ASU-SARS-CoV-2 qPCR Test

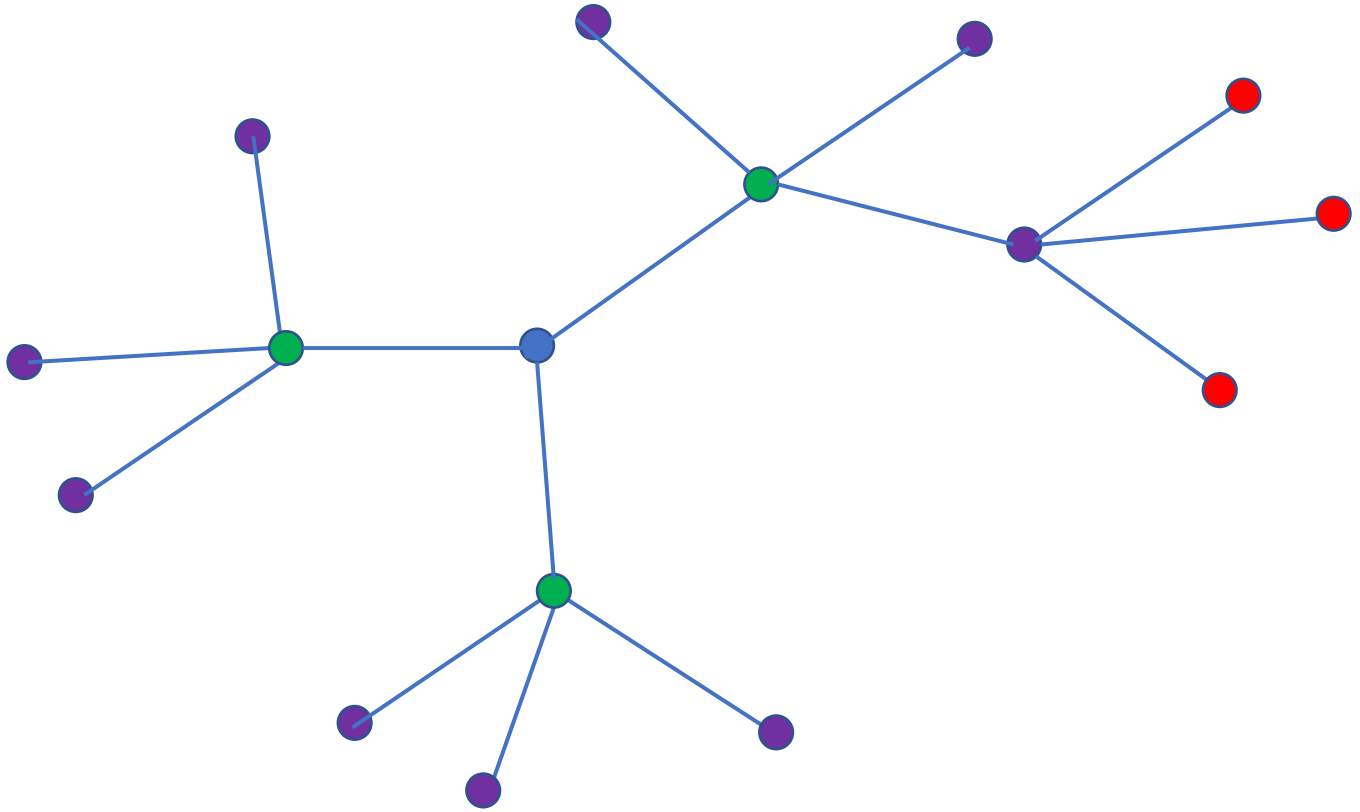
ASU Biodesign Clinical Testing Laboratory

ASU Biodesign Institute
Arizona State University

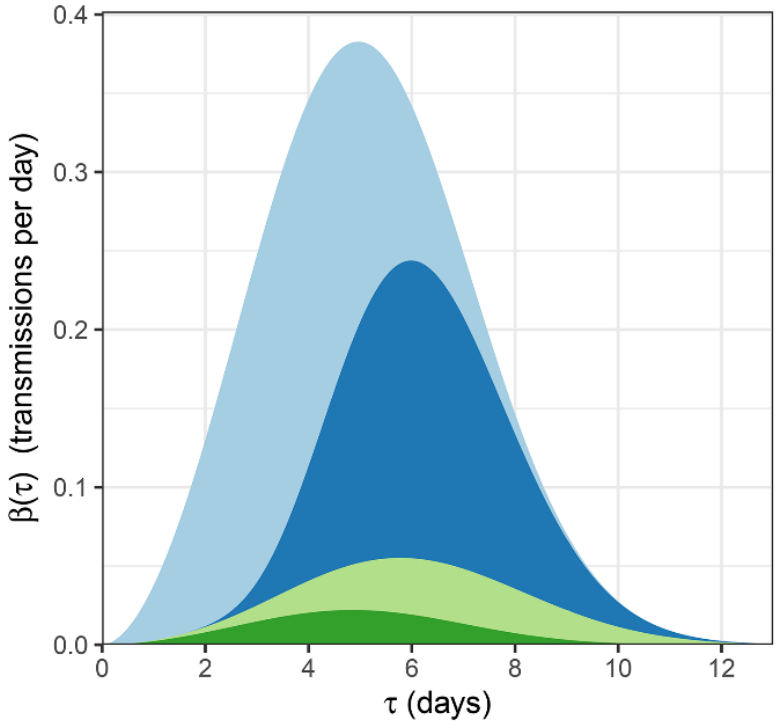
Clinical Testing Lab

Transmission of virus is exponential…

But not simultaneous



Viral spreading occurs presymptomatically



Quantifying SARS-CoV-2 transmission suggests epidemic control with digital contact tracing

Luca Ferretti[1]*, Chris Wymant[1]*, Michelle Kendall[1], Lele Zhao[1], Anel Nurtay[1], Lucie Abeler-Dörner[1], Michael Parker[2], David Bonsall[1,3]†, Christophe Fraser[1,4]†‡

Science 31 March 2020

R_0 = 2.0:

- R_p = 0.9 from pre−symptomatic
- R_s = 0.8 from symptomatic
- R_e = 0.2 from environmental
- R_a = 0.1 from asymptomatic

Temporal dynamics in viral shedding and transmissibility of COVID-19

Xi He[1,3], Eric H. Y. Lau [2,3].....Fang Li[1,4] and Gabriel M. Leung [2,4]

Nature Medicine, April 15, 2020

We observed the highest viral load in throat swabs at the time of symptom onset, and inferred that infectiousness peaked on or before symptom onset. We estimated that 44% (95% confidence interval, 25–69%) of secondary cases were infected during the index cases' presymptomatic stage, in settings with substantial household clustering, active case finding and quarantine outside the home.

Offensive strategy against the virus

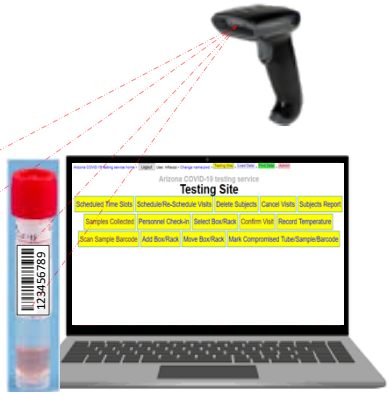
- Social distancing alone is not sufficient
- Test all cases and essential infrastructure personnel
- Then test all contacts of positive cases
- Separate positives from negatives until positives clear
- More important to test the asymptomatic contacts than the cases
- Current testing capabilities are inadequate
- Testing only symptomatic individuals is not sufficient
- The more testing we can do, the faster we can start moving again

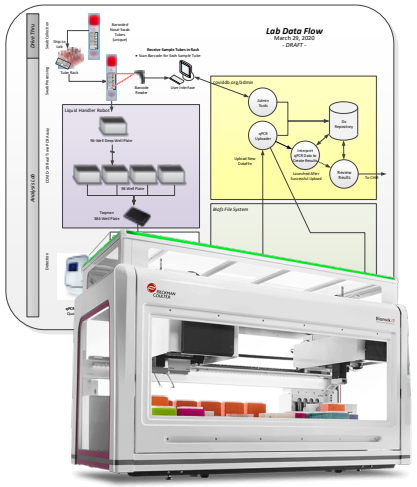
Teams

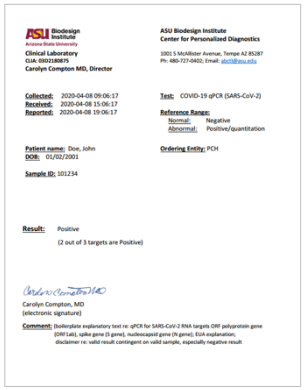
- **Sample Procurement** (Joe Miceli, David Thomas)
- **Virus testing and automation** (Ian Shoemaker, Vel Murugan)
- **Database tracking, Participant Portal** (Jin Park, Mike Fiacco)
- **Contact Tracing** (Scott Jacobson, Tim Lant)
- **Regulatory clearance** (Mitch Magee)
- **Communications** (Heidi Gracie)
- **Partnerships** (Tamara Deuser)

Workflow and Informatics for COVID-19 Testing

Signup for Test Online	Collect Sample Data at Event	Automated Assay in Lab	Analyze Assay Results	QC and Medical Review	Deliver Test Results







- Participant Enters Symptoms
- Schedules Appt

- Participant Check-In
- Barcoded Samples
- Workflow Mgt

- High-Throughput Robotics
- qPCR Result Data

- FDA EUA Criteria
- Computer Assisted Analysis

- Automated QC
- Medical Director Approval

- Rapid Turnaround
- Test Results to Partners/Providers

Integrated Database

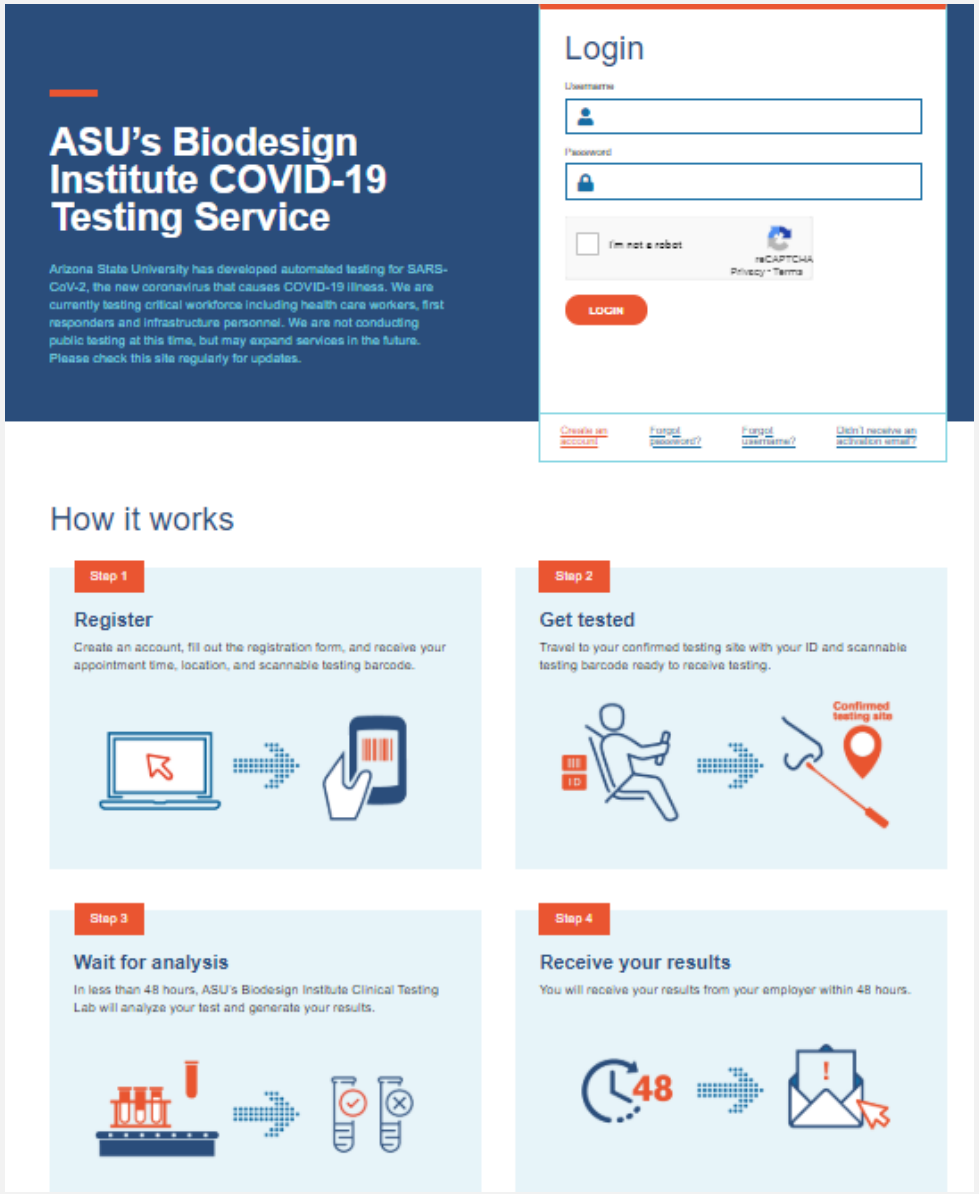
- Enterprise Class Server Platform
- Secure Partitioning
- Mirroring, Daily Backup and Archiving Policies

Participant Portal Sign-up Instructions

Arizona State University has developed automated testing for SARS-CoV-2, the new coronavirus that causes COVID-19 illness. ASU is currently testing critical workforce including health care workers, first responders and infrastructure personnel.

To register for a test, go to **azcovid19test.asu.edu** and select “Create an account.”

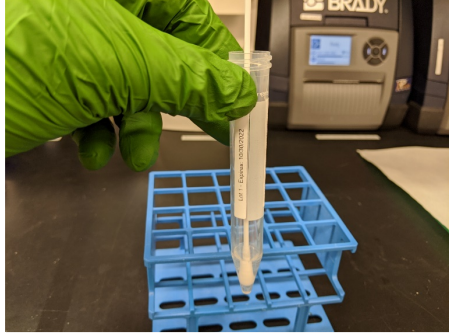
- Choose a username, create a password and input **your company email address** on the account creation page. In the “Partner Code” field, enter company code: **2HEdks88732sXxjPN6BVhgkj**
- You will receive an email confirming your account. Click the link in the email to navigate back to the site and log in. If you didn’t receive an email, choose the “Didn’t receive an activation email?” on the home page and be sure to check your spam folder in case the message was mistakenly filed.
- Once you have logged in, click the “Request a test” button.
- Fill out the form and submit your request. You may be asked to choose a testing site and agree to waiver.
- Upon form submission, you will receive a scannable barcode and a personal test number. Bring this information with you to your testing site to receive your test. You will also be assigned a time slot for your test.
- In less than 48 hours, ASU’s Biodesign Institute Clinical Testing Lab will process your sample and return the results to your company health representatives.
- For any questions, please contact Contact: **123-234-5858**.



Sample Collection

Collection Kit

- 500 Test Kits (Swab + Tube) sent out to stock test sites
- Swabs
  - 78,000 Nasopharyngeal Swabs
  - 3D printer teams at ASU looking at local partnerships to print FDA approved nasopharyngeal swabs
  - CARBON/ADIDAS 3D Printer Partnership says they can be making 1M per week nationally, this will go to a central QC facility prior to distribution, no delivery timeline yet
- Viral Transport Media
  - 30,000 – Commercial Tubes on hand
  - Home made - Filling 2k tubes / day
    - 15,000 tubes on hand
    - 7,000 tubes – awaiting QC
- **We will offer to supply to broader community in AZ – Mayo Interested**



Sample Collection

Face Shields

- ASU Luminosity Lab – 3D Printed, Reusable Face Shields
  - Local healthcare providers have approved design and are requesting initial runs

- Biodesign/Luminosity Lab – Disposable face shields
  - 2k face shields made at Biodesign
  - Average: 300/day – one production line
  - Ramping up to three production lines over next week using Luminosity Lab Team

Sample Collection

Sample Collection Logistics

- Drive-up sample collection and transport
- Sample collecting performed by Registered Nurses from Edson College of Nursing and Health Innovation
- ASU provides clinical resources (trained staff, PPE, sample chain of custody from site to laboratory)
- Partner provides non-clinical equipment and personnel to maintain traffic and security
- 2 and 3 station configurations
- Averaging 45+ samples per station per 4-hour shift
- 3 minutes per car

Biodesign Laboratory

- Completed $40M project with BARDA using qPCR and automation
- Demonstrated 2400 samples processed in 24 hr
- Repurposed existing equipment and personnel for Covid19
- Good Laboratory Practices (GLP) with Quality Management System with QA/QC

ASU Biodesign Institute
Arizona State University

Clinical Testing Lab

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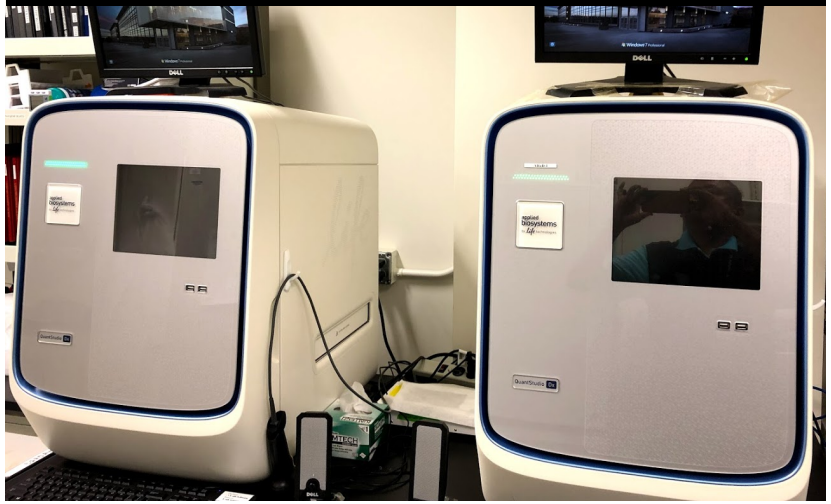
Reliable, fast and efficient method of sample processing through automation

Reagent prep & Sample handling

Sample prep and qPCR plate making

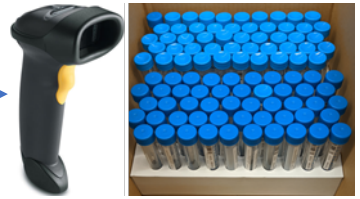
qPCR and Data Analysis - 384 well (60 min)



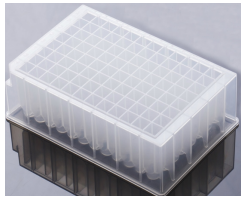
ASU CoVID-19 qPCR Test workflow overview

Sample Receipt

Heat Inactivation
65°C for 30 min



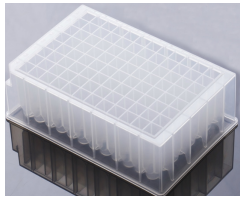
QC Label check and
arrange (60 min)



400 µL in to Kingfisher
Deep Well-block (30 min)

KingFisher™ Flex
Purification System

96 sample prep
in 30 min



Eluted RNA in
50 µL

Biomek FX^{P} ™ Automated
Workstation

qPCR Plate
making (10 min)

QunantStudio ™
Dx

384 Well
qPCR 75 min

- Extract RNA from patient sample using the MagMAX™ Viral/Pathogen Nucleic Acid Isolation Kit using KingFisher Flex system
- MS2 Phase used to monitors RNA extraction
- Purified nucleic acid is reverse transcribed into cDNA and PCR amplified using the TaqPath™ RT-PCR COVID-19 Kit and the Applied Biosystems™ QuantStudio Fast Dx Real-Time PCR instrument.
- Probes anneal to three specific SARS-CoV-2 target sequences located between three unique forward and reverse primers for ORF1ab, N Protein and S Protein Genes

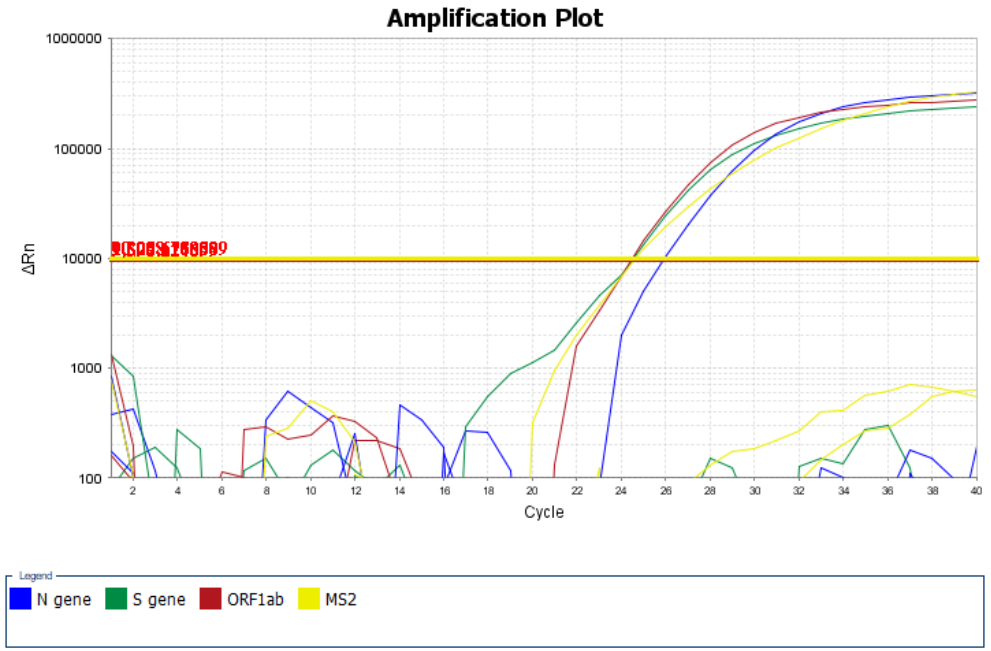
Result interpretation for patient samples

ORF1ab	N gene	S gene	MS2	Status	Result	Action
NEG	NEG	NEG	NEG	Invalid	NA	Repeat test. If the repeat result remains invalid, consider collecting a new specimen.
NEG	NEG	NEG	POS	Valid	SARS-CoV-2 Not Detected	Report results to healthcare provider. Consider testing for other viruses.
Only one SARS-CoV-2 target = POS			POS or NEG	Valid	SARS-CoV-2 Inconclusive*	Repeat test. If the repeat result remains inconclusive, additional confirmation testing should be conducted if clinically indicated.
Two or more SARS-CoV-2 targets = POS			POS or NEG	Valid	Positive SARS-CoV-2	Report results to healthcare provider and appropriate public health authorities.

*Samples with a result of SARS-CoV-2 Inconclusive shall be retested one time.

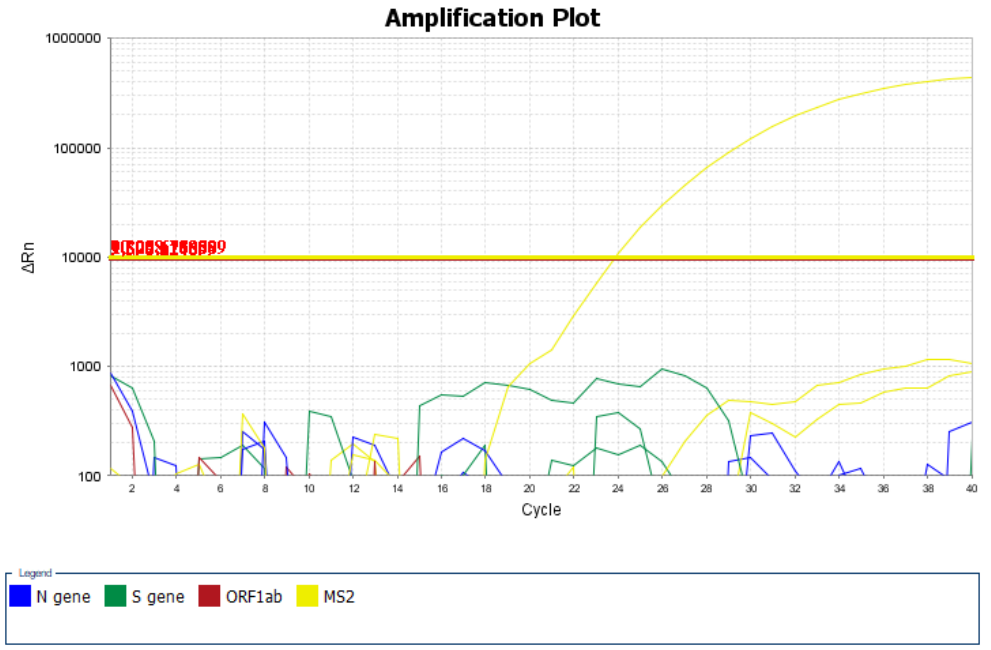
qPCR Results

CoVID-Positive



All viral genes and the process control MS2 is positive

CoVID-Negative



Viral genes are negative and the process control MS2 is positive

Limit of detection is 0.5 virus particle in 1 μL of sample

Regulatory

- Internal IBC and IRB approvals fast tracked
- CLIA Registration Complete – #03D2180875
  - Medical Director: Dr. Carolyn Compton
- FDA Emergency Use Authorization (EUA) in place
- Updating Quality Systems Documents for CLIA/CAP
- CDC import permit to receive serum samples
  - Permit #: 20200325-1100A - Italy
  - Permit #: 20200331-1158A - Spain

Contact Tracing

Contract tracing is a critical public health capability that is necessary to re-open US cities.

Concept

We must rapidly identify all contagious individuals and get them in quarantine. The SARS CoV2 virus is most infectious pre-symptomatically, so focusing on individuals with symptoms is too late. Contact tracing moves upstream to test/isolate anyone who has had contact with a known positive to prevent spread, even if they are asymptomatic.

Planned Activities:

- Designing tracing program with modalities for traditional contact tracing (telephone-based)
- Evaluating technology-assisted contract tracing apps (mobile/wearable)
- Developing training materials and protocols
- Establishing technology-enabled asynchronous virtual call center
- Recruiting volunteers from existing staff and student worker groups
- Coordinating with Maricopa County, Pima County, and ASU Campus Health
- Ongoing technology evaluation to expedite/expand tracing capabilities