USET COVID-19 ECHO

May 1, 2020

Because there is Strength in Unity

Nashville Area COVID-19 Epidemiology

33 Sites Reporting		
Number Tested	Number Positive	Number Negative
2051 (1289)	151 (69)	1593 (1101)

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Laboratory Testing for COVID-19

USET TEC ECHO Presentation

May 1, 2020

Harry J Brown, MD

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Today's Talk

- Sensitivity and Specificity
- FDA Emergency Use Authorization
- Molecular Testing
- Abbott ID NOW
- Antibody Testing
- What's on the Horizon
- What should we be doing?

Sensitivity and Specificity

	Disease *Positive*	Disease *Negative*
Test *Positive*	**True Positives**	**False Positives**
Test *Negative*	**False Negatives**	**True Negatives**
	TP+FN	TN+FP

Sensitivity

	Disease *Positive*	Disease *Negative*
Test *Positive*	**True Positives**	**False Positives**
Test *Negative*	**False Negatives**	**True Negatives**
	TP+FN	TN+FP

Sensitivity is a measure of a test's ability to detect people who have a disease

Defined as: $\frac{\text{True Positives}}{\text{True Positives + False Negatives}}$

SNOUT – **S**e**N**sitive test with **N**egative result rules **OUT** disease

Desirable to have a highly sensitive SCREENING test (few false negatives)

Specificity

	Disease *Positive*	Disease *Negative*
Test *Positive*	**True Positives**	**False Positives**
Test *Negative*	**False Negatives**	**True Negatives**
	TP+FN	TN+FP

Specificity is a measure of a test's ability to detect people who DO NOT have a disease

Defined as: $\frac{\text{True Negatives}}{\text{True Negatives + False Positives}}$

SPIN – **SP**ecific test with **P**ositive result rules **IN** disease

Desirable to have a highly specific DIAGNOSTIC test (few false positives)

FDA Emergency Use Authorization (EUA)

- Not the same as full FDA approval
- Can only be issued during a declared Public Health Emergency that has been authorized by the Secretary of Health and Human Services
- Only valid during the period of emergency
- FDA does a risk vs. benefit analysis to determine if new product is most likely safe and effective

Tests for SARS-CoV-2/COVID-19 and Potential Uses

Type of Test	Measure	Value	Beneficiary
Nucleic acid amplification test for viral RNA *(nasopharyngeal swab, oropharyngeal swab, sputum, bronchoalveolar lavage fluid, others)*	Current infection with SARS-CoV-2	• Inform individual of infection status so they can anticipate course of illness and take action to prevent transmission • Inform patient management and actions needed to prevent transmission • Inform actions needed to prevent transmission	• Individual • Healthcare or long-term care facility • Public health
Antibody detection	Past exposure to SARS-CoV-2	• Detect susceptible individuals (antibody negative) and those previously infected • Identify individuals with neutralizing antibodies • Facilitate contact tracing and surveillance	• Identify those potentially immune to SARS-CoV-2 (if tests can detect protective immunity, individuals could be returned to work) • Healthcare facilities: Experimental therapy • Public health

Robin Patel et al. mBio 2020; doi:10.1128/mBio.00722-20

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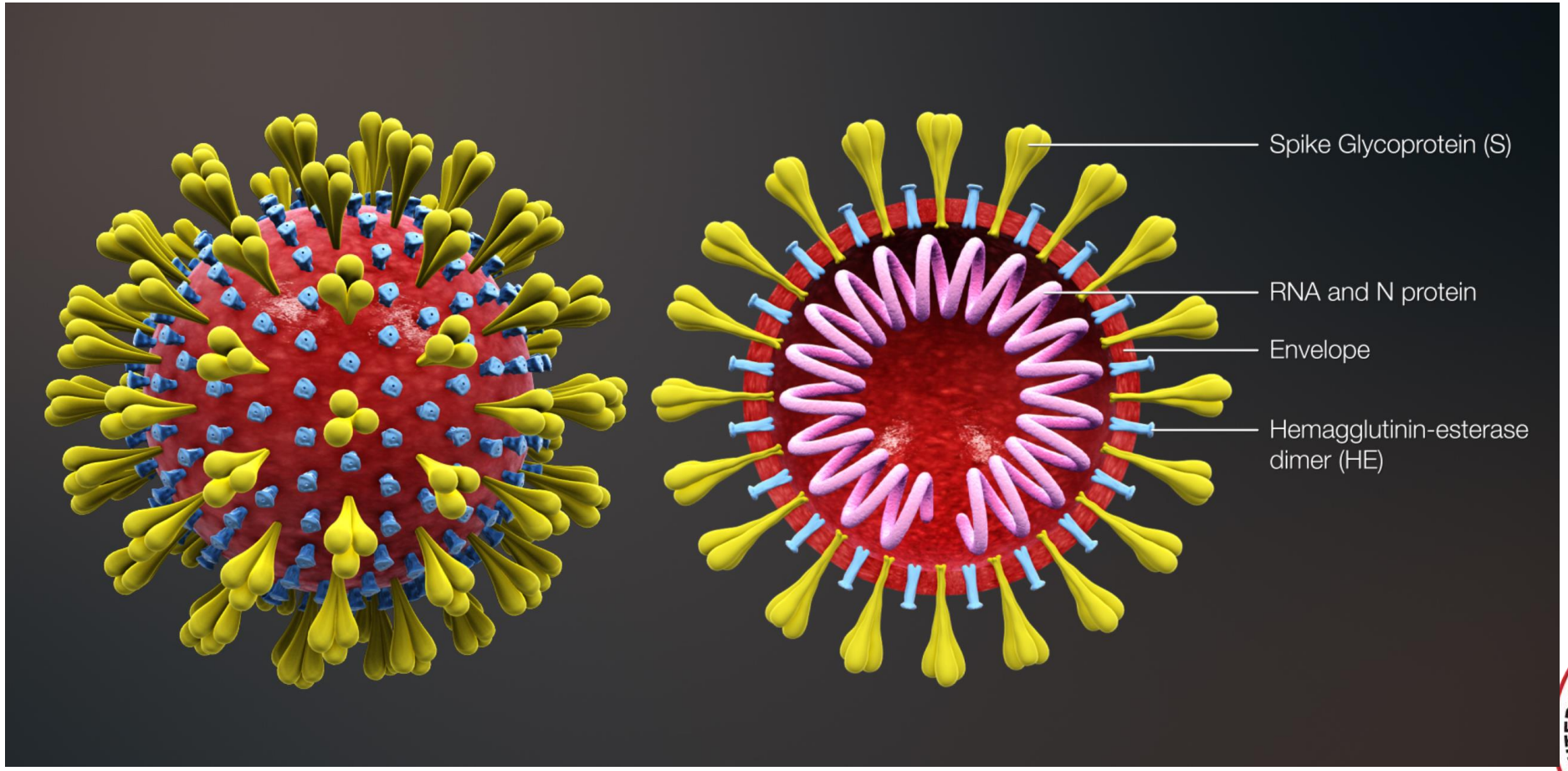
Molecular Testing

When it comes to COVID-19, these are all names for testing for the presence of virus:

- Molecular Testing
- Nucleic Acid Amplification Test
- PCR – Polymerase Chain Reaction (RT-PCR)
- RNA Test
- Viral Particle Test
- Viral Nucleic Acid Test

SARS-CoV-2 Structure



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What is PCR?

- Polymerase Chain Reaction is a Nucleic Acid Amplification process
- PCR is a method to identify a specific gene or genes
- RT-PCR is used for RNA viruses
- Usually requires expensive equipment and a sophisticated laboratory to perform
- Usually takes 2 to 8 hours to perform the test because of multiple thermal cycles

PCR Sensitivity and Specificity

- PCR has good sensitivity and specificity when performed correctly
- The actual sensitivity/specificity is unknown, because there isn't really a "gold standard"
- Sensitivity of the test (ability to find infected people) suffers mainly due to (1) low numbers of viral particles in the sample, (2) poor sampling technique, or (3) storage and transportation of the specimen

CLIA-Waived Molecular Tests

- There are currently 3 “CLIA-Waived” NAATs with EUA:

1) Cephid Xpert Xpress
2) Abbott ID NOW
3) Mesa Biotech Accula

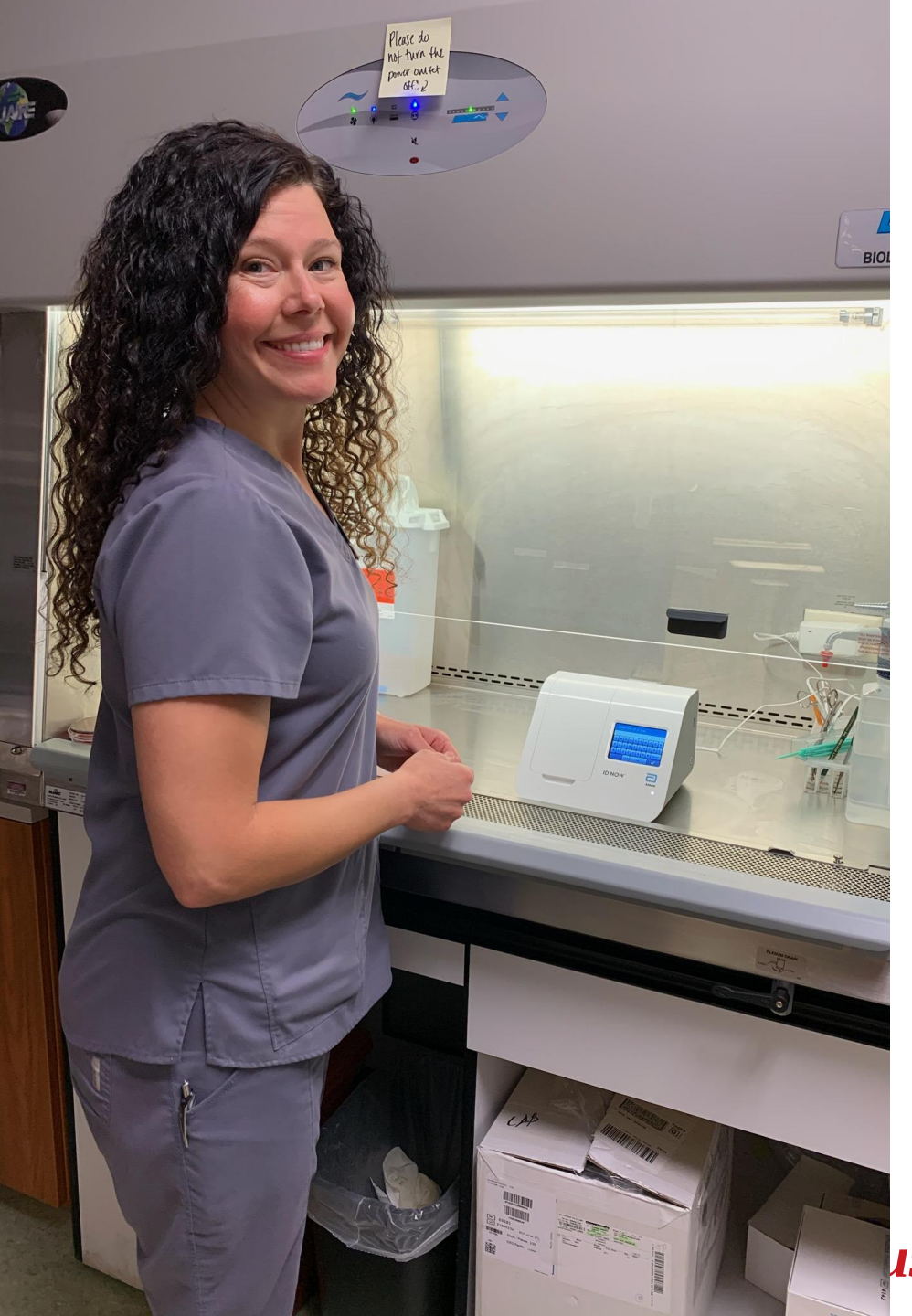
All use faster technology than usual PCR, but basic principle is the same

All claim high sensitivity and specificity

Only Accula was actually tested for cross reactivity

Abbott ID NOW Instrument

- Rapid test that looks for unique piece of viral nucleic acid (region of RdRp gene)
- Isothermal process technology has been used for RSV, influenza, and Group A strep
- Current test cartridges limited
- Sensitivity, specificity is UNKNOWN
- NOT RECOMMENDED for mass screening at this time



Abbott ID NOW Covid-19

- Positive test in as little as 5 minutes
- Negative test in about 13 minutes
- Swab should NOT be put into saline or viral transport media
- High specificity, unknown sensitivity
- LOD (Limit of Detection) 125 copies/mL

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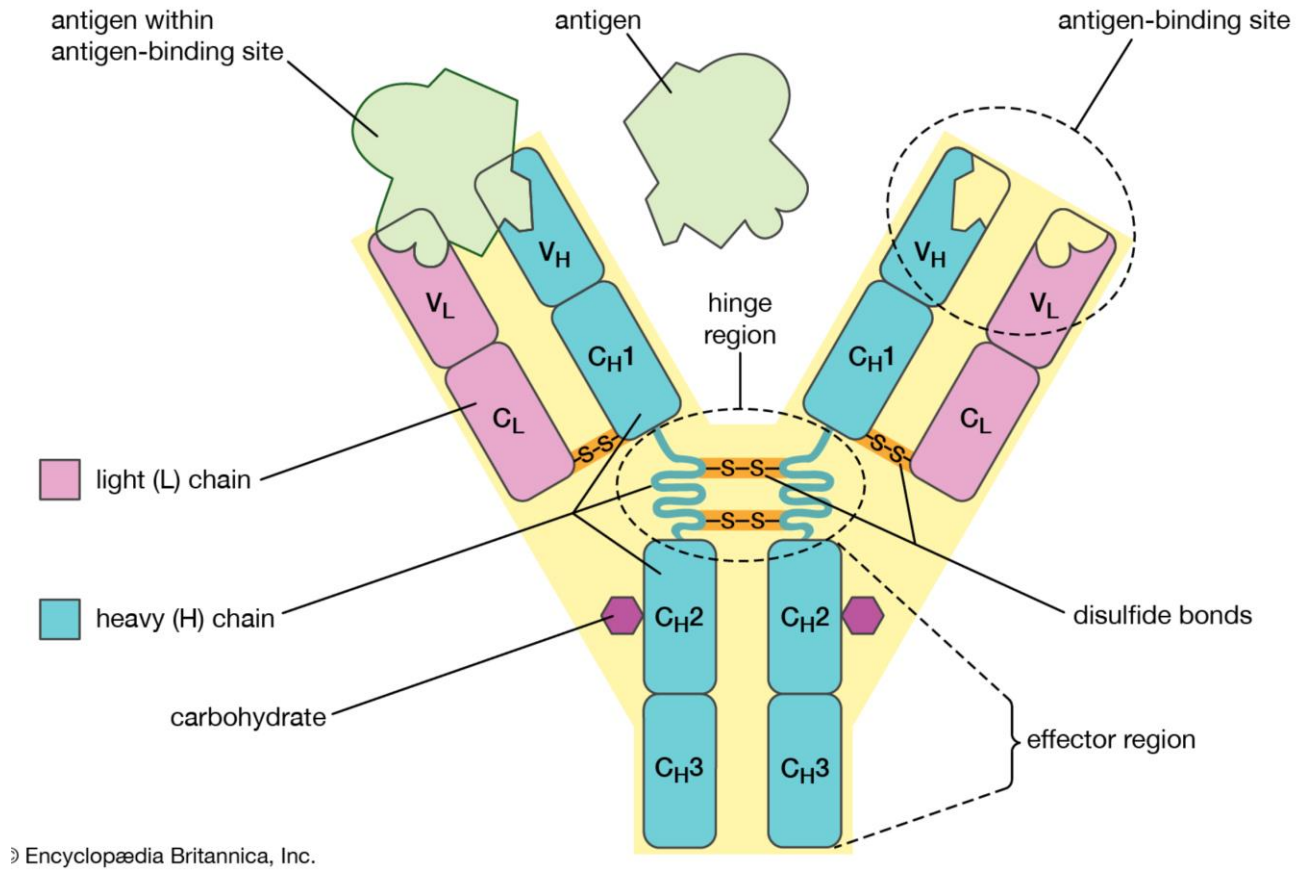
A Brief Review of Immunology

- The body makes antibodies in response to antigens
- Antibodies then bind to antigens to assist in an immune response to get rid of infections or other antigens
- Sometimes antibodies confer immunity, sometimes they do not



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Antibody Testing

- Also known as serology, immunoassay
- Tests for antibodies to SARS-CoV-2
- Not really useful for diagnosing acute infection (may be some situations that it would help)
- Currently is the Wild West
- What is the utility of Ab testing?
  - A positive test means that someone was infected
  - High titers during infection correlate with severity
  - A negative test probably means the person was not infected

Current Antibody Tests with EUA

Company- Test	Type	Antibody (Antigen)	Sens / Spec	Cross Reactivity?
Cellex qRapid Test	Lateral Flow IA	IgM, IgG	94% / 96%	Tested – number not specified
Chembio DPP	Lateral Flow IA	IgM, IgG (Nucleocapsid)	IgM: 77% / 98% IgG: 87% / 93%	Cross reactive with some HCoV
Ortho VITROS	Chemiluminescence ImmunoAssay	Total Ab (Spike)	83% / 100%	Not tested against HCoV
Mt Sinai Lab	ELISA	IgG (Spike)	92% / 100%	Not tested against HCoV

Current Antibody Tests with EUA

Company- Test	Type	Antibody (Antigen)	Sens / Spec	Cross Reactivity?
Autobio Diagnostics Rapid Test	Lateral Flow IA	IgM, IgG (Spike)	IgM: 85% / 99% IgG: 86% / 99%	Tested against HCoV Negative for CR
Ortho VITROS	Chemiluminescence Immunoassay	IgG (Spike)	88% / 100%	Not tested against HCoV
DiaSorin LIAISON	Chemiluminescence Immunoassay	IgG (Spike 1 & 2)	98% (>14 days) / 99%	Tested against HCoV Negative for CR
Abbott Architect	Chemiluminescent Microparticle IA	IgG (Nucleocapsid)	100% (>14 days) / 99%	Not tested against HCoV
BioRad Platelia	ELISA	Total Ab (Nucleocapsid)	92% / 99%	Tested against HCoV Negative for CR

What's on the Horizon?

- Many more molecular and serological tests
- Rapid Antigen Tests
  - Several currently in development (at least 5)
  - Could be great clinical help
  - Sensitivity and Specificity may be lacking

Conclusions

- Right specimen, right time
  - Nasopharyngeal first week, lower resp after first week
- Not all tests are created equal
  - Buyer beware
- Molecular testing for acute infections (for now)
- Antibody tests may be helpful for epidemiology
- Much unknown
  - Does positive serology equal immunity?