COVID19 Seroconversion Volunteer Screening Feasibility Study

development time – 3 weeks

Execution of testing – 3 to 4 days
(~1000 individuals screened)

linearly scalable, modular, amenable to relocation and duplication

SmartAnimal

Version 1, 26MAR2020

MSC
McNeil Scientific Consulting

Rationale

Many believe that spikes of hospitalizations will occur in some of our metropolitan and surrounding areas. This will result in mental and physical fatigue for those in the medical field, and additional risks will be incurred as our PPE is depleted. For some, the draw to help save lives in such a desperate situation will require action of themselves, despite the personal risk of exposure and infection. This may even describe you.

Recent studies have shown that previously infected people exhibit a strong antibody response to the virus, which may confer an immunity to re-infection. This has not been proven, but more definitive conclusions on this matter are only days or weeks away. The immunoglobulin assay is a hot topic in the current news cycle, but implementation is weeks away at best, and supply is not yet known.

Anticipating both a surge in volunteerism and impending resolution on the immunity question, it is our goal to provide this test as rapidly as possible. Time is of the essence.

This effort is being supported free of charge by individual volunteers, by Smart Animal, Inc. and by McNeil Scientific Consulting, LLC.

Background/Proposal

The Immunoglobulin assay originating from efforts led by the Krammer lab at Icahn School of Medicine at Mt. Sinai (digitally published 18March2020) is now in use (Wadsworth Laboratories) to screen for COVID19 seroconverted members of the local population.

Uses:

1. Epidemiology studies
2. Treat infected patients with harvested anti-COVID19 immunoglobulins
3. Create a workforce of potentially immunized members of the community.

Proposal:

To rapidly replicate this assay and subsequently establish a structural screening program, with the goal of identifying Volunteers as either naïve or inoculated to the virus.

Advantages:

1. Roles/Assignments based on risk reduction
2. Personal comfort/confidence
3. Reduction in PPE consumption

This test will likely NOT be FDA approved during the time frame of this feasibility study. However, the results may still assist with appropriate task assignments. Additionally, results may be retroactively affirmed by later testing studies.

Overview of Proposal
1000 Volunteer Testing Execution

Testing site is a drive through process where Volunteers arrive on site with State ID card. Test site has a queue capacity of approximately 20 vehicles, 5 registration stations, an additional 10 vehicle queue, and 8 sampling stations.

Anticipate processing 300-500 vehicles per day over 8 to 10 hours (total 3 days).

1. Volunteers are digitally registered at a tent station by Staff, and receive a sampling kit and barcode label for ID.
2. Volunteers park at a sampling station, where staff members instruct and visually examine the self-blood draw (finger stick) and deposit in the supplied bar coded sample vial. After transferring the vial to observing staff, Volunteers exit the testing site.
3. Staff delivers vial to outdoor tent where sample is heat inactivated and centrifuged.
4. Samples are transferred to indoor facility where it is distributed to individual testing stations.
5. Samples are read (barcode) and plated for assay. Approximately 5 assays per plate.
6. Plates are processed per written SOP and 96 well plate data is entered into spreadsheet.
7. Data for Volunteer profile and sample results are merged by barcode tracking.
8. Upon notification (within 2 days), volunteer proceeds to separate registration site where they are provided with a color coded wristband identifying their immunogenic status.

Overview of Proposal Development Tasks

1. Creation of ELISA test reagents. The recombinant antigenic COVID19 viral proteins are currently in production. Purification and characterization of these reagents will be performed by routine established procedures.

2. Assay development. Based on the digital publication of the Krammer Laboratories. Development will be initiated with available materials, then refined with reagents produced in step 1.

3. Equipment acquisition and testing. Necessary test equipment will be obtained either used, refurbished or new (depending on budget).

4. Site preparation. Outdoor tents, stations, signage, traffic and supervision controls.

5. Sample kits. To reduce the demand on necessary PPE, individuals will receive kits containing vials and implements to perform self-sampling (blood) with minimal assistance of personnel.

6. Sample and results tracking. A barcode system, coupled with spreadsheet and reporting software, will need to be established and tested to allow Volunteers to be matched to their test results.

7. Status Identification. Once Volunteers have been screened, they will be provided with an identifying colored armband/wristband to visibly demonstrate their testing status.

Development
1. Creation of ELISA Test Reagents

- Plasmids expressing COVID 19 protein (based on either the Spike 1 protein or RBD domain, were provided by generous donation of the Krammer Lab at Mt. Sinai, NY) to McNeil Scientific Consulting (MSC). These plasmids are undocumented and therefore cannot be used to create a "Released" assay.
- MSC is in the process of acquiring traceable plasmids and a control aliquot of the Receptor Binding Domain from BEI.
- Plasmids are currently being amplified by GeneWiz (Cambridge, MA). This should be repeated at greater scale once traceable plasmids are received.
- Resulting preps will be used to transfect cells and produce recombinant proteins in cell culture harvest at ThermoFisher laboratories. Turnaround time is 1-3 weeks from present. This operation should also be repeated and scaled up with traceable material.
- Reagent for ~1000 tests will be purified and characterized by volunteer effort at MSC Labs. This will eventually be repeated at larger scale with traceable reagents.
- Additional materials for development (plates, tips, detection antibodies and reagents, etc.) are commercially available.

Development
2. Assay Development

- Once reagents are in place, assay development will be performed by a volunteer effort at MSC Labs. Timeframe will be approximately 1 week, assuming we can obtain SOPs from hospital labs already developing this assay for release.
- This will provide a capable measurement, but this assay cannot be Qualified in such a short timeframe with undocumented reagents. As such, it will be unsuitable for screening patients, donors or healthcare workers.
- Life saving Volunteers would likely be low on the priority list for the initial production lots of Qualified seroconversion tests. Therefore, the most practical use for this informal test would be for this population, to provide an indication of their immune status.
- THIS STUDY IS FOR FEASIBILITY, and is the first step in providing a reliable testing procedure. Future iterations of the test will be available in the weeks following this proposal, and will benefit from data obtained by this preliminary testing of ~1000 members of the population.

Development
3. Equipment Acquisition + Testing

- Equipment will need to be acquired, set up, and tested in order to perform the Immunoglobulin Assay. Although not complex, the equipment required will need to be purchased. Quality (used vs. new) will depend on funding.
- The intention is to provide up to 4 individual workflow stations, with additional equipment on site for redundancy purposes [~$10k per station minimum].
- Work stations will be composed of: bench space for paperwork and manual pipetting, plate mixers, small refrigerators, incubators (?), plate washers, plate readers, computers and bar code scanners.
- Where possible, equipment type and models for each workstation will be matched to limit variations in written testing procedures.
- In addition, other equipment will need to be acquired, including:
  - Detection reagents [$2k]
  - Pipettors, tips, buffer reservoirs, buffer prep vessels [$2k]
  - Timers, calibrated thermometers, heating blocks [$5k]
  - Waste disposal [$2k]
- All equipment can be tested and workflow stations set up at testing site.

Development
4. Site Preparation

- Site has been identified and landlord permission has been obtained. Traffic flow as indicated below. An experienced Site Manager would be valuable.
- Registration of volunteers and blood sample acquisition will require signage and traffic control measures, toilets and cleaning supplies, waste disposal, refreshments, and PPE (minimized).
- Tents/shelters will be required for staff performing registrations, staff supervising sample draws, and for inactivation of samples prior to bringing them into the testing labs. We need support staff, laptops or workstations and power supply.
- We need someone to arrange for permits, licenses, etc. to fast track this study!

Development
5. Sample Kits

Preparation of approximately 1500 kits is necessary [$3k]. Kits will be assembled in advance by volunteer effort and will contain:

- Sticker sheet of barcode labels
- Alcohol wipes
- Spring-loaded safety lancet
- Sample collection tube, pre-labeled with barcode
- Band-aids
- Instructions for use
- Follow up instructions to obtain results and identification

Registration and self collection of samples will be supervised activities, but minimizes the amount of PPE required to collect ~1000 individual tests.

All samples will be heat inactivated in heating blocks which are individually monitored by new NIST-calibrated thermometers, rendering them BSL1, prior to being provided to the testing lab.

Development
6. Sample and Results Tracking

- A barcode system linking a Volunteer's registration information to their sample kits and subsequently to their test results will need to be established.
- All data will be stored securely, tamper proof, in a central location but backed up to a separate remote location.
- Spreadsheet data collection with automatic population of fields. Programmer will need to co-design how plate readouts are merged with barcoded Volunteer profile.
- Results will need to be statistically determined. Each sample will be titration to 4 points, performed in triplicate (assumed, we do not yet have a working protocol from testing hospitals). Only samples falling on the standard curve (which must also be determined for each plate tested) can be used to tabulate results.
- 5 samples per plate (assumed) will require at least 200 plates to test 1000 individuals.
- Costs: laptops for registration, barcode scanners. Operation must be confirmed in the field.

Note that we are only able to test 1000 individuals in this first feasibility study. Such a limited scope will allow for us to audit and confirm results, or even execute without a functioning barcode tracking system if required.

Development
7. Status Identification

- Volunteers will be contacted within 2 days with seroconversion results and will report back to registration.
- Non-converted Volunteers (naïve or susceptible to infection) will be given a YELLOW wristband containing their name, barcode, and date for re-testing (2 months).
- Converted Volunteers (potentially immunized) may be re-tested to confirm results if additional test capacity has been created. These individuals will be given a GREEN wristband, containing their information, and date for re-testing (1 month).
- Upon obtaining the results from re-testing, a new band (YELLOW or GREEN) will be assigned.
- **Color of bands will allow health care professionals to rapidly assess volunteer risk and deploy them appropriately where they will be most effective.**
- Bands will be durable, removable, and made of a washable or sterilizable material.
- Cost $10 per bracelet (may be assumed by volunteer).
- These items will need to be sourced from several vendors.

Summary of Requirements for Development Stage

Stage	Materials	Personnel	Completion	Notes
Reagents	$9k	1 (MSC)	April 7	Repeat at larger scale
Assay Dev	$1k	2 (MSC)	April 12	Confirm with bulk reagents
Equipment	$60k – 150k	1 acquisition 2 testing, setup	April 12	
Site Prep	$20k	6 staff 1 coordinator 1 permit person	April 12	Refreshments, cleaners, PPE
Sample Kits	$3k	1 acquisition 2 assembly	April 12	
Tracking	$10k barcode scanners, laptops	2 programmers	April 10	Completed, Reviewed, Tested
Status ID	$10k	1 sourcing, pre – orders. 2 receiving, audit	April 14	
TOTAL	$110k - $200k	22 volunteers		National guard?

Summary of Requirements for Screening Study (April 13-16)

Station	Role	Personnel	Notes
Parking lot	Traffic flow, information, cleaning, refreshments	8	Police/security in addition
Registration	Data Entry, ID check IT support.	6	Laptops with barcode scanner and WIFI
Sampling Stations	Instruct and verify self-sample technique	9	Training required. Runner to deliver samples.
Sample Inactivation	Monitor temperature controls, track and document inactivation time (barcode?)	3	This is a critical task and will require a full-time supervisor.
Sample Testing	Receive inactivated samples and complete entire assay flow.	6	Includes a Runner and reagent supply tech.
Data Security	Observe collection of date to ensure it is complete and accurate.	2	Probably the same individuals who designed the software
Exit Registration	Volunteer verification of results and status. Prep wristbands.	4	Takes place 2-3 days after screening begins
Host/Hostess	These are volunteers! Treat them well!	??	Gifts? Ideas welcome.

Closing Info

1. This Screening Study is repeatable. Cost to repeat is significantly less once it has been developed.
2. This Screening Study is modular. It can be increased in scale without difficulty.
3. This Screening Study is self-contained. It can be packed up and relocated anywhere in the country.
4. This Screening Study can be readily duplicated anywhere in the world.

Propagation of this Screening Study would be beneficial to epidemiologists.

It would assist in getting our country headed back to normalcy.

It would help increase the scale and confidence of our great volunteer spirit.

But Boston does not have much time. Funding this project and/or lending the support of the National Guard/Peace Corps would be amazing.

Thank you for considering this proposal.

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