Acute Cardiovascular Care Association of the ESC

ACCA
Acute Cardiovascular Care Association

Core Curriculum

November 2014

Authors: *Susanna Price , Magda Heras,& ACCA education committee members 2012-2014 : Jose (Pepe) Barabes, Sofie Gevaert, Philip Raake, Rene Tio, Iwan van der Horst, Danilo Neglia*
Reviewers, *ACCA Board 2012-2014: Christiaan Vrints, Hector Bueno, Bulent Gorenek, Christian Mueller, Doron Zahger, Uwe Zeymer, Kurt Huber, Francois Schiele, Maddalena Lettino, Nikoloaos Nikolaou*

Preface

Part 1: The Core Curriculum for the Acute Cardiac Care Cardiologist

Part 2: The Core Curriculum for the Acute Cardiac Care Cardiologist per Topic

Part 3: The Certification Process in Acute Cardiac Care

Preface

The previous Curriculum for Acute Cardiac Care was written when recognition of the subspecialty was in its infancy, and served to define the knowledge, skills and professional domains of the acute cardiac care cardiologist. Since the last version, in addition to the significant changes in practice witnessed in general cardiology, developments at the acute end of the specialty and also intensive care have been equally rapid, demanding increasing recognition for the requirement for a defined subspecialty. This cumulated in formation of the Acute Cardiac Care Association of the European Society of Cardiology in 2013, whose mission statement is "To improve the quality of care and outcomes of patients with acute cardiovascular diseases." This includes leading in supporting education and training, providing access to educational materials for subspecialty certification in acute cardiac care.

The requirement to manage the significant co-morbidiites of the increasingly ageing population has resulted in an evolution of the the CCU, being renamed the cardiac care unit (or cardiac intensive care unit) more closely aligned with medical intensive care units, and widespread recognition of the requirement for appropriately trained practitioners. Acute cardiac care recognises and rightly demands that the focus of care should be the needs of the patient, rather than their geographical location. This mirrors the concept of intensive care "without walls", encompassing the whole patient pathway up to and including the transition to less acute care. Always an example of multidisciplinary/multiprofessional working, the intensive care cardiologist should expect to work with other cardiological and non-cardiological specialists, cardiac surgeons and anaesthetists to determine the optimal management of the sickest patients. The curriculum for Acute Cardiac Care will inevitably continue to change as the subspecialty develops, and as differences in training and provision of intensive and acute cardiac care continue to evolve across the different countries of Europe and the ESC member states. In this curriculum, the ACCA is setting a standard that cardiologists and national societies can use in further defining the subspecialty. In line with the 2013 Core Curriculum in Cardiology, the acute cardiac care curriculum describes an optimal rather than a minimum standard, appreciating that not every training system will necessarily be able to provide the full curriculum in every training centre.

This curriculum defines the clinical, patient-orientated training of the acute cardiac care cardiologist. The overall structure of the previous version has been changed to be aligned with the updated Core Curriculum in Cardiology of the ESC

as closely as possible. The basic content of the curriculum has not been altered significantly, except where there have been changes in practice that needed to be reflected, and/or in order to maintain coherence with the new 2013 Core Curriculum for the General Cardiologist. The document describes the competencies of the sub-specialist in acute cardiac care cardiology, with knowledge and skills required in addition to those of the general cardiologist. The first part of the curriculum covers general aspects of training, and is followed by a comprehensive description of the specific components in y chapters. In line with the Core Curriculum for the General Cardiologist, each of the chapters includes statements of the objectives, and is further subdivided into the required knowledge, skills and behaviours and attitudes. The requirements for intensive care training are in line with the recommendations outlined in the European Society of Intensive Care Medicine CoBaTrICE collaboration, and to avoid duplication, where relevant reference is made to the CoBaTrICE general intensive care training requirements. It is recommended that following completion of core cardiology training, the acquisition of competence in acute cardiac care cardiology requires a minimum of 12 months of additional full-time training, but the absolute duration content and composition of which will vary depending upon the previous training pathway (see section 1.2).

The revised 2014 Curriculum for Acute Cardiac Care has been reviewed by the Education Committee, and the Board of the ACCA. The document does not include minimal/optimal numbers of procedures to obtain competence, but where experience rather than competence is required, minimum suggested numbers are given as guidance only. The document does not address evaluation/assessment in detail. As in general cardiology and intensive care medicine, regular, structured and formally documented trainee assessment is crucial to implementation of the curriculum, and should include knowledge-based assessments (formative and summative), formally observed procedures and practices, a log-book and recognition of the potential role of simulation techniques in both training and assessment. The document additionally sets out requirements for potential acute cardiac care cardiologists to undertake full ESC certification in acute cardiac care; training centre requirements and the certification process is described in detail.

Part 1: The Core Curriculum for the Acute Cardiac Care Cardiologist

1.1. The acute cardiac care cardiologist and the subspecialty

The subspecialty of acute cardiac care aims to deliver expert care to patients presenting with acute cardiac conditions, extending beyond the requirements outlined in the Core Curriculum for the General Cardiologist. This is irrespective of their place within the patient pathway, thereby encompassing pre-hospital, emergency, acute and intensive cardiac care. Although the number of patients with acute cardiovascular disorders or severe cardiac co-morbidities requiring special treatment is increasing, there is to date no pan-European standardised and accepted training program for physicians in acute cardiac care, and encompassing the whole spectrum of acute/critical illness in this patient population. This curriculum provides recommendations for the standards for training in acute cardiac care, as well as a template for the range of knowledge and skills required for those already practising in the area. Completion of the curriculum should equip the trained cardiologist with the knowledge, skills, behaviours and attitudes to act independently as an expert in the

- diagnosis, assessment and management of cardiovascular emergencies
- diagnosis, assessment and management of the acutely/critically ill cardiac patient
- prevention and management of associated organ dysfunction in the critically ill cardiac patient
- determination of more long-term management as part of a step-down strategy from the ICCU

The ability to apply knowledge to clinical problems requires knowledge of the indications for, and further, the performance and interpretation of cardiological and intensive care investigations, treatments and procedures/interventions. It requires in-depth knowledge and experience of general cardiology, and general intensive care, as well as the other cardiological and non-cardiological sub-specialties, sufficient to ensure appropriate referral for more advanced investigations and therapies. The content of the 2014 curriculum is inspired by the ESC Textbook of Intensive and Acute Cardiac Care, the 2013 ESC Core Curriculum for the General Cardiologist, relevant published ESC guidelines, and the ESICM CoBaTrICE collaboration.

Having already completed training in general cardiology, the acute cardiac care physician in the ICCU will, by definition, be a physician with a thorough basic training in internal medicine including pulmonary, renal, and metabolic diseases,

and advanced training in cardiology to the level required for certification as a cardiologist at a National level. The acute cardiac care cardiologist will be able to recognise and treat a wide variety of acute, as well as chronic cardiovascular conditions leading to acute cardiological deterioration, and be well acquainted with the range of diagnostic and therapeutic tools available to the modern cardiologist. In addition, such a physician should be able to investigate and manage resulting organ system dysfunction, and be competent the operation of available equipment including monitoring (invasive and non-invasive), cardiac pacemakers, defibrillators, ventilators (invasive and non-invasive), renal replacement therapy and mechanical circulatory support. A comprehensive knowledge of interventions to treat cardiac pathology and also associated non-cardiac conditions such as liver, gastrointestinal, neurological and renal dysfunction is mandatory, in addition to knowledge regarding the management of infection, nutrition, sedation, and analgesia.

Although the natural evolution of the specialty of cardiology has increasingly required team-working between cardiologists with different profiles and between related specialties, the nature of acute cardiac care has always demanded effective multi-professional and multidisciplinary team-working. Effective communication and multidisciplinary/multiprofessional team-working is imperative in order to optimise the delivery of patient-centred care to the critically ill, including end-of-life decision making, potentially in high-stress and time-pressured environments and frequently involving relatives and surrogate decision-makers. The acute cardiac care cardiologist must know the strengths and limitations of every investigation and intervention, including the added complexity of the acutely unwell/critically ill patient, where frequently the evidence-base is less solid than in other areas of cardiology, the risks of patient transportation potentially significant, and the costs of patient care substantially higher. In the acute/critical setting, involvement of patients and their relatives in decision-making is challenging, and skilful communication (respecting their ethical, cultural and religious background) is vital to communicate effectively and allow informed decision-making about treatment options.

Good clinical governance is central to the practice of modern medicine. The acute cardiac care cardiologist must treat patient data with confidentiality, in accordance with personal eta protection legislation in the European Union. The process of continuing medical education with lifelong learning, demonstrating acquisition of knowledge and performance of current best clinical practice is imperative, demonstrating compliance with national and local appraisal and revalidation processes where present. Further, implementation of strategies and structures proposed to minimise risk and maximise patent safety must be

integral, encompassing the ethical principles of autonomy, beneficence, non-maleficence and distributive justice.

Assessment of competence is not included in this document. As in general cardiology, this does not obviate the need for regular structured and formally documented assessment throughout the training programme. This should include assessments of knowledge (formative and summative), formally observed procedures and practices, completion of logbooks, acquisition of multi-source feedback and where available and appropriate, the use of simulators (applicable to both training and assessment).

The training should continue with the ethos of lifelong learning, enabling the acute cardiac care cardiologist to improve their knowledge of and experience in the practice of the subspecialty, to adapt to technological innovations, to provide the educational and experiential preparation necessary to underpin ongoing progression, and to respond to changing societal expectations. Depending upon the centre in which the acute cardiac care cardiologist eventually practices, trainees may wish/need to undertake additional training in the supra-specialist areas of acute cardiac care, including extracorporeal support, congenital heart disease in the critically ill, intensive care echocardiography, either as an additional fellowship or as CME in their subsequent consultant career. Throughout the training programme and throughout their career, the acute cardiac care cardiologist should apply the best available evidence to deliver optimal patient-centred care.

1.2 General aspects of training in the sub-specialty

This curriculum is relevant to board-certified or country-recognised cardiologists who wish to be certified in acute cardiac care. A comprehensive cardiological background is necessary not only to master the technical aspects of the cardiological techniques, but also to recognise the indications, and the contraindications of different cardiological interventions for patients in need of intensive acute cardiac care and/or general intensive care who have cardiovascular complications/co-morbidities. The cardiologist will additionally need to have had training and experience in the field of general internal and intensive care medicine. They must have the necessary linguistic ability to communicate with patients and colleagues in the country of training and later in the country of practice. Training should be undertaken in recognised national/international training centres and under the supervision of appropriately qualified supervisors (see below).

Learning outcomes should be clearly defined, and are preferred to recommendations based solely on the amount of time spent in a particular department and/or on the number of procedures performed. However, in order to provide guidance for training in this relatively new subspecialty, recommendations for minimal duration of training is outlined. *Learning outcomes* should include *knowledge*, and specific and generic *skills* including communication and appropriate *behaviours* and *attitudes* that will be further reinforced during ongoing training.

Many of the skills outlined in this Curriculum are supplementary to those expected from general cardiologists and general intensivists not working regularly in a CCU/ICCU. In order to gain sufficient experience, following completing cardiology training and certifying as a cardiologist, the potential acute cardiac care cardiologist will be required to work full time in a Cardiac Intensive Care Unit for a total of at least 12 months(1), with additional on-call/night-time/weekend duties for the equivalent of at least 1 night per week for at least three years. To achieve these goals, the cardiologist must additionally undertake the following periods of full-time training (*minimum*): anaesthesia (2)1 month, pulmonology/respiratory medicine 1 month, nephrology 1 month, and general intensive care 3 months. A *minimum* of a total of 6 months ICCU during general cardiology training, 6 months training as junior attending physician (post-residency) and 6 months in the other listed specialties should have been undertaken. This gives a total of at least 21 months of intensive care training over their whole training period (at least 3 months general intensive care, 6 months cardiac intensive care as part of general cardiology training plus 12 months as part of sub specialist training).

The duration of anaesthesia training will be similarly supplemented by having undertaken anaesthesia as part of general cardiology training/more junior training, with a recommended minimum total of 6 months dedicated anaesthesia/airway training in total.

The trainee will assume appropriate responsibility in obtaining the theoretical knowledge outlined in the curriculum. To do this, they are advised to use the ESC Textbook of Intensive and Acute Cardiac Care, current ESC guidelines, the ESCeL programme, and other teaching materials from the different and relevant Associations and Working Groups of the ESC. Reference to training materials from the ESICM and/or national intensive care and cardiological societies will also be useful.

Footnotes:

(1) Or part time equivalent

(2) Should be more than a month in particular if none has previously been undertaken

The acute cardiac care cardiologist will be required to engage in continuous, independent self-directed learning and self-assessment.
They should also be involved in the management of an appropriate case mix and number of patients. The following considerations apply:

- Participation in the clinical management of inpatients including the CICU and ICU including supervised ward rounds and consultation regarding acute cardiac referrals should constitute a substantial part of the training programme
- Supervised involvement in the management of new admissions/referrals should be undertaken at least weekly throughout the programme
- At least 2h/day in structured learning under direct supervision of a clinical supervisor which may include:
  - explicit learning: journal clubs, methodology of research and statistics, postgraduate teaching, training in communication skills, exercises in evidence-based medicine, discussion of guidelines for clinical practice, lectures/tutorials/seminars, simulation-based learning, web-based learning, courses, annual meetings of scientific societies
  - implicit learning: ward rounds, case-based discussions, supervised acquisition of diagnostic, investigational and therapeutic skills
- Basic, clinical and/or translational research in cardiovascular medicine is an inherent part of training in acute cardiac care. Trainees should be stimulated to participate in basic or clinical research and develop a critical and research-orientated approach to clinical practice. If research is performed on a full-time basis such that impacts to prevent sufficient progression of clinical training, adaption of the training time should be considered
- The training programme should be clearly defined for each individual, incorporate a periodic review of their progress and a formal review/assessment at least annually.

In order to ascertain that the trainee has fulfilled the above requirements they will be assessed by an examination, and presentation of a log-book.

Candidates may wish to undertake an additional year of training, with the aim of extending their skills in more specialised techniques, and/or obtaining advanced training in intensive care medicine. This may be undertaken through the relevant national or international training bodies. Further, acute cardiac care cardiologists may wish to proceed to work in centres with GUCH and/or complex cardiac surgery including extracorporeal support and transplantation, in which case additional specific training will be required.

1.3 Requirements for training institutions and trainers

1.3.1 Requirements for training institutions

- Training institutions should be recognised by a National Training Authority as being complement to provide a complete training programme, either in the same centre or in collaboration with others.
- The ideal solution is for a training programme to be situated within a comprehensive cardiothoracic centre, where all aspects of cardiovascular disease are managed, and covering the full curriculum. However, it is recognised that not every aspect of training is likely to be widely available at single sites; here, rotation through different institutions or sessional attendance in centres providing sub-specialties or technologies that are not widely available may need to be incorporated into the programme. In each centre, the trainee will be required to have a nominated supervisor (cardiologist), in addition to trainers/supervisors in the non-cardiological subspecialties where relevant.
- Training institutions should have a library and internet facilities, offering access to the current scientific literature, specifically major international journals relating to cardiology and intensive care medicine, and should provide the necessary infrastructure for education, including conference rooms and allocated office space for trainees.
- The training institution alone (or as part of a structured and organised collaboration) should have the necessary facilities to ensure that trainees can fulfil all aspects of the Acute Cardiac Care Curriculum with a sufficient number of patients and procedures for developing the required skills.
- The trainee should be provided with the opportunity to participate in basic scientific or clinical research.

1.3.2 Requirements for trainers

Trainers should be recognised by the National Training Authorities and supervision of training should be available at all times. There should be an adequate number of expert cardiologists and intensivists in the training institution to ensure training in all areas included in the Acute Cardiac Care Curriculum. Delivery of the curriculum may be facilitated by a structure that includes a Director of Training (National/Regional/Local), an educational supervisor (or training mentor) and multiple clinical supervisors (or clinical trainers). The educational supervisor (or equivalent) should be responsible for organising the training programme in acute cardiac care, co-ordinating external

rotations to other centres, attendance at courses and congresses, an organising structured learning. It is necessary that both trainee and educational supervisors are subject to periodic assessment.

1.4 Learning outcomes

These are specific statements of intent which express what the learner will be able to do at the end of the educational intervention. They are framed in terms of the trainees' capabilities in specific tasks. Objectives are classified under the headings of knowledge, skills and behaviours and attitudes. Each objective defines what is to be achieved.

- ***Knowledge****:* The knowledge-base trainees require. The subject matter is defined by the ESC Acute Cardiac Care Curriculum chapters. This knowledge includes mechanisms of diseases as the rational basis for long-term learning.
- ***Skills:*** The effective application of knowledge to problem-solving, clinical decision-making and performing procedures, acquired from experience and training.
- ***Behaviours and attitudes****:* The attitudes that underlie best behaviour in clinical practice that trainees need to develop and demonstrate

Categories and levels of competence

This section of the curriculum describes the different levels of competence expected for skills related to investigations and procedures. These are defined as follows:

- **Level I:** experience of selecting the appropriate diagnostic or therapeutic modality and interpreting results or choosing an appropriate treatment. This level of competency does not include performing a technique, but participation in procedures during training may be valuable;
- **Level II:** goes beyond Level I. In addition to Level I requirements, the trainee should acquire practical experience but not as an independent operator. They should have assisted in or performed a particular technique or procedure under the guidance of a trainer. This level also applies to circumstances in which the trainee needs to acquire the skills to perform the technique independently, but only for routine indications in uncomplicated cases;
- **Level III:** goes beyond the requirements for Level I and II. The trainee must be able independently to recognise the indication, perform the technique or procedure, interpret the data and manage the complications.

Level of competence of cardiological skills

The table below summarises the level of competence that the ESC considers desirable for a trainee in acute cardiac care to achieve. Additional critical care competencies are outlined in the ESICM CoBaTrICE collaboration. It is appreciated that the organisation of cardiac services and the resources for training are not uniform throughout Europe and ESC member states, but the curriculum aspires to an optimal rather than a minimal standard. In countries (or centres) that are currently unable to deliver training in all its aspects, the curriculum should be used as a benchmark to promote policies for improvement. Rotation of trainees between different centres can, in most situations, provide an adequate solution.

Part 2: The Core Curriculum for the Acute Cardiac Care Cardiologist per Topic

Cardiologists training for certification in Acute Cardiac Care must be fully trained in general cardiology. Therefore, the following topics focus on the additional, specific aspects of patient care in the ICCU. Thus, possession of general cardiology knowledge, skills and behaviours and attitudes is considered a given.

2.1. History taking and clinical examination

Objectives

History taking
To establish a relationship with a patient and/or relatives based on empathy and trust, and to obtain a clinical history relevant to acute cardiac care including:
- the patient's/relative's spontaneous account of the symptoms
- questions focused on the presence/absence of cardiovascular symptoms, and indicators of critical illness
- the past history
- cardiovascular risk factors and reversible causes for cardiovascular diseases
- symptoms of any co-morbidities
- family history (cardiovascular and other diseases)
- current and past drug therapy
- social history (including socio-economic situation, professional, educational and religious background

Clinical examination
The trainee should complement the subjective findings from the clinical history with the objective findings on clinical examination of the patient, to establish a diagnosis and management plan:
- to perform a general examination of the patient searching for manifestation of cardiovascular critical illness and/or evidence of co-existing illness
- to examine the heart and cardiovascular system

Knowledge

History taking

- Symptoms of cardiovascular disease and features that differentiate from non-cardiovascular conditions
- Symptoms/features associated with critical illness, their relative importance
- Cardiovascular risk factors derived from the patent's (or relative's) history
- Names, pharmacology and side-effects of the drugs prescribed to cardiovascular patients
- Co-morbidities and previous health status using appropriate sources of information
- Sources and methods of obtaining clinical information
- Relevance of previous health status in determining risk of critical illness and outcomes
- Significance and impact of co-morbid disease on the presentation of acute cardiac illness

Clinical examination

- Clinical signs associated with critical illness, their relative importance and interpretation
- Static and dynamic haemodynamic variables and their relevance for the critically ill cardiac patient
- Features on general examination caused by cardiovascular disease

Skills

History taking

The ability to:

- maintain a professional and reassuring approach to generate confidence and trust in patents and their relatives
- obtain relevant information from the patient, relatives and other secondary sources
- listen effectively
- acquire, interpret, synthesise, record and communicate (written and verbal) clinical information
- Develop a limited differential diagnosis and and to establish a diagnostic and therapeutic plan
- clarify important clinical information

Clinical examination

The ability to:

- make and record accurate observations about the clinical state of the patient
- perform a thorough clinical examination, elicit and interpret clinical signs (or relevant absence of clinical signs) in the ICU environment
- recognise impending organ system dysfunction
- respond rapidly to acute changes in monitored variables
- minimises patient distress
- record the clinical findings in a structured electronic or written file

Behaviours and attitudes

- consults, communicates effectively with patients, relatives and the healthcare team
- promotes respect for patient privacy, dignity and confidentiality
- avoids extensive invasive procedures or monitoring which cannot be adequately interpreted at the bedside
- minimises patient discomfort in relation to monitoring devices
- ensures safe and appropriate use of equipment - including supporting other members of staff
- considers patient comfort during procedures/investigations
- avoids unnecessary investigations
- demonstrates compassionate care of patients and relatives
- Recognises personal limitations, seeks and accepts assistance or supervision

2.2 Non-invasive cardiac investigations

2.2.1 The electrocardiogram

Objectives

To select, perform and interpret the ECG in the context of acute cardiac care

Knowledge

- the cellular and molecular mechanisms involved in the electrical activity of the heart
- the anatomy and physiology of the conducting system
- the electrical vectors throughout the cardiac cycle
- common artefacts and lead reversal ECGs
- characteristic appearance of and explanation for the ECG in patients with:
  - ischaemia and infarction
  - conduction disturbances
  - tachycardias and bradycardias
  - pre-excitation
  - chanellopathies
  - repolarisation disturbance due to:
    - electrolyte imbalance
    - hypothermia
    - anti-arrhythmic and other drugs
  - pericarditis, myocarditis
  - arrhythmogenic cardiomyopathy
  - pacemaker, ICD and CRT devices and their dysfunction
- pitfalls in the interpretation of the ECG in the critically ill patient
- indications for 3- and 12- lead monitoring in the acutely/critically ill
- indications for ambulatory ECG in the acutely/critically ill

Skills

- the ability to perform and systematically interpret the ECG
- integration of the ECG findings within the clinical context

Behaviours and attitudes

communication of the ECG findings (together with its limitations) to the remainder of the multidisciplinary team, the patient and/or relatives where relevant

2.2.2 Non-invasive imaging in general

Objectives

- To select the appropriate imaging modality in the context of acute cardiac care:
  - non-invasive imaging in general
  - echocardiography of the heart and vessels
  - other non-invasive imaging techniques
- To interpret and integrate the results into patient care
- To perform and interpret most TTE and TOE studies independently

Knowledge

- The sensitivity and specificity of different imaging techniques related to diagnosis in the acute cardiac care setting
- The risks of each technique in the acutely unwell/critically ill cardiac patient
- The effects of critical illness and interventions on investigation results and their interpretation

Skills

The ability to:
- choose the appropriate imaging technique for specific clinical situations
- interpret results of imaging within the context of the acutely unwell/critically ill cardiac patient
- ensure patent safety through:
  - preparation of the patient
  - prevention, detection and management of contrast-induced acute kidney injury
  - safe transfer of the acutely unwell patient (where appropriate)

Behaviours and attitudes

- selection of imaging techniques, modalities and protocols in a clinically relevant manner
- appropriate liaison with experts in the available techniques
- recognition of the strengths and weaknesses of the different non-invasive imaging modalities in the context of acute/critical care

a) Echocardiography

Knowledge

- all techniques outlined in the core curriculum in general cardiology using both transthoracic and trans-oesophageal approaches, and including contrast and stress echocardiography in the acute setting
- the use of lung ultrasound
- the potential role and limitations of focused cardiac ultrasound
- The effects of critical illness/interventions that may influence echocardiography findings, including:
  - intubation and positive pressure ventilation
  - weaning from mechanical ventilation
  - filling status
  - pharmacological and mechanical circulatory and respiratory support
  - metabolic and arterial blood gas status
  - effects of sedation on myocardial function
  - the normal range in the critical care setting
- indications/considerations for echocardiography/cardiothoracic ultrasound in addition to that outlined in the core cardiology, and in the context of acute/critical illness:
  - cardiac arrest & post-resuscitation syndrome
  - acute chest pain
  - acute coronary syndromes
  - myocarditis
  - Takotsubo cardiomyopathy
  - aortic dissection and other aortic syndromes
  - chest trauma
  - pericarditis
  - acute dyspnoea
  - cardiomyopathies

- acute pulmonary embolism
- pneumothorax
- the effects of positive pressure ventilation, and weaning from mechanical ventilation
- haemodynamic instability and shock (hypovolaemic, distributive (sepsis and the sepsis syndromes, obstructive)
- dynamic left ventricular outflow tract obstruction
- tamponade
- cardiogenic shock (including complications of acute MI)
- severe and/or acute valvular disease (including prosthetic valve dysfunction)
- arrhythmia
- assessment of haemodynamics
- optimisation of cardiac output
- post-procedural (catheter laboratory and cardiac surgery) complications
- extracoproreal support

Skills

The ability to perform and interpret the following in the context of acute/critical illness:

- trans-thoracic echocardiography
- trans-oesophageal echocardiography
- stress echocardiography
- lung ultrasound
- vascular ultrasound (including ultrasound-guided vascular access)

Behaviours and attitudes

- integration of echocardiography within the clinical context, and other available investigations
- recognition of the strengths and weaknesses of echocardiography in the specific clinical situation and in the context of other imaging modalities
- communication of findings and potential limitations/diagnostic uncertainties with the multidisciplinary team directly responsible for patient care
- appropriate discussion with the multidisciplinary imaging teams to ensure the best diagnostic pathway for the patient

b) Other noninvasive imaging techniques

Knowledge

- techniques and indications for CMR, Cardiac X-ray computed tomography and nuclear techniques relevant to the critically ill
- risks in undertaking remote cardiac imaging in the acutely unwell/critically ill, including transportation
- requirements for safe CMR in the acutely unwell/critically ill patient
- risks of administration of contrast and other agents in the acutely unwell/critically ill patient
- sensitivity, specificity and relevance of non-invasive imaging techniques in the diagnosis of acute cardiac care conditions, including:
  - aortic syndromes
  - endocarditis
  - thoracic trauma
- complementary role of imaging techniques in acute/critical illness
- role of relevant extra-cardiac imaging provided by these techniques

Skills

The ability to:

- work within the multidisciplinary team to select appropriate indications for and avoid contraindications to non-invasive imaging techniques (including extra-cardiac structures) for the optimal diagnosis in the acutely unwell/critically ill patient
- display and interpret cardiac CT, CMR and nuclear impinging in the clinical context (Level II competence)

Behaviours and attitudes

- cooperation with other imaging specialists and the multidisciplinary team
- awareness of the side-effects of contrast media and recognition of the risks of remote imaging in the critically ill
- continuing curiosity and willingness to refer for the rapidly evolving indications in the field of non-invasive cardiac imaging

2.3 Invasive imaging: cardiac catheterisation and angiography

Objectives

- To perform and analyse:
  - coronary and LV angiography
  - cardiac catheterisation and haemodynamics
- To obtain informed patient consent for invasive cardiac catheterisation and angiography (where possible)
- To inform patient relatives/representatives of the indications, risks and intended benefits of cardiac catheterisation and angiography in the critically ill, unable to give informed consent

Knowledge

- principles and techniques of cardiac catheterisation and angiography as outlined in the core curriculum for general cardiology
- effects of critical care interventions on haemodynamic and oximetric data
- implications of catheter laboratory imaging and interventions to subsequent management of the acutely unwell/critically ill patient
- strategies to reduce the risk of contrast-induced acute kidney injury
- types of and indications for mechanical circulatory support available in the catheter laboratory

Skills

The ability to:
- perform and interpret left and right heart catheterisation as outlined in the core curriculum for general cardiology
- insert intra-aortic balloon pump
- assist in the performance of percutaneous coronary intervention

Behaviours and attitudes

- working with the multi disciplinary team to ensure the appropriate performance of inviasive/non-invasive tests
- awareness of the risks of investigation and intervention in the critically ill

2.4 Clinical pharmacology

Objectives

- To know the theory and practice of pharmacological treatment of acute cardiovascular disorders and their complications

- To have a detailed knowledge of pharmacological interventions in critical care

Knowledge

- the basic science of pharmacology including: applied chemistry, principles of pharmacology, pharmacokinetics and pharmacodynamics
- Evidence-based medicine as the basis for pharmacological intervention
- Systemic pharmacology including:
    - hypnotics, sedatives and intravenous anaesthetic agents
    - analgesics
    - non-steroidal anti-inflammatory agents
    - neuromuscular blocking agents (depolarising and non-depolarising)
    - neuro-active drugs: anticonvulsants, antidepressants
    - respiratory system drugs
    - antidiabetic agents
    - antibiotics, antifungal and antiviral agents
    - corticosteroids and other hormone preparations
    - gastrointestinal drugs: antacids, drugs affecting secretion and motility, antiemetic agents
    - immunosuppressants
    - plasma volume expanders
- cardiovascular agents including:
    - antiarrhythmic drugs
    - anticoagulants, antiplatelet and fibrinolytic agents
    - beta- and alpha-adrenergic receptor blockers
    - calcium antagonists
    - diuretics
    - inhibitors of the RAS
    - autonomic system agents (inotropes, vasodilators, vasoconstrictors)
    - anti-ischaemic agents (nitrates, potassium channel blockers, haemodynamically neutral agents)
    - sinus node inhibitors

Skills

The ability to:

- assess the risk: benefit ratio of prescribing a drug within the clinical and pharmacological context of the patient
- monitor the desired effects and side-effects of a pharmacological intervention

- prevent, recognise and manage drug reactions and interactions
- evaluate the design of published trials based on pharmacological interventions

Behaviours and attitudes

- communicate with the multidisciplinary team
- apply evidence-based medicine where relevant to pharmacological intervention
- consider the cost-effectiveness of prescribed treatments

2.5 Patient safety

Objectives

To understand the principles of systems of care to maximise patient safety

Knowledge

- principles of risk prevention
- common sources of error and factors contributing to critical incidents
- epidemiology and prevention of hospital acquired infections
- principles of outcome prediction and scoring systems
- the non-clinical role of the acute cardiac care specialist (administration and management, conflict resolution, debriefing)
- confidentiality and data protection
- concept of risk:benefit ratio and cost effectiveness of interventions
- purpose and methods of clinical audit
- local, national and international healthcare legislation relevant to the acutely unwell cardiac patient

Skills

The ability to:
- consult referring clinicians, promoting and organising the multidisciplinary team
- lead, delegate and supervise appropriately

- apply measures to prevent hospital-acquired infection / complications appropriately
- maximise safety in daily practice
- monitor, report and act upon complications
- implement and evaluate protocols and guidelines
- participate in quality control, audit and reflective practice

Behaviours and attitudes

- recognizes personal limitations, seeks and accepts advice/ supervision/ assistance
- Accepts responsibility for patient care
- works effectively with the healthcare team
- practices patient-centred care

2.6 Professionalism

Objectives

To practice the best medicine possible, within the ethos of good medical practice

Knowledge

- ethical principles of good medical practice
- consent and assent: ethical and legal issues in decision making (including the non-competent patient)
- confidentiality and data protection
- mechanisms of effective communication, including breaking bad news
- principles of teamworking, appraisal and assessment
- methods and mechanisms of lifelong learning
- principles and appraisal of evidence-based medicine

Skills

The ability to:
- demonstrate good medical practice in every day practice
- contribute to departmental activities

- participate in audit, peer review and continuing medical education

Behaviours and attitudes

- probity and respect at the centre of relationships with patients, relatives and colleagues
- desire for lifelong learning at core of practice
- works effectively within the multidisciplinary team
- recognises personal limitations
- recognises impaired performance in self and colleagues, and deals with appropriately
- ensures patient-centred care

2.7 General core intensive care medicine

The basis of optimal patient management in the CCU/ICCU includes many of the principles required in the management of acutely and/or critically ill patients with non-cardiac disease. In order to achieve this, the ACC cardiologist will be required to understand the pathophysiology, clinical presentation, investigation, treatment options, complications and secondary prevention measures which underpin the general management of the critically ill. The knowledge, skills and attributes for general core intensive care medicine are outlined in the European Society of Intensive Care Medicine (ESICM) core syllabus for critical care: Competency Based Training programme in Intensive Care Medicine for Europe(CoBaTrICE (3)).

Footnote:
(3) CoBaTrICE is the Competency Based Training programme in Intensive Care Medicine for Europe and other world regions, and was developed as an international partnership of professional organisations and critical care clinicians (www.cobatrice.org).

These objectives will be achieved by:

- A complete theoretical knowledge of the principles underlying general care of the critically ill patient;
- Application of this theoretical knowledge in the management of patients admitted requiring Level II and III care to develop Level II & III competence where indicated.

It is recognised that in certain countries, the role of the clinician in managing organ support varies (i.e. renal replacement therapy) and this is taken into account within the logbook requirements, however, theoretical knowledge is required. With respect to cardiac intensive care, some specific competencies should be highlighted (below) however, this list is not exhaustive, and referral to the CoBaTrICE curriculum is recommended:

Knowledge

- The early warning signs and symptoms of impending critical illness;
- Causes of cardiorespiratory arrest/cardiorespiratory compromise, identification of patients at risk (including the use of early warning systems) and early implementation of corrective treatment of reversible causes;
- Algorithms of basic and advanced life support, including indications for not starting resuscitation or ceasing an initiated attempt;
- Epidemiology, pathophysiology, diagnosis and management of cardiac emergencies including ACS, acute heart failure, cardiogenic shock, life-threatening arrhythmias, cardiac arrest, post-resuscitation care, pericardial tamponade, pulmonary embolism, acute pulmonary hypertension, acute valve disease, acute myocarditis, endocarditis, aortic dissection, thoracic trauma;
- Pharmacology, indications and contraindications of therapy used to support the circulation;
- Advanced mechanical circulatory support (ECMO and other assist devices);
- Epidemiology, pathophysiology, diagnosis and management of relevant critical care pathologies including acute respiratory failure, renal failure, gastro-intestinal failure, hepatic failure, neurological dysfunction and delirium, sepsis, and healthcare acquired infections;
- Epidemiology, pathophysiology, diagnosis and management of respiratory and ventilatory failure;
- Respiratory physiology and pathophysiology: gas exchange, gas transport, hypoxia, hypo- and hypercapnoea;
    - Interpretation of arterial and venous blood gas samples;
    - Causes, prevention and management of respiratory failure;
    - Causes, prevention and management of ventilatory failure;
    - Oxygen therapy and selection of administration devices;
    - Indications selection and management of different methods of invasive and non-invasive mechanical ventilation;
    - Effects of mechanical ventilation on the circulation
    - Pathogenesis, diagnosis, prevention and principles of therapy for acute lung injury/adult reparatory distress syndrome;

- Epidemiology, pathophysiology, diagnosis and management of renal failure;
  - Principles of fluid, electrolyte, acid-base and renal support;
  - Renal pathophysiology, regulation of fluid, electrolyte and acid-base balance;
  - Causes, diagnosis, prevention and management of renal failure;
  - Knowledge of renal replacement therapies;
  - Treatment strategies for abnormalities of fluid, electrolyte and acid-base disturbances;
  - Identification and prevention of the use/dose-adjustments of nephrotoxic drugs in patients with renal dysfunction;
  - Blood glucose homeostasis: pathophysiology, indications and monitoring;
- Epidemiology, pathophysiology, diagnosis and management of gastrointestinal and hepatic failure;
  - Assessment and management of nutritional therapy;
  - Prevention of stress ulceration;
- Epidemiology, pathophysiology, diagnosis and prevention/management of infection;
  - Indications for microbiological sampling and interpretation of investigations;
  - Selection, indications, complications, interactions and monitoring of common antimicrobial drugs;
  - Epidemiology, pathophysiology, diagnosis and management of sepsis and the sepsis syndromes;
- Criteria for admission and discharge from intensive care;
- Intensive care scoring systems and risk stratification;
- Complications of critical care;
- Care bundles commonly used in the intensive care;
- Quality measures in intensive care;
- Palliative care.

Skills

The ability to:

- communicate and consult with the wider multidisciplinary team to determine optimal patient management

- examine patients and request appropriate investigations to formulate an appropriate differential diagnosis and management plan
- evaluate the impact of prior health on outcomes
- perform and interpret data from investigations appropriately and in the clinico-pathological context
- appropriately prioritise patient investigation and management
- monitor physiological function as indicated
- recognise the requirement for repeated investigations
- document clearly patient investigation and management
- recognise the deteriorating/non-responding patient
- interpret haemodynamic variables and manage appropriately
- optimise cardiac function
- optimise the circulation using fluids and vasoactive drugs
- identify risk factors for developing renal dysfunction and manage accordingly
- co-ordinate management of patients requiring renal replacement therapy
- recognise and manage impending organ dysfunction
- recognise and manage metabolic abnormalities appropriately
- manage the ventilatory status of the patient according to their underlying pathophysiological condition, including initiation, management and weaning from invasive and non-invasive ventilatory support
- prescribe drugs and therapies safely
- manage antimicrobial/antiviral/antifungal drug therapy appropriately
- administer blood and blood products safely
- co-ordinate provision of nutritional assessment and support
- apply care bundles where appropriate

Behaviours and attitudes

- safe and appropriate use of interventions (including equipment, devices and drugs)
- maintenance of a clearly defined therapeutic strategy, based on the best available evidence
- appropriate referral and consultation with the multidisciplinary and multi professional team
- appropriate evaluation and modification of interventions depending upon clinical response
- recognition of limitations of self and others

2.8 Acute coronary syndromes

Objectives

To perform specialist assessment and treatment of patients with ACS including:

- STE-ACS (ST-segment elevation ACS) or STEMI (ST-segment elevation myocardial infarction);
- NSTE-ACS (non-STE-segment elevation ACS) or NSTEMI (non-ST-segment elevation myocardial infarction)
- Unstable angina

Knowledge

- Diagnostic criteria for ACS and myocardial infarction;
- Universal definition of myocardial infarction;
- Non-atherosclerotic causes of ACS (e.g. variant angina, coronary dissection, tako tsubo cardiomyopathy, coronary embolism);
- Events that precipitate ACS;
- Dominant features of ACS;
- Diagnostic process in patients with chest pain with suspicion of unstable angina, NSTE-ACS or STE-ACS;
- Diagnostic techniques including ECG, troponin and other biomarkers, echocardiography and other imaging modalities, including challenges in the intubated/ventilated patient;
- Explain initial risk stratification for STE-ACS and NSTE-ACs and the utilisation of different risk scores;
- Monitoring (ECG and haemodynamic monitoring);
- Treatment of ACS: pre- and early hospital pharmacological therapies. Indications for interventional therapy based on clinical judgement and available risk scores;
- Describe the importance of time to treatment and the choices of repercussion;
- Explain haemodynamic problems related to AMI (left ventricular failure and cardiogenic shock, right ventricular infarction, mechanical problems);
- Describe associated arrhythmias (bradyarrhythmias, ventricular arrhythmias and supraventricular arrhythmias);
- Early and late complications of ACS and their treatment;
- Outline risk stratification after AMI;
- Explain secondary prevention measures.

Skills

The ability to:

- Analyse clinical, ECG, laboratory and echocardiography data to diagnose AMI and its complications;

- Apply risk scores to stratify patients with ACS;
- Evaluate time delays and hospital setting to determine the best reperfusion strategy;
- Obtain informed consent/assent for invasive procedures;
- Monitor patients with ACS;
- Participate in primary angioplasty;
- Prescribe appropriate pharmacological treatment including analgesics, anti-ischaemic drugs, anticoagulants, fibrinolytics, platelet inhibitors, statins and other drugs for secondary prevention;
- Discuss haemodynamic measurements and imaging findings;
- Interpret rhythm disturbances;
- Evaluate short and long-term risk;
- Select the best secondary prevention strategies;
- Diagnose and treat complications during the acute phase of ACS.
- Work within the multi-disciplinary/multi-professional team throughout the patient pathway

Behaviours and attitudes

- Team working with other specialists, including medics/paramedics in pre-hospital care, cardiac surgeons, nurses and physicians in the emergency department, cardiac monitoring unit and catheterisation laboratory;
- Appreciation of the urgency of decision-making in patients with ACS;
- Appreciation of the distress that unexpected and serious illness causes both to patents and their relatives;
- Willingness to play an appropriate role in a hospital network for optimal management of patients presenting with ACS, and transferring in a timely manner;
- Reference to appropriate guidelines to select the best evidence-based strategies.

2.9 Acute heart failure and cardiogenic shock

Objectives

- To recognise the impact of acute heart failure on morbidity and mortality in the individual patient and the population at large;
- To diagnose and treat patients with AHF, recognising the different underlying causes;

- To perform specialist assessment and treatment of patients with acute heart failure;
- To work with patients/relatives and the multidisciplinary team;
- To refer appropriately for advanced circulatory support;
- To organise structured management by the heart-failure team during and after intensive care admission

Knowledge

- Definition of acute heart failure and cardiogenic shock;
- Differential diagnosis of potential underlying causes and precipitants;
- Pathophysiology of acute heart failure and cardiogenic shock, systolic and diastolic dysfunction;
- Identify the maladaptive responses to acute and chronic heart failure;
- Explain the symptoms and signs in acute heart failure;
- Indications, limitations, complications and interpretation of invasive and non-invasive haemodynamic monitoring;
- Identify the need for invasive/non-invasive haemodynamic monitoring;
- Outline diagnostic tests: chest X-ray, ECG, central venous and arterial oxygen saturation, general biochemistry and full blood count, natriuretic peptides imaging (echo, MRI), endomyocardial biopsy to confirm diagnosis, determine prognosis;
- Describe the use of diuretics, vasodilators, inotropes and vasoactive agents: Indications and contraindications, potential adverse effects and monitoring requirements;
- Assess the response to treatment;
- Explain when and how to use mechanical ventilation (invasive and non-invasive), ultrafiltration and dialysis techniques;
- Interventional therapies including surgical and percutaneous procedures;
- Describe associated arrhythmias;
- Indications for extracorporeal support (including percutaneous and surgical ventricular assist devices, ECMO and other assist devices), surgical treatment (CABG, valve replacement, heart transplantation);
- Complications of acute heart failure and cardiogenic shock;
- Explain predictors of survival and outcomes;
- Principles of palliative care.

Skills

The ability to:

- Interpret clinical findings, chest X-ray, ECG, laboratory, and echocardiography data to diagnose acute heart failure and its underlying causes;
- Analyse the causes of AHF in relationship with patients medical history;
- Interpret results of diagnostic tests to determine the best treatment options;
- Select the optimal noninvasive and invasive tests to obtain the appropriate diagnosis;
- Utilise invasive and non-invasive cardiac output monitoring as necessary;
- Interpret haemodynamic (invasive and non-invasive) measurements and imaging findings;
- Select the optimal drug treatment according to changes in patient condition;
- Apply invasive or non-invasive mechanical ventilation, when needed;
- Interpret and treat acute rhythm disturbances;
- Refer appropriately for extracorporeal support;
- Insert IABP or select other percutaneous cardiac support, if needed;
- Cooperate with multidisciplinary team;
- Identification and management of other organ dysfunction;
- evaluate short and long-term risk;
- Select the best secondary prevention strategies.

Behaviours and attitudes

- Choose properly the best treatment strategies for each patient;
- Recognise complications in a timely manner;
- Participate in the treatment decision from the emergency room until discharge;
- Consult with other colleagues on specific matters (imaging, cardiac catheterization, surgical options, arrhythmia ablation, etc);
- Inform the patient and family members of the prognosis and treatment decisions;
- Educate patient and family members on secondary prevention measures;
- Refer to appropriate guidelines to choose the best evidence-based therapies.

2.10 Myocarditis

Objectives

To perform a comprehensive assessment and treatment of patients with myocarditis

Knowledge

- Describe the aetiology of acute myocarditis;
- Explain the pathology of viral, non-viral and non-infective myocarditis;
- Outline clinical features and complications;
- Identify diagnostic tests: chest X-ray, ECG, natriuretic peptides, general biochemistry and full blood count, imaging (echocardiography, cardiac magnetic resonance imaging), endomyocardial biopsy;
- Describe the use of inotropes, diuretics, beta-blockers, ACE-inhibitors, anthyarrhythmics drugs, and immunosuppressive agents: Indications and contraindications;
- Outline the need for ventricular support (percutaneous and surgical ventricular assist devices) or heart transplantation);
- Explain predictors of survival and outcomes.

Skills

The ability to:

- Analyse the causes of myocarditis;
- Interpret clinical findings to diagnose myocarditis: laboratory data, ECG, imaging data (echocardiography, cardiac magnetic resonance imaging, coronary angiography), haemodynamic data and endomyocardial biopsy findings;
- Select the best drug treatment according to changes in patient condition;
- Interpret rhythm disturbances;
- Select the best ventricular support, when needed;
- Insert IABP or other percutaneous assist devices, if needed (level III);
- Cooperate with surgeons regarding ventricular assistance devices and heart transplantation;
- Evaluate short and long-term prognosis in relation to requirement for mechanical support and/or transplantation;
- Evaluate patients for endomyocardial biopsy, recognising the diagnostic yield and potential risk of the procedure;
- Select the best secondary prevention strategies

Behaviours and attitudes

- Be alert to the possibility of inflammatory cardiomyopathy in the presence of acute heart failure;
- Recognise complications in a timely manner;
- Cooperation with the multidisciplinary and multiprofessional team for timely differential diagnosis and further treatment;

- Inform the patient and family members of the prognosis and treatment decisions;
- Referral to appropriate guidelines to choose the best evidence-based therapies.

2.11 Cardiac tamponade

Objectives

To perform specialist assessment and treatment of patients with cardiac tamponade

Knowledge

- Describe the classification and definition of pericardial effusion and cardiac tamponade;
- Epidemiology, pathophysiology an aetiology of pericarditis, pericardial effusion and tamponade;
- Outline signs and symptoms of cardiac tamponade;
- Challenges of diagnosis post-cardiac surgery;
- Relevant investigations: chest X-ray, ECG, general biochemistry and full blood count, and echocardiography;
- Limitations of echocardiographic diagnosis of tamponade;
- Explain the effects of positive pressure ventilation on the physiology of tamponade;
- Indications for pericadiocentesis (percutaneous or surgical);
- Drug therapy for controlling pericardial inflammation;
- Management of pericarditis and its complications;
- Explain outcomes according to diagnosis.

Skills

The ability to:
- Analyse the cause of pericardial collection
- Interpret clinical findings to diagnose cardiac tamponade: chest X-ray, ECG, echocardiographic findings and laboratory data
- Interpret hemodynamic changes due to cardiac tamponade
- Interpret echocardiographic features of tamponade
- Perform pericardiocentesis or refer patient for surgical drainage as appropriate

Behaviours and attitudes

- Work with the multidisciplinary/multiprofessional team
- Empathic and supportive approach towards the psychologically vulnerable oncological patient.
- Refer to the appropriate guidelines to choose the best evidence-based therapies

2.12 Acute valvular disease

Objectives

To assess, diagnose and treat patients with acute valvular heart disease (VHD):
- acute diseases of the native aortic, mitral pulmonary and tricuspid valves and their combinations;
- surgically or percutaneously repaired cardiac valves;
- surgically or percutaneously implanted valvular prostheses.

Knowledge

- Epidemiology of acute VHD;
- Haemodynamics of acute VHD, and differences from chronic valvular disease;
- Pathophysiology: effects of acute VHD on the heart and circulation;
- Natural history of acute VHD;
- Strengths and limitations of diagnostic techniques, in particular echocardiography, and the value of additional procedures such as fluoroscopy, X-ray CT, CMR and invasive haemodynamic assessment;
- Effects of intensive/acute care interventions (including positive pressure ventilation, vasoactive agents and pacing) on the severity of VHD;
- Indications, benefits and risks of medical therapy, surgical and percutaneous interventions for VHD;
- Indications for and management of anticoagulant therapy including on the ICU and in the immediate post-operative period;
- Role of concomitant coronary heart disease in VHD and its impact on surgical management.

Skills

The ability to:
- Take a history and perform an appropriate clinical examination;
- select and interpret monitoring
- Use appropriate invasive and/or non-invasive diagnostic techniques;

- Interpret results of diagnostic procedures in the context of critical illness;
- Assess risks and benefits of valvular interventions in the acute setting according to patient characteristics and the type of intervention;
- Determine with the multidisciplinary team whether and when surgery or percutaneous intervention is indicated;
- Recognise and manage the complications that may occur in patients with prosthetic valves and/or after valvular interventions.

Behaviours and attitudes

- Provision of balanced, readily understood and appropriate information to the patent and/or relatives regarding the risks, benefits and timing of different valvular interventions;
- Explanation of the pros and cons of each type of prosthesis;
- Ability to work within the multidisciplinary team for optimal patient/relative management;

2.13 Infective endocarditis

Objectives

To assess, diagnose and treat patients with infective endocarditis (IE) of native and prosthetic valve, prosthetic material and indwelling devices.

Knowledge

- Epidemiology of endocarditis with respect to the ageing patient population, to surgical interventions and to the increasing prevalence of implanted prosthetic material;
- Clinical features of different forms of endocarditis, including native valve, right heart, prosthetic (early and late post-operatively), catheter and cardiac device-related infection;
- Classification of IE according to the mode of acquisition;
- Explain the pathophysiology of endocarditis;
- Outline clinical findings (cardiac, systemic);
- Describe diagnostic tests: general biochemistry, full blood count and inflammatory markers, chest X-ray, ECG, microbiology, echocardiography;

- Describe the potential use of adjunctive investigations on the ICU (i.e. white cell scan, FDG-PET scan);
- Describe the requirement and choice for non-cardiac investigations to delineate complications;
- Describe the appropriate use of antibiotics, medical and surgical treatment: Indications and contraindications;
- Explain predictors of survival and outcomes;
- Discuss the relationship between infection and cardiac disease;
- Analyse the cause of endocarditis in relationship with patient's medical history.

Skills

The ability to:
- Take a relevant history and perform an appropriate clinical examination;
- Interpret clinical findings;
- Analyse chest X-ray, ECG, laboratory data and echocardiographic findings;
- Interpret haemodynamic changes;
- Select the adequate antibiotic regimen and other medical treatment;
- Work within the multidisciplinary team to plan required interventions including surgery, including need and timing;
- Manage and monitor a critically ill patient with endocarditis;
- Organise immediate and intermediate-term follow-up;
- Recognition and management of complications in a timely manner.

Behaviours and attitudes

- Commitment to working within the multidisciplinary team;
- Appropriate discussion with the patient and relatives regarding prognosis and treatment decisions;
- Referral to appropriate guidelines to choose the best evidence-based therapies.

2.14 Diseases of the aorta

Objectives

- To assess diseases of the aorta, and trauma to the aorta and heart;

- To implement appropriate medical therapy, recognise the indications for interventional or surgical treatment and to work within the multidisciplinary team to manage the patient optimally

Knowledge

- epidemiology, aetiology, pathology, genetics, pathophysiology and clinical presentations of aortic disease, aortic root disease and trauma to the heart including:
  - aneurysm of the thoracic aorta;
  - classification of aortic dissection;
  - Leriche's syndrome;
  - aortic atherosclerosis types I-IV;
  - inflammatory aortic disease;
  - trauma of the heart;
  - trauma of the vessels including acute aortic dissection and aortic rupture
- classification of aortic dissection
- clinical signs and symptoms
- strengths and limitations of different imaging modalities
- appropriate monitoring
- appropriate medical, interventional and surgical management strategies

Skills

The ability to:

- obtain a relevant history and perform an appropriate clinical examination
- select and interpret monitoring
- select and interpret appropriate imaging studies
- manage different acute aortic pathologies with the appropriate treatment modality in a timely manner
- recognise complications in a timely manner
- work within the multidisciplinary team to ensure optimal patient management
- inform the patient/relatives of the treatment decisions and prognosis
- initiate secondary prevention measures where relevant

Behaviours and attitudes

- team-working with the multidisciplinary team
- recognition of the urgency required in managing patient with diseases of the aorta

- recognition of the requirement for transition to longer-term management

2.15 Trauma to the aorta and heart

Objectives

- To assess patients with potential and actual aortic and cardiac trauma
- To implement appropriate medial therapy and recognise the indications for interventional or surgical treatment

Knowledge

- Describe the incidence and causes of trauma to the aorta/heart
- explain the pathophysiology of different trauma (deceleration/penetrating/blunt/electrical etc)
- discuss the relationship between the type of trauma and pathology
- identify injured structures and location of rupture
- outline clinical signs and symptoms
- describe appropriate diagnostic tests with their strengths and limitations
- outline the urgency of surgical repair and medical management of pain and other complications
- outline predictors of survival and outcomes

Skills

- analyse and interpret investigations
- working within the multidisciplinary and multiprofessional team to optimise patient management
- recognise complications in a timely manner
- inform the patient/relatives on the treatment decisions and prognosis
- Referral to appropriate guidelines to choose the best evidence-based therapies.

2.16 Arrhythmias

Objectives

To assess and treat patients with acute arrhythmias and conduction disturbances in the context of acute cardiac care

Knowledge

- Classification and definition of:
  - (a) Bradycardias
  - (b) tachycardias
    - (I) supraventricular arrhythmias including atrial fibrillation and flutter
    - (II) ventricular arrhythmias including VT storm
- Epidemiology, pathophysiology, diagnosis and clinical features of arrhythmias and conduction disturbances in the critically ill patient population
- Causes and relevance of arrhythmia in critically ill patient population, including important differences with the non-critically ill patient population
- Prognosis, including risk evaluation including factors relevant to the critically ill patient population
- Principles of electrocardiography and electrophysiology , including performance of atrial ECG by standard, epicardial and trans-oesophageal methods
- Describe diagnostic procedures: ECG, Holter, carotid sinus massage, tilt-test, invasive electrophysiology, exercise test, echocardiography, MRI
- Invasive and device management of arrhythmias, including catheter ablation, pacemaker insertion (including oesophageal pacing), ICD and surgical therapy, including intervention in the critically ill
- Pharmacology of anti-arrhythmic drugs and knowledge of pro-arrhythmic effects of cardiovascular and other drugs used in the intensive care setting
- Outline the use of drugs to treat rhythm disturbances and prevention of emboli
- Importance of co-existing structural heart disease, including coronary artery disease
- Evaluation of arrhythmia risk in the critically ill patient population

Skills

The ability to:

- Interpret surface ECG and clinical findings
- Perform an atrial ECG in patients with epicardial pacing wires
- Analyse the causes of rhythm disturbances in relationship with patient medical history and their critical/acute illness
- Identify and classify different rhythm disturbances on 12-lead electrocardiography and atrial electrocardiography
- Select the optimal treatment option to end/manage an arrhythmic episode

- Outline predictors of survival and outcomes in the different categories
- Interrogate devices (pacemakers and ICDs) and make measurements and parameter changes
- Carry out temporary pacing
- Mange critically ill patients with ICDs and other implanted devices
- Select the best secondary prevention strategies
- Recognise and manage complications of arrhythmia and related interventions in a timely manner
- Identify and refer appropriate patients for electrophysiological intervention

Behaviours and attitudes

- team-working with electrophysiologists and heart failure specialists for the follow up of patients with device therapy
- participation in treatment decisions throughout the patient pathway
- Inform the patient and/or next of kin regarding treatment decisions and prognosis
- Application and reference to guidelines to determine the optimal evidence-based therapies

2.17 Pulmonary embolism

Objectives

To assess and manage patients with pulmonary embolic disease, including prevention strategies.

Knowledge

- Epidemiology of pulmonary embolic diseases
- Risk factors for deep vein thrombosis and pulmonary embolic diseases in the critical and non-critical care settings
- Preventative measures, indications, contraindications and effectiveness
- Classification of pulmonary embolism
- Clinical presentation of the following in the critical care and non-critical care setting:
  - superficial and deep vein thrombosis
  - acute pulmonary embolism
  - acute-on chronic pulmonary embolism
- Diagnosis of deep vein thrombosis and pulmonary embolism
- Management of acute pulmonary embolism including
  - anticoagulant therapy
  - thrombolytic therapy
  - catheter intervention
  - surgical intervention
  - cardiovascular support (pharmacological and mechanical)
- Management of chronic thrombi-embolic pulmonary hypertension, including perforative management of thrombo-endarterectomy
- Care bundles for VTE thromboprophylaxis, including
  - compression stockings
  - pneumatic boots
  - prophylactic anticoagulant therapies
  - acute indications for caval filter insertion

Skills

The ability to:

- analyse pulmonary embolism in relation to the clinical history and perform an appropriate clinical examination

- Interpret ECG, computerised tompography, echocardiography, and laboratory investigations in acute PE
- select the most appropriate therapy including cardiovascular support (pharmacological and mechanical)
- select the most appropriate VTE thromboprophylactic strategies

Behaviours and attitudes

- active participation with the multidisciplinary team for optimal diagnosis and treatment
- ensure patient and relatives understand the diagnosis, the prognosis and the treatment decisions, including requirement for secondary prevention measures
- application and reference to guidelines to determine the optimal evidence-based therapies

2.18 Pulmonary arterial hypertension

Objectives

- To diagnose and treat acutely unwell patients with pulmonary hypertension
- To determine the different causes of pulmonary hypertension

Knowledge

- definition and pathophysiological classification of pulmonary hypertension
- clinical features of different types of pulmonary hypertension, including pulmonary hypertensive crisis
- epidemiology of pulmonary hypertension
- triggers of pulmonary hypertensive crisis, including critical care factors
- diagnostic criteria of pulmonary hypertension
- importance of investigations in diagnosis and risk stratification of patients with pulmonary hypertension
- medical, surgical and interventional management of pulmonary hypertension, including pharmacological and mechanical circulatory support

Skills

The ability to:

- obtain a relevant history and perform an appropriate clinical examination
- recognise the the clinical signs and symptoms in patients with pulmonary hypertension
- interpret investigations including laboratory investigations, arterial blood gases, chest radiography, echocardiography, CT pulmonary angiography and haemodynamics derived from cardiac catheterisation, if necessary in the context of critical care
- select the optimal treatment strategy, if necessary in conjunction with the multidisciplinary team, and including surgical/interventional management where appropriate
- minimise the impact of intensive care strategies/interventions on pulmonary vascular resistance and right ventricular afterload
- evaluate prognosis in response to the underling disease and response to interventions
- initiate end-of-life care when appropriate

Behaviours and attitudes

- active participation with the multidisciplinary team for optimal diagnosis and treatment
- acknowledgement of the importance of expert centres and appropriate and timely referral of patients when appropriate
- ensure patient and relatives understand the diagnosis, the prognosis and the treatment decisions
- application and reference to guidelines to determine the optimal evidence-based therapies

2.19 Sudden cardiac death and resuscitation

Objectives

- to manage patients with aborted SCD, those with life-threatening arrhythmias and those with increased risk of SCD
- to carry out A(C)LS and post-resuscitation care

Knowledge

- definition of SCD
- epidemiology, aetiology, pathology, pathophysiology and clinical presentation of cardiorespiratory arrest, predisposing conditions and peri-arrest arrhythmias
- early warning signs of impending critical illness/the deteriorating patient
- methods and guidelines of basic and advanced life support, including airway management, appropriate drug use, defibrillation, pacing, vascular access modification of resuscitation techniques in special circumstances (hypotehermia, immersion, poisoning, pregnancy, anaphylaxis, acute asthma, ongoing cardiac ischaemia)
- pharmacology: actions, indications and contraindications of the main drugs used in the management of cardiac arrest
- principles and application of therapeutic hypothermia
- indications for mechanical circulatory support, including pacing and extracorporeal support
- indications for not starting resuscitation or ceasing an initiated attempt
- methods for assessing neurological function
- relevance of prior health status in determining risk of critical illness and outcomes
- recognition of and principles of management of raised intracranial pressure
- legal and ethical issues relating to organ donation
- criteria for admission to and discharge from intensive care
- diagnostic work-up and risk stratification of survivors
- recommendations for primary and secondary prevention of SCD

Skills

The ability to:

- obtain a relevant and timely history, and perform an appropriate clinical examination
- recognise signs and symptoms of impending cardiac arrest
- assess, predict and manage circulatory shock
- Recognise and manage emergencies; seek assistance appropriately
- undertake resuscitation in a timely manner in accordance with clinical guidelines and the patient status
- lead and co-ordinate the resuscitation team
- analyse SCD/deterioration in relation to the medical history
- consider legal and ethical issues: patient autonomy, appropriateness of resuscitation and ICU admission
- consult the views of referring clinicians

- assess and communicate effectively the risks and benefits of ICU admission
- refer appropriately for specialist interventions where indicated
- explain life-sustaining therapies and their expected outcome in a comprehensible manner to the patient/relatives prior to ICU admission (where possible)
- order and prioritise appropriate investigations
- assess and document Glasgow Coma Scale
- check and assemble resuscitation equipment
- monitor vital physiological functions as indicated
- recognise and respond rapidly to adverse trends in monitored patients
- obtain appropriate vascular access
- support relatives witnessing an attempted resuscitation
- participate in timely discussion and regular review of "do not actively resuscitate" orders and treatment limitation decisions
- risk-stratify post-arrest, and refer appropriately for ongoing intervention/investigation

Behaviours and attitudes

- aware of the importance of prodromal symptoms and signs
- recognition of the urgency in the management of the deteriorating patient and in cardiac arrest
- appreciation of the importance of timely institution of organ-system support
- appreciate SCD survivor and family anxieties
- clear explanations to patients, relatives and staff
- compassionate care of patients and their relatives
- awareness of the importance of personal limitations, requesting/accepting assistance and supervision where appropriate
- awareness of the importance of working with the whole multidisciplinary team, relatives (and where appropriate patients) where ongoing life-sustaining care appears futile in order to determine the best ongoing management strategy for the patient
- Referral to current resuscitation guidelines to choose the best evidence-based therapies

2.20 Adult congenital heart disease/grown-up congenital heart disease

Objectives

- to assess and provide immediate management of patients with congenital heart disease who are critically ill/deteriorating
- to appreciate the potentially adverse effects of ICU interventions on the patient with congenital heart disease

Knowledge

- understand the anatomy and normal physiology of :
  - valve and outflow tract lesions
  - septal defects
  - coarctation of the aorta
  - Ebstein's anomaly
  - aortic and pulmonary malformations
  - venous anomalies
  - transposition of the great arteries (complete and congenitally corrected)
  - tetralogy of Fallot
  - functionally univentricular hearts and the Fontan circulation
  - congenital malformations of coronary arteries
  - cyanotic congenital heart disease and secondary erythrocytosis
  - pulmonary hypertension in congenital heart disease
  - Eisenmenger syndrome
- understand the pathophysiology, natural history and complications of palliative and corrective surgery and interventions for congenital heart disease
- know the likely potential causes for acute deterioration in the congenital patient, based upon the underlying diagnosis and previous interventions
- know the pitfalls in investigation and the use of standard monitoring techniques in the patient with congenital heart disease
- know the physiological effects of common acute care interventions (intubation and positive pressure ventilation, inotropes, vasodilators, vasoconstrictors, volume resuscitation) and their potential adverse effects on the congenital circulation

Skills

The ability to:

- take a relevant history from the patient and/or relatives and perform an appropriate clinical examination
- recognise the deteriorating/at risk/critically ill patient with congenital heart disease
- appreciate that the clinical appearance of the GUCH patient may lead to an underestimation of the severity of their clinical status
- obtain immediate relevant investigations for diagnosis of the cause for deterioration
- seek immediate expert help both locally, and also from the regional GUCH centre

Behaviours and attitudes

- understand the importance of liaising with experts in ACHD/GUCH, and recognise the need for emergency management in these patients
- awareness of the importance of personal limitations, requesting/accepting assistance and supervision in the investigation and management of the acutely unwell GUCH patient

Part 3: The Certification Process in Acute Cardiac Care

Through the ESC, the ACCA offers the opportunity for certification in acute cardiac care. This certification comprises two parts:

Part I: Demonstration of theoretical knowledge of intensive and acute cardiac care by undertaking and passing a multiple-choice examination
Part II: Demonstration of competence with maintenance of a training record and submission of a logbook

The aim of the certification in acute cardiac care is to promote standards of training and education in acute cardiac care in Europe, thereby improving the quality of care and outcomes of patients with acute cardiovascular diseases. As a range of different specialists and professions manage patients with acute cardiovascular disorders, the ACCA have chosen to open Part I of the certification process (the theoretical examination) to all regularly involved in acute cardiac care. Part II of the certification process (demonstration of training and competence) is only open to cardiologists who have successfully passed Part I of the certification process, as it requires submission of a logbook demonstrating competence in undertaking specialist cardiological procedures on the background of completion of training in general core cardiology (i.e. as a subspecialty of cardiology).

3.1.: Part I

Part I of the certification process is open to all regularly involved in the care of patients with acute cardiovascular diseases, including doctors of all relevant specialties, nurses, nurse practitioners and other healthcare professionals who are members of the ACCA. The examination comprises 100 multiple choice questions related to the theoretical knowledge of acute cardiac care. Details regarding the examination and preparation are found in supplementary material.

3.2: Part II

This requires applicants to be registered medical practitioners who hold a cardiology specialist qualification issued by a National Authority of Health (or equivalent) of the European Union. They must be members of the ACCA, and have passed Part I of the certification within the preceding 12-24 months. A number of assessment methods will be used to ensure that knowledge; skills and professionalism outlined in the curriculum have been achieved including:

- Presentation of a logbook confirming the procedures undertaken, countersigned by their educational supervisor (or equivalent) to confirm they have met the required levels of competence
- Confirmation that the required training programme has been undertaken
- Evidence of ongoing training and assessment during the training period

Full details regarding the documentation required, including the logbook are found in supplementary material.

Supplementary material

Supplementary material regarding the certification process, requirements for training centres and training programmes in acute cardiovascular care may be found online (www.escardio.org/communities/ACCA/pages/welcome.aspx)