

European Society of Cardiology Core Curriculum for cardio-oncology

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Cardio-oncology is a rapidly growing field of cardiovascular (CV) medicine that has resulted from the continuously increasing clinical demand for specialized CV evaluation, prevention and management of patients suffering or surviving from malignant diseases. Dealing with CV disease in patients with cancer requires special knowledge beyond that included in the general core curriculum for cardiology. Therefore, the European Society of Cardiology (ESC) has developed a special core curriculum for cardio-oncology, a consensus document that defines the level of experience and knowledge required for cardiologists in this particular field. It is structured into 8 chapters, including (i) principles of cancer biology and therapy; (ii) forms and definitions of cancer therapy-related cardiovascular toxicity (CTR-CVT); (iii) risk stratification, prevention and monitoring protocols for CTR-CVT; (iv) diagnosis and management of CV disease in patients with cancer; (v) long-term survivorship programmes and cardio-oncology rehabilitation; (vi) multidisciplinary team management of special populations; (vii) organization of cardio-oncology services; (viii) research in cardio-oncology. The core curriculum aims at promoting standardization and harmonization of training and evaluation in cardio-oncology, while it further provides the ground for an ESC certification programme designed to recognize the competencies of certified specialists.

Keywords

Cardio-oncology • Cancer • Cardiotoxicity • Anticancer therapy • Chemotherapy • Immunotherapy • Radiotherapy • Targeted therapies • Hormonal therapy

Definition of cardio-oncology

The term cardio-oncology refers to the cardiovascular (CV) assessment, treatment and follow-up of patients and survivors with malignancies, aimed at the prevention, timely diagnosis, risk stratification and effective management of CV disease (CVD).^{1,2}

One key aim of cardio-oncology is to render cancer patients fit from a CV perspective to receive the best available anticancer treatment, ideally without any compromises or interruptions due to CV morbidity.^{2,3}

A cardio-oncology service covers the whole journey of a patient with cancer, starting at diagnosis. CV risk stratification, CV profile optimization and application of any preventive measures are required before and during active cancer therapy. CV surveillance and timely diagnosis and treatment of incident CVD are also essential during and after completion of cancer therapy.¹

The need for cardio-oncology

Cardiovascular disease represents the second leading cause of death in patients with malignancies after cancer progression, and it is more frequent in these patients compared to the general population.^{1,2,4} The impact of CVD in cancer is growing, given the complexity of modern anticancer therapy, including targeted agents and immunotherapy, which increases survival of patients on the one hand, and is burdened by progressively higher rates of cardiac and vascular events on the other.^{3–5} Moreover, the appreciation of shared risk factors and pathophysiological mechanisms that may simultaneously lead to both CVD and cancer, linking them in a potentially reciprocal manner, have lately attracted much attention.⁶ At least one third of patients with newly diagnosed cancer have pre-existing CVD and at least 30% of cancer patients treated with cardiotoxic drugs develop some degree of CV toxicity.^{4,7} As a result, the rising clinical demand and the revived research interest have rendered cardio-oncology a rapidly growing field of CV medicine.

The European Society of Cardiology (ESC) Core Curriculum for cardio-oncology is a consensus document that

defines the level of experience and knowledge required for cardiologists in the field of cardio-oncology. It aims at promoting standardized and harmonized training and evaluation in cardio-oncology. The ESC Core Curriculum for cardio-oncology will further provide the ground for an ESC certification programme designed to recognize the competencies of certified specialists.

The concept of a Core Curriculum for cardio-oncology

This curriculum aims at defining the sub-specialty of cardio-oncology and describing its place as a new field of CV medicine. It details the knowledge, skills and attitudes required for cardio-oncology practice.

The Royal College of Physicians and Surgeons of Canada has produced a widely accepted standard framework of physician roles, CanMEDS, which identifies and describes the abilities physicians require to effectively meet the healthcare needs of the people they serve (*Table 1*).⁸ The ESC has adopted the CanMEDS roles in the ESC Core Curriculum for the Cardiologist,⁹ and they are an integral part of the Core Curriculum for cardio-oncology.

As a sub-specialty of cardiology, cardio-oncology must be seen in the context of the ESC Core Curriculum for the Cardiologist and the Union of European Medical Specialists (UEMS) European Training Requirements.⁹ The ESC Core Curriculum focuses on the acquisition of clinical competencies for the investigation, evaluation, diagnosis, treatment, and care of the wide range of patients with CVD, defined by a series of entrustable professional activities (EPAs).

Trust is central to the delivery of good healthcare. During training, trainers develop increasing trust in their trainees' abilities to undertake professional activities safely, effectively, and independently. EPAs provide a systematic process to record the acquisition of the necessary skills, knowledge, integrity, reliability, humility, and professional role in a

Table 1 CanMEDS physician competency framework

Role	Description	Key competencies
Medical expert	As medical experts, physicians integrate all the CanMEDS roles, applying medical knowledge, clinical skills, and professional values in their provision of high-quality and safe patient-centred care. Medical expert is the central physician role in the CanMEDS framework and defines the physician's clinical scope of practice	<ul style="list-style-type: none"> • Practise medicine within their defined scope of practice and expertise • Perform a patient-centred clinical assessment and establish a management plan • Plan and perform procedures and therapies for the purpose of assessment and/or management • Establish plans for ongoing care and, when appropriate, timely consultation • Actively contribute, as an individual and as a member of a team providing care, to the continuous improvement of healthcare quality and patient safety • Apply novel digital methods of diagnosis, treatment communication and process to achieve optimal clinical outcomes
Communicator	As communicators, physicians form relationships with patients and their families that facilitate the gathering and sharing of essential information for effective health care	<ul style="list-style-type: none"> • Establish professional therapeutic relationships with patients and their families (in-person and virtual communication) • Elicit and synthesize accurate and relevant information, incorporating the perspectives of patients and their families • Share healthcare information and plans with patients and their families • Engage patients and their families in developing plans that reflect the patient's healthcare needs and goals • Document and share written and electronic information about the medical encounter to optimize clinical decision-making, patient safety, confidentiality, and privacy
Collaborator	As collaborators, physicians work effectively with other healthcare professionals to provide safe, high-quality, patient-centred care	<ul style="list-style-type: none"> • Work effectively with physicians and other colleagues in the healthcare professions • Work with physicians and other colleagues in the healthcare professions to promote understanding, manage differences, and resolve conflicts • Hand over the care of a patient to another healthcare professional to facilitate continuity of safe patient care
Leader	As leaders, physicians engage with others to contribute to a vision of a high-quality healthcare system and take responsibility for the delivery of excellent patient care through their activities as clinicians, administrators, scholars, or teachers	<ul style="list-style-type: none"> • Contribute to the improvement of healthcare delivery in teams, organizations, and systems • Engage in the stewardship of healthcare resources • Demonstrate leadership in professional practice
Health advocate	As health advocates, physicians contribute their expertise and influence as they work with communities or patient populations to improve health. They work with those they serve to determine and understand needs, speak on behalf of others when required, and support the mobilization of resources to effect change	<ul style="list-style-type: none"> • Manage career planning, finances, and health human resources in a practice • Respond to an individual patient's health needs by advocating with the patient within and beyond the clinical environment • Respond to the needs of the communities or populations they serve by advocating with them for system-level change in a socially accountable manner
Scholar	As scholars, physicians demonstrate a lifelong commitment to excellence in practice through continuous learning and by teaching others, evaluating evidence, and contributing to scholarship	<ul style="list-style-type: none"> • Engage in the continuous enhancement of their professional activities through ongoing learning • Teach students, residents, the public, and other healthcare professionals • Integrate best available evidence into practice • Contribute to the creation and dissemination of knowledge and practices applicable to health
Professional	As professionals, physicians are committed to the health and well-being of individual patients and society through ethical practice, high personal standards of behaviour, accountability to the profession and society, physician-led regulation, and maintenance of personal health	<ul style="list-style-type: none"> • Demonstrate a commitment to patients by applying best practices and adhering to high ethical standards • Demonstrate a commitment to society by recognizing and responding to societal expectations in health care • Demonstrate a commitment to the profession by adhering to standards and participating in physician-led regulation • Demonstrate a commitment to physician health and well-being to foster optimal patient care

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holistic clinical context. With repeated formative assessments, the progress of trainees through the levels of independence can be documented from Level 1 (trainee is able to observe) to Level 5 (trainee is able to supervise others in performing the activity) (Table 2). When a trainee is trusted to perform a defined professional activity at the level of independence required in the curriculum, the EPA has been completed. For patients to be given optimal CV care, the clinicians responsible for that care must have the knowledge, skills and attitudes to be able to safely perform that aspect of care independently (Level 5 independence: able to supervise others in performing the activity).

Some aspects of cardiology are so common, and/or so urgent, that all cardiologists must be able to safely perform these activities independently. This is reflected in the ESC Core Curriculum for the Cardiologist, where these EPAs require Level 5 independence – for example, manage a patient with arterial hypertension. However, there are many less common and less urgent presentations and procedures where outcomes are improved by concentrating the delivery of care in sub-specialists. The ESC Core Curriculum recognises this, requiring lower levels of independence for some EPAs (for example, manage cardiac dysfunction in oncology patients – Level 4 independence: able to perform the activity under distant supervision).

Table 2 Levels of independence

Level 1	Trainee is able to <i>observe</i>
Level 2	Trainee is able to <i>perform the activity under direct supervision</i> (proactive, close supervision, supervisor in the room)
Level 3	Trainee is able to <i>perform the activity under indirect supervision</i> (reactive, on-demand supervision, trainee has to ask for help, supervisor readily available, within minutes)
Level 4	Trainee is able to <i>perform the activity under distant supervision</i> (reactive, supervision available remotely, e.g. within 20–30 min, on the phone or post hoc)
Level 5	Trainee is able to <i>supervise others</i> in performing the activity

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The purpose of the ESC Core Curriculum for cardio-oncology is to define the requirements necessary to deliver cardio-oncology care across all the required presentations and investigations, recognising that the care of our patients will be shared between oncologists and other clinicians, cardio-oncology specialists and other cardiologists, each according to their competencies and the local hospital organization.

The curriculum is divided into 8 chapters (Figure 1), each containing the EPAs required for an area of practice (Table 3). All EPAs share a common structure, including the description of the clinical competence, CanMEDS roles, knowledge, skills, and attitudes required to perform the professional activity, as well as the tools suggested for assessing each professional activity. Each EPA also specifies the level of independence that a trainee is expected to achieve at the end of training. Table 3 summarises the level of independence required for each EPA for cardio-oncologists. Moreover, Table 3 also presents the level of independence that the authors of this document believe should be attained by all general cardiologists also caring for patients with cardio-oncology (i.e. level of independence for general cardiologists).

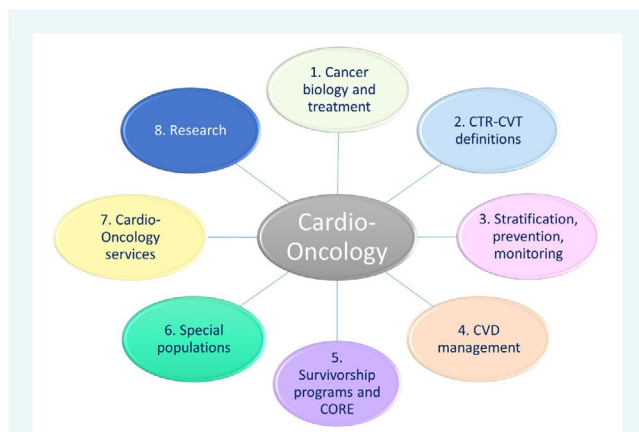


Figure 1 Core curriculum chapters. CORE, cardio-oncology rehabilitation, CTR-CVT, cancer therapy-related cardiovascular toxicity; CVD, cardiovascular disease.

As EPAs focus on skills, they are best assessed in a clinical context. The assessment of knowledge will be supported by an ESC subspecialty examination in cardio-oncology, which is under development. For each EPA the following assessment tools will be used: multiple choice questions (MCQs), case-based discussions, mini clinical evaluation exercise (mini-CEX), multiple consultant reports and multi-source feedback. Regular multi-source feedback is essential to supplement other forms of assessment.

Cardio-oncology training requirements

There are different models of cardio-oncology services, depending on the structure of local health services. Cardio-oncology structures that serve as training centres should have fully equipped outpatient clinics and dedicated inpatient teams. Administrative support is needed to ensure that patients are seen in the clinic without unnecessary delay. Regular multidisciplinary team meetings should be encouraged to review complex patients. Research is an important pillar of cardio-oncology and services should be encouraged to participate in national and international networks. The collection of clinical data in local registries and audit is also recommended to facilitate quality control.

General sources of knowledge

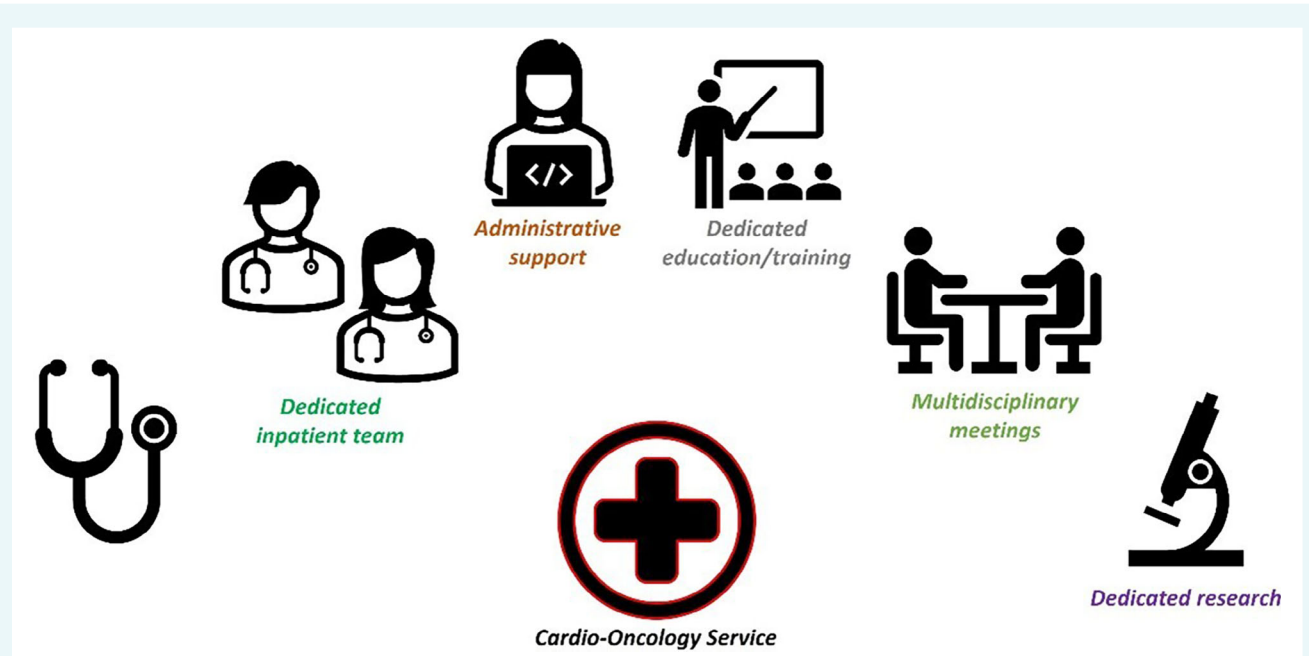
In addition to specific guidelines and position papers provided at the end of each EPA, ESC published specific documents for the general cardiologist and dedicated cardio-oncology material which may serve as other relevant sources of knowledge:

- ESC Textbook of Cardiovascular Medicine, 3rd edition
- ESC Education Topic of the Month: Cardio-oncology, September 2022 (<https://www.escardio.org/Education/ESC-Education-by-Topic/Topic-of-the-Month/cardio-oncology>)
- ESC 365 on-line resources (<https://esc365.escardio.org/results?page=1&query=cardio-oncology>)
- National Cancer Institute online resources (<https://www.cancer.gov/about-cancer/treatment/types>)

Table 3 Entrustable professional activities (EPAs) required for each Core Curriculum chapter and levels of independence required for each EPA for general cardiologists and for cardio-oncologists

EPA	Lol for cardio-oncologist	Lol for general cardiologist
Chapter 1. Principles of cancer biology and therapy		
EPA 1.1 Describe the principles of cancer biology and the properties, effects, indications, contraindications, and secondary effects of cancer therapies	4	2
Chapter 2. CTR-CVT forms and definitions		
EPA 2.1 Define the diagnostic criteria of CTR-CVT	5	3
Chapter 3. CTR-CVT risk stratification, preventive interventions and CV monitoring protocols		
EPA 3.1 Assess CTR-CVT risk before, during and after cardiotoxic cancer therapies	5	3
EPA 3.2 Manage a prevention programme for patients with cancer and with significant CV comorbidities and/or under cardiotoxic therapies	5	3
EPA 3.3 Comprehensive CV assessment of patients with cancer during and after cardiotoxic cancer therapies	5	3
Chapter 4. Diagnosis and management of CVDs in patients with cancer		
EPA 4.1 Manage a patient with CTR-CVT	5	3
EPA 4.2 Manage a patient with cancer and pre-existing or new CVD not related to cancer treatment	5	4
Chapter 5. Long-term survivorship programmes and cardio-oncology rehabilitation		
EPA 5.1 Manage a CV prevention and CORE programme for a patient with cancer and a cancer survivor	4	2
Chapter 6. Multidisciplinary team management of special populations		
EPA 6.1: Management of patients with cardiac tumours, cancer and pregnancy, carcinoid heart disease, light chain-cardiac amyloidosis, and cardiac implantable electronic devices	5	3
Chapter 7. Organization of a cardio-oncology service		
EPA 7.1 Design, implement and evaluate the organization of a cardio-oncology service	5	2
Chapter 8. Research in cardio-oncology		
EPA 8.1 Design and implement basic, translational, and clinical research in cardio-oncology	4	2

CORE, cardio-oncology rehabilitation; CTR-CVT, cancer therapy-related cardiovascular toxicity; CV, cardiovascular; CVD, cardiovascular disease; EPA, entrustable professional activity; Lol, level of independence.

**Figure 2** Cardio-oncology service requirements.

Core curriculum chapters

Chapter 1: Principles of cancer biology and therapy

EPA 1.1	Describe the principles of cancer biology and the properties, effects, indications, contraindications, and secondary effects of cancer therapies		
Level of independence	For cardio-oncologist	4	For general cardiologist
Scope and timeframe	<ul style="list-style-type: none"> Understanding the principles of cancer biology in cancer patients Understanding the role of the different alternatives for cancer treatment Understanding the properties, effects, indications, contraindications, and secondary effects of cancer therapies 		
Setting	<ul style="list-style-type: none"> Inpatient Outpatient Home-based Community 		
Including	<ul style="list-style-type: none"> Surgery Radiotherapy Chemotherapy Biologic agents Immunotherapies Endocrine therapy 	Excluding	<ul style="list-style-type: none"> Cancer treatment prescription
CanMEDS roles	<ul style="list-style-type: none"> Medical expert Collaborator Scholar 		
Knowledge^{1,10}	<ul style="list-style-type: none"> Know the fundamentals of cancer biology Know the fundamentals of systemic therapies in solid tumours Know the fundamentals of systemic therapies in haematological malignancies Know the fundamentals of radiation therapy 		
National Cancer Institute online resources (https://www.cancer.gov/about-cancer/treatment/types)			
Skills	<ul style="list-style-type: none"> Understand basic concepts on cancer biology, different tumour types and different tumour stages, and mechanisms of metastases Understand different cancer treatment regimens including surgery, radiotherapy, chemotherapy, biologic agents, cellular therapy, immunotherapies and endocrine therapy Understand the CV toxicities of different systemic therapies used to treat patients with solid tumours, as well as risk factors facilitating the occurrence of those toxicities Understand the CV toxicities of different systemic therapies used to treat patients with haematologic malignancies, as well as risk factors facilitating the occurrence of those toxicities Understand the mechanisms, timeline and clinical manifestations of radiotherapy-related cardiac injury 		
Attitudes	<ul style="list-style-type: none"> Work in a multidisciplinary team of healthcare professionals including medical oncologists, radiation oncologists, haematologists, specialized nurses and surgeons Be aware of the evolution of anticancer drugs and new therapeutic schemes Be aware of the evolution of radiotherapy regimens and techniques, which might impact the risk of radiation-related cardiac injury Be familiar with the terminology used in reports of pathology and imaging exams performed in cancer patients Be familiar with the staging of the cancer types 		

Chapter 2: Cancer therapy-related cardiovascular toxicities – forms and definitions

EPA 2.1	Define the diagnostic criteria of cancer therapy-related cardiovascular toxicities (CTR-CVT)			
Level of independence	For cardio-oncologist	5	For general cardiologist	3
Scope and timeframe	<ul style="list-style-type: none"> Patients with cancer, during and after treatment with cardiotoxic therapies 			
Setting	<ul style="list-style-type: none"> Inpatient Outpatient Home-based Community setting Cardiology or Oncology/Haematology departments 			
Including	<ul style="list-style-type: none"> New CVD related to cancer therapies Deterioration of pre-existing CV conditions 			
CanMEDS roles	<ul style="list-style-type: none"> Medical expert Communicators Collaborator Scholar Professional 			
Knowledge^{1,11}	<ul style="list-style-type: none"> Identify the different forms of CTR-CVT Know major and minor criteria for each CTR-CVT type diagnosis 			
Common Terminology Criteria for Adverse Events (CTCAE)				
Skills	<ul style="list-style-type: none"> Select the appropriate complementary test to confirm or rule out CTR-CVT Interpret results of CV imaging and other complementary investigations performed in oncology patients and derive diagnostic and prognostic information Perform an interdisciplinary work with the oncologists, haematologists, radio-oncologists, and other healthcare professionals 			
Attitudes	<ul style="list-style-type: none"> Work in a multidisciplinary team of healthcare professionals including medical oncologists, radiation oncologists, haematologists, specialized nurses and surgeons Communicate to ensure that the diagnosis is understood by healthcare professionals and patients and their families and/or caregivers 			

Chapter 3. Cancer therapy-related cardiovascular toxicity risk stratification, preventive interventions, and cardiovascular monitoring protocols

EPA 3.1	Assess cancer therapy-related cardiovascular toxicity (CTR-CVT) risk before, during and after cardiotoxic cancer therapies			
Level of independence	For cardio-oncologist	5	For general cardiologist	3
Scope and timeframe	<ul style="list-style-type: none"> Adult cancer patients, either with known or unknown CVD and/or CV risk factors Before initiation of anticancer treatment, during cancer therapy and after completion of cancer treatment 			
Setting	<ul style="list-style-type: none"> Inpatient Outpatient Home-based Community setting Cardiology or Oncology/Haematology departments 			

Chapter 3 Continued

EPA 3.1	Assess cancer therapy-related cardiovascular toxicity (CTR-CVT) risk before, during and after cardiotoxic cancer therapies		
Level of independence	For cardio-oncologist	5	For general cardiologist
Including	<ul style="list-style-type: none"> CV assessment before, during and after cardiotoxic therapies Investigating history of previous cancer and exposure to previous cancer therapies Use and focused interpretation of cardiac imaging tools and biomarkers (e.g. electrocardiogram [ECG], echocardiography, coronary computed tomography [CT] including coronary calcium score, cardiac magnetic resonance, cardiac troponin, natriuretic peptides, and future validated biomarkers) to define CVD and CV toxicity risk 		
CanMEDS roles	<ul style="list-style-type: none"> Medical expert Communicators Collaborator Leader Scholar 		
Knowledge ^{1,12–15}	<ul style="list-style-type: none"> Understand the concept and definitions of CTR-CVT risk and the role of risk estimation Understand the concept that CTR-CVT risk is dynamic and changes over time; therefore, it should be assessed at baseline, during treatment and after treatment Interpret the influence of CV risk factors and CVD in patient prognosis (differentiate mortality and morbidity) and quality of life Understand the concept of frailty in cardio-oncology Understand and apply cardio-oncology risk stratification tools (e.g. HFA-ICOS risk assessment tools) Identify patients at high and very-high risk for CRT-CVT Understand that different cancer therapies, including in the same class, pose different risk of cardiotoxicity (e.g. anthracycline equivalence doses of cardiotoxicity) Acknowledge the investigations needed to diagnose risk profiles according to the specific antineoplastic treatment scheduled 		
Skills	<ul style="list-style-type: none"> Perform a comprehensive CV risk assessment using appropriate risk calculators and including additional tests, if necessary Perform a basic assessment of frailty in patients >70 years old (e.g. G8 score) to identify patients that should be referred for a geriatric assessment Evaluate the risk of CTR-CVT in active cancer and the associated oncology therapies Identify cancer patients with greater expected CTR-CVT risk Interpret results of CV imaging and other complementary investigations performed in oncology patients and derive diagnostic, therapeutical and prognostic information Perform an interdisciplinary work with the oncologists, haematologists, radio-oncologists, and other healthcare professionals Apply effective communication and motivational skills to support the patient in making positive lifestyle and behaviour modifications 		
Attitudes	<ul style="list-style-type: none"> Promote baseline risk evaluation before cancer treatment Work in a multidisciplinary team of healthcare professionals including medical oncologists, radiation oncologists, haematologists, specialized nurses and surgeons Communicate to ensure that the diagnosis is understood by healthcare professionals and patients and their families and/or caregivers Explore patient expectations, values, and priorities Adopt a shared decision approach by actively engaging the patient and his/her family/caregiver in management decisions based on individual values, preferences, and associated conditions and comorbidities Be aware of the evolution of oncology therapies and their potential cardiac side effects 		

Chapter 3 Continued

EPA 3.2		Manage a prevention programme for patients with cancer with significant CV comorbidities and/or under cardiotoxic therapies	
Level of independence	For cardio-oncologist	5	For general cardiologist 3
Scope and timeframe	<ul style="list-style-type: none"> • Adult cancer patients, either with known or unknown CVD and/or CV risk factors • Before initiation of anticancer treatment, during cancer therapy and after completion of cancer treatment 		
Setting	<ul style="list-style-type: none"> • Inpatient • Outpatient • Home-based • Community setting 		
Including	<ul style="list-style-type: none"> • Cardiology or Oncology/Haematology departments • Guidance for lifestyle recommendations, guideline-directed CV medical therapy, referral for CV examinations and follow-up • Identification of targets for CV prevention • Apply specific preventive interventions in different settings (e.g. smoking, alcohol abuse, obesity, diet and physical activity, blood pressure and lipid-lowering medications, anticoagulation, antidiabetic medication) 		
CanMEDS roles	<ul style="list-style-type: none"> • Medical expert • Communicators • Collaborator • Leader • Scholar • Professional 		
Knowledge ^{1,12,16}	<ul style="list-style-type: none"> • Interpret the influence of CV risk factors and CVD in patient prognosis (differentiate mortality and morbidity) and quality of life • Understand that different cancer therapies, including in the same class, pose different risk of cardiotoxicity (e.g. anthracycline equivalence doses of cardiotoxicity) • Understand the general strategies for reducing CV risk, and those specific to different cancer therapies 		
Skills	<ul style="list-style-type: none"> • Interpret results of CV imaging and other complementary investigations performed in oncology patients and derive diagnostic, therapeutical and prognostic information • Apply preventive strategies according to risk stratification before, during and after cancer treatment • Perform an interdisciplinary work with the oncologists, haematologists, radio-oncologists, and other healthcare professionals • Apply effective communication and motivational skills to support the patient in making positive lifestyle and behaviour modifications 		
Attitudes	<ul style="list-style-type: none"> • Work in a multidisciplinary team of healthcare professionals including medical oncologists, radiation oncologists, haematologists, specialized nurses and surgeons • Communicate to motivate patients to sustain long-term adherence with lifestyle, exercise training, and medical therapy • Explore patient expectations, values, and priorities • Adopt a shared decision approach by actively engaging the patient and his/her family/caregiver in management decisions based on individual values, preferences, and associated conditions and comorbidities • Be aware of the evolution of oncologic therapies and their potential cardiac side effects 		

Chapter 3 Continued

EPA 3.3		<i>Comprehensive CV monitoring of a patient with cancer during and after cardiotoxic cancer therapies</i>	
Level of independence	<i>For cardio-oncologist</i>	5	<i>For general cardiologist</i> 3
Scope and timeframe	<ul style="list-style-type: none"> • Adult cancer patients, either with known or unknown CVD and/or CV risk factors • Before initiation of anticancer treatment, during cancer therapy and after completion of cancer treatment 		
Setting	<ul style="list-style-type: none"> • Inpatient • Outpatient • Home-based • Community setting • Cardiology or Oncology/Haematology departments 		
Including	<ul style="list-style-type: none"> • Use and focused interpretation of cardiac imaging tools and biomarkers (e.g. ECG, echocardiography, coronary CT and coronary calcium score, cardiac magnetic resonance, cardiac troponin, natriuretic peptides, future validated biomarkers) 		
CanMEDS roles	<ul style="list-style-type: none"> • Referral for clinical follow-up and CV examinations • Medical expert • Communicators • Collaborator • Leader • Scholar • Professional 		
Knowledge ^{1,12,14,15}	<ul style="list-style-type: none"> • Understand the concept and definitions of CTR-CVT risk and the role of risk estimation • Understand the concept that CTR-CVT risk is dynamic and changes over time; therefore, it should be assessed at baseline, during treatment and after treatment • Interpret the influence of CV risk factors and CVD in patient prognosis (differentiate mortality and morbidity) and quality of life • Understand that different cancer therapies, including in the same class, pose different risk of cardiotoxicity (e.g. anthracycline equivalence doses of cardiotoxicity) • Acknowledge the investigations needed to diagnose risk profiles according to the specific antineoplastic treatment scheduled 		
Skills	<ul style="list-style-type: none"> • Understand the general strategies for reducing CV risk, and those specific to different cancer therapies • Organize a personalized CV monitoring strategy based on the cancer treatment scheme and the individual CV toxicity risk • Interpret results of CV imaging and other complementary investigations performed in oncology patients and derive diagnostic, therapeutic and prognostic information that may change risk categorization and monitoring needs • Perform a multidisciplinary work with the oncologists, haematologists, radio-oncologists, and other healthcare professionals • Apply effective communication and motivational skills to support patient's and family's caregivers' adherence to follow-up visits 		
Attitudes	<ul style="list-style-type: none"> • Work in a multidisciplinary team of healthcare professionals including medical oncologists, radiation oncologists, haematologists, specialized nurses and surgeons • Communicate to ensure that the CV monitoring plan is understood by healthcare professionals, patients, and family/caregivers • Communicate to motivate patients and family/caregivers to sustain long-term adherence to follow-up visits • Explore patient expectations, values, and priorities • Adopt a shared decision approach by actively engaging the patient in management decisions based on individual values, preferences, and associated conditions and comorbidities • Be aware of the evolution of oncologic therapies and their potential cardiac side effects 		

Chapter 4: Diagnosis and management of cardiovascular disease in patients with cancer

EPA 4.1		Manage a patient with cancer therapy-related cardiac toxicities	
Level of independence	For cardio-oncologist	5	For general cardiologist
			3
Scope and timeframe	<ul style="list-style-type: none"> Adult cancer patients who present with new CTR-CVT during and after cancer treatment Referral to Cardio-Oncology Clinic and treatment of CTR-CVT 		
Setting	<ul style="list-style-type: none"> Inpatient Outpatient Home-based Community setting 		
Including	<ul style="list-style-type: none"> Cardiology or Oncology/Haematology departments Diagnosis and management of CRT-CVT Indication for and interpretation of basic and advanced investigations Initiation and monitoring of medical therapy for CRT-CVT Understanding of cardiac surveillance protocols Discussion of continuing cancer treatment in multidisciplinary teamwork Principles of restarting anticancer treatment Guidance, lifestyle recommendations, guideline-directed CV medical therapy, referral for CV examinations, follow-up 		
CanMEDS roles	<ul style="list-style-type: none"> Medical expert Communicators Collaborator Scholar 		
Knowledge ^{1,11,12,17,18}	<ul style="list-style-type: none"> Professional Understand the concept and definitions of CTR-CVT Understand that different cancer therapies, including in the same class, pose different risk of cardiotoxicity (e.g. anthracycline equivalence doses of cardiotoxicity) Understand the principles of CV investigation, including cardiac imaging tools and biomarkers Acknowledging the risk of cancer undertreatment due to CTR-CVT Know ESC guidelines on treatment of CTR-CVT, and general ESC guidelines on treatment of CVD Be aware of possible interactions between CV and anticancer drugs 		
Skills	<ul style="list-style-type: none"> Interpret results of CV imaging and other complementary investigations performed in oncology patients and derive diagnostic, therapeutic and prognostic information Assess pharmacology of drugs, their potential interactions and side effects in relation to new treatments administered for managing the manifestations of cardiotoxicity Perform an interdisciplinary work with the oncologists, haematologists, radio-oncologists, and other healthcare professionals Build a network of experts, able to collaborate with the oncologists and cardio-oncologists, with competence on all the potential manifestations of cardiotoxicity, able to plan the most complex interventions and procedures that may be needed in selected patients with cardiotoxicity Apply effective communication and motivational skills to support the patient in making positive lifestyle and behaviour modifications 		
Attitudes	<ul style="list-style-type: none"> Work in a multidisciplinary team of healthcare professionals including medical oncologists, radiation oncologists, haematologists, specialized nurses and surgeons Understand that patients often present with overlapping and non-specific symptoms including fatigue, impaired exercise tolerance, anorexia, and chest pain Recognize the risk of undertreatment of cancer and the importance of avoiding unnecessary interruption of cancer treatment Communicate to ensure that the diagnosis is understood by healthcare professionals, patients, and family/caregivers Communicate to motivate patients and family/caregivers to sustain long term adherence with lifestyle, exercise training, and medical therapy Explore patient expectations, values, and priorities Adopt a shared decision approach by actively engaging the patient in management decisions based on individual values, preferences, and associated conditions and comorbidities Be aware of the evolution of oncologic therapies and their potential cardiac side effects 		

Chapter 4 Continued

EPA 4.2		Manage a patient with cancer and preexisting or new CVD not related to cancer treatment	
Level of independence	For cardio-oncologist	5	For general cardiologist
Scope and timeframe	<ul style="list-style-type: none"> Adult cancer patients presenting with prevalent CVD at baseline or developing an acute CVD that is not related to cancer treatment; this may also occur during cancer survivorship decades after incident cancer diagnosis 		
Setting	<ul style="list-style-type: none"> Inpatient Outpatient Home-based Community setting 		
Including	<ul style="list-style-type: none"> Cardiology or Oncology/Haematology departments Perform risk stratification and management of CVD as per ESC guidelines Indication for and interpretation of basic and advanced investigations Discussion of continuing cancer treatment in multidisciplinary teamwork Principles of restarting anticancer treatment Guidance, lifestyle recommendations, guideline-directed CV medical therapy, referral for CV examinations, follow-up 		
CanMEDS roles	<ul style="list-style-type: none"> Acknowledge gaps in relation to best CV practice when applied to patients with cancer Medical expert Communicators Collaborator Scholar 		
Knowledge ^{16–25}	<ul style="list-style-type: none"> Professional Acknowledge the prevalence of CVD in patients with newly diagnosed cancer Knowledge of ESC guidelines on acute and chronic CVD Understand CVD guideline recommended treatment strategies, in particular in relation to patients with cancer (e.g. delivery of invasive therapies, risk vs. benefits, balance between ischaemic and bleeding events) Understand how cancer prognosis influences the decision-making process for CV interventions (e.g. non-coronary interventions) Interpret the influence of CV risk factors and CVD on patient prognosis (differentiate mortality and morbidity) and quality of life Understand the principles of CV investigation, including cardiac imaging tools and biomarkers Understand the role of CV primary and secondary prevention, particularly in relation to the evolving evidence base around patients with cancer Acknowledge the risk of cancer undertreatment due to prevalent or emerging CVD 		
Skills	<ul style="list-style-type: none"> Be aware of possible interactions between CV and anticancer drugs Interpret results of CV imaging and other complementary investigations performed in oncology patients and derive diagnostic, therapeutical and prognostic information Assess pharmacology of drugs, their potential interactions and side effects in relation to new treatments administered for managing of CVD Perform an interdisciplinary work with the oncologists, haematologists, radio-oncologists, and other healthcare professionals Build a network of experts, able to collaborate with the oncologists and cardio-oncologists, with competence on all the potential manifestations of CVD in cancer patients, able to plan the most complex interventions and procedures that may be needed in selected patients Apply effective communication and motivational skills to support the patient in making positive lifestyle and behaviour modifications 		
Attitudes	<ul style="list-style-type: none"> Work in a multidisciplinary team of healthcare professionals including medical oncologists, radiation oncologists, haematologists, specialized nurses and surgeons Promote baseline risk evaluation before cancer treatment Understand that patients often present with overlapping and non-specific symptoms including fatigue, dyspnoea, impaired exercise tolerance, anorexia, and chest pain Recognize the risk of undertreatment of CVD in cancer patients Communicate to ensure that the diagnosis is understood by healthcare professionals, patients and family/caregivers Communicate to motivate patients and family/caregivers to sustain long-term adherence with lifestyle, exercise training, and medical therapy Explore patient expectations, values, and priorities Adopt a shared decision approach by actively engaging the patient in management decisions based on individual values, preferences, and associated conditions and comorbidities Discuss, when appropriate, end-of-life care with patients 		

Chapter 5: Long-term survivorship programmes and cardio-oncology rehabilitation

EPA 5.1		<i>Manage a CV prevention and cardiac rehabilitation programme for a patient with cancer and a cancer survivor (Cardio-Oncology Rehabilitation: CORE)</i>	
Level of independence	For cardio-oncologist	4	For general cardiologist 2
Scope and timeframe	<ul style="list-style-type: none"> • Adult cancer patients and adults who are childhood and adolescent cancer survivors • At the time of cancer diagnosis, during anticancer treatment, follow-up surveillance 		
Setting	<ul style="list-style-type: none"> • Inpatient • Outpatient • Home-based • Community setting • Virtual (including online and tele-rehabilitation), as part of shared models integrating primary care and oncology services (survivorship programmes) 		
Including	<ul style="list-style-type: none"> • Investigating history of previous cancer and exposure to previous cancer therapies • Use and focused interpretation of cardiac imaging tools and biomarkers (e.g. ECG, echocardiography, coronary CT including coronary calcium score, cardiac magnetic resonance, cardiac troponin, natriuretic peptides, and future validated biomarkers) • Guidance for lifestyle recommendations, guideline-directed CV medical therapy, referral for CV examinations and follow-up • Identification of targets for CV prevention • Apply specific preventive interventions in different settings (e.g. smoking, alcohol intake, obesity, diet and physical activity, blood pressure and lipid-lowering medications, anticoagulation, antidiabetic medication) • Performing and interpretation of quality of life and patient-reported outcome measures (PROMs) assessments 		
CanMEDS roles	<ul style="list-style-type: none"> • Medical expert • Communicators • Collaborator • Leader • Health advocate 		
Knowledge ^{1,26–29}	<ul style="list-style-type: none"> • Scholar • Identify clinical interactions between cancer and CVD during the continuum of cancer treatment and survivorship • Understand the concept that CTR-CVT risk is dynamic and changes over time; therefore, it should be assessed at baseline, during treatment and after treatment • Interpret the influence of CV risk factors and CVD on patient prognosis (differentiate mortality and morbidity) and quality of life • Understand the strategies for preventing CV risk as a general principle, and specific to different cancer therapies • Acknowledge the role of exercise in cardio-oncology rehabilitation to minimize the negative effects of cancer therapies (e.g. cardiotoxicity, fatigue, bone loss, lymphoedema, autonomic dysfunction, depression, anxiety) • Understand the role of cardio-oncology rehabilitation and its intersection with traditional oncology rehabilitation as well as cardiac rehabilitation and cancer survivorship programmes 		
Skills	<ul style="list-style-type: none"> • Understand and apply quality of life and PROMs assessment tools • Perform a comprehensive CV risk assessment using appropriate risk calculators and including additional tests, if necessary • Interpret results of CV imaging and other complementary investigations performed in oncology patients and derive diagnostic, therapeutical and prognostic information • Apply preventive strategies according to risk stratification after cancer treatment • Perform and interpret exercise capacity tests (ECG exercise testing, cardiopulmonary exercise testing, 6-min walking test, strength tests) for tailored exercise recommendations and risk stratification • Identify the appropriate cardio-oncology rehabilitation setting (residential, outpatient, centre-based, community-based, home-based) according to patient's preferences and possibilities • Adapt type and intensity of training to cancer localization, cancer stages and specific sequelae (e.g. appropriate intensity in case of cachexia or frailty, role of upper body strength training in breast cancer, role of inspiratory muscle training in thoracic cancer) • Perform an interdisciplinary work with the oncologists, haematologists, radio-oncologists, and other healthcare professionals • Apply effective communication and motivational skills to support the patient in making positive lifestyle and behaviour modifications 		
Attitudes	<ul style="list-style-type: none"> • Promote excellence in cardio-oncology rehabilitation with a goal of incorporating its content and practice as a standard of care for cancer patients and survivors at high risk for CVD • Work in a multidisciplinary team of healthcare professionals including medical oncologists, radiation oncologists, haematologists, specialized nurses and surgeons • Communicate to motivate patients to sustain long term adherence with lifestyle, exercise training, and medical therapy • Explore patient expectations, values, and priorities • Adopt a shared decision approach by actively engaging the patient in management decisions based on individual values, preferences, and associated conditions and comorbidities 		

Chapter 6: Direct effects of cancer on the heart and special populations

EPA 6.1	<i>Management of patients with cardiac tumours, cancer and pregnancy, carcinoid heart disease, light chain-cardiac amyloidosis and cardiac implantable electronic devices</i>			
Level of independence	<i>For cardio-oncologist</i>	5	<i>For general cardiologist</i>	3
Scope and timeframe	<ul style="list-style-type: none"> • Adult cancer patients before, during and after cancer therapy (special populations are defined under 'including') 			
Setting	<ul style="list-style-type: none"> • Inpatient • Outpatient • Community setting • Emergency department • Cardiology or Oncology/Haematology departments 			
Including	Special population in this setting includes those with: <ul style="list-style-type: none"> • cardiac tumours • cancer and pregnancy • carcinoid heart disease • light-chain cardiac amyloidosis (AL-CA) • cancer patients with cardiac implantable electronic devices (CIED) 			
CanMEDS roles	<ul style="list-style-type: none"> • Medical expert • Communicators • Collaborator • Leader • Health advocate • Scholar • Professional 			
Knowledge^{1,30}	<ul style="list-style-type: none"> • Acknowledge the existence, needs and focused CV management of special cancer population • Understand the principles of CV investigation, including cardiac imaging tools and biomarkers • Understand CVD guideline-recommended treatment strategies, in particular in relation to patients with cancer (e.g. delivery of invasive therapies, risk vs. benefits, balance between ischaemic and bleeding events) • Acknowledge the impact of radiation treatment on CIEDs, as well as the role of dose and treatment beam energy 			
Skills	<ul style="list-style-type: none"> • Interpret results of CV imaging and other complementary investigations performed in oncology patients and derive diagnostic, therapeutical and prognostic information • Assess pharmacology of drugs, their potential interactions and side effects • Perform an interdisciplinary work with the oncologists, haematologists, radio-oncologists, and other healthcare professionals • Build a network of experts, able to collaborate with the oncologists and cardio-oncologists, with competence on all the potential manifestations of CVD in cancer patients, able to plan the most complex interventions and procedures that may be needed in selected patients • Apply effective communication and motivational skills to support the patient in making positive lifestyle and behaviour modifications • Recognise the need for non-surgical, surgical and/or chemotherapy treatments for cardiac tumours and carcinoid valvular heart diseases • Differentiate AL-CA from other conditions with similar clinical presentations • Identify the level of risk of CIED malfunction during radiotherapy or surgery 			
Attitudes	<ul style="list-style-type: none"> • Work in a multidisciplinary team of healthcare professionals including medical oncologists, radiation oncologists, haematologists, specialized nurses and surgeons • Understand that patients often present with overlapping and non-specific symptoms including fatigue, impaired exercise tolerance, anorexia, and chest pain • Recognize the risk of undertreatment of CVD in cancer patients • Communicate to ensure that the diagnosis is understood by healthcare professionals and patients • Communicate to motivate patients to sustain long-term adherence with lifestyle, exercise training, and medical therapy • Explore patient expectations, values, and priorities • Adopt a shared decision approach by actively engaging the patient in management decisions based on individual values, preferences, and associated conditions and comorbidities 			

Chapter 7: Organization of a cardio-oncology service

EPA 7.1		Design, implement and evaluate the organization of a cardio-oncology service	
Level of independence	For cardio-oncologist	5	For general cardiologist
Scope and timeframe Setting Including CanMEDS roles Knowledge ^{1,12,31–35} World Health Organisation, 2016. Catalogue of resources to support HSD transformations	<ul style="list-style-type: none"> • Adult cancer patients • At the time of cancer diagnosis, during anticancer treatment, follow-up surveillance • Inpatient • Outpatient • Community setting • Design, implementation, and evaluation of the organization of a cardio-oncology service (Figure 2) • Medical expert • Communicators • Collaborator • Leader • Health advocate • Scholar • Professional • Know definitions and standards for a cardio-oncology service • Understand the objectives of a cardio-oncology service: <ul style="list-style-type: none"> ◦ Facilitation of anticancer treatment, minimizing treatment interruptions ◦ CV prevention in cancer patients ◦ Risk stratification of CVD in cancer patients ◦ Optimization of CV profile in cancer patients independently of delivery of potentially cardiotoxic anticancer treatments ◦ Early identification and treatment of CTR-CVT ◦ Surveillance for late CV complications • Understand the structure and organization of a cardio-oncology service including administrative, technical and human resources needed for cardio-oncology practice • Recognize key points in the implementation of cardio-oncology clinics: <ul style="list-style-type: none"> ◦ Eligible patients ◦ Roles and responsibilities ◦ Pathways for cancer patients in cardio-oncology services ◦ Requirements of specialized cardio-oncology clinics and centres ◦ Governance and audit ◦ Cancer survivorship programme ◦ Training and education ◦ Registries and clinical trials ◦ Funding and organizational issues ◦ Knowledge translation 		
Skills	<ul style="list-style-type: none"> • Perform an interdisciplinary work with the oncologists, haematologists, radio-oncologists, specialized nurses and other healthcare professionals • Build a network of experts, able to collaborate with the oncologists and cardio-oncologists, with competence on all the potential manifestations of CVD in cancer patients, able to plan the most complex interventions and procedures that may be needed in selected patients • Apply effective communication and motivational skills to support the patient in making positive lifestyle and behaviour modifications • Explore patient expectations, values, and priorities • Adopt a shared decision approach by actively engaging the patient in management decisions based on individual values, preferences, and associated conditions and comorbidities 		
Attitudes	<ul style="list-style-type: none"> • Apply digital methods of diagnosis, treatment communication and process to achieve optimal clinical outcomes • Actively contribute, as an individual and as a member of a team, to the continuous improvement of healthcare quality and safety of cancer patient • Work in a multidisciplinary team of healthcare professionals including medical oncologists, radiation oncologists, haematologists, specialized nurses and surgeons • Share healthcare information and plans with all the components of the cardio-oncology service • Engage all the components of the cardio-oncology service in developing plans that reflect the patient's healthcare needs and goals • Document and share written and electronic information about the medical activity to optimize clinical decision-making, patient safety, confidentiality, and privacy • Adopt a shared decision approach by actively engaging the patient in management decisions based on individual values, preferences, and associated conditions and comorbidities 		

Chapter 8: Research in cardio-oncology

EPA 8.1	<i>Design and implement basic, translational and clinical research in cardio-oncology</i>		
Level of independence	<i>For cardio-oncologist</i>	4	<i>For general cardiologist</i>
Scope and timeframe	<ul style="list-style-type: none"> • All phases of research, from conception of studies to dissemination of results 		
Setting	<ul style="list-style-type: none"> • Research laboratory (translational research) • Cancer screening programmes, primary care setting, inpatient, outpatient, Emergency department, Cardiology or Oncology/Haematology departments, national registries (translational and clinical research) 		
Including	<ul style="list-style-type: none"> • Study design and general knowledge of the main methodologies used in research 		
CanMEDS roles	<ul style="list-style-type: none"> • Expert • Collaborator • Leader • Health advocate • Scholar 		
Knowledge ^{1,36–39}	<ul style="list-style-type: none"> • Appraise the existing evidence bases, be updated on the main findings of previous cardio-oncology research • Identify key areas of research: generation of new or incremental evidence; resolution of controversy; verification of novel hypotheses • Be aware of funding opportunities, stakeholders, and collaborators • Choose research methodology appropriately (standardization, collection, analysis, and interpretation of data) • Recognize possible biases/confounders • Synthesize and present the results to specialists, non-specialists, and general public • Manage audits of regulatory authorities 		
Skills	<ul style="list-style-type: none"> • Perform an interdisciplinary work with the oncologists, haematologists, radio-oncologists, specialized nurses, other healthcare professionals and patients' representatives (in clinical research) • Put research in perspective: potential implications for future research, improvement of clinical practice, therapeutic discovery • Attend webinars, congresses, and other events allowing discussion with peers and stakeholders (including policy makers, health services, healthcare professionals, academia, and members of the public) • Participate in the education of oncologists, haematologists, radio-oncologists (including attending actively to local, regional, national and/or international lectures, symposia, webinars) • Ask collaborators and other investigators to critically review the research hypothesis and plan • Become familiar with the processes leading to approval of a research project (Institutional Animal Care and Use Committee, Ethics Committee, other institutional boards) • Directly observe how research experiments and assessments are done • Visit research groups and facilities • Participate in peer-review of scientific articles and grant applications • Join PhD programmes and/or post-graduate courses focused on research in cardio-oncology • Actively contribute to patient recruitment for trials and registries 		
Attitudes	<ul style="list-style-type: none"> • Actively contribute, as an individual and as a member of a team, to the continuous improvement of healthcare quality and safety of cancer patient • Work in a multidisciplinary team of healthcare professionals including medical oncologists, radiation oncologists, haematologists, specialized nurses and surgeons • Explain research to stakeholders in an effective manner • Involve patients in research (clinical research) • Foresee pitfalls and find solutions 		

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