



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

### **PURPOSE**

The "EuroELSO Guidelines for Training and Continuing Education of ECMO Specialists" 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 specialists. It is assumed that each ECLS center develops their institution specific guidelines & policies for training ECLS Specialists, which may vary. In the development of these documents and programs, ECMO Directors & Coordinators must take into account their institution's requirements for in-house 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 Specialist" is defined for the purpose of these guidelines as "the technical specialist trained to manage the ECMO system and the clinical needs of the patient on ECMO under the direction and supervision of a licensed ECMO trained physician". The individual functioning as the ECMO Specialist should have a strong critical care background in neonatal, pediatric and/or adult critical care and have attained one of the following:

1. Successful completion of a nurse training program in a national or European recognized school of nursing, successful completion of the required examinations and holder of a work visa or an official license to practice, issued by the national government.
2. Successful completion of an accredited school of respiratory therapy, successfully completion of the required examinations and holder of a work visa or an official license to practice, issued by the national government.

3. Successful completion of an accredited school of perfusion and holder of a national and/or European certification, issued by the European Board of Cardiovascular Perfusion (EBCP).
4. Physicians trained in ECMO who have successfully completed institutional training requirements for the clinical ECMO specialists.
5. Other medical personnel such as biomedical engineers or technicians who received specific ECMO training and have practiced as an ECMO specialist since the initiation of their programs, and who have completed equivalent training in ECMO management as the other specialists, have successfully documented necessary skills as an ECMO specialist, and who have been approved specifically as an ECMO specialist by the medical director. These personnel can be approved institutionally as an ECMO specialist under the “grandfather” principle. However ELSO does not encourage or support the new training of individuals except as outlined in 1-4 above.

## **TRAINING**

Training of the ECMO should be issued on 2 levels :

1. **Basic Training** for new ECMO programs or for all new ECLS specialists. The basic training is beneficial to all those interested in ECLS technology for professional purposes which can either be clinical, educational, research related as commercially related. All centers offering ECLS therapy should offer this basic training to those taking care of the ECMO patient. Basic training consists of didactic training, wetlab training and bedside training.
2. **Advanced training** for experienced ECMO programs or experienced ECLS specialists : for centers which have been in ongoing operation to keep updated, to gain new insights and to address specific areas of problems.

**Basic training** can be offered by ECLS specialized trainers in any established and experienced ECMO center as long the suggested curriculum is adhered to (cfr infra) or standardized EuroELSO course material is used.

It is the aim of EuroELSO to provide online educational material or e-learning for basic didactic ECMO training. The goal is to help centers to provide educational material for quality inhouse ECMO training and to standardize ECMO courses. ECMO trainers can use these EuroELSO labeled basic courses to teach ECLS related fundamentals without having to invest time to make new courses and to ensure uniformity in basic ECLS knowledge amongst European ECMO centers. They are also useful for self-education so that trainees can prepare themselves ahead of any practical ECMO training or prior to an advanced ECMO course or ECMO meeting.

The didactic online courses are prepared by experienced ECMO trainers and are in accordance with ELSO guidelines. They will be updated on a regular base.

The didactic courses are available to all individual EuroELSO members or to EuroELSO registered centers via the ECMO coordinator or Program Director. Online testing will become available and it is recommended to take exam and renew certificate of basic theoretical ECLS knowledge on a yearly base.

Water drills or practical skills training should be performed in every individual center, using the local equipment and local protocols. There will also be written guidelines for hands-on and simulation required in basic courses.

**Advanced training programs** will focus on team interaction, complex clinical cases and complex ECLS related issues such as patient transportation, cannulation, human factor training,.... Advanced training courses should request a EuroELSO quality label guaranteeing the advanced level of content and high experience of trainers. Advanced training courses can ask support or guidance from EuroELSO.

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

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

- 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)
- Respiratory ECMO, including :
  - Causes & pathophysiology of severe respiratory failure in adults & pediatrics
  - 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 in adults & pediatrics
  - 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 : ECPR
- Cannulation, including :
  - Drainage & return canula : choice of canula site, approach (peripheral, central), techniques (surgical, percutaneous), type & specifications of canula (double/single lumen, single/multiple staged, length & diameter, coating), choice of canula (pressure/flow charts)

- Unloading of the heart (LV venting canula, IABP, Impella) in VA ECMO
- Distal limb cannulation in VA ECMO
- Canula related complications (perforation, position, kinking, recirculation, clotting)
- Physiology of coagulation, including :
  - Coagulation cascade - Clotting abnormalities
  - Blood surface interactions – Coating
  - Heparin and alternative anticoagulants
  - Blood products & interactions - Blood product management of the bleeding patient
  - Laboratory tests for anticoagulation management (ACT, aPTT, hep concentration, TEG, FDP, d-dimers,...)
  - 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 saturations, pressures, bubble detector, servoregulator
  - Hardware : features and alarms
- Daily Patient & Circuit monitoring management on ECMO, *including :*
  - Patient : Fluid, electrolytes & nutrition - Respiratory - Neurologic - Infection control - Sedation & pain control - Hematology - Cardiac - NIRS - Mobilization & patient positioning - Psychological
  - Circuit: Aseptic sampling technique - Pump/gas flow - Pressure monitoring - Blood product infusion techniques - Circuit infusions - Management of anticoagulation - Circuit checks - Hemofiltration set-up - Bedside care of the ECMO patient
  - The use of documentation such as the flowsheet, physician and standing orders
- Emergencies & complications during ECMO, including :
  - Medical: Uncontrolled bleeding – Pneumothorax - Cardiac Arrest - Hypotension/hypovolemia – Hypertension - Coagulopathy - Seizures – Tamponade - Limb hypoperfusion/ischemia – Harlequin syndrome – LV distention – Heart cavities/aortic root clots - Hemolysis
  - Mechanical: Circuit disruption - Tubing rupture - System or component alarm/failure (pump, bladder, venous return monitor, oxygenator, heater) – Circuit air & air embolus - Inadvertent decannulation - Clots – Recirculation
- Weaning from ECMO , including : Clinical indications & monitoring of pulmonary and/or cardiac recovery - Pump/gas flow weaning techniques for VA/VV ECMO – ACT monitoring during weaning - Ventilatory changes during weaning - Trial off support - Decannulation procedures (Potential complications - Vessel ligation - Vessel reconstruction) – post ECMO support & complications

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

**B. Water-drills**: These sessions should be small enough so that each individual 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 reasonable period of time.

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. Bedside training** : new ECMO specialists should have a minimal hours (?) of bedside ECMO training under supervision of an experienced ECMO specialist.

**D. High fidelity simulation training** performed by experienced trainers can partially replace bedside clinical hours and are ideal to evaluate if the ECMO specialist achieved the required competence in managing ECMO related interventions in routine and emergency situations.

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

A. **Written Evaluation**: Each specialist 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/Oral Exam**: Written exam, with pre-determined passing level, covering didactic and laboratory sessions should be taken by all Specialists.

C. **Institutional Certification**: Institutional certification of ECMO Specialists 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.

## **CONTINUING EDUCATION OF THE ECMO SPECIALIST**

### 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.

B. Water-drills: Water drills should be held periodically throughout the year as specified by the particular ECMO center. The exact interval should be based on volume of ECMO patients treated in the ECMO center.

C. Annual examination: This is recommended to verify the knowledge and skills of all specialists. Ongoing evaluation of performance should also be conducted and reviewed with the Specialist.

D. Minimum number of hours of pump time: Each center should set a minimum amount of pump time for the specialist to maintain competency. For example, a center might specify that each Specialist performs at least one 8-hour clinical shift every eight weeks in order to maintain certification. Re-training should be undertaken if this standard is not met.

E. Attendance at multicenter national or international ECMO meetings is recommended to share experience, gain new insights and get updated concerning ongoing research & new technologies.