EuroIntervention 2017;12:2028-2030 published online November 2016

# A cardiac catheterisation laboratory core curriculum for the continuing professional development of nurses and allied health professions: developed by the Education working group of the Nurses and Allied Professions Committee for the European Association of Percutaneous Cardiovascular Interventions (EAPCI) 2016

**Lynne Hinterbuchner**[1], BScN; Salomé Coelho[2], RN; Ricardo Esteves[3], MSc, CPL; Sarah Carson[4], RN; Lene Kløvgaard[5], RN; Lino Gonçalves[2,6], MD, PhD; Stephan Windecker[7], MD, PhD; David Zughaft[8]*, BScN; *Authors/Task Force Members*

*Review: EAPCI Scientific Documents Committee, Marco Valgimigli[7], MD, PhD; Robert A. Byrne[9], MB, BCh, PhD*

*1. Department of Cardiology, Paracelsus Medical University, Salzburger Landeskliniken, Salzburg, Austria: 2. Department of Cardiology, Centro Hospitalar e Universitário de Coimbra - Hospital Geral, Coimbra, Portugal; 3. Heart and Vessels Department, Hospital Santa Maria, CHLN, Lisbon, Portugal; 4. Bristol Heart Institute, University Hospitals Bristol NHS Foundation Trust, Bristol, United Kingdom; 5. Department of Cardiology, Rigshospitalet, University of Copenhagen, Copenhagen, Denmark; 6. Faculty of Medicine, University of Coimbra, Coimbra, Portugal; 7. Department of Cardiology, Swiss Cardiovascular Centre, Bern University Hospital, Bern, Switzerland; 8. Department of Cardiology, Lund University, Lund, Sweden; 9. Deutsches Herzzentrum München, Technische Universität München, Munich, Germany*

*This paper also includes supplementary data published online at: http://www.pcronline.com/eurointervention/113th_issue/330*

**KEYWORDS**

- allied professionals
- curriculum
- education
- nursing

## Abstract

**Aims:** The aim of this report is to provide a standard educational structure for nurses and allied professionals (NAP) specialising in interventional cardiology. The curriculum can also be used as a basis for training on a certificate-based level in interventional cardiology.

**Methods and results:** The curriculum was developed by a panel of experts from various allied health professions. The syllabus focuses on nine core areas of themes essential for NAP working in interventional cardiology. The highly technical knowledge required for working in interventional cardiology as well as the various roles of the different professional groups have been taken into consideration.

**Conclusions:** This core curriculum will ensure that essential content is covered during education and a basic level of quality is achieved across specialty cardiovascular educational programmes throughout Europe.

**Corresponding author: Department of Cardiology, Lund University, Skane University Hospital, SE-221 85 Lund, Sweden. E-mail: David.Zughaft@med.lu.se*

© Europa Digital & Publishing 2017. All rights reserved.

SUBMITTED ON 08/05/2016 - REVISION RECEIVED ON 1st 18/08/2016 / 2nd 11/10/2016 - ACCEPTED ON 26/10/2016

DOI: 10.4244/EIJ-D-16-00374

## Introduction

Interventional cardiology has witnessed tremendous changes over the years with increasing complexity and diversity[1]. Procedures carried out in the coronary catheterisation laboratory (cathlab) have developed from mainly diagnostic to treatment of acute myocardial infarction, cardiogenic shock and complex structural heart disorders[2]. The role and competency requirements of cathlab nurses and allied professionals (NAP) have both changed[3]. In the treatment of patients with severe cardiac conditions, the contribution of NAP as part of the multidisciplinary team is vital. This reinforces the need for well-educated professionals[3,4].

In Europe, the complexity of diverse educational standards for NAP is significant[5]. Due to the lack of academic and clinical criteria for specialist nursing in cardiology, there is a high variability of competencies and skills throughout Europe, and thus no general guidelines or standardisation[6].

In the context of increasing complexity and competency requirements for NAP working in the cathlab and the lack of an educational structure, the development of a European Core Curriculum is essential. The primary objective of this curriculum is to provide a standard educational structure for NAP specialising in interventional cardiology. A secondary objective is to provide a basis for certificate-based education, subsequently clarifying the speciality requirements beyond basic training[7].

## Methods

### DEVELOPMENT OF THE CORE CURRICULUM

The framework of the curriculum is composed of nine core themes. The rationale behind the structure is based on the curriculum framework of cardiovascular nursing, developed by the Cardiovascular Council of Nurses and Allied Professions (CCNAP)[8], with the addition of competency requirements for interventional cardiology adapted from the theory of Benner[9] **(Table 1)**. The basic foundation of educational strategies, assessment, approaches, and evaluation can thus be found in the CCNAP document[8].

In the development of this curriculum, the diverse levels of education and differences in rules and regulations for NAP according to country-specific professional policy were taken into consideration.

### LEARNING OBJECTIVES FOR THE SPECIALITY OF INTERVENTIONAL CARDIOLOGY

- Apply evidence-based medicine and current guidelines of the European Society of Cardiology (ESC) to meet individual patient needs and characteristics.
- Be able to understand and explain to patients and relatives the medical procedure or surgical treatment.
- Acquire the theoretical knowledge and practical skills to assist in all interventional procedures in the cathlab.
- Assist in pre-procedural, intraprocedural and post-procedural patient care and management. Particular emphasis should be on pharmacological treatment, control of haemostasis, haemodynamics, and prevention of bleeding complications, prevention of allergic reactions and prevention of renal insufficiency.
- Identify the optimal strategy and assist in managing and handling of intraprocedural complications.

## Results

### CARDIAC CATHLAB CORE CURRICULUM CONTENT

The syllabus was developed by a panel of experts from various allied health professions working in the cathlab, representing different areas of expertise (medicine, nursing, cardiopulmonary technician, research and administration). The syllabus content, presented in **Online Appendix 1**, is arranged into nine themes, basing parts of the content on the CCNAP curriculum[1]. The nine themes are presented in **Table 2**, and the complete content with learning objectives, knowledge, skills, attitudes and behaviours

**Table 2. The nine themes of the core curriculum.**

| | Theme |
|---|---|
| 1 | Fundamentals of cardiovascular pathophysiology |
| 2 | Procedures and techniques |
| 3 | Radiation and imaging |
| 4 | Optimising cardiovascular health in the cathlab |
| 5 | Assessment, planning and managing patient care in interventional cardiology |
| 6 | Pharmacology and appropriate use of medications in the cathlab |
| 7 | Principles and practices of person and family care and emotional care |
| 8 | Physical wellbeing and comfort in the cathlab |
| 9 | Evaluation of the quality of care and research in interventional cardiology |

**Table 1. Levels of experience and time frames for education/training.**

| Level | Beginner | Advanced beginner | Competent | Proficient | Expert* |
|---|---|---|---|---|---|
| Time frame | 6 months | 6 months - 1 year | 1-2 years | 3-5 years | 5-10 years |
| Autonomy | Major supervision | Minor supervision, achieves most tasks alone | Achieves most tasks using own judgement | Takes full responsibility for own work, and that of others | Takes on responsibility beyond existing standards |
| Knowledge | Minimal, not connecting it to practice in the cathlab | Working knowledge of key aspects of practice in the cathlab | Good working and background knowledge in the cathlab | Greater depth of understanding in the cathlab and cardiology | Deep understanding and authoritative knowledge in the cathlab |

Adapted from the theory of Benner P[9]. *Many countries require a degree to be considered an expert.

can be found in the full version, which can be downloaded free of charge from the EAPCI website: (https://www.escardio.org/static_file/Escardio/Subspecialty/EAPCI/Documents/Core%20curriculum%20EAPCI%20NAP_160318%20version%201.4%20final.pdf)

## Discussion

The cathlab specialty involves many technical and task-oriented skills. This curriculum together with the documentation matrix **(Online Appendix 2)**, emphasises the use of competencies in order to document, develop and maintain the professional and specialised skills used in a cathlab setting. Accreditation through certification is one of the goals of the European Association of Percutaneous Cardiovascular Interventions (EAPCI) Nurses and Allied Professionals Education group. A further goal includes the development of a modular curriculum using the European Society of Cardiology e-Learning platform (ESCeL), which will constitute the foundation for a certification process.

## Conclusions

This curriculum was developed to provide an educational structure for nurses and allied professionals specialising in interventional cardiology, and to provide the basis for training on a certificate-based level. Even though there will be difficulties in implementation due to legislation, regulations and differences in scope of practice, the EAPCI Nurses and Allied Professionals Committee intends to strive for a common European routine for education, networking and research. Furthermore, standardisation of the competencies required to work in the highly specialised area of a cardiac catheterisation laboratory will contribute to the ESC mission to reduce the burden of cardiovascular disease in Europe.

## Impact on daily practice

The variability of competencies and skills of Nurses and Allied Professionals in Europe is significant due to a lack of academic and clinical criteria for specialist nursing. The level of competency and standards of practice can be improved by using the curriculum for training of NAP. Furthermore, using the matrix to capture the NAP competencies allows the user to document and follow training of new staff members, new procedures and new equipment.

## Acknowledgements

The authors would like to acknowledge Jean Fajadet and William Wijns for their invaluable support to the creation of a Nurses and Allied Professionals Committee in the EAPCI community, Marielle De La Torre and the EAPCI administration, all nurses and allied professionals in the EAPCI and EuroPCR community and the CCNAP.

## Conflict of interest statement

S. Windecker reports research contracts to the institution from Abbott Vascular, Biotronik, Boston Scientific, Medtronic, Edwards Lifesciences and St. Jude Medical. The other authors have no conflicts of interest to declare.

## References

1. Kirtane AJ, Doshi D, Leon MB, Lasala JM, Ohman EM, O'Neill WW, Shroff A, Cohen MG, Palacios IF, Beohar N, Uriel N, Kapur NK, Karmpaliotis D, Lombardi W, Dangas GD, Parikh MA, Stone GW, Moses JW. Treatment of Higher-Risk Patients With an Indication for Revascularization: Evolution Within the Field of Contemporary Percutaneous Coronary Intervention. *Circulation.* 2016;134:422-31.

2. Yadlapati A, Gajjar M, Schimmel DR, Ricciardi MJ, Flaherty JD. Contemporary management of ST-segment elevation myocardial infarction. *Intern Emerg Med.* 2016;11:1107-13.

3. Zughaft D, Harnek J. A review of the role of nurses and technicians in ST-elevation myocardial infarction (STEMI). *EuroIntervention.* 2014;10 Suppl T:T83-6.

4. Fajadet J. The new Nurses and Technicians committee of the EAPCI: towards the common objective of the best care for our patients. *EuroIntervention.* 2014;9:1378-9.

5. Dury C, Hall C, Danan JL, Mondoux J, Aguiar Barbieri-Figueiredo MC, Costa MA, Debout C. Specialist nurse in Europe: education, regulation and role. *Int Nurs Rev.* 2014;61:454-62.

6. Working Group of the Education Committee of the ESC Council on Cardiovascular Nursing and Allied Professions; Working Group of the Education Committee of the ESC Council on Cardiovascular Nursing and Allied Professions. Education for nurses working in cardiovascular care: a European survey. *Eur J Cardiovasc Nurs.* 2014;13:532-40.

7. Rauen C, Tollefson T, Dietzler H. Certification: A C edential of Competence. *Crit Care Nurse.* 2016;36:80-3.

8. Astin F, Carroll D, De Geest S, Fernandez-Oliver AL, Holt J, Hinterbuchner L, Jennings C, Jones I, Ketchell A, Kletsiou E, Ruppar T, Bustelo AS, Serafin A, Uchmanowicz I. A Core Curriculum for the Continuing Professional Development of Nurses Working in Cardiovascular Settings: Developed by the Education Committee of the Council on Cardiovascular Nursing and Allied Professions (CCNAP) on behalf of the European Society of Cardiology. *Eur J Cardiovasc Nurs.* 2015;14:S1-17.

9. Benner P. From novice to expert. *Am J Nurs.* 1982;82:402-7.

## Supplementary data

**Online Appendix 1.** The cardiac catheterisation laboratory core curriculum. Example of documentation matrix.

**Online Appendix 2.** The cardiac catheterisation laboratory core curriculum. Themes and indicative content.

*The supplementary data are published online at: http://www.pcronline.com/eurointervention/113th_issue/330*

# Supplementary data

## Online Appendix 1. The cardiac catheterisation laboratory core curriculum. Themes and indicative content

| | |
|---|---|
| **Fundamentals of cardiovascular pathophysiology** | |
| 1.1 Coronary | Coronary artery anatomy and physiology |
| | Flow dynamics – cardiac cycle |
| | Ischaemic heart disease (ACS, SCS) |
| 1.2 Non-coronary | Valvular heart disease |
| | Heart failure and cardiogenic shock |
| | Conduction (arrhythmias) |
| | Vascular diseases (carotid and peripheral) |
| | Cardiomyopathies and pericardial diseases |
| | Infectious diseases |
| | Congenital heart diseases |
| | Abdominal and thoracic aortic aneurysms & dissections |
| | Parasympathetic & sympathetic nervous system |
| | Renal regulation of blood pressure |
| **Procedures and techniques** | |
| 2.1 Aseptic technique | Pathogens |
| | Hand washing and universal precautions (PPE, gloving, isolation) |
| | Methods of sterilisation and disinfection |
| | Sterile table set-up (sterile field), maintenance and percutaneous access, sterile draping |
| 2.2 Vascular access | Access-site evaluation, choosing & positioning (Allen test) |
| | Closure techniques (manual compression, devices, closing) |
| | Detection and treatment of vascular site complications |
| 2.3 Coronary, valvular, and structural diagnostic procedures and materials | Angiography techniques (native coronaries, grafts, LIMAs, RIMAs, vasospasm, collateral circulation) |
| | Types of lesion and QCA – vessel measurement |
| | Left ventriculography |
| | Aortography |
| | Left/right catheterisation |
| | Haemodynamics (pressures, values, blood flow, cardiac output, wave forms) |
| | IVUS |
| | OCT |
| | ICE |
| 2.4 Coronary angioplasty procedures and materials | PCI techniques (preparation of lesion, complex, occlusion) |
| | Appropriate catheter selection |
| | Types of angioplasty guidewire |
| | Types of balloon (semi-compliant, non-compliant, DEB, cutting) |
| | Types of stent (BMS, DES, scaffolds, self-expanding, covered) |
| | CTO (devices) |
| 2.5 Special techniques | FFR/iFR/ PdPa |
| | Rotational atherectomy |
| | Embolic protection devices (filters, proximal devices) |
| | Thrombectomy devices (manual, automatic) |
| | Occlusive balloons |
| | Target temperature management/therapeutic hypothermia |
| | LVAD |
| | IABP |
| | Temporary pacing |
| | Pericardiocentesis |

| Procedures and techniques (cont'd) | |
|---|---|
| 2.6 Structural heart disease | Mitral, aortic and pulmonary valvuloplasty |
| | Congenital interventions (PFO, ASD, coils, VSD closure) |
| | Percutaneous paravalvular leak closure and LAAO |
| | TAVR |
| | Mitral valve interventions |
| | TMV |
| | Septal closure with alcohol |
| 2.7 Peripheral interventions | Carotid artery angiography and stenting (filters) |
| | Peripheral arteriography and angioplasty |
| | Renal intervention |
| | Neurological interventions for stroke events (optional) |
| **Radiation and imaging** | |
| 3.1 Radiation physics and terminology | Radiation production, units and characteristics |
| | Imaging system |
| | Principles, positioning and operation of the fluoroscopic X-ray equipment |
| 3.2 Radiation risks and protection | Biological effects of radiation (injuries) |
| | Radiation safety/protection (patients and personnel) |
| | Dose reduction techniques |
| | Radiation exposure monitoring and limits |
| 3.3 Injectors and lesion visualisation | Contrast injection systems and techniques |
| | Digital imaging systems and flat panels |
| 3.4 Intracoronary imaging modalities | OCT/OFDI |
| | IVUS |
| | ICE |
| | NIRS |
| | Intermodality (imaging) |
| | TEE |
| **Optimising cardiovascular health in the cathlab** | |
| 4.1 Cardiovascular risk factors | CVD burden and statistics |
| | Modifiable and non-modifiable risk factors |
| | Emerging risk factors |
| | CVD burden and statistics |
| | Modifiable and non-modifiable risk factors |
| | Emerging risk factors |
| 4.2 Individualised risk factors | Risk SCORE system |
| | Prevention strategies |
| **Assessment, planning and managing patient care in interventional cardiology** | |
| 5.1 Patient preparation | Medical records |
| | Physician's orders |
| 5.2 Basic assessment techniques | History and physical exam |
| | Vital signs |
| | Central nervous system (CNS) assessment |
| | Respiratory system assessment |
| | Cardiovascular assessment |
| | ECG monitoring & interpretation |
| | Peripheral vascular assessment |
| | Procedural risk assessment |
| 5.3 Interpretation of laboratory studies | Chemistries, cardiac enzymes, troponin |
| | Electrolytes |
| | Haematology & coagulation studies |
| | Lipid panel |

| Assessment, planning and managing patient care in interventional cardiology (cont'd) | |
|---|---|
| 5.4 IV therapy | IV insertion |
| | IV assessment & maintenance |
| 5.5 Post-procedure patient care | Haemostasis |
| | Documentation |
| | Handover |
| | Transport |
| 5.6 Patient management during procedure | Point of care testing - ACT, oximetry |
| | Patient positioning |
| | High-risk patient |
| 5.7 Complications & emergencies | Shock |
| | Anaphylaxis |
| | Coronary complications |
| | Tamponade |
| 5.8 Life support skills | ACLS & BCLS |
| **Pharmacology and appropriate use of medications in the cathlab** | |
| 6.1 Pharmacokinetics & pharmacodynamics | Antiplatelet agents (IIb/IIIa receptor antagonists, $P2Y_{12}$ inhibitors) |
| | Anticoagulants (heparin and low molecular heparins) |
| | Direct thrombin inhibitors (bivalirudin) |
| | Thrombolytic |
| | Contrast media |
| | Antiarrhythmic |
| | Nitrates |
| | Other antianginals |
| | Cardiac glycosides |
| | Vasopressors & vasodilators |
| | Calcium channel blockers |
| | ACE inhibitors, angiotensin receptor blockers (ARBs), aldosterone antagonists |
| | Beta-blockers |
| | Other antihypertensive agents |
| | Sedatives and reversal agents |
| | Analgesics and reversal medications |
| | Antibiotics |
| | Antiemetics |
| | Steroids |
| | Antihistamines |
| | Cholesterol lowering agents |
| | Oxygen |
| | IV inotropes |
| 6.2 Medications & polypharmacy | Uses in the cathlab |
| | Level of significance for interactions |
| | Known interactions with commonly used medications in the cathlab |
| | Relative vs. absolute contraindication |
| | Beers criteria |
| 6.3 Routes of administration | Intracoronary (IC) |
| | Intra-arterial (IA) |
| | Intravenous (IV) |
| | Sublingual (SL) |
| | Subcutaneous (SQ) |
| | Oral (PO) |
| | Topical |

| Pharmacology and appropriate use of medications in the cathlab (cont'd) | |
|---|---|
| 6.4 Proper documentation of medications & medical and legal aspects | Risk/benefit of medication |
| | Compliance issues |
| | 5 rights: patient, method, dose, drug & route |
| | Electronic & paper charting |
| | Local standard & policies of medication administration |
| 6.5 Drug and IV infusion calculations | Basic calculations |
| | IV drips units/hour |
| | IV drips microgram/min |
| | IV medication preparation/correct mixing solutions |
| 6.6 Conscious sedation | Aldrete score |
| | Monitoring |
| | Hospital standards |
| | Agents used |
| | ACLS algorithms |
| | 1st line drugs |
| | 2nd line drugs |
| **Principles and practices of person and family care and emotional care** | |
| 7.1 Shared decision making | Tools & approaches |
| | Communication skills |
| | Reflective practice |
| 7.2 Person and family-centred healthcare | Professionalism |
| | Ethics |
| | Therapeutic relationships |
| **Physical wellbeing and comfort in the cathlab** | |
| 8.1 Patient rights & safety | Informed consents |
| | Hospital standards for the cathlab |
| | Psychosocial, physical and environmental needs |
| 8.2 Symptom assessment | Safe care of sedated, unconscious patients |
| | Management of acute chest pain and symptoms |
| 8.3 End of life care | Patient care with dignity and confidentiality |
| **Evaluation of the quality of care and research in interventional cardiology** | |
| 9.1 Quality care & quality indicators | Systems and organisational theory |
| | Hospital standards |
| | Measurement of quality care |
| 9.2 Risk assessment | Audit & inspections |
| | Evaluation |
| | IT skills, electronic health records |
| 9.3 Research and investigation | Investigation and research methodologies overview |
| | Articles and publications modalities |
| | Landmark studies of interventional cardiology |

ACS: acute coronary syndrome; ACLS: advanced cardiac life support; ACT: activated clotting time; ASD: atrial septal defect; BLS: basic cardiac life support; BMS: bare metal stent; CTO: chronic total occlusion; CVD: cardiovascular disease; DEB: drug-eluting balloon; DES: drug-eluting stent; ESCeL: European Society of Cardiology e-Learning; FFR: fractional flow reserve; IABP: intra-aortic balloon pump; ICE: intracardiac echo; iFR: instantaneous wave-free ratio; IVUS: intravascular ultrasound; LAAO: left atrial appendage occlusion; LVAD: left ventricular assist devices; NIRS: near-infrared spectroscopy; OCT: optical coherence tomography; OFDI: optical frequency domain imaging; Pa: proximal aortic pressure; PCI: percutaneous coronary intervention; Pd: distal coronary pressure; PFO: patent foramen ovale; PPE: personal protection equipment; QCA: quantitative coronary angiography; SCS: stable coronary syndrome; TAVR: transcatheter aortic valve replacement; TMV: transmitral valve; VSD: ventricular septal defect

## Online Appendix 2. The cardiac catheterisation laboratory core curriculum. Example of documentation matrix

**Every time the trainee achieves a skill they should sign their initials in the proper column. The last pages of the Matrix are for documenting reflection of the trainee's progress. The local trainer should then countersign each level as the trainee progresses through each level of training. As some trainees learn quicker or have some type of experience they may go on to the next level quicker than others. There is no set time frame of how quickly or slowly one makes progress. The trainee must be signed off by the local trainer, before they progress to the next level.**

| | | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| | Fundamentals of cardiovascular pathophysiology | Knowledge | Recognises / is aware of | Ability to describe | Understands / demonstrates | Able to teach others |
| Coronary | Coronary anatomy | | | | | |
| | Coronary physiology | | | | | |
| | Flow dynamics/ cardiac cycle | | | | | |
| | Ischaemic heart disease ACS | | | | | |
| | Ischaemic heart disease SCS | | | | | |
| Non-coronary | Valvular heart disease | | | | | |
| | Heart failure | | | | | |
| | Cardiogenic shock | | | | | |
| | Conduction system/ arrhythmias | | | | | |

NAPs Matrix "log book" version 1.2 30.04.2016