, which have since been updated (08.24.2021) to be exact values

New Infections among 500 Students after 1 semester

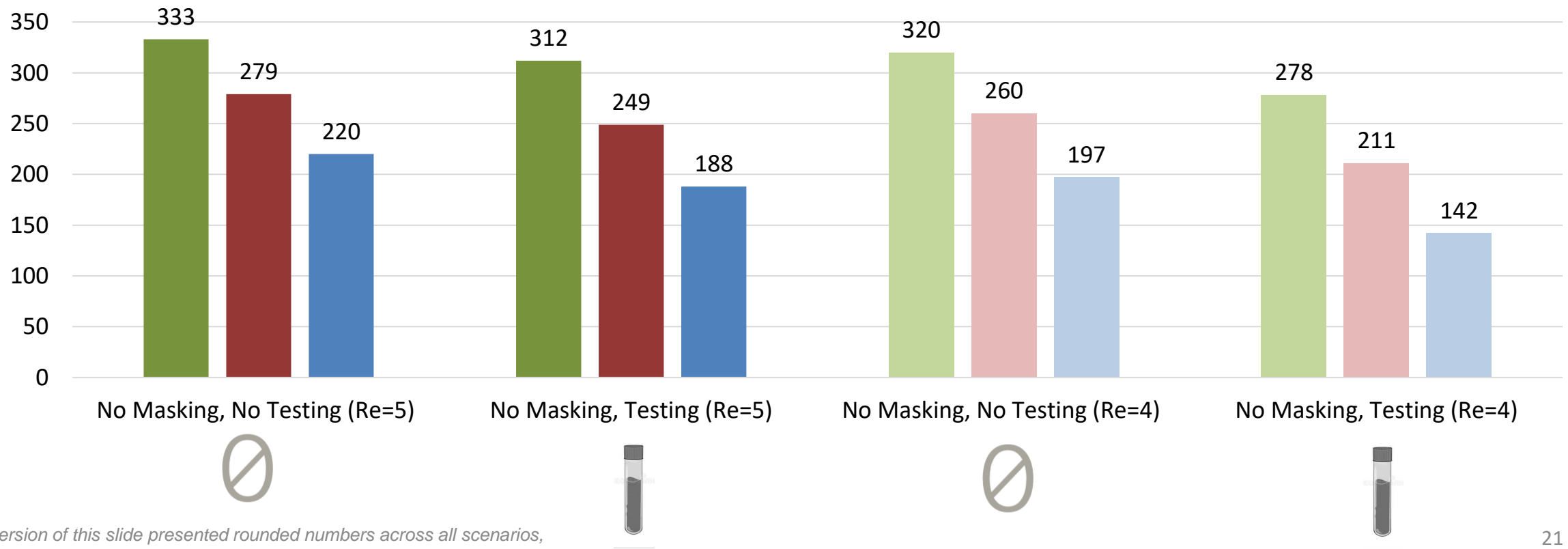
- Elementary School Setting (incoming protection = 30%)
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A prior version of this slide presented rounded numbers across all scenarios, which have since been updated (08.24.2021) to be exact values

New Infections among 500 Students after 1 semester ($Re = 5$ vs $Re = 4$)

- Elementary School Setting (incoming protection = 30%)
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- High School Setting (incoming protection = 50%)



A prior version of this slide presented rounded numbers across all scenarios, which have since been updated (08.24.2021) to be exact values

What does this all mean?

1. The Delta variant is *very* infectious; kids under 12 years old are not yet eligible for vaccines and therefore remain unprotected
2. Without masks or testing, up to 90% of susceptible students may become infected by the end of the semester (if only 30% have incoming protection)
3. Masks and testing, in combination, can prevent 40-70% of new infections (or more with high-quality, well-fitting masks)

Consequences may extend beyond the classroom and after the semester...

- Additional cases in the community--including among elderly grandparents and other family members--especially when community rates are already increasing ([Goldhaber, 2021](#))
- More infected students leads to more days of school absences, forcing caregivers to take time off work
- Multi-inflammatory syndrome or Long-Covid, which occurs among nearly half of students and can last up to 8 months ([Buonsenso, 2021a](#), [Buonsenso 2021b](#))

...and if school-based infections become too great, a return to virtual learning may follow

- Virtual learning is associated with...
 - Prolonged mental health concerns among students ([Golberstein, 2020](#))
 - Minimal or no learning gains ([Engzell, 2021](#))
- Recall: the risk of severe disease for COVID-19 *remains reduced* for those of younger ages, in the event they do become infected within school

The best place for K12 children this fall is the classroom: universal masking and routine testing can ensure that they and their families remain safe and that their learning journey can continue smoothly

For additional information, please visit covsim.hosted-wordpress.oit.ncsu.edu/ or write to us at covsim-team@ncsu.edu