Sustainable Energy Access for COVID-19 Testing
## GLOSSARY

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>COVID-19</td>
<td>Coronavirus Diseases-2019</td>
</tr>
<tr>
<td>SARS-CoV-2</td>
<td>Severe Acute Respiratory Syndrome Coronavirus 2</td>
</tr>
<tr>
<td>2019-nCoV</td>
<td>Novel Coronavirus</td>
</tr>
<tr>
<td>RT-PCR</td>
<td>Reverse Transcription Polymerase Chain Reaction</td>
</tr>
<tr>
<td>POC PCR</td>
<td>Point-of-Care Polymerase Chain Reaction</td>
</tr>
<tr>
<td>PCR Machine</td>
<td>Polymerase Chain Reaction Machine</td>
</tr>
<tr>
<td>ICMR</td>
<td>Indian Council of Medical Research</td>
</tr>
<tr>
<td>NIV</td>
<td>National Institute of Virology</td>
</tr>
<tr>
<td>RNA</td>
<td>Ribonucleic Acid</td>
</tr>
<tr>
<td>DNA</td>
<td>Deoxyribonucleic Acid</td>
</tr>
<tr>
<td>PPE</td>
<td>Personal Protective Equipment</td>
</tr>
</tbody>
</table>
Sustainable Energy Access for COVID-19 Testing

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Sustainable Energy Access for COVID-19 Testing

PATHWAY TO RECOVERY

**AWARENESS**
- IEC/ BCC
- Community Kiosks
- Training of healthcare staff, teachers

**SCREENING**
- Patient History
- IR Thermometer
- Rapid diagnostic Tests

**QUARANTINE**
- Home Based
  - Self Quarantine
- Institution Based
  - Quarantine wards

**TESTING**
- Specimen storage
- Specimen Transportation
- Government approved kits and labs

**THERAPEUTIC CARE**
- Isolation wards (Health Centres / Hospitals / Makeshift Units)
- Dedicated wards
- ICU- District & Govt, Private hospitals

**ASYMPTOMATIC OR MILD**
- IR Thermometer
- Ventilation
- Oxygen Cylinder/ Concentrator
- Defibrillator
- ECG

**MODERATE**
- IR Thermometer
- Ventilation
- Oxygen Cylinder/ Concentrator
- Pulse Oximeter
- Multi parameter monitor

**SEVERE**
- IR Thermometer
- Ventilation
- Oxygen Cylinder/ Concentrator
- Pulse Oximeter
- Multi parameter monitor
- Defibrillator
- ECG
- X-ray

**PATHWAY TO RECOVERY**

**AWARENESS**

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- Patient History
- IR Thermometer
- Rapid diagnostic Tests

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- IR Thermometer
- Ventilation
- Oxygen Cylinder/ Concentrator
- Pulse Oximeter
- Multi parameter monitor
- Defibrillator
- ECG
- X-ray

**PATHWAY TO RECOVERY**
Sustainable Energy Access for COVID-19 Testing

**TESTING PROCESS**

**Sample Collection**

- **District Surveillance Office**
- **Sample Collection (PHC, CHC Private Hospital)**
- **Sample Transportation**
- **Sample Testing**

**Viral Detection**
- Rapid RT PCR Test
- Antibody Test

**Specimen Collection Details**

Specifications on storage for specimen mentioned in the table below:

<table>
<thead>
<tr>
<th>Specimen type</th>
<th>Collection materials</th>
<th>Transport to Laboratory</th>
<th>Storage till Testing</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nasopharyngeal and oropharyngeal swab</td>
<td>Dacron or polyester flocked swabs*</td>
<td>2 - 8 °C</td>
<td>≤5 days: 2 - 8°C &gt;5 days: -70 °C</td>
</tr>
<tr>
<td>Bronchoalveolar lavage</td>
<td>sterile container*</td>
<td>2 - 8 °C</td>
<td>≤48 hours: 2 - 8°C &gt;48 hours: –70 °C</td>
</tr>
<tr>
<td>Tracheal aspirate, nasopharyngeal aspirate or nasal wash</td>
<td>sterile container*</td>
<td>2 - 8 °C</td>
<td>≤48 hours: 2 - 8°C &gt;48 hours: –70 °C</td>
</tr>
<tr>
<td>Sputum</td>
<td>sterile container</td>
<td>2 - 8 °C</td>
<td>≤48 hours: 2 - 8°C &gt;48 hours: –70 °C</td>
</tr>
<tr>
<td>Tissue from biopsy or autopsy including from lung</td>
<td>sterile container with saline</td>
<td>2 - 8 °C</td>
<td>≤24 hours: 2 - 8°C &gt;24 hours: –70 °C</td>
</tr>
<tr>
<td>Serum (2 samples – acute and convalescent)</td>
<td>Serum separator tubes (adults: collect 3-5 ml whole blood)</td>
<td>2 - 8 °C</td>
<td>≤5 days: 4 °C &gt;5 days: –70 °C</td>
</tr>
</tbody>
</table>

Note: The above recommendation as per WHO. It also recommends the use of VTM (Viral Transport Medium) containing anti fungal and antibiotic supplements for transport of samples. Avoid repeated freezing and thawing of specimens.
Sustainable Energy Access for COVID-19 Testing | SAMPLE COLLECTION

**SAMPLE COLLECTION**  Collecting virus samples by nasopharyngeal (NP) swab, oropharyngeal (OP) swab method

### Requirements for Clinical Sample Collection

1. Sample vials and Virus Transport Medium (VTM)
2. Adsorbent material (cotton, tissue paper), paraffin, seizer, cello tape
3. A leak-proof secondary container (e.g., ziplock pouch, cryobox, 50 mL centrifuge tube, plastic container)
4. A suitable container (e.g., thermocol box, ice-box, hard-board box) (minimum dimensions: 10 x 10 x 10 cm)

### Different Methods of Sample Collection

1. COVID WISK
2. LABORATORY
3. MOBILE COVID 19 TESTING VAN
4. DRIVE IN COVID 19 SAMPLE COLLECTION

*Specimen Collection, Packaging and Transport Guidelines for 2019 novel Coronavirus (2019-nCoV) - As per ICMR on 20/1/2020*
A WISK (Walk-in Sample Kiosk) is a mobile cubicle with a sealed glass front, and have extended gloves attached in the front, through which a medical practitioner standing in the cubicle can collect samples.

Even a swab can be collected without direct exposure and contact. After the swab collection, the gloves can be sanitised from outside.

**The Kiosk can be used to for any type of test.**

### Medical consumables

- Viral Transport Medium (VTM)
- Flocked Dacron swabs (2 swabs/ sample collection from 1 patient)
- Disinfectant

### Materials required for infrastructure

- Aluminium fabrication with multi wood
- Glass (8 mm thickness) with Gloves
- Magnetic door - 2 nos.

### Electrical appliances required

- Exhaust fan (to maintain the temp)
- LED Tube light
- Cold Carrier box
### Solar System Designs for COVID19 WALK_IN SAMPLE KIOSKS (WISK)

**Option 1 - 80 - 100 samples/day Collection & Transportation**

<table>
<thead>
<tr>
<th>Load Type</th>
<th>Wattage (W)</th>
<th>No of Appliances</th>
<th>Hours of Usage</th>
<th>Energy Consumed (Units/Day)</th>
</tr>
</thead>
<tbody>
<tr>
<td>DC Wall Fan</td>
<td>14</td>
<td>1</td>
<td>12</td>
<td>0.48</td>
</tr>
<tr>
<td>DC LED Light</td>
<td>5</td>
<td>1</td>
<td>8</td>
<td>0.048</td>
</tr>
<tr>
<td>Mobile Charging</td>
<td>20</td>
<td>1</td>
<td>3</td>
<td>0.06</td>
</tr>
<tr>
<td>Cold Carrier Box</td>
<td>36</td>
<td>4</td>
<td>4</td>
<td>0.576</td>
</tr>
</tbody>
</table>

- **Max Load that can be Connected**: 183 W
- **Max Units of Energy (kWh) Usage per day**: 0.85 kWh
- **System Voltage**: 24 V
- **Cost**: INR 62,000*  
  
  *The cost does not include the cost of the Cold Carrier Box (Suggested technology- Black Frog)*

### Option 2 - 40 - 50 samples/day Collection & Transportation

<table>
<thead>
<tr>
<th>Load Type</th>
<th>Wattage (W)</th>
<th>No of Appliances</th>
<th>Hours of Usage</th>
<th>Energy Consumed (Units/Day)</th>
</tr>
</thead>
<tbody>
<tr>
<td>DC Wall Fan</td>
<td>14</td>
<td>1</td>
<td>12</td>
<td>0.48</td>
</tr>
<tr>
<td>DC LED Light</td>
<td>5</td>
<td>1</td>
<td>8</td>
<td>0.048</td>
</tr>
<tr>
<td>Mobile Charging</td>
<td>20</td>
<td>1</td>
<td>3</td>
<td>0.06</td>
</tr>
<tr>
<td>Cold Carrier Box</td>
<td>36</td>
<td>2</td>
<td>4</td>
<td>0.288</td>
</tr>
</tbody>
</table>

- **Max Load that can be Connected**: 111 W
- **Max Units of Energy (kWh) Usage per day**: 0.56 kWh
- **System Voltage**: 12 V
- **Cost**: INR 45,000*
MOBILE COVID19 TESTING VAN

This is to collect the samples from potential coronavirus patients at their doorstep. This would save time and energy of both patients and lab technicians as the vehicle can be taken to any remote area, especially in contaminated zones, without much difficulty.

DRIVE-IN COVID19 SAMPLE COLLECTION

This is to collect the sample from patients who can arrive in their car at the location. During the process, you never need to leave your vehicle as the test can be conducted through the vehicle’s window itself. The test would be conducted by trained medical staff who would use the maximum amount of safety equipment with masks, gloves, medical scrub suits, and face protective equipment.

Solar System Designs for Mobile Testing Solutions

50 samples/day Collection & Transportation

<table>
<thead>
<tr>
<th>Load Type</th>
<th>Wattage (W)</th>
<th>No of Appliances</th>
<th>Hours of Usage</th>
<th>Energy Consumed (Units/Day)</th>
</tr>
</thead>
<tbody>
<tr>
<td>DC LED Light</td>
<td>5</td>
<td>2</td>
<td>8</td>
<td>0.04</td>
</tr>
<tr>
<td>Mobile Charging</td>
<td>20</td>
<td>1</td>
<td>3</td>
<td>0.06</td>
</tr>
<tr>
<td>Cold Carrier Box</td>
<td>72</td>
<td>1</td>
<td>3</td>
<td>0.29</td>
</tr>
</tbody>
</table>

Max Load that can be Connected 97 W
Max Units of Energy (kWh) Usage per day 0.39 kWh
System Voltage 12 V
Cost INR 35,000*

Solar Panel 150 Wp
Solar Battery 150 Ah, 12 V
Charge Controller 15 A, 24 V

*The cost does not include the cost of the Cold Carrier Box (Suggested technology- Black Frog)
**Sustainable Energy Access for COVID-19 Testing | SAMPLE COLLECTION**

**DISTRICT SURVEILLANCE OFFICE** To store the samples collected from different PHC, CHC & Private Hospitals

Option 1: 100 Litres DC Fridge - 500 - 900 Samples

- Solar Panel: 300 Wp
- Solar Battery: 200 Ah, 12 V

Cost: INR 68,000*

Option 2: 150 Litres DC Fridge - 1,100 - 1,400 Samples

- Solar Panel: 400 Wp
- Solar Battery: 360 Ah, 12 V

Cost: INR 86,000*

Option 3: 200 Litres DC Fridge - 1,400 - 1,700 Samples

- Solar Panel: 450 Wp
- Solar Battery: 400 Ah, 12 V

Cost: INR 98,000*

Option 4: 268 Litres DC Fridge - 1,900 - 2,200 Samples

- Solar Panel: 900 Wp
- Solar Battery: 300 Ah, 24 V

Cost: INR 127,000*

*The cost is inclusive of the cost of the fridge
Sustainable Energy Access for **COVID-19 Testing** | **SAMPLE TESTING**

### TYPES OF TESTING

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Viral Detection (Based on virus detection technology)</th>
<th>Rapid RT-PCR Tests (Based on virus detection technology)</th>
<th>Antibody Test/ Rapid Tests (Based on antibody detection technology)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>About</strong></td>
<td>To determine whether a nasopharyngeal sample is positive for coronavirus. Reverse Transcriptase Polymerase Chain Reaction (RT - PCR) is the technique used.</td>
<td>COVID-19 Rapid Diagnostics Test (RDT) identifies body's response to coronavirus after the onset of infection and gives a qualitative result. Implementing rapid screening for COVID-19 helps in controlling the spread of the virus by identifying infection rapidly and accurately. There are two types of COVID-19 rapid tests currently in use or in development: direct SARS-CoV-2 antigen detection and indirect antibody detection tests.</td>
<td>The antibody test knows as serological test uses a few drops of blood drawn from vein and dropped into the device containing a small strip, similar to the combination of a blood glucose test and home pregnancy kit. The test identifies antibodies to the Coronavirus in a patient's bloodstream to determine whether that person previously had COVID - 19 and possibly recovered.</td>
</tr>
<tr>
<td><strong>List of administrators</strong> (As per ICMR guideline of 16/4/2020)</td>
<td>Govt Laboratories reporting to ICMR</td>
<td>Rapid diagnostics</td>
<td>Antibody test kits for Covid-19</td>
</tr>
<tr>
<td><strong>Private Laboratories</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Approved by</strong></td>
<td>India Council of Medical Research (ICMR)</td>
<td>India Council of Medical Research (ICMR)</td>
<td>NIV Pune</td>
</tr>
<tr>
<td><strong>Time required to get results</strong></td>
<td>5 - 6 hours</td>
<td>2.5 hours - 3 hours</td>
<td>30 min - 1 hour</td>
</tr>
<tr>
<td><strong>Electrical equipments required</strong> (As per ICMR guideline of 13/4/2020)</td>
<td>RT-PCR, Deep Freezer (-20 degree C &amp; -80 degree C), Refrigerator (4 degree C), Microcentrifuge / Refrigerated Centrifuge, Vortex Mixer, Microspin, Autoclave</td>
<td>RT-PCR, Deep Freezer (-20 degree C &amp; -80 degree C), Refrigerator (4 degree C), Microcentrifuge / Refrigerated Centrifuge, Vortex Mixer, Microspin, Autoclave</td>
<td>Does not require electricity supply as the device contains a small strip</td>
</tr>
</tbody>
</table>
# Sustainable Energy Access for COVID-19 Testing | SAMPLE TESTING

## Electrical Equipment Detail

### Real Time PCR (RT - PCR)

A real-time RT-PCR test intended for the qualitative detection of nucleic acid from the 2019-nCoV in upper and lower respiratory specimens. Real-time PCR machine calibrated for the fluorophore dyes which are present on the probes.

<table>
<thead>
<tr>
<th>Power consumption</th>
<th>300 W</th>
</tr>
</thead>
<tbody>
<tr>
<td>Voltage</td>
<td>220 - 240 Vac</td>
</tr>
</tbody>
</table>

### Vortex Mixer

A vortex mixer is used to mix small vials of liquids in a quickly oscillating circular motion. When the motion of the rubber cup holder on the mixer is transmitted to the liquid sample, a vortex is created.

<table>
<thead>
<tr>
<th>Power consumption</th>
<th>30 W</th>
</tr>
</thead>
<tbody>
<tr>
<td>Voltage</td>
<td>220 - 240 Vac</td>
</tr>
</tbody>
</table>

### Cold Centrifuge/Microfuge

A microcentrifuge, also called a microfuge, is used to spin small (2 ml or less) liquid samples at high speeds. Refrigerated centrifuges protect sensitive samples from heat degeneration, protect the sample’s integrity. Also important are safety features, ergonomic adaptations and ease of use.

<table>
<thead>
<tr>
<th>Power consumption</th>
<th>60 - 72 W</th>
</tr>
</thead>
<tbody>
<tr>
<td>Voltage</td>
<td>220 - 240 Vac</td>
</tr>
</tbody>
</table>

### Microspin

Microspin is used for extracting RNA/DNA samples, sedimentation of biological components, biochemical and chemical analysis of microsamples.

<table>
<thead>
<tr>
<th>Power consumption</th>
<th>60 W</th>
</tr>
</thead>
<tbody>
<tr>
<td>Voltage</td>
<td>220 - 240 Vac</td>
</tr>
</tbody>
</table>
**Sustainable Energy Access for COVID-19 Testing | SAMPLE TESTING**

## ELECTRICAL EQUIPMENT DETAIL

### Deep Freezer

A deep freezer is required to store reagents & samples. A 20°C - 80°C deep freezer are required to store of reagents (primers/probes/positive controls) & aliquoted samples/viral RNA in Cryovials respectively.

<table>
<thead>
<tr>
<th>Power consumption</th>
<th>120 W</th>
</tr>
</thead>
<tbody>
<tr>
<td>Voltage</td>
<td>220 - 240 Vac</td>
</tr>
</tbody>
</table>

### Refrigerator

A refrigerator is required to store viral transport medium, and for short term storage of samples and extracted RNA. It should maintain at a temp 4°C.

<table>
<thead>
<tr>
<th>Power consumption</th>
<th>100 - 130 W</th>
</tr>
</thead>
<tbody>
<tr>
<td>Voltage</td>
<td>220 - 240 Vac</td>
</tr>
</tbody>
</table>

### Autoclave

Autoclave can sterilize solids, liquids, hollows, and instruments of various shapes and sizes. A very basic autoclave is similar to a pressure cooker; both use the power of steam to kill bacteria, spores and germs resistant to boiling water and powerful detergents.

<table>
<thead>
<tr>
<th>Power consumption</th>
<th>1 - 2 kW</th>
</tr>
</thead>
<tbody>
<tr>
<td>Voltage</td>
<td>220 - 240 Vac</td>
</tr>
</tbody>
</table>
## Solar System Designs for Testing Labs

Govt approved RT PCR Viral detection - 20 samples in a day (8 hours)
Rapid RT - PCR - 40 samples- Since it gives test results in 2.5 hours, they can do 40 samples in a day

<table>
<thead>
<tr>
<th>Load Type</th>
<th>Wattage (W)</th>
<th>No of Appliances</th>
<th>Hours of Usage</th>
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</tr>
</thead>
<tbody>
<tr>
<td>RT-PCR</td>
<td>300</td>
<td>1</td>
<td>8</td>
<td>2.4</td>
</tr>
<tr>
<td>Deep Freezer (-20 degree C)</td>
<td>120</td>
<td>1</td>
<td>24</td>
<td>1.2</td>
</tr>
<tr>
<td>Deep Freezer (-80 degree C)</td>
<td>140</td>
<td>1</td>
<td>24</td>
<td>1.4</td>
</tr>
<tr>
<td>Refrigerator (4 degree C)</td>
<td>130</td>
<td>1</td>
<td>24</td>
<td>1.3</td>
</tr>
<tr>
<td>Microcentrifuge</td>
<td>72</td>
<td>1</td>
<td>4</td>
<td>0.288</td>
</tr>
<tr>
<td>Vortex Mixer</td>
<td>30</td>
<td>1</td>
<td>4</td>
<td>0.12</td>
</tr>
<tr>
<td>Microspin</td>
<td>60</td>
<td>1</td>
<td>4</td>
<td>0.24</td>
</tr>
</tbody>
</table>

Max Load that can be Connected: 852 W W
Max Units of Energy (kWh) Usage per day: 6.95 kWh
System Voltage: 96 V
Cost: INR 380,000*

* The cost includes cost of the solar energy system only.

For the current design, it is assumed that the labs will be operating for 8 hrs/day. If the number of tests/day are increased, the operating hours for the equipments would increase. While the number of equipments per lab will remain the same, the solar energy system design would need to be altered accordingly.

Note:
1. The usage of Autoclave is minimal here as the chemical disinfect is used
2. All electrical equipment power consumption varies based on the labs
REFERENCES

Prerequisites for establishing COVID-19 testing facility in Government and private Medical Colleges (Date: 13/04/2020)
https://www.mohfw.gov.in/pdf/NotificationofICMrguidelinesforCOVID19testinginprivatelaboratoriesIndia.pdf
Thank You!

Do get in touch for further information and assistance.

Write to us at:
covid19@selcofoundation.org

SELCO Foundation COVID-19 Response Website:
covid-19.selcofoundation.org

SELCO Foundation