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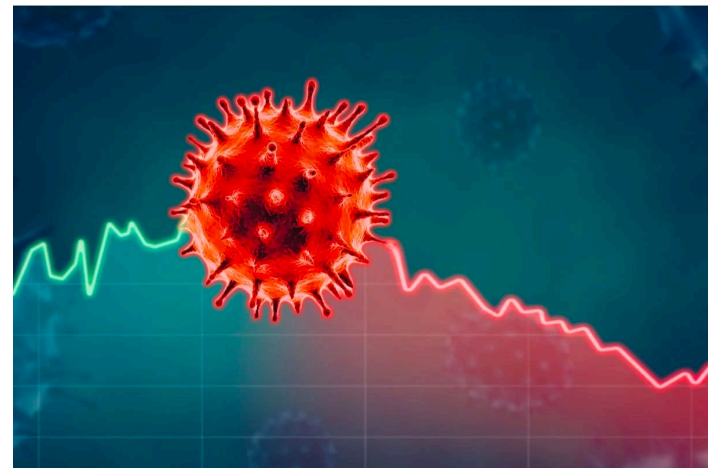
Evolution of the newest diagnostic methods for COVID-19: a Chinese perspective

Key words: SARS-CoV-2; COVID-19; Diagnosis; PCR;
Immunoassay; Radiography

Research Summary

This review mainly focused on evolution of SARS-CoV-2 detection methods used in China and the experience gained along the way:

- **Clinical manifestation**
- **SARS-CoV-2 virus isolation**
- **Gene detection**
- **Immunodiagnosis**
- **Imaging diagnosis**



Schematics of common COVID-19 detection techniques

COVID-19 Diagnostic Methods

Sample Collection

Nasopharyngeal swab <15 min

Cotton swab is inserted into nostril to absorb secretions.



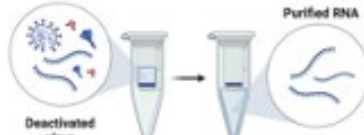
Collected specimen 0-72h

Specimen is stored at 2-8°C for up to 72 hours or proceed to RNA extraction.



RNA extraction ~45 min

Purified RNA is extracted from deactivated virus.

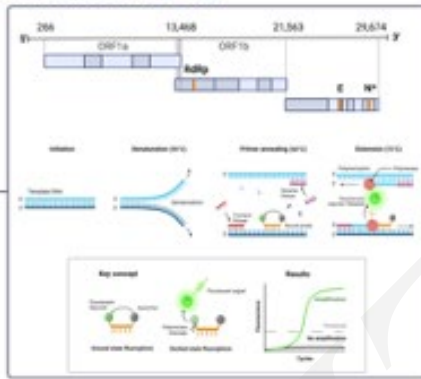


I. Fluorescent Dye-Based Real Time PCR (qPCR)

RT-qPCR ~1 h per primer set

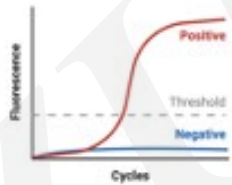
Purified RNA is reverse transcribed to cDNA and amplified by qPCR.

Retro transcription



Test results real-time

Positive SARS-CoV-2 patients cross the threshold line within 40.00 cycles (< 40.00 Ct).



II. Loop-Mediated Isothermal Amplification (LAMP)

LAMP

Purified RNA is reverse transcribed to cDNA and amplified by LAMP (primers with high specificity: ORF1AB-4 and S-123 primers).

Retro transcription



Test results

Combined with pH indicator, turbidity and color changes can be used for quantitative analysis (Results Visualization)



Clinical Symptoms

Fever

Eye Damage.

- Conjunctivitis

Cough & Sputum

Cardiac Trauma

ALT ↑ AST ↑
BIL ↑ AIB ↓

Acute Kidney Injury

Gastrointestinal symptoms

- Abdominal Pain
- Diarrhea

Arthralgia

III. LAMP Detection Based on CRISPR/Cas12a

RT-LAMP 60°C, 40min

Purified RNA is reverse transcribed to cDNA and amplified by LAMP

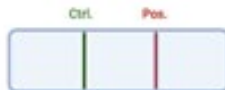
Retro transcription

Retro transcription

Mixing and Cas12a Cleavage 37°C, 5min



Test results



IV. Serologic Diagnostic Test



1 Sample loading

Add drop of blood or serum in sample well (S)



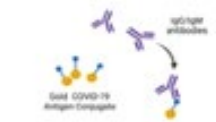
2 Buffer loading

Add dilution phosphate saline buffer to sample well



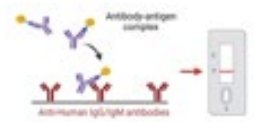
3 Sample incubation

Capillary action moves sample across lateral flow test.



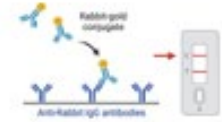
4 Antibody-antigen recognition

Antibodies with specificity for COVID-19 bind to gold COVID-19-antigen conjugates in conjugate pad.



5 COVID-19 antibody detection

Sample enters testing well (T) and COVID-19 antibody-antigen complex binds to immobilized anti-human IgG/IgM antibodies.



6 Control antibody detection

Rabbit anti-gold conjugate binds to immobilized anti-rabbit IgG antibodies.



7 Interpreting results

Positive: one strip each in C well and T well
Negative: one strip in C well

Innovation points

A series of comprehensive tables were generated to summarize the latest knowledge about CBX proteins.

Table 1 | Effects of knock down or overexpression of *Cbx* genes.

Table 2 | Phenotypes of *Cbx* KO mice and human patient with point mutations.

Table 3 | SUMOylation substrates of CBX4.

Table 4 | Post translational modification of CBX proteins.

Table 5 | Cancers associated with aberrant expression of CBX proteins.