

## Guidelines

**\*On behalf of the Association for European Paediatric and Congenital Cardiology working group “pulmonary hypertension, heart failure, and transplantation”.**

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# Recommendations from the Association for European Paediatric and Congenital Cardiology for clinical training in paediatric heart failure and transplantation\*

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## Abstract

Advanced medical and surgical treatment of heart failure and management of patients following heart transplantation is an emerging area. Treatment options at various levels are becoming available in an increasing number of countries. This rapidly evolving field involves a complex multi-disciplinary approach with a number of complementary medical and surgical strategies, including pharmacotherapy, structural cardiac interventions, electrophysiological optimisation, mechanical circulatory support, and heart transplantation. Furthermore, the importance of psycho-social support and care of patients and their families cannot be overstated. The aforementioned challenges and dynamics of new developments require guidance for core and advanced medical training in heart failure and transplantation. The Association for European Paediatric and Congenital Cardiology working group “pulmonary hypertension, heart failure and transplantation” has produced this document as an expert consensus statement; however, all recommendations must be considered and applied in the context of the local and national infrastructure and legal regulations.

## Background

Treatment of advanced heart failure including mechanical circulatory support and heart transplantation has grown rapidly over the past two decades and now comprises complex integrated care pathways involving numerous medical and surgical teams in decision-making process and management. Therefore, clinical core training in paediatric cardiology must include sufficient exposure to develop competency in the evaluation of patients with heart failure in order to counsel patients and families competently and make an appropriate referral. Trainees wishing to develop a special interest in heart failure and transplantation should aim to achieve basic competence in paediatric cardiology during the initial training period – core speciality training. Trainees who enter a specific sub-specialist training post will spend a much greater proportion of clinical and research time devoted to heart failure and transplantation. We have here set out guidance for paediatric cardiology trainees in Europe wishing to pursue basic and advanced programmes in paediatric heart failure and transplantation. Tenets of the requirements of these programmes have previously been outlined by North American Societies for both paediatric<sup>1,2</sup> and adult heart failure.<sup>3,4</sup>

## Training in heart failure and transplantation

Core (general) paediatric cardiology training will include an introduction to the care of patients with heart failure and post heart transplant. Those wishing to specialise in this field will require an additional period of 2 years’ training in an accredited specialist centre in order to achieve the curriculum competencies and obtain necessary experience in transplant medicine. For a trainee aiming to become a general cardiologist with a special interest in heart failure, 1 year of training in a specialist transplant cardiology unit will be sufficient. In such cases, a year in pulmonary hypertension training or cardiovascular imaging would be a useful, but not essential, complementary addition.<sup>1</sup> The syllabus for the core training should include evaluation and treatment of the ambulatory patient with heart failure, and development of skills and knowledge needed for an appropriate referral to the dedicated advanced heart failure and transplant unit (Table 1).

**Table 1.** Summary of paediatric cardiology training in heart failure and transplantation.

Core training in heart failure and transplantation
Training programme curriculum
Medical knowledge, skills, attitudes, and understanding of HF
Core knowledge base for cardiac transplantation and MCS
Teaching and learning methods
Learning with peers
Work-based experiential learning
Paediatric cardiology on-call
Consultant-led ward rounds
MDT meetings
Formal postgraduate teaching
Independent self-directed learning
Assessment
Workplace based
Clinical assessment, case discussion, and patient survey
Supervision and feedback
Record of assessment, progress logbook, and portfolio of educational activities
MSF
Advanced training in heart failure and transplantation
2 years in a recognised centre
Adequate volume of OHTXs, VAD implants
Well-developed HF service teams
Regular HF/TX MDTs
Attendance and abstract presentation at international meetings
Participation in research
Exposure to surgery for OHTX, VAD, and ECMO
Possible additional ACHD experience

ACHD = adult CHD; ECMO = extracorporeal membrane oxygenator support; HF = heart failure; MCS = mechanical circulatory support; MDT = multi-disciplinary team; MSF = multi-source feedback; OHTX = orthotopic heart transplantation; VAD = ventricular assist device

## Training programme curriculum

### Heart failure

- Recognition of the signs and symptoms of heart failure in children, and the ability to make a differential diagnosis and initiate treatment.
- Understand the pathophysiology and aetiologies – structural and non-structural – of heart failure, including atrial pathologies and ventricular interactions.
- Familiarity with a variety of diagnostic tools to establish an accurate diagnosis such as non-invasive imaging – by means of echocardiogram and MRI – genetic evaluation, metabolic assessment, endomyocardial biopsy, and cardiac catheterisation.

- Evaluation and interpretation of the results of arrhythmia testing, exercise testing, biomarker levels, non-invasive imaging, and cardiac catheterisation to plan the appropriate treatment.
- Understanding the principles of medical management of heart failure – acute, chronic, and decompensated.
- Familiarity with diuretics, antiarrhythmics, inotropic and lusitropic agents, anticoagulation, angiotensin-converting enzyme inhibitors, beta-blockers, and age-dependent variations in dosing.<sup>2,5</sup>
- Understanding of the place of additional therapies in the heart failure management, including interventional, such as creation of an interatrial communication in patients supported by extracorporeal membrane oxygenation, and electrophysiological, such as cardiac resynchronisation therapy and arrhythmia management.<sup>2,6</sup>
- Application of mechanical circulatory support such as extracorporeal membrane oxygenator support, ventricular assist device support, and transplantation in the treatment of end-stage heart failure; individualised surgical and hybrid strategies should be known sufficiently to facilitate discussion with surgical colleagues.

### Cardiac transplantation and mechanical support

- Indications and contraindications for heart transplantation.
- Assessment of donor suitability including matching criteria, importance of human leucocyte antibodies, and blood group status.
- Outcomes of heart transplantation, including mortality and major morbidities.
- Complications associated with heart transplantation such as an acute and chronic rejection, coronary allograft vasculopathy, and those associated with immunosuppression such as renal dysfunction, infection, hypertension, diabetes, and post-transplant lymphoproliferative disease.
- Physiology of the denervated, transplanted heart.
- Common adverse events and drug interactions associated with immunosuppressive medications.
- Blood group mismatch transplantation and complications.
- Human leucocyte antibodies mismatch transplantations and complications.
- Heart transplant rejection recognition, diagnostic tools, and treatment.
- Understanding of mechanical circulatory support in the heart failure patient pathway such as the use of extracorporeal membrane oxygenation and ventricular assist devices as a bridge to transplantation and potentially as a bridge to recovery or as destination therapy in selected groups.
- Familiarity with research areas and methodology relating to advanced heart failure management including epidemiology, novel pharmacological treatments, and clinical trials of novel therapies including stem cell and regenerative strategies.

### Teaching and learning methods

The curriculum should be delivered through a variety of learning experiences. There will be a balance of different modes of learning methods from formal teaching programmes to experiential learning “on the job”.

This section identifies the types of practical situations in which a trainee will learn.

- Learning with peers: there are many opportunities for trainees to learn from each other through work and discussion.
- Outpatient learning: this includes active participation in medical heart failure and transplant clinics assessing new and follow-up patients. The degree of autonomy and responsibility of the trainee increases as competency improves.
- Inpatient learning and ward rounds: ongoing clinical care of inpatients provides an opportunity for learning and reflection. Ward rounds should usually be led by a consultant (attending) and include feedback on clinical and decision-making skills. Trainees should have supervised responsibility for the care of inpatients. This includes day-to-day review of clinical conditions, note keeping, and the initial management of the acutely ill patient with referral to, and liaison with, other clinical colleagues.
- Intensive care: trainees should spend some time in cardiac intensive care unit and be involved in the care of patients with heart failure and post heart transplantation requiring intensive care input.
- Paediatric cardiology on-call commitment: trainees should participate in the on-call rota in order to achieve adequate experience in the management of cardiac emergencies. This is a critical part of training as it enhances trainee's independence and provides basis for critical reading and reflection of clinical problems.
- Multi-disciplinary team meetings: fellows should attend the meetings where clinical problems are discussed with clinicians in other disciplines and decisions are made. These provide excellent opportunities for observation of clinical reasoning.
- Formal postgraduate teaching: the content of these sessions is determined by the local faculty of medical education and should be based on the curriculum. There are many opportunities to advance the knowledge at local departmental, regional, national, and international meetings. Suggested additional activities include case presentations, journal clubs, audit, and research projects.
- Independent self-directed learning: this includes a variety of activities such as reading of web-based material, textbooks, journals, and maintenance of personal portfolio – self-assessment, reflective learning, and personal development plan. This has a potential of achieving the higher personal learning goals, beyond the essential, core curriculum.

All the aforementioned learning activities should be documented in the logbook, preferably electronically.

### Assessment

The purpose of the assessment system is to stimulate learning and enhance the training process by making clear goals and objectives and motivating trainees to ensure that they receive adequate training and experience. It enables trainees to receive feedback, measure their own performance, and identify areas for development and improvement. It also ensures that trainees possess the essential underlying knowledge and skills required for their speciality. A robust assessment has the potential to identify trainees in difficulties needing an extra support to achieve their competency or to consider change of career

direction. Owing to the small size of the sub-speciality, it is currently not feasible to run a full sub-speciality certificate examination to assess knowledge and skills.

There are a variety of assessment methods such as clinical examination, observation of procedural skills, case-based discussion, multi-source feedback, patient survey, audit assessment, and teaching observation. More information about these methods including guidance for trainees and assessors can be found on the Joint Royal Colleges of Physicians Training Board website ([www.jrcptb.org.uk](http://www.jrcptb.org.uk)).<sup>7</sup>

Workplace assessments take place throughout the training programme to allow trainees to continually gather evidence of the acquired knowledge and skills. These should preferably be recorded electronically.

Assessing the trainee's clinical encounter with a patient can provide an indication of the ability essential for good clinical practice, such as history taking, examination, differential diagnosis, clinical reasoning, decision-making, and application of medical knowledge. Discussing a variety of elements such as a focused clinical problem, procedure, or patient's discharge planning and giving/receiving an immediate feedback is useful, as it can potentially enhance the learning.

Multi-source feedback is a formal record of the wider team's perception of working and interacting with a trainee. It is widely used in the business world as a useful tool in assessing the generic skills such as communication, leadership, team working, reliability, and professionalism. The General Medical Council in the United Kingdom has set out the attributes expected from a doctor, and the domains about which information is collected in multi-source feedback assessments mirror these.<sup>8</sup> An equally important opinion of a trainee's performance comes from a patient–doctor consultation, which can be collected in patients' survey. This is intended to assess the aspect of the doctor's interpersonal skills, communication skills, attitudes, and professionalism.

Teaching observation is designed to provide structured, formative feedback to trainees on their competence at delivering teaching.

Reflective summaries give an insight into the learning process, and the trainees should be encouraged to reflect on various events such as difficult clinical, social, or ethical scenarios, complaints, or complications encountered. This should include the key learning points and an action plan.<sup>9</sup>

### Training progress

The trainee must demonstrate that each of the educational objectives set out in the curriculum and reflected in the personal development plan has been achieved. As each goal is attained, the trainee is deemed competent in that particular area of practice. The formal requirements of training are completed when competence has been demonstrated in all areas of heart failure and transplantation training. The review of competence progression is the review of evidence of training and assessment. Doctors in training should maintain their personal development plan, logbook, and portfolio of educational activities according to national guidelines if they exist.

### Supervision and feedback

All elements of work in training posts must be supervised, with the level of supervision varying depending on the experience of the trainee. This must routinely include the opportunity to

personally discuss all cases and events if required. As training progresses, the trainee should have the opportunity for increasing autonomy, consistent with safe and effective care for the patient. The degree of responsibility of the trainee will also increase over time as competency increases.

Trainees should have a named clinical/educational supervisor, responsible for overseeing their training/education that should be part of the clinical speciality team. The supervisor should discuss with trainees issues of clinical governance, risk management, any raised issues related to doctor or patient safety, and reports of any untoward clinical incidents involving the trainee.

Opportunities for feedback to trainees about their performance will arise through the use of the workplace-based assessments, regular appraisal meetings with supervisors, other meetings and discussions with supervisors and colleagues, and feedback from an annual assessment review by the designated panel.

### Advanced training (2 years)

This should be achieved in a recognised centre that has an established heart failure/transplantation and mechanical support programme. Ideally the centre would perform 10–20 paediatric and congenital cardiac transplants, which may include adult congenital, per year. Ventricular assist device implantations might typically be 5–10 patients/year.

The centre(s) selected for sub-specialisation should have a well-developed heart failure service involving a number of integrated multi-disciplinary teams and specialists, to include heart failure cardiologists, interventional and electrophysiology cardiology, and paediatric/congenital cardiac surgery; transplant immunology; infectious disease/immunology; renal, pulmonary and gastrointestinal; microbiology and virology; and pharmacology, dentistry, physiotherapy, psychosocial/family education, and support.

It is anticipated that the centre(s) selected for advanced training would therefore have dedicated multi-disciplinary meetings specifically for management of heart failure and transplant patients.

The International Society for Heart and Lung Transplantation Annual Registry Report provides data on numbers of transplants and outcomes achieved by different centres worldwide. The International Society for Heart and Lung Transplantation further holds lists of training programmes available in Europe, the United States of America, and Canada.

The sub-speciality advanced training trainee should aim to attend at least one speciality international meeting per year, such as the Association for European Paediatric and Congenital Cardiology, The International Society for Heart and Lung Transplantation, International Paediatric Transplant Association, or The European Association for Cardio-Thoracic Surgery, which would allow the fellow to contribute to the furthering of knowledge; the fellow would also realise the importance of exchange of ideas with other members of the international paediatric heart failure community and its role in advancing the understanding and management of heart failure in this rapidly developing and expanding sub-speciality.

The advanced trainee would be expected to take an active role in heart failure research, as this is an essential part of the role of any heart failure specialist. This could encompass both clinical/epidemiological, basic scientific, and translational endeavours. There a number of pathways to pursue research, and this should be tailored to meet the individual career goals.<sup>10</sup>

It is desirable that the specialist be exposed to at least five surgical procedures for organ procurement and implantation, as well as ventricular assist device implantation and extracorporeal membrane oxygenation deployment.

It is recognised that some programmes have specialists with expertise in management of both children and adults with congenital heart failure. Should an advanced fellow wish to acquire additional skills in adult congenital heart diseases heart failure management, this would be an accepted addition to the period of sub-speciality training if not already acquired during time spent at paediatric-only centres.

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