



## **EuroELSO GUIDELINES FOR TRAINING & CONTINUING EDUCATION OF ECMO PHYSICIANS**

### **PURPOSE**

The "EuroELSO Guidelines for Training & Continuing Education of ECMO Physicians" is a document developed by the Extracorporeal Life Support Organization (ELSO) as a reference for current & future ECMO centers and has been adapted by the European ELSO chapter (EuroELSO) to adhere to European regulations and to reach harmonization throughout European ECMO centers.

It is to be used as a guideline for designing training & education programs for ECLS physicians in accordance with institution specific guidelines & policies. In the development of these documents and programs, ECMO Directors must adhere to institutional requirements for training programs and must have policies & procedures reviewed by appropriate hospital committees. *Please note that institutional and personnel requirements for ECMO programs are addressed in the ELSO document, "Guidelines for ECMO Centers", and will not be discussed in this document*

### **INTRODUCTION**

The term "*ECMO-trained Physician*" is defined in these guidelines as "the physician trained to manage the clinical needs of the patient on ECMO and direct and supervise ECMO specialists\*". The individual functioning as the ECMO physician should have a background in either adult, paediatric or neonatal intensive care medicine, cardiothoracic surgery, anaesthesia or cardiology and be registered with the medical board in their country of practice. They may be in either a training or consultant grade. Physicians must have successfully completed their institutional training requirements.

There should be a 24/7 ECMO patient coverage by a member of the medical staff who has received specific ECMO training according institutional training requirements.

The ECMO-trained physician should at least have completed the basic ECMO training with the recommended training curriculum and physicians responsible for cannulation should additionally take a cannulation course.

It is recommended that all ECMO trained physicians

- undertake basic and advanced training in the provision of ECMO
- participate in advanced ECMO courses and attend ECMO meetings
- exchange knowledge and experience with other ECMO centers & within national and international ECMO organizations
- supervise the institutional participation in ECMO registries
- record and evaluate in-house ECMO patient data
- keep updated concerning latest ECMO related development and research.

## **TRAINING**

General training

ECMO physicians should receive specific training on the intensive care management of ECMO patients and where appropriate to their role, training in retrieval medicine and cannulation (open or percutaneous depending on their role):

### **Physician Basic Training: Training curriculum:**

The training programme should be individualized to the institutional requirements.

**A. Didactic Course:** The didactic course will take 24-36 hours and should include, but not be limited to the following modules:

- Introduction to ECMO, including: Historical background & growth – Evidence, worldwide experience & research - Indications & time of decision - Risks & benefits - ELSO mission & data registry
- Basic ECMO physiology, including:
  - Types of ECMO + characteristics
    - VA – VV – AV – hybrid configuration
    - Respiratory – Cardiac
    - Adult – pediatric
  - Basic gas exchange physiology (Oxygen content, delivery & consumption)
  - Optimisation of physiology on ECMO (maximizing systemic oxygenation on VV ECMO and systemic oxygen delivery on VA ECMO)
- Respiratory ECMO, including:
  - Causes & pathophysiology of severe respiratory failure
  - Evidence, Criteria & contraindications for respiratory ECMO including: Patient Selection, Selection criteria, Pre-ECMO evaluation
  - Ongoing research
  - Pre ECMO procedures: Timing, logistics & responsibilities
  - Special procedures/protocols: ECCO2R
- Cardiac ECMO , including:
  - Causes & pathophysiology of severe cardiac failure
  - Evidence, criteria & contraindications for cardiac ECMO including: patient selection, selection criteria, pre-ECMO evaluation
  - Ongoing research

- Pre ECMO procedures: Timing, logistics & responsibilities
- Special procedures/protocols: ECPR
- Cannulation, including:
  - Use of imaging to guide cannulation (vascular ultrasound, echocardiography and/or fluoroscopy as per institutional requirements)
  - Ionising Radiation (Medical Exposure) Regulations (IRMER) training as per institutional and national requirements
  - Drainage & return cannula: choice of cannula site, approach (peripheral, central), techniques (surgical, percutaneous), number (single, dual, triple), type & specifications of cannula (double/single lumen, single/multiple staged, length & diameter, coating), choice of cannula (pressure/flow charts)
  - Unloading of the heart (LV venting cannula, IABP, Impella) in VA ECMO
  - Distal limb cannulation in VA ECMO
  - Different methods to verify cannula position
  - Cannula related complications (perforation, position, kinking, recirculation, clotting, ischaemia, oedema)
  - Specific procedural training in cannulation using learning aids such as cannulation mannequins, animal models and bedside teaching as per institutional requirements and availability. A minimum of 10 supervised cannulations should be undertaken prior to competency being signed off
- Physiology of coagulation, including:
  - Coagulation cascade - Clotting abnormalities
  - Blood surface interactions – Coating
  - Heparin & alternative anticoagulants
  - Blood products & interactions - Blood product management of the bleeding patient
  - Laboratory tests for anticoagulation management (ACT, aPTT, heparin concentration, TEG, FDP, D-dimers, platelet count & function)
  - Anticoagulation management
- ECMO equipment, including:
  - ECMO Circuit: composition, design & priming
  - Oxygenator: types, function & blood gas control
  - Heat exchanger
  - Blood pump: types & characteristics
  - In-/online monitoring: venous & arterial O<sub>2</sub> saturations, circuit pressures, bubble detector, servoregulator
  - Hardware: features & alarms
- Daily Patient & Circuit monitoring management on ECMO, *including:*
  - Patient: Intensive care management of the patient on ECMO including full multiple organ support in line with national requirements for intensive care training
  - Circuit: Interpretation of circuit assessment and monitoring
  - Appropriate documentation and plans for the day
- Emergencies & complications during ECMO, including:

- *Medical*: Supervision and direction of the response to all medical complications on ECMO
- *Mechanical*: Identification and management of mechanical complications including the indication and method of circuit change and cannula repositioning/replacement
- Weaning from ECMO , *including*: Clinical indications & monitoring of pulmonary and/or cardiac recovery - Pump/gas flow weaning techniques for VA/VV ECMO – coagulation targets during weaning - Ventilator changes during weaning - Trial off support –

Decannulation from ECMO including role specific surgical and non-surgical techniques and their complications

Post-ECMO intensive care support of the ECMO patient in line with national Intensive Care medicine training

- Short- & long-term outcome of ECMO patients: Institutional follow-up protocol
- Ethical & social issues: Parental & family support - Withdrawal from ECMO support

**B. Water-drills**: These sessions (4-6hrs) should be small enough so that each ECMO physician has hands-on experience. A full understanding of the driving console technology, operation modes and all possible circuit emergencies with the appropriate intervention should be accomplished by the end of this session.

- Each trainee should be able to recognize all functions of the hardware or driving console, change settings and manage hardware alarms.
- Each trainee should be able to understand and operate all ancillary ECMO monitoring/devices such as Oxygen saturation monitor, pressure monitors, gas supply and blender
- Each trainee should be able to understand and demonstrate how an ECMO circuit is composed, primed and how an ECMO run is technically initiated.
- Each trainee should be able to access and sample ports to the circuit, incorporate hemofiltration filter into the ECMO circuit, change pigtails and stopcocks, perform a daily ECMO circuit check.
- Each trainee should be taught how to act in emergencies while awaiting the technical back-up (perfusionist) to arrive; loss of venous return, air removal, clamping off patient from circuit, handcrank in case of pump failure, back-up battery in case of prolonged power failure, urgent IV fluid administration...
- Each trainee should be able to describe and conceptually demonstrate how to change the major equipment (circuit, pump, oxygenator, heat exchanger) in a time consistent with clinical requirements.

For new centers the water drill sessions should be repeated until all team members gain a solid understanding of the management of the ECMO system and are fully competent managing simulated ECMO emergencies. For experienced centers, water drills should be organized on a regular base, taking into account the in-house case load and ongoing maintenance of experience.

**C. High Fidelity Simulation training** requires high tech simulation equipment and - if performed by experienced trainers - can partially replace bedside clinical hours, especially in low volume centers.

High fidelity simulation training is ideal to evaluate if the ECMO physician achieved the required knowledge and competence in managing ECMO related interventions in routine & emergency situations.

High Fidelity simulation training will be able to realistically imitate the physiology of the ECLS supported patient and help ECMO physicians understanding the:

- the interaction between patient hemodynamics & circuit support
- the interaction between patient lung function & oxygenator support
- the interaction between ECLS flow and patient generated flow in different cannulation configurations
- the influence of patient fluid status to circuit functioning and patient support
- the influence of patient pressures on circuit generated flow and vice versa

High Fidelity simulation training is also an efficient tool to recognize importance of and train in teamwork & communication skills (cognitive, .technical and behavioral skills)

**D. Bedside training:** new ECMO physicians should have a minimum of 100hrs supervised practice at the bedside by a competent ECMO physician until deemed competent according to locally developed competencies. During this training, the trainee should gain understanding of the interaction between ECLS support & patient physiology and will be taught how to take care of a patient on ECLS support.

#### **EVALUATION & INSTITUTIONAL CERTIFICATION OF THE ECMO Physician**

A. **Written Evaluation:** Each physician should have on record a written evaluation of their skills and competence during all sessions of the ECMO training course including; course attendance, water-drills and examinations.

B. **Written and/or Oral Exam:** All physicians should undertake a locally developed examination covering didactic and laboratory sessions with a locally agreed pass mark.

C. **Institutional Certification:** Institutional certification of ECMO physicians will be granted after successful completion of the ECMO training course (didactic, water drills, bedside training) and successfully passing the oral and/or written exam and any relevant locally agreed competencies.

#### **CONTINUING EDUCATION OF THE ECMO physician**

A. **In-house team meetings:**

- Which includes: Case reviews - Updates on ECMO therapy - Quality assurance - Review of ECMO policy and procedures - Administrative information
- Frequency of meetings should be based on the size of the team and the volume of ECMO patients treated.
- Attendance records should be monitored and team members should be required to attend a certain number of meetings as specified by the particular ECMO center.
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B. **Attendance at multicenter national or international ECMO meetings** is recommended to share experience, gain new insights and get updated concerning ongoing research & new technologies.