COLLEGE OF MEDICINE TUCSON
Pathology

ARIZONA TELEMEDICINE PROGRAM

SOUTHWEST TELEHEALTH RESOURCE · CENTER TRC

Improving Access to Quality Medical Care Webinar Series

Presented by

The Arizona Telemedicine Program and Southwest Telehealth Resource Center

May 8, 2020 4PM Arizona (7PM EST)

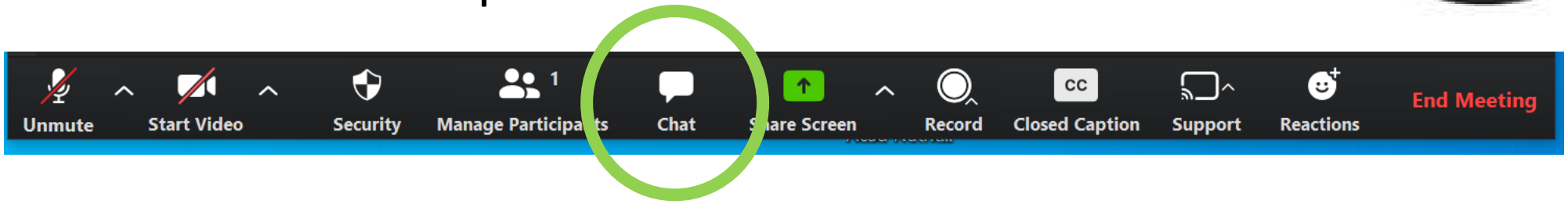

Welcome
SWTRC region - AZ, UT, CO, NM & NV
Fellow HRSA Telehealth Resource Centers
All other participants from the US & abroad

The **Arizona Telemedicine Program,** the **Southwest Telehealth Resource Center & UA's Department of Pathology** welcomes you to this free webinar. The practice & delivery of healthcare is changing, with an emphasis on **improving quality, safety, efficiency, & access to care**.

Telemedicine can help you achieve these goals!

Webinar Tips & Notes

- Mute your phone &/or computer microphone
- Time is reserved at the end for Q&A, please use the Chat function to ask questions



- Please fill out the post-webinar survey
- Webinar is being recorded
- Recordings will be posted on the SWTRC website

http://www.southwesttrc.org

“Understanding Your COVID-19 Test Results”

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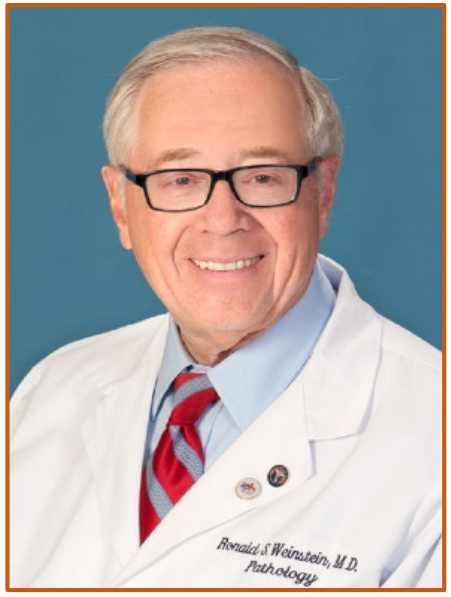

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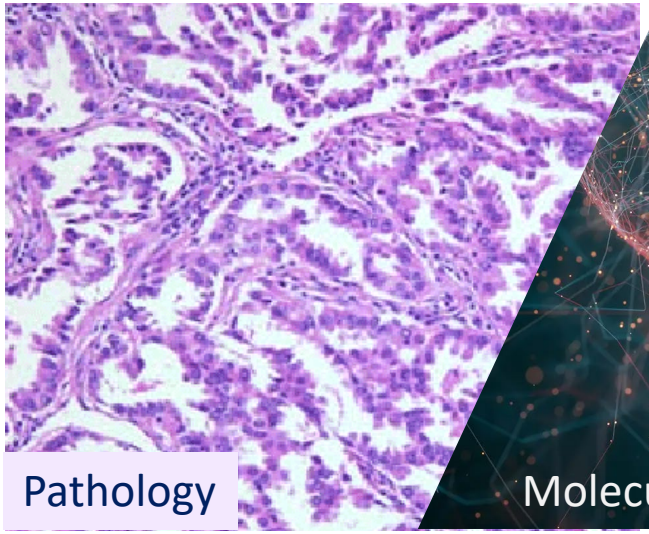
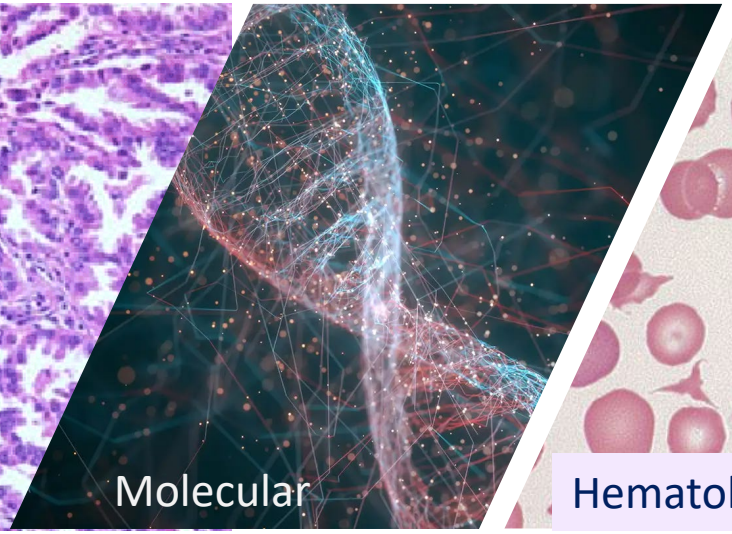
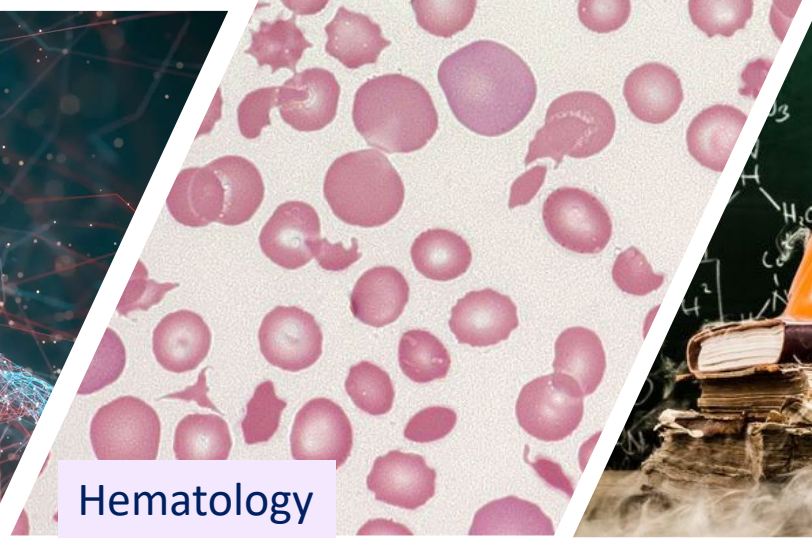


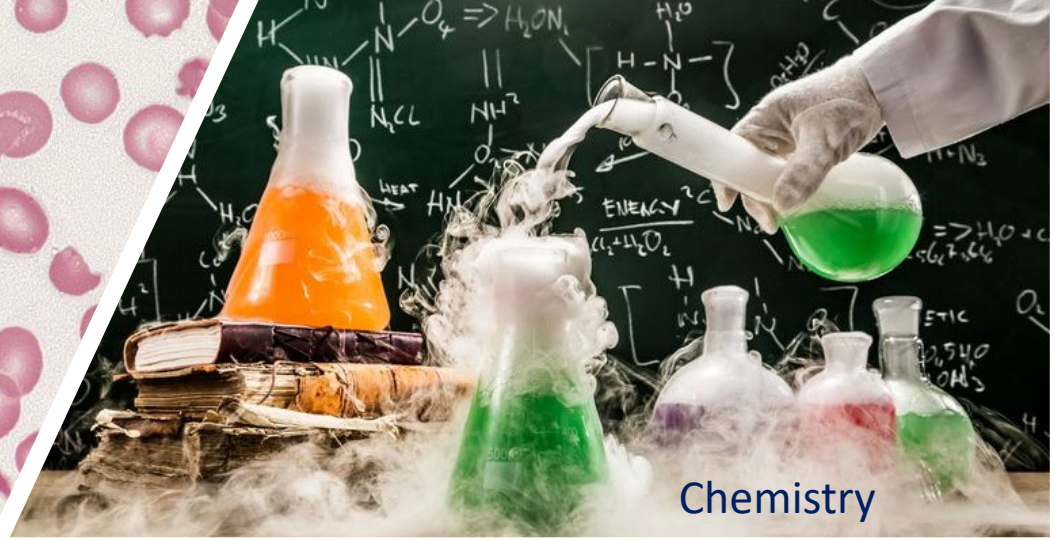
Pathology



Molecular

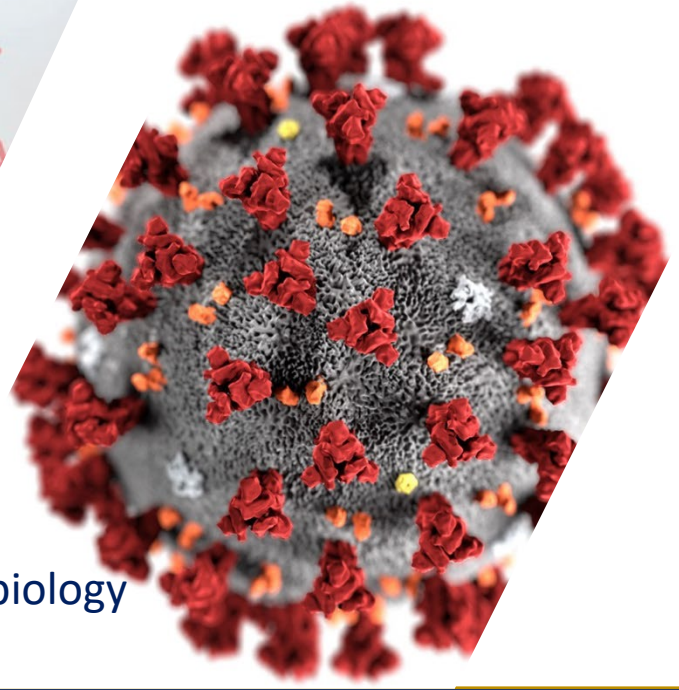


Hematology



Chemistry

Blood Bank
Transfusion Medicine



Microbiology

Lab Medicine

- **A major hub in the healthcare system**
- **Most treatment decisions are based on lab test results.**
- **Analysis of blood, saliva, NPS, urine, stools, and others and provide essential information to assess health, diagnosed disease and plan therapy.**
- **Adhere to rigorous quality control standards to assure accurate and consistent testing.**
- **Lab Medicine Team: highly trained physician, scientists, medical technologists, technicians, and others.**
- **Leaders in research and education.**

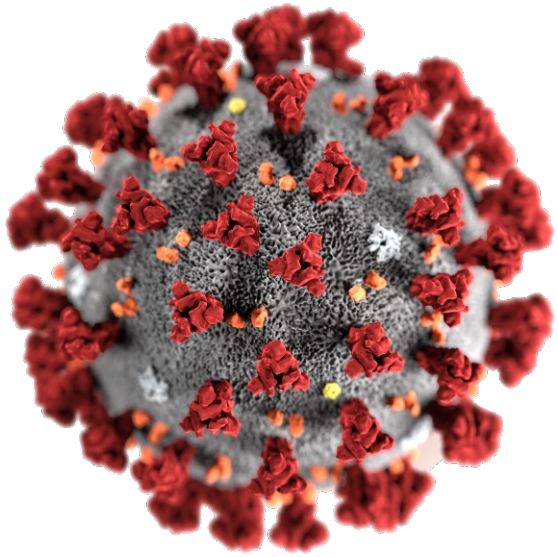
Learning objectives

- Understand the basic principles of testing for COVID-19
  - What tests are available?
  - How do they work?

- Interpret COVID-19 molecular and antibody tests
  - What do these tests tell us and our physicians?

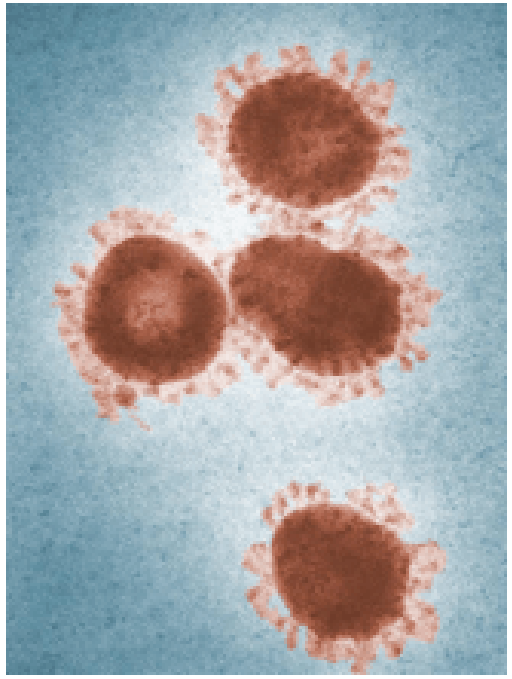
The opinions expressed in this presentation do not necessary represent those of my employer, or the entities that I represent

What is COVID-19?



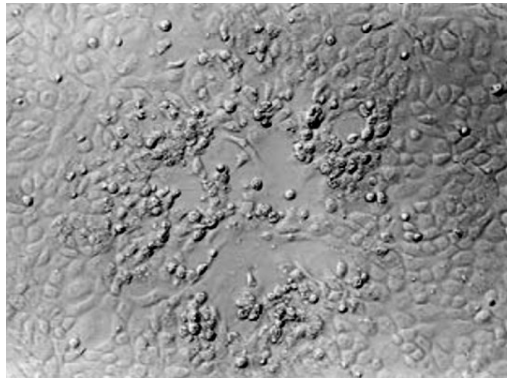
- COVID-19 stands for **CO**rona**VI**rus **D**isease 20**19**
  - COVID-19 is caused by infection with SARS-CoV-2

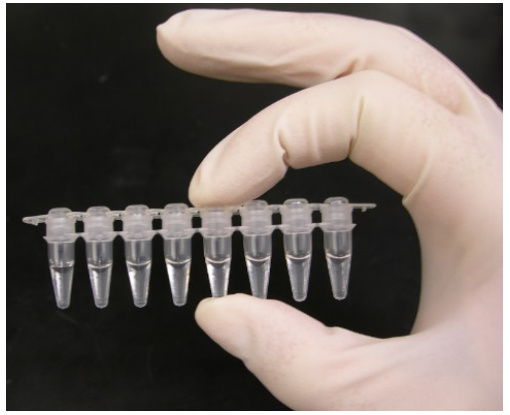
- **S**evere **A**cute **R**espiratory **S**yndrome **CO**rona**V**irus **2** (SARS-CoV-2) is a close relative of the SARS virus that emerged in Asia in the early 2000s
  - Both SARS and SARS-CoV-2 are closely related to coronaviruses that infect bats



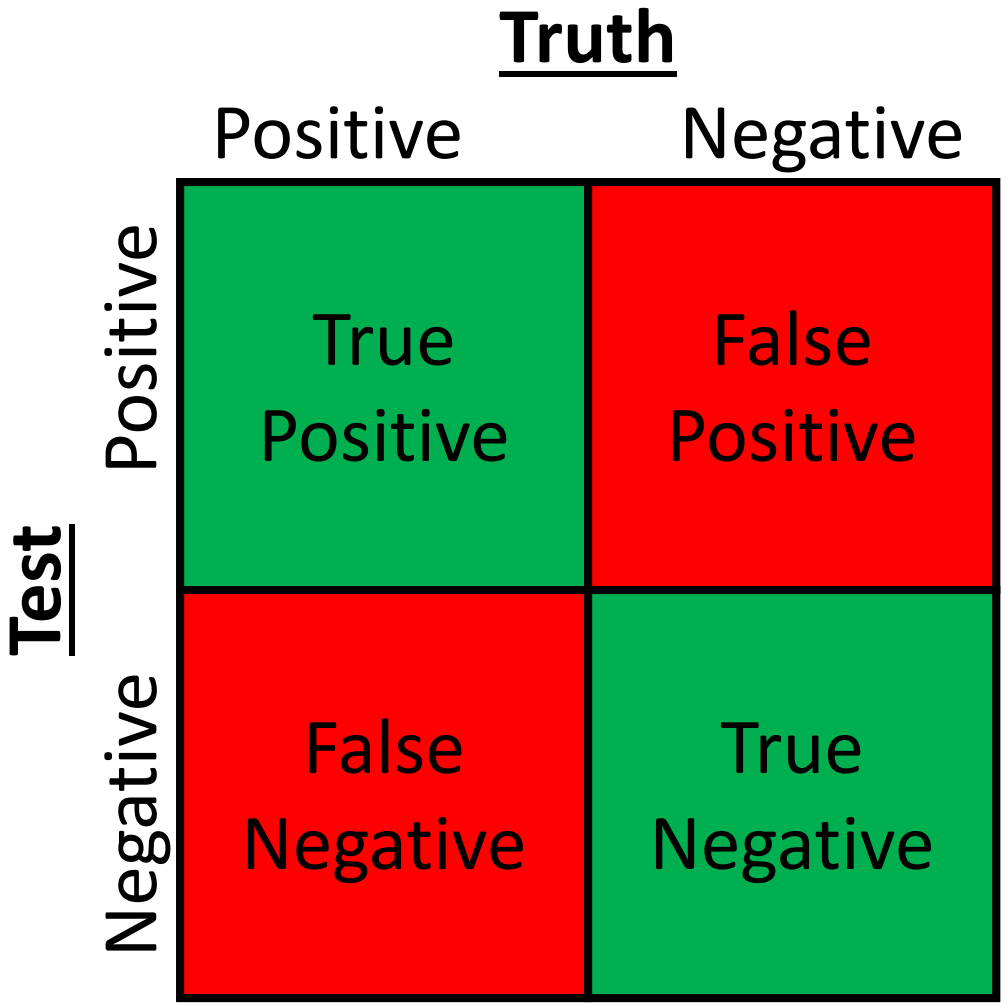
How do we normally detect respiratory viruses?

- Three common types of tests used:
  - Antigen detection
    - Must have an infection with lots of virus to detect
  - Culture
    - Can be risky, especially with very infectious viruses
    - Can identify multiple types of viruses in a single culture
  - Molecular tests, like Polymerase Chain Reaction (PCR)
    - Can detect low levels of virus
    - Some common viruses are closely related, need to evaluate for cross-reactivity
- Antibody testing is not commonly used for diagnosis of or determining exposure to respiratory viruses

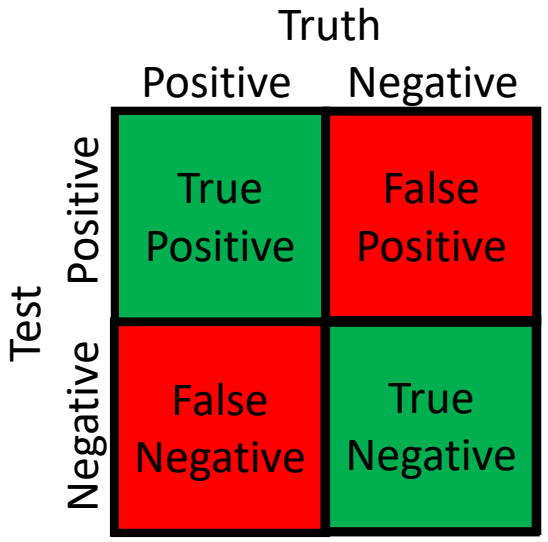




How is test performance measured?



How is test performance measured?



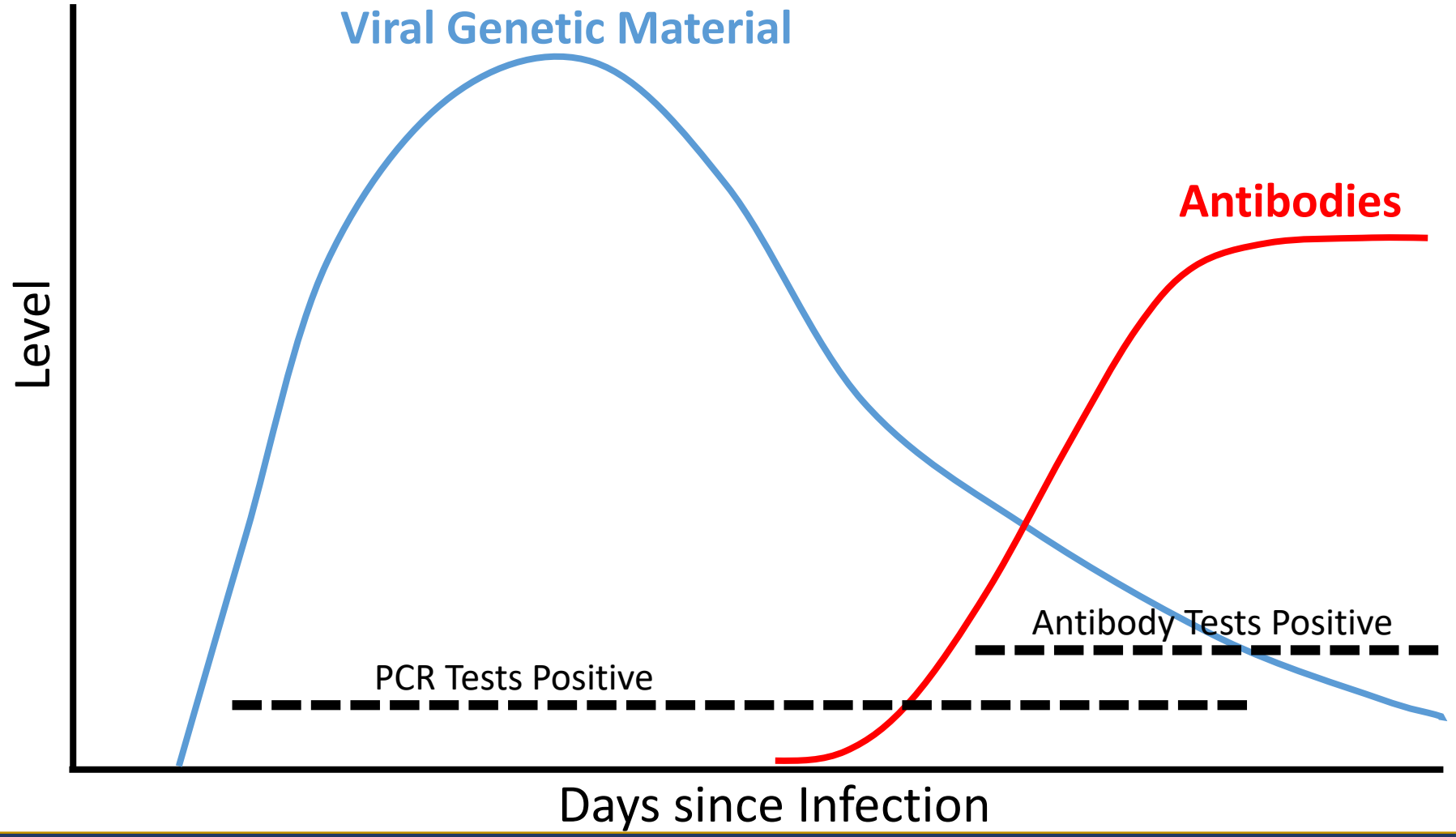
- Sensitivity
  - 100 people **with** an infection
  - If 94 test positive (**TRUE POSITIVE**), **Sensitivity = 94%**
  - Gives you an estimate of the **FALSE NEGATIVE** rate (100% - sensitivity = **6%**)
  - False negatives usually occur when the test cannot detect very low levels of virus

- Specificity
  - 100 people **without** an infection
  - If 98 test negative (**TRUE NEGATIVE**), **Specificity = 98%**
  - Gives you an estimate of the **FALSE POSITIVE** rate (100% - specificity = **2%**)
  - False positives usually occur when the test cross-reacts with other viruses

What diagnostic tests are available for SARS-CoV-2?

- Polymerase Chain Reaction (PCR)
  - Was developed within weeks of first cases
  - Very specific – do not need to worry much about cross-reactivity
  - Tends to be very sensitive as well
- Antibody testing
  - Has taken months to be developed
  - **Can be** specific, it is important to understand if there might be cross-reactivity
  - Sensitivity varies based on other factors. For example:
    - How long ago did the patient develop symptoms?
    - How old is the patient?
    - How severe is the infection?
    - Does the patient have the ability to produce antibodies?

Typical timeline of viral infection



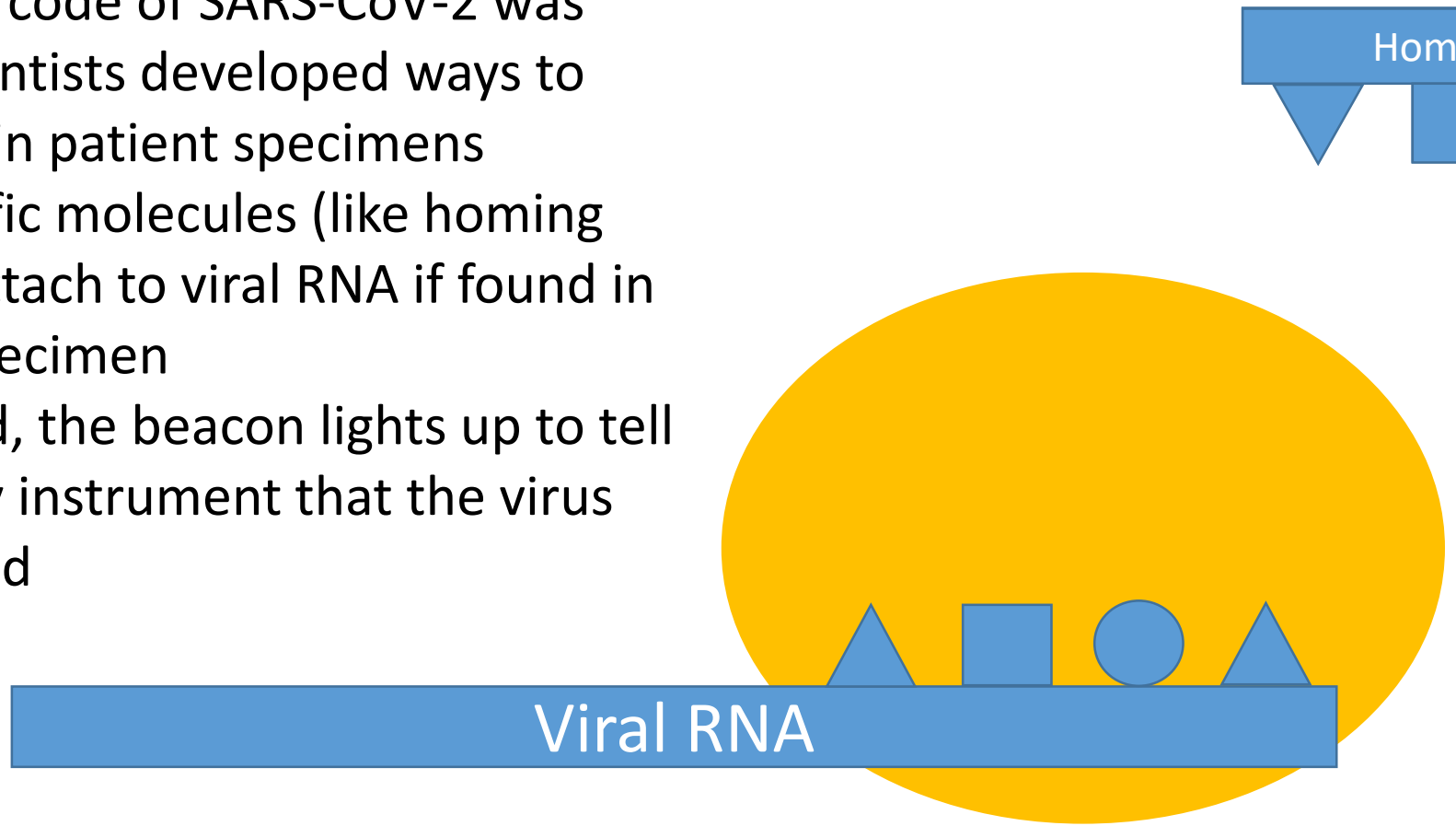
PCR for COVID-19

What is a molecular test? What is PCR?

- Detection of the genetic material of the virus
  - All viruses, bacteria, plants, fungi and animals have genetic material
  - Some have genetic material made only of **R**ibo**N**ucleic **A**cid (RNA), like the SARS-CoV-2 virus
  - Many have genetic material made from **D**eoxyribo**N**ucleic **A**cid (DNA), like humans
- Once the RNA code of SARS-CoV-2 was unlocked, scientists developed very specific molecules to target the SARS-CoV-2 RNA code
  - These molecules act like homing beacons to find the viral RNA in a patient specimen
  - Laboratory instruments amplify the signal of the homing beacons using PCR

How does this work?

- After the RNA code of SARS-CoV-2 was unlocked, scientists developed ways to find the virus in patient specimens
- Created specific molecules (like homing beacons) to attach to viral RNA if found in the patient specimen
- Once attached, the beacon lights up to tell the laboratory instrument that the virus has been found



Understanding PCR testing results

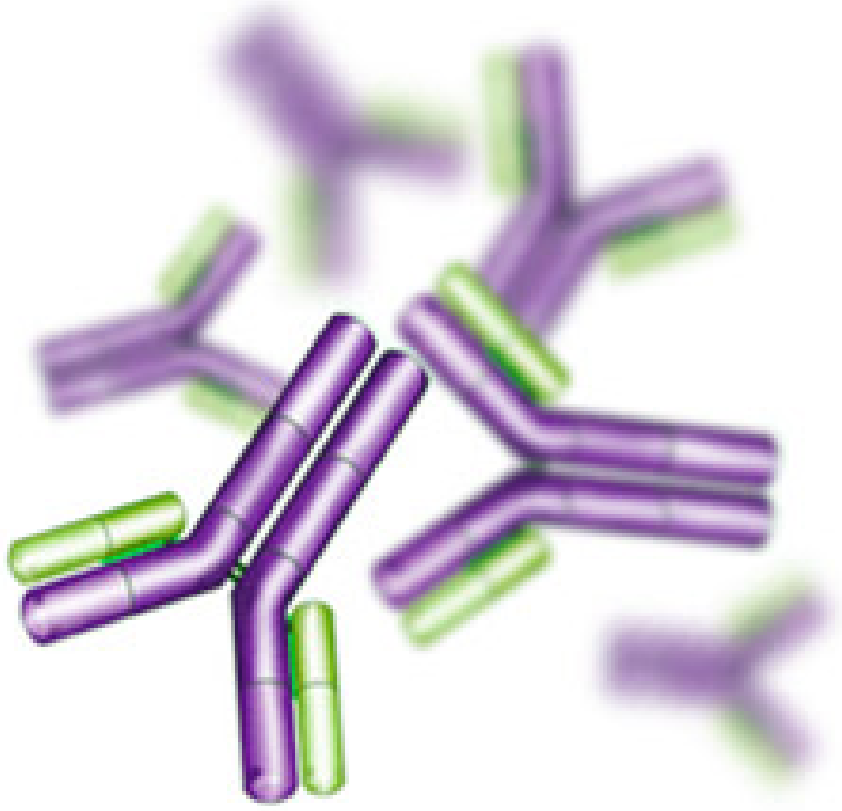
- Positive/Detected
  - SARS-CoV-2 RNA found in your specimen
  - What does this mean?
    - You have COVID-19.

- Negative/Not Detected
  - No SARS-CoV-2 RNA found in your specimen
  - What does this mean if I have symptoms of COVID-19?
    - You could have a different respiratory infection, **OR**
    - You could have COVID-19, and the result is a false negative
    - Potential cause of false negatives – not enough or no virus in the specimen

Understanding PCR testing results

- Inconclusive/Presumptive Positive
  - *Not all assays use this result*
  - Some tests use multiple viral RNA “homing beacons” – this is the result if not all homing beacons find their target
  - What does this mean?
    - You may have very low levels of virus in your specimen, **OR**
    - This could be a false positive result
  - A new specimen should be collected and you should be retested
- Invalid
  - What does this mean?
    - Specimen was not correctly collected, **OR**
    - There are substances in the specimen preventing the PCR test from working properly
  - A new specimen should be collected and you should be retested

Antibody testing for COVID-19



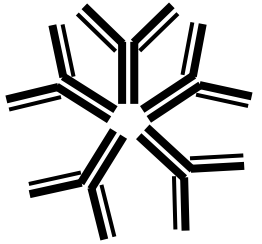
What is an antibody?

- Antibodies are part of your immune system's normal defense
  - Proteins developed by cells in your body
  - Can help to fight off current and future infections
  - Can be used as a marker of exposure/infection with a virus

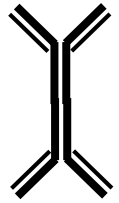
- There are multiple types (or isotypes) of antibodies
  - Each has a different function
  - Each can be found in different parts of your body
  - Each is developed at different times during infection

Immunoglobulin isotypes

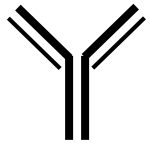
- Immunoglobulin isotype M (IgM)
  - Typically the first type of antibodies produced
  - Helpful to fight new infections
  - Found in blood and lymphatics



- Immunoglobulin isotype A (IgA)
  - Produced early in infection
  - Found on mucosal surfaces (respiratory tract, digestive system, in saliva, tears, breastmilk)

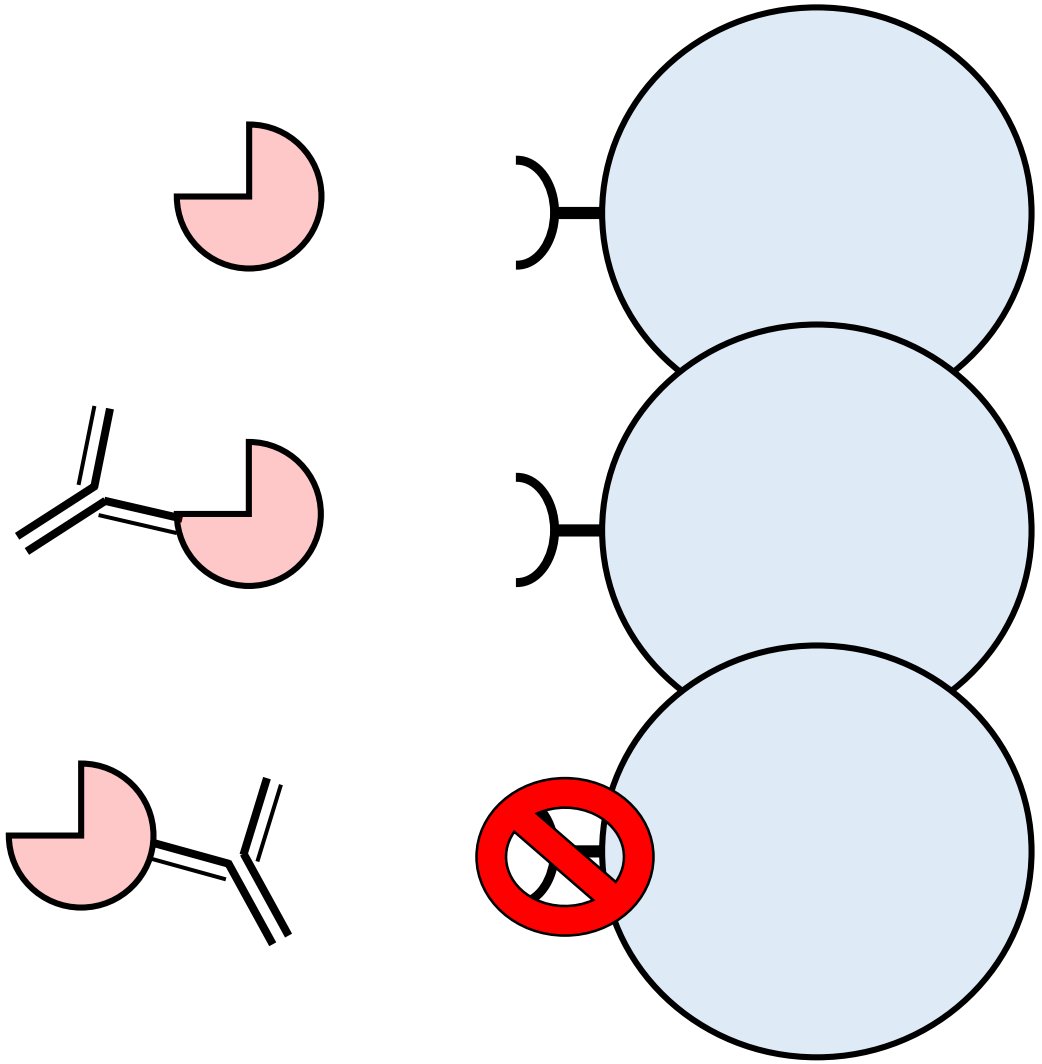


- Immunoglobulin isotype G (IgG) – most common antibody
  - Produced later in infection
  - Found in blood and body fluids
  - Can be protective against future bacterial and viral infections

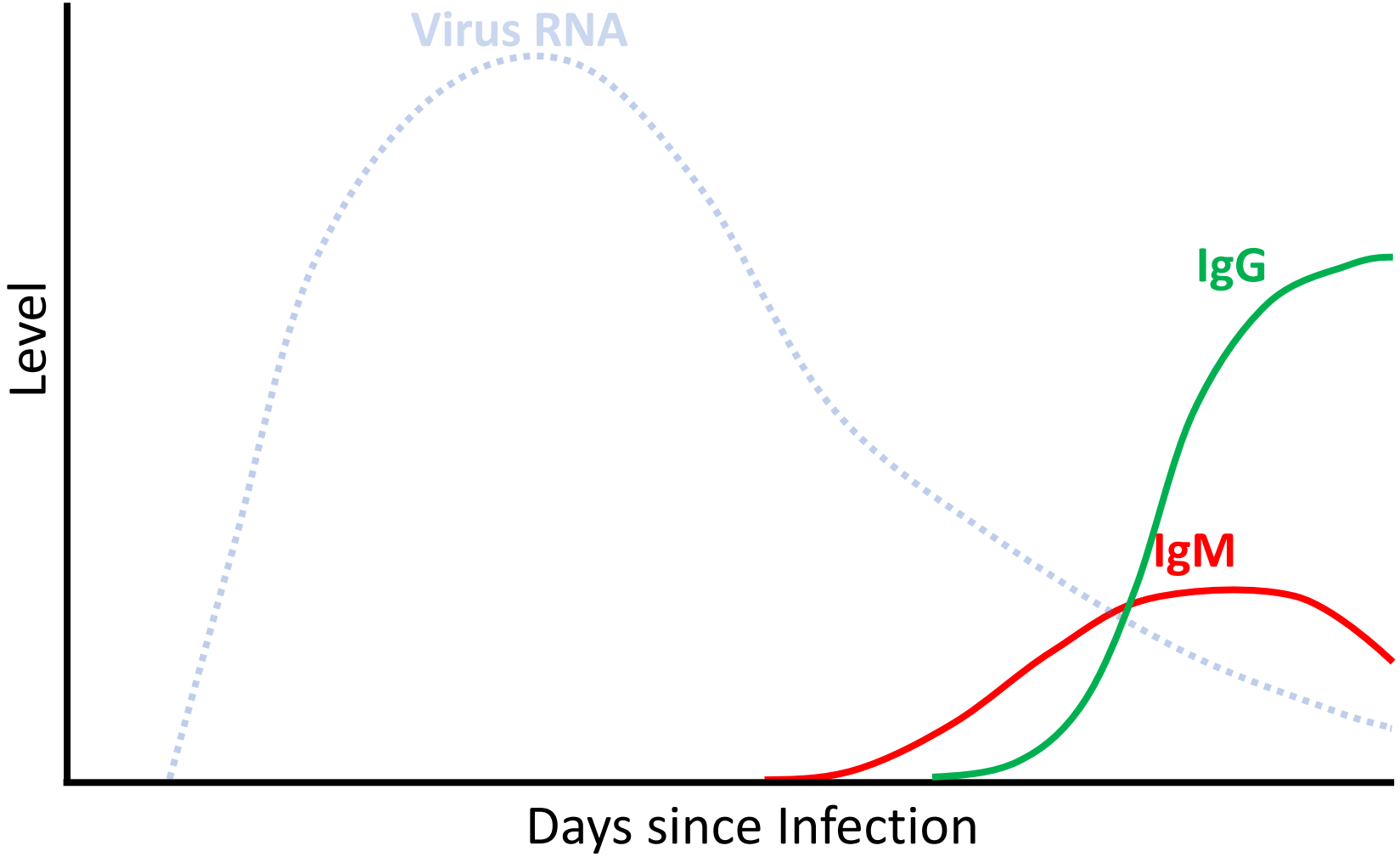


What is a neutralizing antibody?

- This is a topic commonly discussed in the media
- Neutralizing antibodies attach to a virus and prevent it from infecting again
  - Presence of neutralizing antibodies can help determine if you are “immune” to a future infection with a virus
- How do these work?



Timing of antibody development during infection



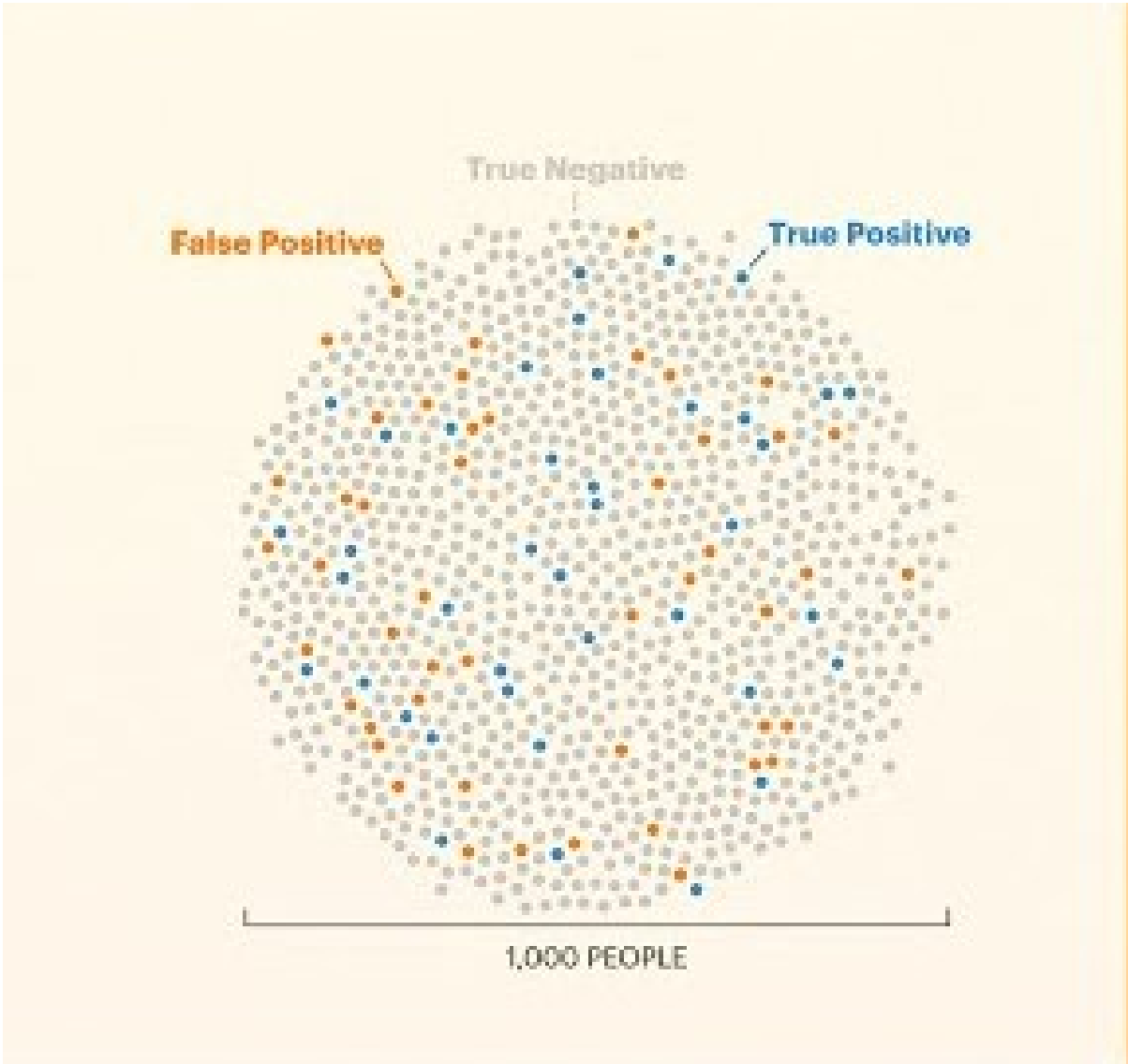
Types of antibody tests available

- Total antibody tests
  - These detect all types of antibodies for a virus
  - Do not tell you whether you have IgM, IgG, or IgA
  - Questions about current *vs*. past exposure to the virus
- Isotype-specific tests
  - Can tell you if you have IgM, IgG, or IgA antibodies for a virus
  - Depends on the isotype the test looks for
- Not all tests created equally
  - There are lots of potential antibody targets for SARS-CoV-2
  - Not all SARS-CoV-2 antibodies are neutralizing antibodies

Understanding antibody testing results

- Positive
  - Total antibody test
    - You have been exposed to the virus, you might be currently infected with the virus
  - Isotype-specific test
    - IgM/IgA – you could be currently infected with the virus
    - IgG – you have been exposed to the virus at some point in the past
  - Could be a false positive result – is the test known to cross-react with other viruses?
- Negative
  - No antibodies detected
  - Could be a false negative – how long ago did you have symptoms? Was your illness severe? Can you make antibodies?
- Equivocal
  - Your antibody levels are elevated, but not high enough to be considered positive
  - Could be low level positive – perhaps you should re-test in a week or 2 weeks
  - Could be a false positive due to a cross-reaction with something else

My antibody test is positive, what does that mean?



Important take-home points

- Different tests provide us with different pieces of the puzzle
  - Some tests are diagnostic – tell you whether you are currently infected
  - Some tests are non-diagnostic – may only tell you whether you have ever been exposed/infected, but not when
- Interpretation of testing depends on context
  - Molecular tests tend to be much more accurate that antibody tests, even when not many people are infected
- **Positive antibody testing =/= immunity**
  - We still have many questions about this
    - Will we have any type of lasting immunity?
    - If so, will that be short-term or long-term, and will it require a yearly vaccination booster to maintain?

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