

*A Practical Guide for ECMO Service Utilization  
in COVID-19 Patients  
(Version 1.0) April 28, 2021*

## 1. Introduction:

### 1.1 Background:

The COVID-19 pandemic, a novel and highly transmissible respiratory virus, is placing significant stress on health care systems around the world. Intensive care units (ICU)s are forced to rapidly increase capacity in order to accommodate a large number of critically ill patients.

Extracorporeal Membrane Oxygenation (ECMO) is a highly technical therapy and is resource intensive. While the distribution of this therapy should be as impartial as possible, during a pandemic such as COVID-19, offering this limited advanced and resource-intense service should be directed and focused on candidates with the highest chances for recovery while being able to provide other available ICU resources and maintaining an environment of patient and staff safety.

The Saudi Ministry of Health (MOH) has established a nationwide ECMO Program that helped to extend the service across the country, utilizing the services of the lifesaving hotline 1937.

With the building up of the team experience and the emergent of new evidence about the disease and technology, a further program enhancement is needed.

### 1.2 Aim of the Scope:

To establish a practical guide for ECMO utilization in COVID-19 pandemic for adult patients admitted to the ICUs with refractory hypoxic and/or hypercapnic respiratory failure which will assure:

- Efficient utilization of ECMO service in the COVID-19 era.
- Unifying the selection criteria for ECMO candidacy.
- Decrease the mortality and morbidity for the ECMO patients.
- Provide guidance for remote hospitals to identify patient requiring potentially ECMO service early.
- Assure clear understanding of the MOH ECMO referring system to hospitals.

### 1.3 Targeted Population:

All adult COVID 19 patients suffering from acute hypoxic and/or hypercapnic respiratory failure refractory to optimum conventional acute respiratory distress syndrome (ARDS) management.

### 1.4 Targeted End User:

- Adult critical care medicine physicians
- Adult anesthetist physicians.
- Adult cardiac surgeon.
- Perfusionists.
- ICU nurses.
- Respiratory therapists.

### 1.5 Conflict of interest:

No conflict of interest.

### 1.6 Funding:

None.

## 2. Definitions:

- ECMO: extracorporeal membrane oxygenation.
- VV ECMO: veno-venous ECMO.
- VA ECMO: veno-arterial ECMO.

## 3. Best practice recommendations:

### 3.1 Patient selection and timing of ECMO initiation:

ECMO indications during the COVID 19 crisis should be based on ECMO system capacity in the region to insure offering it to those who would benefit the most. The capacity of ECMO system will be decided by the MOH leadership. The MOH leadership will assure that the ECMO service will be provided to all indicated cases.

### -The ECMO System Capacity is divided to the following:

#### (i) Conventional Capacity (Green Zone)

##### Definition:

- System is running regularly with normal existing ECMO system capacity.
- Green zone: <30% occupancy of ECMO machines in the region.
- Action → Judicious patient selection for COVID-19 and NON COVID-19 cases (as per the ECMO selection criteria below)

#### (ii) Contingency Capacity Tier I (Yellow Zone):

##### Definition:

- System is running with expanding existing capacity.
- Yellow Zone: 30-60% occupancy of ECMO machines in the region.
- Action → Follow up strict ECMO criteria including Age <45 (check selection criteria section below).

#### (iii) Contingency Capacity Tier II (Red Zone):

##### Definition:

- System is running with stretched existing capacity close to saturation.
- Red Zone: 60-90% occupancy of ECMO machines in the region
- Restricted patient selection (selection criteria section below).

- **Action** → ECMO utilization inside the hospital or as retrieval should be discussed in the ECMO committee of the designated center in that region and approved by MOH ECMO program director.  
→ We highly recommend that services that might utilize ECMO (e.g., cardiac surgery, high risk PCI, etc.) should decrease the load to only emergency base cases. A decision should be made by hospital administration.

**(iv) Crisis Capacity (Black Zone):**

Definition:

- System and capacity are overwhelmed.
- Black zone: >90% occupancy of ECMO machines in the region.
- **Action** → ECMO services should be temporarily suspended. The decision will come from MOH leadership.

**3.2 Selection of COVID- 19 patients needing ECMO referral (See Algorithm in Appendix I):**

- ECMO Criteria should only be considered to carefully selected patients.
- ECMO should not be considered in patients who are unlikely to benefit and in those with significantly reduced life expectancy from pre-existing disease.

**3.2.1 Selection criteria for VV ECMO referral for COVID -19 refractory ARDS in green zone:**

COVID-19 patient with acute refractory respiratory failure will be considered for ECMO if they meet all of the following:

- 1) Age < 55 years old
- 2) No comorbidities (except controlled DM and HTN).
- 3) Single organ failure (Lung).
- 4) PaO<sub>2</sub>/FiO<sub>2</sub> < 100 on FiO<sub>2</sub> 100% and PEEP > 14.
- 5) Well sedated for achieving Richmond Assessment Score (RAS) of -3.
- 6) Paralyzed with muscle relaxants.
- 7) Completed at least one trial of prone positioning for at least > 16 hrs.
- 8) Mechanically ventilated for less than 5 days.
- 9) O<sub>2</sub> Saturation < 85% despite the completion of all of the above treatment options.
- 10) Normal troponin, D dimer, Liver enzymes, and renal function (excluding reversible prerenal failure by only IV fluid management) and with no evidence of myocarditis.

**3.2.2 Selection criteria for VV ECMO referral for COVID- 19 refractory ARDS will be modified once there is increase demand on the ECMO service as follow:**

- 1) Yellow Zone:
  - i. Age limit will be reduced to 45 years old.
  - ii. Patient should not have any comorbidities.
  - iii. Patient should not have acute renal failure.
  - iv. PaO<sub>2</sub>/FiO<sub>2</sub> < 100 on FiO<sub>2</sub> 100% and PEEP > 14.
  - v. Other criteria should be as above in the green zone criteria.
- 2) Red Zone:
  - i. Age limit will be reduced to 35 years old.
  - ii. Other criteria should be as above in the green zone criteria.
  - iii. The final decision will be by the MOH program director and the MOH ECMO committee.
- 3) Black Zone:
  - i. ECMO service will be suspended.

### 3.3 Process of referring potential ECMO cases to ECMO centers:

The MOH has created a hotline for ECMO consultations and retrievals through 1937 center. This has increased the catchment area for cases and supported the referring hospitals in optimizing the care for these severely critical care patients.

To refer a case that potentially need ECMO service, follow the below steps:

1. Apply the selection criteria mentioned above to your patient.
2. Call **1937** and press 1 to reach the lifesaving line.
3. Ask for the ECMO consultant on call (service available 24/7).
4. Complete the ECMO referral form which will be provided by the ECMO coordinator.
5. Once the referral is completed and submitted, the ECMO consultant will discuss the case thoroughly with the referring physician.
6. The ECMO consultant will decide whether the case is indicated or not.
7. If case is accepted:
  - a. The referring physician will secure the consent from the patient next of kin as per the referring hospital procedure consent policy and explain the advantages and disadvantages of the ECMO as per the recommendations of the ECMO consultant on call. The consent has to involve that the patient will also be transferred to the ECMO center designated by the ECMO consultant on call.
  - b. The referring physician should call the ECMO consultant, in case the consent is not secured and/or refusal of the procedure to close the case.
  - c. Once consent is secured, the referring hospital will immediately create an official referral on Ehalaty through the medical coordination office in the referring hospital to the ECMO center recommended by the ECMO consultant and provide the Ehalaty number to the 1937 lifesaving coordinator assigned to the case.

- d. The referring physician will continue to manage the patient appropriately until the ECMO retrieval team arrives.
- e. The referring physician will assure implementation of the ECMO consultant recommendations that will be sent in written as a reply to the ECMO referral form.

### References:

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## Flow Chart for COVID 19 ARDS patients needing ECMO service (Green Zone)

