RESPONDING TO THE COVID-19 PANDEMIC

COVID-19 continues to rage across the world, hitting the United States and many other countries hard, highlighting weaknesses in health system preparedness. **Globally, the total number of confirmed cases of COVID-19 has grown to more than 54.7 million, along with more than 1.3 million deaths reported in 191 countries** and regions as of November 16, 2020.[1] While the world awaits development of a successful vaccine, **International Medical Corps is there, in the US and globally, meeting the most critical needs, keeping health workers safe and innovating to help bring this outbreak to an end.**

As part of its global response to COVID-19, as of November 13, International Medical Corps has:

- **supported 1,171 health facilities**, including more than 100 facilities in 10 major hotspots in the US, offering emergency medical field units, medical equipment, personal protective equipment (PPE), medical volunteers and training;
- **trained more than 20,712 frontline healthcare professionals** on infection prevention and control (IPC) measures;
- **reached more than 3.4 million people with awareness-raising activities**, including messages on COVID-19, health and hygiene promotion, and community well-being activities;
- **screened more than 2.8 million individuals for COVID-19**; and
- **distributed more than 18.8 million PPE and IPC items** to supported health facilities.

International Medical Corps also expanded use of an innovative **high-flow nasal oxygen (HFNO) treatment, ultimately donating 72 HFNO units across 13 hospitals throughout the US and Puerto Rico**.

CASE STUDY: INTERNATIONAL MEDICAL CORPS INNOVATES TO HELP KEEP PATIENTS OFF VENTILATORS

Investing in Care Where it Is Needed Most

Early in the COVID-19 pandemic, the healthcare sector was faced with a massive wave of severe cases of COVID-19 manifesting as acute respiratory failure (ARF). Approximately 15% of patients with COVID-19 will have severe disease, and an alarmingly high 5% will require intensive-care unit (ICU) treatment—including oxygen therapy, and sometimes mechanical ventilation. In COVID-19, as with most other diseases, mechanical ventilation is not a direct treatment but is instead a supportive measure to ensure continued lung function while the disease runs its course. It is a complex process reserved for the ICU setting and is done only if respiratory parameters are incompatible with life. COVID-19 presents a unique disease course, with several differences in ventilator management. One difference is the prolonged dependency patients have on the ventilator—more than two weeks for a majority of patients. Despite prolonged treatment, early in the outbreak, case-fatality rates for patients on mechanical ventilation reached 60%.[1] Those that do survive suffer significant physical and mental morbidity from prolonged ventilator dependency.

With the massive burden of COVID-19 infections, hospitals across the globe were overwhelmed with patients suffering from ARF and requiring intensive respiratory support. The number of patients requiring mechanical ventilation quickly outstripped available resources. All forms of ventilatory support were in short supply, with a production timeline of two to three months before additional supplies could be obtained. International Medical Corps recognized that alternative treatment options would be critical to the response, requiring innovative approaches to supporting patients with ARF.

[1] https://coronavirus.jhu.edu/

[1] Petrelli CM, Jones SA, Yang, J, et al. Factors associated with hospital admission and critical illness among 5279 people with coronavirus disease 2019 in New York City: prospective cohort study. BMJ 2020;369

Leading in High-Flow Nasal Oxygen Treatment: Adapting Respiratory Therapy to COVID-19

International Medical Corps' teams quickly understood that assessing and supporting the "oxygen ecosystem" was key in the response to COVID-19. We leveraged lessons learned in critical care and analyzed the existing evidence base, in consultation with respiratory critical-care specialists and hospital partners, to determine alternatives to mechanical ventilation. HFNO treatment emerged as an innovative and promising approach to responding to the burden of ARF associated with COVID-19, at a fraction of the production time and cost. An HFNO is essentially a high-concentration oxygen-delivery device with special flow characteristics that offers a small amount of pressure to wash out the upper airway cavity (nose, mouth and throat) and keep it filled with high levels of oxygen. By providing high concentrations of oxygen immediately accessible to the lungs, it decreases respiratory effort and improves pulmonary properties.[2,3] HFNO is, essentially, oxygen delivery with some modest ventilatory assistance. Patients are more comfortable on HFNO and can avoid the lung damage that can come with the constant positive pressure of ventilators. (See *Appendix A: Understanding the Oxygen Ecosystem*.)

Now, several months into the pandemic, HFNO treatment is seen as a mainstay treatment for severe COVID-19 patients, with growing evidence showing the added benefit of preventing the need for mechanical ventilation.[4,5] With early recognition and institution of HFNO treatment, a patient's natural respiratory mechanism can be preserved, to avoid the need for ventilatory support and its associated morbidity and mortality.

In consultation with hospital partners and critical care specialists, International Medical Corps delivered HFNO supplies for innovative treatment of ARF and COVID-19 before shortages for such supplies emerged. International Medical Corps was able to donate 72 HFNO units to 13 hospitals, along with other key medical equipment (see the table below).

Equipment Provided to Support the Oxygen Ecosystem

Oxygen Ecosystem Component	Equipment
Diagnostic	Pulse Oximeter = 240 (17 hospitals)
Supply	Oxygen concentrator = 45 (7 hospitals)
Delivery	HFNO = 72 (13 hospitals)

As these patients are prevented from having to progress to mechanical ventilation, International Medical Corps and our partners will see the long-term impact of this innovative HFNO treatment on ARF and COVID-19 morbidity and mortality.

INTERNATIONAL MEDICAL CORPS: FIRST RESPONDER

International Medical Corps is a global, humanitarian, nonprofit organization dedicated to saving lives and relieving suffering through emergency response and development programs. Our mission is to improve the quality of life through health interventions, healthcare training and related activities that build local capacity in underserved communities worldwide as they make the journey from relief to self-reliance. Since our founding in 1984, our teams have delivered some $3.2 billion in relief and training services to tens of millions of people, in more than 80 countries, suffering from the devastating impact of humanitarian crises. With a staff of more than 7,200 worldwide—more than 90% of whom are recruited locally—our teams ensure that the knowledge required to prepare for and respond effectively to a disaster remains anchored within the community. Over the last year, we reached more than 8 million people in 30 countries affected by armed conflict, natural disaster and disease.

[2] Rochwerg B, Brochard L, Elliott MW, et al. Official ERS/ATS clinical practice guidelines: Noninvasive ventilation for acute respiratory failure. Eur Respir J. 2017;50(4).
[3] Frat JP, Coudroy R, Marjanovic N, et al. High flow nasal oxygen therapy and noninvasive ventilation in the management of acute hypoxic respiratory failure, Annals of Translational Medicine. 2017 5(14):297
[4] Sun Q, Qiu H, Huang M, Yang, Yi. Lower mortality of COVID-19 by early recognition and intervention: experience from Jiangsu Province. Annals of Intensive Care. 2020; 10(30).
[5] Society of Critical Care Medicine: https://www.sccm.org/COVID19RapidResources/Resources/High-flow-nasal-cannula-(HFNC)-use-in-COVID-19-res

APPENDIX A: UNDERSTANDING THE OXYGEN ECOSYSTEM

Mechanical Ventilation in COVID-19

Mechanical ventilation is an invasive form of respiratory support where a patient is placed in a medically induced coma while a tube is placed through their nose or mouth into the trachea to stabilize and support respiration. The tube is then connected via a tubing circuit to a ventilator machine that can support respiration using a host of variables that relate to oxygenation (the percent concentration of oxygen delivered by the ventilator to maintain physiologic blood-oxygen levels) and ventilation (a formula of pressures to deliver oxygen down the length of airways while allowing carbon dioxide to be expired).

Oxygen Ecosystem

Mechanical ventilation is only one part of the overall "oxygen ecosystem" of a health facility. Assessing and supporting the whole of the oxygen ecosystem is a component of the clinical response to COVID-19. The oxygen ecosystem encompasses several components that can be broken down into three parts: 1) diagnostics, 2) supply and 3) delivery or therapy. Examples of diagnostics include pulse oximetry and blood gases. Pulse oximetry is a non-invasive method of measuring the oxygen saturation of the blood through the absorption pattern of two wavelengths of light sent across a body part (typically a finger or earlobe) to a photodetector. These devices vary in size from small, portable fingertip sensors to fixed, multi-parameter, critical care monitors. Blood-gas measurement requires a sample of blood and offers better accuracy, but requires a fixed laboratory with a blood gas analyzer.

Medical-grade oxygen supply comes in a number of forms, including liquid concentrate, compressed gases and ambient oxygen generators. Liquid oxygen is stored in tanks and is the primary form of oxygen stores for hospitals. It is routed throughout the hospital via a complex network of piping. Compressed gases are stored in cylinders and primarily used for back-up and transportation. Ambient oxygen generators can range in size from large oxygen-converting plants to smaller portable units, such as oxygen concentrators. Oxygen generators require a reliable source of power to ensure continuous supply of medical-grade oxygen.

Depending on the needs of the patient, oxygen delivery and therapy can be administered via two treatment tiers. The first level is to deliver oxygen only, using the spontaneous respiration of the patient. This primarily involves the use of various cannula and mask configurations that are connected to an oxygen flow meter that regulates the oxygen source. Oxygen delivery can range from low dose, at 1-2L/min via a nasal cannula, to high doses, at 10L/min using a non-rebreather mask. This requires the spontaneous respiration of the patient in order to breath in the flow of oxygen.

As patients become more critical, spontaneous respiration is either weak or completely lost, and assistance with ventilation is needed. These ventilatory support mechanisms can be broken down further into two classes: invasive and non-invasive. Invasive ventilation is described in our earlier section on mechanical ventilation. Equipment used for non-invasive ventilation includes a combination of special masks that create a seal connected to a device that can deliver low levels of pressure to support ventilatory needs. A common device is the continuous positive airway pressure (CPAP) machine, found in many homes to aid in oxygenation while sleeping. The bilevel positive airway pressure (BiPAP) machine found in the hospital setting has added pressure parameters, and its non-invasive ventilatory hood forgoes the mask, instead using a sealed cranial hood.