

Diagnostic Tests in COVID-19

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LEARNING OBJECTIVES

At the end of this lecture, the learner will be able to:

1. Recognize features on diagnostic testing suggestive of COVID19 infection
2. Recognize features on diagnostic testing that suggest a patient may need a higher level of care
3. Understand how to use risk score calculators such as the 4c score for prognosticating patients with COVID-19

LECTURE OVERVIEW

- I. General principles
- II. Definitive COVID-19 diagnostics
- III. Additional lab tests in COVID-19
- IV. Electrocardiograms
- V. Risk scores for prognostication in covid-19

I. GENERAL PRINCIPLES

1. Clinical status is more important in initial evaluation and management
 - If the patient looks ill, the patient is ill regardless of labs
2. Know what testing is available in your hospital system
 - If a test will take several days or weeks to result, it may not be clinically useful
 - If a test is very expensive, determine if the test is clinically useful before ordering it

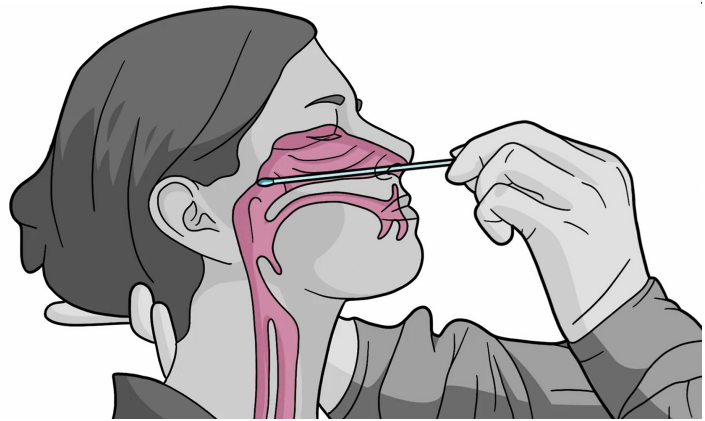
II. DEFINITIVE COVID-19 DIAGNOSTICS

1. Testing and time until results available will vary based on local availability

2. Be aware of your institutional testing protocols

3. PCR tests

- Test for the RNA of SARS-CoV2 viral particles
- There are also similar NAAT (Nucleic Acid Amplification Tests) that also look for genetic material of the virus but are cheaper and faster
- Very specific for COVID-19: if test is positive, confirms patient has viral particles causing COVID-19
- Tests can be less sensitive if swab not obtained properly
 - ◊ Must have clear, consistent approach to how to obtain the test
 - ◊ Follow your hospital's protocol, or the test instructions for your specific test
- Nasopharyngeal swab
 - ◊ Insert swab to posterior oropharynx, leave in place for 10 seconds, rotate swab, remove swab
 - ◊ Video: [Nasal Swab](#)
- Oral swabs
 - ◊ Video: [Oral Swab](#)
- Patients should be assumed to be COVID-19 positive until the PCR test results.
- Repeat tests may be needed depending on clinical suspicion or to determine when isolation protocols can be stopped.



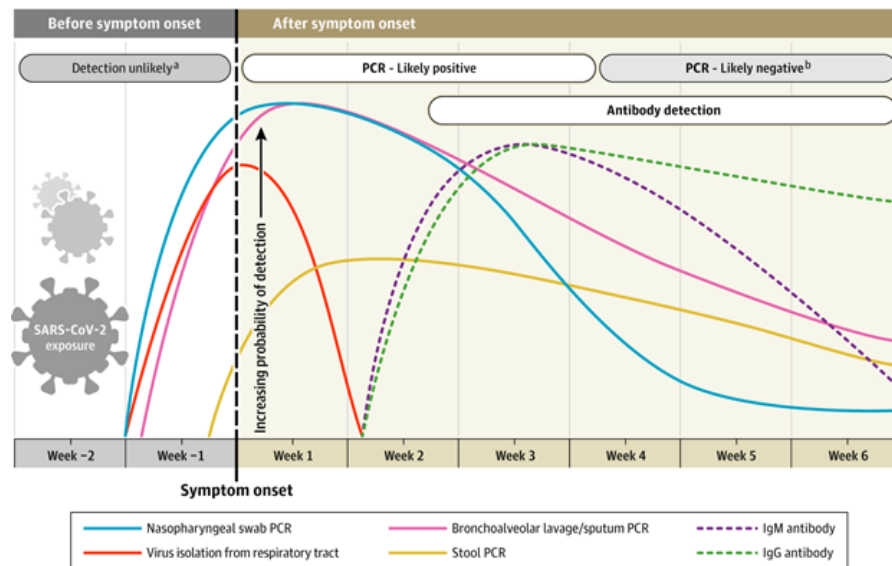
4. Antigen tests

- Tests for presence of viral proteins
- Easy to use, can be performed at home without training in laboratory techniques
- Are often less sensitive than PCR

5. Antibody tests

- Test for serum antibodies to Sars-CoV-2 proteins
- Positive tests indicate prior infection with COVID-19 or vaccination
- Need to ensure test is specific to COVID-19 given prevalence of other coronaviruses

- IgM initial antibody to appear, approximately 1-2 weeks after infection, and lasts for up to 7 weeks
- IgG antibodies appear after several weeks and can last several months
- Although less common, it is possible to become infected with covid-19 after previous infection or vaccination
 - ◊ If a healthcare worker has antibodies to COVID-19, that person should still use appropriate personal protective equipment



III. ADDITIONAL LAB TESTS IN COVID-19

1. Other infections

- Other common causes of fever can still be present, even during a pandemic
 - ◊ Remember other infections common to your area: If malaria, dengue, TB, or HIV are common, consider testing for these infections
 - ◊ Consider other causes of fever depending on symptoms/exam
 - a. Appendicitis, cholecystitis, urinary tract infection, bacterial pneumonia, etc
- Respiratory viral studies to evaluate for co-infection
 - ◊ Infection with one respiratory virus (such as influenza) does not rule out COVID19 infection
- Lower respiratory cultures
 - ◊ Warning: induced sputum samples create aerosolized particles. Avoid if possible.

- ◊ Consider bacterial pneumonia or superinfection, especially in intubated patients
- ◊ Depending on your hospital protocol, sputum samples from an endotracheal tube aspirate can be tested for COVID

2. Arterial blood gas (ABG)

- Most common finding: hypoxemia
- Common: Metabolic acidosis from shock and hypotension
- Consider a mixed acid-base disorder if ABG shows a normal pH but abnormal carbon dioxide (CO_2) and HCO_3^- (bicarbonate)
- Evidence of CO_2 retention is usually not related to COVID-19 infection
 - ◊ Consider an alternate diagnosis

3. Lactic acid

- Often elevated as a sign of poor tissue perfusion and oxygenation

4. Blood tests associated with markers of severe disease

- Glucose
- **Pregnancy test** should be performed in **all women** of child-bearing age
 - ◊ pregnancy has been associated with more severe COVID-19 disease
- Renal function, electrolytes:
 - ◊ Evaluate for kidney injury, electrolyte derangements
 - ◊ Dehydration is common
- Markers of severe disease
- These abnormalities are associated with poor clinical prognosis
 - ◊ Consider admitting to a ward with closer monitoring or to the intensive care unit
- CBC: lymphopenia – absolute lymphocyte count < 0.8 billion/L
- D dimer $> 1000\text{ng/mL}$
- Ferritin $> 300\text{ug/L}$
- CRP $> 125\text{ mg/L}$
- ESR $> 20\text{ mm/hr}$
- LDH $> 245\text{ U/L}$
- Elevated cardiac markers (Troponin, CK-MB) if any anginal concern
- Creatine kinase $> 2\text{x}$ upper limit of normal
- Procalcitonin

- ◊ Poor prognostic sign or can indicate secondary bacterial infection
 - Liver function tests: elevated transaminases
 - Coagulation studies: PTT, INR, fibrinogen
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IV. CARDIAC MONITORING

1. Electrocardiogram (ECG)
 - Often sinus tachycardia
 - Monitor for signs of electrolyte derangements
 - Monitor intervals - many medications prolong QTc
 - ECG can also change in myocarditis or acute coronary syndrome, both of which have been associated with COVID-19
 2. Cardiac monitoring, if available, while in the hospital
 - Arrhythmias common
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V. Risk score calculators

1. Many risk score calculators exist, however, many are not well studied or validated
2. Most require combination of vitals, past medical history laboratory values
3. NEVER use these scores in isolation as your clinical judgement is most important. If the patient appears sick or has unstable vital signs, that is more important than any risk score or individual lab abnormality.
4. Most validated score to date is 4 C score, which predicts in-hospital mortality. You can access this score online, at websites such as <https://www.mdcalc.com/4c-mortality-score-covid-19>. This score includes some laboratory values:

Age, years	<50 0	50-59 +2	60-69 +4	70-79 +6	≥80 +7
Sex at birth	Female 0	Male +1			
Number of comorbidities <small>Comorbidities include chronic cardiac disease, chronic respiratory disease (excluding asthma), chronic renal disease (estimated glomerular filtration rate ≤30), mild to severe liver disease, dementia, chronic neurological conditions, connective tissue disease, diabetes mellitus (diet, tablet, or insulin controlled), HIV or AIDS, and malignancy.</small>	0 0	1 +1	≥2 +2		
Respiratory rate, breaths/min	<20 0	20-29 +1	≥30 +2		
Peripheral oxygen saturation on room air	≥92% 0	<92% +2			

Glasgow Coma Scale	15 0	<15 +2
Select measurement available	BUN	Urea
BUN	<19.6 mg/dL 0	≥19.6 to ≤39.2 mg/dL +1
	>39.2 mg/dL +3	
C-reactive protein	<50 mg/L (<5 mg/dL) 0	50-99 mg/L (5-9.9 mg/dL) +1
	≥100 mg/L (≥10 mg/dL) +2	

0 points
4C Mortality Score
 Low risk
In-hospital mortality **1.2-1.7 %**

Copy Results

Next Steps >>>

Mortality as predicted by the 4C score:

Risk Groups	4C Score	% Mortality	Predictive Value
Very High Risk	≥15	61.5%	PPV 61.5%
High Risk	9 - 14	31.4%	NPV 68.6%
Intermediate Risk	4 - 8	9.9%	NPV 90.1%
Low Risk	≤3	1.2%	NPV 98.8%

SUMMARY

- Specific diagnostic testing for COVID19 may take hours to days to result, depending on local testing availability. Know how to correctly perform and interpret the test at your institution and know the sensitivity and specificity of your test.
- In the initial evaluation, other diagnostic predictors, such as lymphopenia or elevated inflammatory markers, can be used to suggest COVID19 infection
- Some lab tests can be used to predict a high risk of severe infection, indicating a potential need for a higher level of care.
- Use risk calculators such as the 4c score to prognosticate patients, however, never use these in isolation. Remember, if the patient appears sick, this is more important than any specific lab test.

REFERENCES/SUGGESTED READING:

1. Guidelines Management COVID-19 March 17 2020
2. Dubai National Guidelines
3. Clinical Care for Severe Acute Respiratory Infection Toolkit – COVID-19 Adaptation,
<https://www.who.int/publications-detail/clinical-care-of-severe-acute-respiratory-infections-tool-kit>
4. Farkas. “The Internet Book of Critical Care: COVID-19.” <https://emcrit.org/ibcc/covid19/>

ABG Interpretation

5. <https://meducation.net/resources/30154-Arterial-Blood-Gas-Interpretation-Made-Easy>
6. <https://litfl.com/acid-base-disorders/>

4c risk score

7. <https://www.mdcalc.com/4c-mortality-score-covid-19>
8. <https://rebelem.com/the-isaric-who-clinical-characterization-protocol-risk-stratification-of-patients-admitted-to-hospital-with-covid-19/>
9. Knight SR et al; ISARIC 4C investigators. Risk stratification of patients admitted to hospital with covid-19 using the ISARIC WHO Clinical Characterisation Protocol: development and validation of the 4C Mortality Score. BMJ. 2020.