[ECRT](https://ethiocovid19rt.com/)

[***#Proj-Ventilator***](https://join.slack.com/share/zt-e17jbnwl-oXH6uhMMkamSQn0soCZQXA)

***This workstream was created to address the shortage of ventilators and other essential medical devices in Ethiopia, in response to Covid-19 pandemic.***

***Short-Term Projects***

***Long-Term Projects***

**ECRT Team:**

* Lead - Biomedical Engineer, supporting ventilators and respiratory accessories at a large U.S medical device manufacturer.
* Advisors
  + Clinical Advisor - Respiratory Therapist in Ethiopia
  + Manufacturing Advisor - Experienced engineering professional with a demonstrated history of working in medical devices and automotive industries.
  + General Technical Advisor - Biomedical Engineering Professor, San Jose State University
* Engineers and Health professionals:
  + Engineers: Biomedical, Electrical, Mechanical, and Software
  + Health professionals: medical doctors, researchers, and clinicians

**Support from Local Ethiopian Government:**

* We have debriefed the senior advisor to the Ethiopian Ministry of Health and the Director of the Ethiopian Pharmaceutical Supply Agency. He is in alignment with our efforts and wants to help expedite this effort.
* We have also looped in the Ethiopian FDA (E-FDA) Director of Medicine Registration and Licensing to expedite the approval process for Spiro Wave with assist control capabilities.
* We have a clinical advisor, Habtamu Kehali, a respiratory therapist who will be validating products and training clinicians on Spiro Wave in Ethiopia.
* We have been in contact with local manufacturing entities in Ethiopia. We have confirmation from the head of the task force responsible for any kind of medical equipment to be assembled or manufactured in support of Covid-19 in Ethiopia. As soon as we have a clear and concrete plan on what we want, they’ll assign a point of contact to support us for manufacturing.

[**Maintenance of Medical Equipments in Ethiopia**](https://drive.google.com/drive/folders/1wR7itfmRruu7dXS35r1V6_plTUhN2HBh?usp=sharing)

* We are working on supporting [**Tegbaried College**](https://drive.google.com/drive/folders/14Nbl30ZdlBuFUWSs9fcTJb0IInTF4IhU?usp=sharing) efforts to repair and maintain faulty essential medical devices, below is the list of devices as prioritized by the Federal Ministry of Health ([FMOH](https://drive.google.com/file/d/1k5AMsUgROWcgPbSmv7EHfUyb8rGAsn4a/view)):

1. Mechanical Ventilator
2. Oxygen Concentrator
3. Patient Monitor
4. ECG

* Ethiopian Airlines Aviation Academy, Tegbaried Polytechnic College, and other institutions are repairing these devices to assist with the fight against the virus.
* The Associate Dean at Tegbaried Polytechnic College has requested our assistance in sourcing parts for the equipment requiring maintenance (see below). His efforts have been recognized by the Ministry of Health - Dr. Lia Tadesse.
* Needs:
  + [List of Accessories](https://docs.google.com/spreadsheets/d/1OKLIk86wIXym2wqHh6cRr_snB5tVM_Y9/edit#gid=2088322240)
  + [Covid-19 Maintenance Report](https://drive.google.com/file/d/1EtOMuQZdswA6eip0Jmq0ds1lmqq8hSzR/view?usp=sharing)
* [Cost Breakdown of Parts Needed](https://docs.google.com/spreadsheets/d/1KlWemwnPVk4OOu4BwTmTMRRhn--RoCSMuW_988v-LVY/edit#gid=2088322240)
* [Sourcing of Parts](https://docs.google.com/document/d/1MDeebTvcENiKIAYwdzhMTVtLVBWYW26m/edit)

Funding/Marketing Team working on fundraising campaign

**Sourcing List from Ethiopia Clinicians and Doctors**

The following items/devices are also important and yet missing from the recent government's bid to procure items in line with Covid 19.

* HEPA filter (bacteria and viral filter)
* Pulse-oximeters with capnometer capability
* High flow [Oxygen Therapy](https://drive.google.com/drive/folders/1vMNaohJ6e6aZFYjhqHHJmsQMzknO-jkB?usp=sharing) unit
  + Next Steps: summarize findings (is HFOT a better option?)
* Ambu-bag with PEEP valve option
* Video laryngoscopes
* Heater and humidifiers for the existing ventilators in country - most of the ventilators we have here don’t have this important add-on

[Oxygen Support Strategy For Ethiopia](https://drive.google.com/file/d/1qjoLReheJMASTByZi9DVvsly_vVBwMNe/view?usp=sharing)

[Oxygen Supplement may decrease death in Covid-19 patients](https://drive.google.com/file/d/1SNNIS7PvfmdxrTVc3OVIrLUZjc-oac63/view?usp=sharing)

We’re working on [Medical Device Acquisition Document](https://docs.google.com/document/d/1p0mWqlP0-n10UN-39be2uKcgO5mHInlVPEH0jfalk-E/edit?usp=sharing) to get all the information the funding team needs to raise money to support this.

**New initiative**

* + **Refurbished ventilators:**
    - Ideation phase - looking to acquire refurbished ventilators from the U.S

[**Local Manufacturing Initiative**](https://drive.google.com/open?id=1WkfvrIDeGA5dnnTyHXvMYQ-Kri4yqBh8)

Initial Planning and Preparation:

* [Design and Development Plan Proposed](https://docs.google.com/spreadsheets/d/1q-dXtvLxC20pxYXJf9PfjgR2XL4rULYtlUBsbdcWdLY/edit?usp=sharing)
* [Ethiopia product specification for a low-cost ventilator that meets minimum clinical and performance requirements tailored to Ethiopia](https://drive.google.com/file/d/104SlG0-raS4feIjTKrI_sFwBLwEB8Xz_/view?usp=sharing)
* [User Need Requirements](https://drive.google.com/file/d/1WitcPoqPPmHopEo9YMWe8MoB9p_oZJxK/view?usp=sharing)
* [Risk Management Plan](https://drive.google.com/open?id=12qN_6bU0QUNP8t1dg10ujaL623I8XmeX)

To give you a bit more context, we came across [a list of open source ventilator projects](https://docs.google.com/spreadsheets/d/1inYw5H4RiL0AC_J9vPWzJxXCdlkMLPBRdPgEVKF8DZw/edit#gid=0) ranked based on openness, buildability, community support, functional testing, reliability testing, COVID-19 Suitability, clinician friendliness and manufacturability.

Open Source Designs In Consideration:

* [Medtronic Open Source Design](https://drive.google.com/open?id=1DNLifXbI-vqsNMp9aK9SCCa1vZzcKaus)
  + [Funding Opportunities](https://drive.google.com/open?id=1s-yy6PeUNyyd9ymL9ACSwKCxCQYWLj9E) - Grant Applications
    - Assess Feasibility
      * Manufacturing capabilities in Ethiopia
      * Bills of Materials
      * Design Transfer
      * Electrical Schematics
      * Mechanical Designs
* [MIT Open Source Design](https://drive.google.com/open?id=1yQP-8z1lwNbFmEWAXvjOD5f-P2mVK4Fl)
  + Contacted Spiro Wave, first system inspired by the [MIT E-VENT](https://e-vent.mit.edu/) to receive Emergency Use Authorization ([Read More](https://docs.google.com/document/d/1omZnFzY81WUeSOQN2kCpw1kA0BO1mZV4a91ACE-ASeQ/edit?usp=sharing))

We quickly realized that [open source](https://github.com/PubInv/covid19-vent-list#almost-buildable-projects) low-cost emergency ventilators have little to no functionality or reliability testing done.

So, we looped in a professor from the [Biomedical Engineering department at SJSU](https://www.sjsu.edu/bme/) on the matter. We discussed this and started applying for research grants – [here](https://drive.google.com/file/d/1k7cGFVJ2VXy4IZQ43O6SbG7DpLZJArxY/view?usp=sharing) to address this problem. We are planning on setting up a system to test ventilators for reliability using the Biopac ventilator validation system.

[**Support Local DIY-Ventilator Prototypes**](https://drive.google.com/open?id=1QiY1fOoSio3neLQevubhwuwMdwptuatg)

Mechanical and electrical engineers from our group have been supporting 3 local R&D teams that are currently working on ventilator prototypes. Teams are working to submit design and working prototype to Ethiopian Airlines for review and potentially local production.

Teams are finding it difficult to source some parts locally. Currently, looking for the following parts:

* [N.E.R.D Group](https://www.facebook.com/watch/?v=588817985041297)
  + Oxygen, Pressure, and Airflow Sensors
  + Brushless DC Motor (If unavailable, alternatives can be used)
* [Zelalem](https://www.youtube.com/watch?v=h0ghTva0924&feature=youtu.be)
* [Ezedin](https://www.youtube.com/watch?v=ZnTzKKRJtQM&feature=youtu.be) 
  + Proximal Flow Sensor (2 pcs)
  + Pressure Sensor (2 pcs)
  + Spectrometer Spectro Sensor (2 pcs)

Data Sources:

[Current COVID-19 Patient Data](https://api.pmo.gov.et/v1/patients/)

[Health Facilities in Ethiopia](https://github.com/africa-covid-19-response-toolkit/core-geo-data/blob/master/hotosm_eth_health_facilities_points.geojson)

[README for an additional location-based data source](https://github.com/africa-covid-19-response-toolkit/core-geo-data/blob/master/README.md)

[List of Hospitals in Ethiopia](https://drive.google.com/open?id=18Ss1T-HC8jp7bEPcyopOKJHdy7qAWiGJ)

[**Research - Ventilators**](https://drive.google.com/open?id=1SqDi7o8ngDIzw31yHMXMKTKLdOWhPPIT)