

# Cardio-Oncology Services: rationale, organization, and implementation

## A report from the ESC Cardio-Oncology council

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Received 5 March 2018; revised 2 May 2018; editorial decision 9 July 2018; accepted 9 July 2018

### Aims

Anticancer therapies have extended the lives of millions of patients with malignancies, but for some this benefit is tempered by adverse cardiovascular (CV) effects. Cardiotoxicity may occur early or late after treatment initiation or termination. The extent of this cardiotoxicity is variable, depending on the type of drug used, combination with other drugs, mediastinal radiotherapy, the presence of CV risk factors, and comorbidities. A recent position paper from the European Society of Cardiology addressed the management of CV monitoring and management of patients treated for cancer.

### Methods and results

The current document is focused on the basis of the Cardio-Oncology (C-O) Services, presenting their rationale, organization, and implementation. C-O Services address the spectrum of prevention, detection, monitoring, and treatment of cancer patients at risk of cardiotoxicity and/or with concomitant CV diseases. These services require a multidisciplinary approach, with the aims of promoting CV health and facilitating the most effective cancer therapy.

### Conclusion

The expected growing volume of patients with cancer at risk of developing/worsening CV disease, the advent of new technological opportunities to refine diagnosis, and the necessity of early recognition of cancer therapy-related toxicity mandate an integrative multidisciplinary approach and care in a specialized environment. This document from the ESC Cardio-Oncology council proposes the grounds for creating C-O Services in Europe based on expert opinion.

### Keywords

Cancer • Management • Services • Cardio-oncology

Cancer is currently the second most common cause of death in Europe after cardiovascular (CV) diseases. With the expected 23.6 million new cancer cases worldwide each year by 2030<sup>1</sup> and the rapidly growing number of patients surviving cancer, often in the setting of advanced age, new or pre-existing CV disease and risk factors, the

management of these patients has become the concern of experts in Cardio-Oncology (C-O).<sup>2</sup> For many years, cardiologists have collaborated with cancer specialists to assist them in the management of CV comorbidities and provide guidance on optimal CV therapy. Currently, the role of the cardiologist has expanded from treating

The opinions expressed in this article are not necessarily those of the Editors of the *European Heart Journal* or of the European Society of Cardiology.

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## Terminology

- Cardio-Oncology Team (C-O Team) is a multidisciplinary team (MDT) of dedicated professionals to provide specialized cardiovascular evaluation and care in all stages of the cancer process.
- Cardio-Oncology Clinic (C-O Clinic) is any organization with a C-O Team and the facilities to take care of ambulatory cancer patients in a coordinated manner. C-O Clinic is supported by the cardiology department to perform additional tests (i.e. invasive) and when a patient is admitted at hospital.
- Cardio-Oncology Services (C-O Services) in tertiary/university health-centres coordinate C-O Clinics around their catchment area, take care of inpatients cardiovascular complications and coordinate research and educational areas in cardio-oncology.
- Oncologists or cancer specialists: These terms refer to either specialists in medical oncology, radiation oncology, and haematology.

acute and chronic effects of cancer therapies to focus on early preventive strategies promoting a multidisciplinary patient-centred approach in a dedicated environment, namely the C-O Clinic.<sup>3,4</sup> A recent position paper of the European Society of Cardiology (ESC) has reported the most common CV complications related to anticancer treatments and has set the optimal management of these patients.<sup>5</sup> Cardio-Oncology is an area in expansion in Europe. However, there are, in our knowledge, very few data about C-O Services with a great confusion of specific roles and organization. In the present document from the ESC Cardio-Oncology council, we focused on the description of the basis of C-O Services, by approaching its rationale, organization, and implementation.

## Cardio-Oncology Services

Cardio-Oncology Services should be conceived as an alliance of dedicated professionals to provide multidisciplinary specialized evaluation and consistent, continuous, coordinated, and cost-effective care during the cancer process.<sup>6,7</sup> The knowledge of the cardiac side effects of anticancer agents and radiation therapy, balanced with the knowledge regarding the natural history of the malignancy and the benefits of oncologic treatments offers the greatest opportunity for long-term disease-free survival. *Table 1* summarizes C-O Services goals.<sup>7</sup>

The degree of organization of a C-O Service has a direct impact on both the quality of patient care and outcome provided. The C-O Team typically includes core members (medical and radiation oncologists, haematologists, cardiologists, and specialized nurses) and support members [patients' general practitioners (GPs), cardiac surgeons, cardiologists specialized in other domains, pathologists, radiologists, palliative care team, clinical laboratory specialists, hospital pharmacists, psychologists, social workers, and data managers]. While the composition of a C-O Team may vary in accordance with hospital size and organization, it is essential to agree on local protocols, as well as clinical and research quality standards that promote the effective use of available resources<sup>8</sup> (*Figure 1*).

## Objectives of Cardio-Oncology Teams

The objectives of C-O Teams include (i) prior to the cancer therapy, the identification of potential risk factors leading to cancer treatment-related CV complications, the optimization of CV health to ensure safe cancer surgery and allow optimal local and systemic

anticancer therapy and when optimization of CV health cannot be achieved, interdisciplinary discussion to ensure most efficacious cancer treatment without substantial CV harm; (ii) during cancer treatment, early identification, and appropriate treatment of CV complications and interdisciplinary discussion to make clinical decisions in patients experiencing CV side effects; (iii) after cancer treatment, optimization of preventive strategies, screening for late-onset complications as well as re-assessment of risk for CV complications in patients in need of treatment for secondary cancers<sup>5,9,10</sup> (*Figure 2*).

- The *prevention of CV complications* in cancer patients requires a comprehensive evaluation of CV risk profile and physical exam, including evidence of manifest arteriosclerotic disease, blood pressure, and cardiac function before starting any kind of potentially cardiotoxic anticancer therapy.<sup>5,10</sup> This screening should be performed by cardiologists in order to select the most appropriate therapy for the individual patient. This is mainly important in the adjuvant setting or for oncologic malignancies with good prognosis where patients are already potentially cured or survive for several years and a high risk of long-term major side effects is not acceptable. Accordingly, cardiologists will discuss with oncologists the expected CV risk of the selected therapy, to define the optimal frequency of CV monitoring. Interactions of cancer drugs with pre-existing cardiac medications (e.g. anticoagulation, drugs metabolized via the cytochrome CYP3A4...) should also be considered prior to treatment in all patients.<sup>11</sup>
- The *optimization of CV health* for cardiac patients and the *facilitation of anticancer treatment* in patients with CV complications are both natural consequences of this approach. This also includes specific recommendations on appropriate use of CV medications such as antiplatelet and anticoagulant therapeutics during cancer treatment.<sup>5,12,13</sup>
- The *early identification and treatment of CV complications* are two core missions of a C-O Team. The oncologists should monitor carefully symptoms/signs during anticancer therapy in order to differentiate those related to cancer from others, directly due to cardiac involvement. The most frequent dilemma is the balance of continuing vs. interrupting anticancer therapy, and whether the cancer or CV disease is the greater threat to the patient's survival.<sup>5</sup> Applying the best of modern cardiology care, with engagement of subspecialties promptly, may be a prerequisite to allow or continue cardiotoxic therapy, or minimizing interruptions of important cancer treatments.<sup>6</sup>
- The *surveillance for late CV complications* in cancer survivors is probably the most difficult to translate into practice because detrimental effects exerted by both systemic anticancer drugs

**Table 1** Goals of the Cardio-Oncology Services**Unification of the cancer care process**

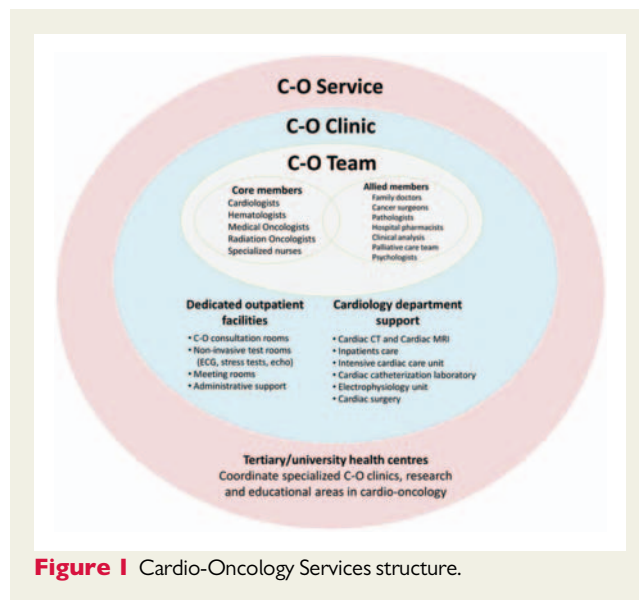
- Effective communication and coordination among professionals involved in cancer patients care to minimize unnecessary costs
- Development and adherence to local clinical protocols to reduce individual decisions
- Optimize acute and long-term cardiovascular health for patients who need potentially cardiotoxic drugs
- Prevention, early diagnosis, and treatment of cancer therapy-related cardiovascular complications
- Reduce interruptions of anticancer drugs
- Coordination of continuous medical education, medical training, and clinical research in cardio-oncology
- Health care quality control for clinical and research practice

and radiotherapy can appear years to decades after receiving these therapies.<sup>1-3</sup> The correct long-term strategy for cardiotoxicity monitoring requires not only the existence of a C-O Team but also the ability to organize a long-term surveillance programme, focused on patients' education and treatment adherence, in collaboration with GPs and specialized nurses. Furthermore, care-takers should be aware that patients after cancer therapy frequently experience atypical CV symptoms—for example silent ischaemia after mediastinal radiation.<sup>9</sup>

## Structure and organization

### Models of Cardio-Oncology Services

Various models of C-O Services exist depending upon the structures of the local health service, hospitals, and their specialization (Table 2).<sup>3-5,14,15</sup> In large tertiary hospitals and university hospitals with cardiology and oncology services, C-O Services can exist within cardiology departments with direct oncology involvement. As services grow, C-O Services may have inpatient dedicated team and outpatient C-O clinics dedicated to specific cancer groups (e.g. breast cancer, lymphoma, long-term survivors) and both cardiology and oncology specialists can deliver the service in the same clinical environment and location. In specialist oncology hospitals two models of service exist depending on both clinical (necessity) and practical (geographical, contractual) issues. Some centres have set up 'in house' cardiology services. Alternatively, specialized oncology centres have partnered with specialist cardiac centres to deliver the C-O Services for their oncology patients. In either case the provision of a MDT meeting is fundamental for the review of complex patients and periodic review of the quality and provision of the C-O Services. Another important variable is the scope of the C-O Services. C-O Clinics deliver CV care for ambulatory patients either using an outpatient clinic model or a dedicated day-case assessment model. In smaller district hospitals C-O Clinics work with a standard outpatient clinic model, with a limited scope in the range of service offered (e.g. symptomatic management of common cardiac symptoms, surveillance imaging for specific treatments follow-up appointment to review the results, and guide treatment after a C-O

**Figure 1** Cardio-Oncology Services structure.

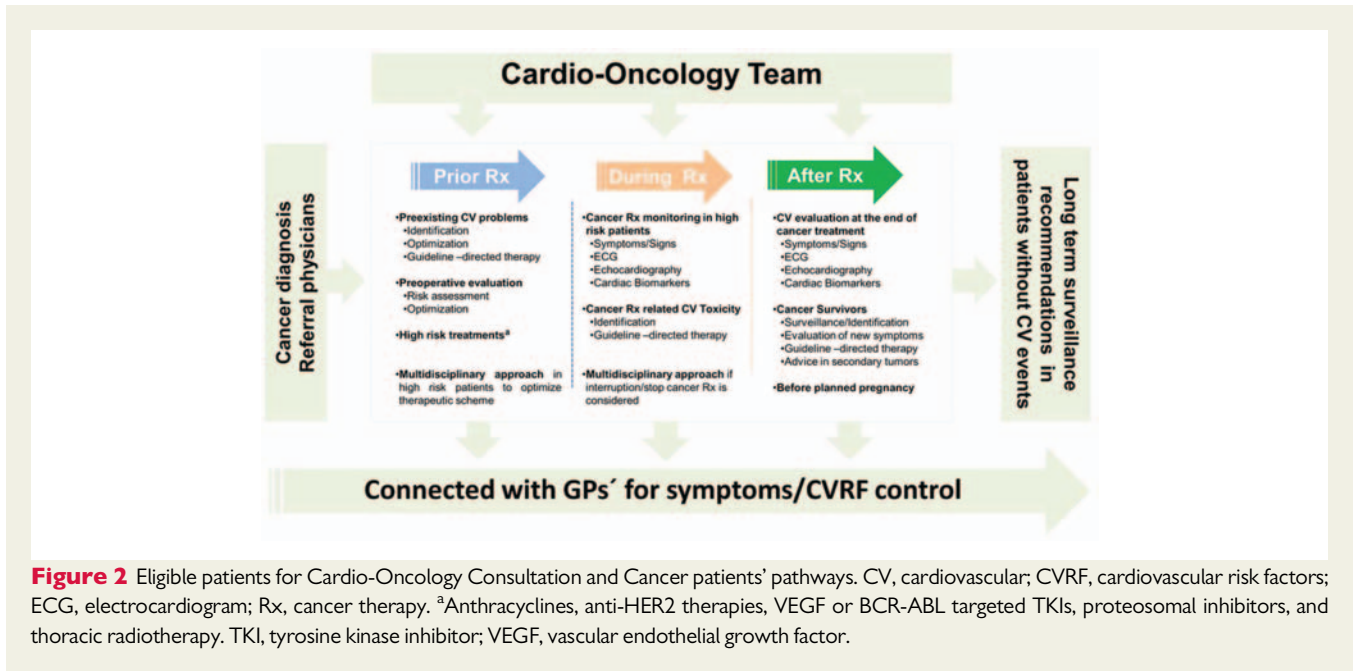
Team discussion). Smaller C-O clinics should ideally be connected in a strategic partnership to larger regional C-O Services, so complex cases can be referred as inpatient or outpatient when required.

In large centres, specific C-O consultations are generally based on a day-case model tailored to the individual patient's need and to the type of anticancer therapy performed. C-O consultation provides clinical review, appropriate non-invasive cardiac investigations [cardiac biomarkers, electrocardiogram (ECG), standard and advanced echocardiography, and stress test] and MDT discussion on the same day, thereby limiting the number of additional visits, and treatment delays or interruptions (Table 3). In tertiary centres, the full range of advanced cardiac imaging (cardiac magnetic resonance and advanced echocardiography, coronary computed tomography angiography) and interventional and electrophysiological treatments, can be delivered in collaboration with the cardiology department.<sup>9,16,17</sup> C-O Team can also provide e-consults for streamline fast patients' care pathways in high-risk populations (Table 3). Follow-up clinics can also be general or specialized, with beyond biological evaluation and ECG, advanced echocardiography support for monitoring patients requiring heart failure surveillance. Further in-hospital support for oncology patients who develop acute or new cardiac symptoms/side effects during admission must also be provided. These larger C-O Services also provide the infrastructure for offering education and training, research, and building national and international networks and registries.

## Implementation of Cardio-Oncology Services

### Eligible patients

Cardio-Oncology consultations are directed at patients at high risk of CV complications related to anticancer treatment<sup>5</sup>: (i) patients receiving potentially cardiotoxic treatment; (ii) patients prior to cancer surgery, if they have previous CV diseases or those who are expected to receive additional cancer treatment; (iii) patients who



develop CV symptoms during oncological treatments; (iv) patients receiving cancer treatment who develop asymptomatic newly reduced cardiac function; (v) patients with prior childhood cancer treatment before planning pregnancy, or developing CV symptoms during pregnancy (Table 3, Figure 2).

## Roles and responsibilities

Oncologists should be in charge for the selection of patients to be referred to the cardiology clinic. The main role of the cardiologists is to facilitate cancer treatments providing clear diagnostic tests, early interventions in case of clinical and subclinical toxicity, and assisting clinical decision-making regarding continuation, modification, or interruption of the cancer therapy.

Responsibility for decision-making, provision of cardiac surveillance, and follow-up should be agreed in a MDT discussion to ensure that optimal care is provided, e.g. if routine cardiac surveillance is provided using biomarkers by an oncologist and heart failure is suspected, further treatment and surveillance may be offered by the cardiologist.

In order to speed up this process, it is recommended to agree on clinical protocols and referral pathways adapted to the centre resources and focus on complex cases during C-O Team discussions. In tertiary centres, dedicated specialist nurses can coordinate all diagnostic tests, cardiology visits, and e-consultations.

## Pathways for cancer patients in Cardio-Oncology Services

Care tracks or pathways, adapted to different therapeutic schemes and previous CV conditions, should be developed among the different health care providers (medical oncologists, radiation oncologists, haematologists, cardiologists, radiologists, cancer surgeons, and anaesthesiologists) to minimize delays in cardiac examinations and treatment decisions. Education of all teams within the C-O Services in this process is mandatory. Audit of the timings from referral initiation, receipt and then patient review is encouraged to identify where

delays can be minimized or prevented. A new cancer diagnosis or new CV symptoms in this population must activate the process for referring patients to the C-O Clinic.

## Requirements of specialized Cardio-Oncology Clinics

Cardio-Oncology Clinic requires a multidisciplinary C-O Team to address the complex clinical and psychological impact of both cancer and cardiac diseases.<sup>14</sup> Cardiologists with a special interest in C-O, heart failure, and advanced cardiac imaging usually lead the service, with support from cardiologists with other specialist expertise (electrophysiology, intervention, grown-up congenital heart disease, vascular disease, hypertension, and pulmonary hypertension). Regular multidisciplinary C-O Team meetings provide a suitable structure to review complex patients.

Efficient secretarial and administrative support is required to ensure patients are scheduled in the C-O Clinic, as well as to organize pathways for appropriate cardiac evaluations and to integrate results for MDT discussion.

Moreover, organized software if available can be implemented to have a complete database of patients and an automatic tool reminding what cancer therapy the patient received, what are and the timing of eventual exams for the follow-up of the patient and an alert to the C-O Service health personnel, to the GP and to the patient of the scheduled activity, to avoid escapes from the follow-up program. This software may facilitate implementation of CV monitoring in patients involved in oncology trials. An example of database is provided in Table 4.

Collection of patient experience via questionnaires or surveys is encouraged and helpful to guide service development, identify weaknesses and inefficiencies, and provide patient-reported outcome measures as one metric of quality. Collection of clinical data in local registries and, when relevant, in national and international registries is encouraged to grow experience and to identify the prevalence and

**Table 2 Organization of Cardio-Oncology Services**

Requirements	General/district hospitals	Tertiary hospitals	Additional at selected centres
<b>Patients</b>	<10 patients /week <sup>a</sup>	> 10 patients/week <sup>a</sup>	> 20 patients/week <sup>a</sup>
Structures of the hospital	Cardiology section/department Oncology section/department  General intensive care unit	Cardiology department Radiation and medical oncology department Haematology department	Tertiary hospital facilities Intensive cardiac care unit  Cardiac transplant program
<b>Multidisciplinary teams</b>			
<ul style="list-style-type: none"> <li>Organization</li> </ul>	Basic Cardio-Oncology Team (core members) or a dedicated consultant cardiologist In Oncology Centres: “in house” basic cardiology services Connected with primary care physicians	Cardio-Oncology Team (core members + allied members)  Connected with primary care physicians and general/district hospitals	Cardio-Oncology Team (core members + allied members) Cardiac rehabilitation centre Heart failure centre Valvular heart centre Facilities for research protocols Connected with primary care physicians, general/district hospitals and tertiary hospitals
<ul style="list-style-type: none"> <li>Dedicated outpatient C-O clinic</li> </ul>	Recommended	Available	Available ( + e-cardio-oncology consult)
<ul style="list-style-type: none"> <li>24/7 h</li> </ul>	Recommended	Available for acute inpatient problems	Available for acute inpatient problems
<ul style="list-style-type: none"> <li>Structured clinical protocols</li> </ul>	Available	Available	Available
<ul style="list-style-type: none"> <li>Cancer survivorship programs</li> </ul>		Available	Available
<ul style="list-style-type: none"> <li>Structured training programs</li> </ul>		Health care professionals training programs	Health care professionals training programs + Educational patients programs
<b>Technical resources</b>			
<i>Cardiac Imaging</i>			
<ul style="list-style-type: none"> <li>Standard Echo</li> </ul>	Yes	Yes	Yes
<ul style="list-style-type: none"> <li>Advanced Echo</li> </ul>	Not mandatory	Yes	Yes
<ul style="list-style-type: none"> <li>CMR, cardiac CT, PET-CT</li> </ul>	Not mandatory	Yes	Yes
<i>Cardiac biomarkers</i>	Yes	Yes	+ New biomarkers/genetics
<b>Procedures available:</b>	Smaller services should be connected to larger regional cardio-oncology services for interventional procedures and complex cases	Available	+ Cardiac transplantation
Cardiac catheterization; electrophysiology, cardiac surgery, cardiac devices			
<b>Data review</b>			
<ul style="list-style-type: none"> <li>Internal audit processes</li> </ul>	Available	Available	Available
<ul style="list-style-type: none"> <li>Databases and research programs</li> </ul>	Not mandatory	Strongly recommended	Lead cardio-oncology research programs

<sup>a</sup>Numbers are suggested by common experience of an expert consensus discussion. CMR, cardiac magnetic resonance; PET\_CT, positron emission tomography-computed tomography.

nature of cardiotoxicity from cancer therapies, and the demographics of patients referred to a C-O Service.

### Governance and audit

Regular C-O governance meetings are encouraged with contribution and feedback from all members of the C-O Team. Review of activity,

referral sources, patient feedback, timings, and rapidity of service delivery (e.g. time from referral to assessment) are important.<sup>14</sup> The impact of the service can be measured using audit (e.g. number of oncology patients who restart and complete oncology protocols following interruption of oncology care for cardiotoxicity, and number of high-risk patients who complete oncology treatment without interruptions for cardiotoxicity).

**Table 3 Objectives, resources, and needs for Cardio-Oncology Consultation and e-consultation**

	Cardio-oncology consultation	e-Cardio-oncology consultation
Objectives	<p>Careful history and physical examination of cancer patients with a moderate to high risk of developing cardiotoxicity or previous heart diseases</p> <ul style="list-style-type: none"> <li>• Before cancer treatment (anticancer drugs, radiotherapy and cancer surgery): optimize cardiovascular treatment, review drug-drug interactions, establish follow-up needs</li> <li>• During cancer treatment: monitoring of cancer treatments. Early diagnosis and treatment of CV complications</li> <li>• Long-term survivors surveillance</li> </ul> <p>Cardiovascular monitoring before planning pregnancy in long-term survivors</p> <p>Cardiovascular monitoring of patients involved in oncologic clinical trials</p>	<p>From cancer specialists to cardiologists</p> <ul style="list-style-type: none"> <li>• Optimization of cardiovascular risk factors control in asymptomatic patients without structural heart disease</li> <li>• Advice regarding drug-drug interactions</li> <li>• Advice regarding referral to centres with greater specialization on cardio-oncology</li> </ul> <p>From GPs' to cardiologists</p> <ul style="list-style-type: none"> <li>• Advice regarding referral to cardio-oncology clinic</li> </ul> <p>From patients to specialized nurses (e-nurse cardio-oncology consult)</p> <ul style="list-style-type: none"> <li>• Tight controls of some patients after C-O consultation focused on diet advices, exercise recommendations, new symptoms, treatment tolerance, treatment adherence, blood pressure, or glucose control</li> </ul>
Human Resources	<p>Cardio-oncologist</p> <p>Specialized nurse</p>	<p>Cardio-oncologist</p> <p>Specialized nurse</p>
Technical resources	<p>Sphygmomanometer</p> <p>ECG including QTc measurement</p> <p>Transthoracic echocardiography</p>	<p>Digitalized medical records</p>
Time consumption	45 min (Clinical history, physical exam, ECG evaluation, and echo)	15 min

**Table 4 Example of a database for evaluation and follow-up of cancer treatment cardiovascular complications**

Baseline data	<ul style="list-style-type: none"> <li>• General demographic and anthropometric data</li> <li>• Contacts of general physician (GP) and other specialists following the patient</li> <li>• Cardiovascular risk factors (previous and active, corrected or not)</li> <li>• Cardiovascular illnesses prior to cancer treatment (coronary artery disease, valvular heart diseases, heart failure, and cardiac arrhythmias)</li> <li>• Relevant general illnesses that may complicate cardiovascular and cancer treatment (e.g. moderate to severe kidney, hepatic, or lung diseases)</li> <li>• Complete information about previous cancer therapies and eventual cardiotoxicities</li> </ul>
Actual cancer disease	<ul style="list-style-type: none"> <li>• Histology, site, tumor node metastasis staging (TNM), surgical treatment, and overall prognosis</li> <li>• Complete information about ongoing cancer drugs (dosages and schedule)</li> <li>• Complete information about planned radiotherapy (location, dosages, and schedules)</li> </ul>
CV monitoring of cancer treatment	<ul style="list-style-type: none"> <li>• Clinical baseline evaluation</li> <li>• Baseline ECG and echocardiography if indicated in local clinical protocols</li> <li>• Follow-up visits and diagnostic tests during cancer treatment</li> <li>• Automatic recall to remember the planned visits/tests</li> <li>• Estimate risk of possible long-term cardiotoxicity</li> </ul>
Cancer therapy induced adverse events	<ul style="list-style-type: none"> <li>• Cardiac events: heart failure, hypertension, cardiac arrhythmias, and vascular events</li> <li>• Specific cardiac treatment</li> <li>• Reversibility of cardiotoxicity</li> </ul>
Periodic automatic recall of the patients and/or the GPs for updating clinical data	

**Table 5** Obstacles in implementing Cardio-Oncology Services

Obstacles	Improvement measures
Cardio-Oncology Services not adapted to cancer patients numbers	<ul style="list-style-type: none"> <li>• Consensus between cardiologists and oncologists to agree on local clinical protocols adapted to available resources and cancer treatment scheme</li> <li>• C-O consultation time should be balanced with the requirement of every specific situation</li> <li>• Case nurse manager</li> <li>• Coordination with reference centres, family doctors, and specialized nurses to improve patients' outcomes</li> </ul>
Lack of professional training on multidisciplinary team work	<ul style="list-style-type: none"> <li>• Implementation of C-O services needs a good team selection of professionals, based on scientific knowledge and on the ability to communicate and obtain consensus in difficult decisions</li> <li>• Continuing medical education</li> </ul>
Absence of C-O service standards (Organization and specific roles of the C-O Services, patients' pathways, communication tools, etc.)	<ul style="list-style-type: none"> <li>• Define organization and specific roles of a C-O team and needs and referral for CO clinics</li> <li>• Continuing medical education, research, and innovation</li> <li>• Prospective database with clinical indicators and therapeutic strategies to clarify how and why final decisions were reached and outcomes</li> </ul>
Lack of funding	<ul style="list-style-type: none"> <li>• Health care quality control for clinical and research practice</li> <li>• Cardio-oncology Services need to be adequately resourced and supported by institutional recognition and opportunities for career development</li> <li>• Facilities: administrative support (to schedule patients' visits and tests; to document activities generated during cardio-oncology team discussions); meeting rooms; access to electronic hospital reports</li> </ul>

Feedback from referring allied members should be collected to further develop the C-O Service and adapt to accommodate new patient groups when new cardiotoxic cancer therapies become licenced. Governance meetings also allow new initiatives to be discussed and implemented, including involvement in C-O networks, conferences, education and training, research studies, and registries.

### Cancer survivorship program

The range of health problems faced by cancer survivors relating to their disease and treatment is broad, and many oncology centres now offer cancer survivorship programs. One essential issue of C-O is to assure a safe long-term survival without the development of a CV disease after defeating a cancer.<sup>9,16</sup> Every patient judged at risk for developing new CV disease should enter in a C-O follow-up program. To achieve a good compliance to this program, patients should be informed about potential risks and consequences of cardiotoxicity, which might be significantly reduced applying tight life-style measures, planned controls, and taking the assigned therapies.<sup>6,13</sup> To reinforce these messages, primary healthcare professionals should actively be involved in the program and intervene whenever appropriate. Specific recommendations about diagnostic tests and timing for long-term follow-up have been emphasized in the recent ESC position paper on cancer treatments and CV toxicity.<sup>5</sup>

### Training and education

Training opportunities for cardiologists, oncologists, haematologists, GPs, and other healthcare professionals are important and should be provided by leading C-O Services.<sup>15,18</sup> In addition to attending C-O ward rounds, clinics and MDT meetings, C-O training should aim to provide an opportunity for cardiology trainees to attend dedicated

tumour committees and learn the nomenclature, treatment options, and the latest decision-making in modern oncology units. Vice versa, oncology trainees wishing to train in C-O should attend cardiology training opportunities in heart failure, cardiac imaging, and cardiac interventions. Coordination with national training programmes to develop a C-O curriculum is required. Specialist nurse training courses and masters for both cardiology and oncology nurses is desirable to develop the new generation of specialized C-O nurses. Larger C-O Services as well as national and international societies should offer dedicated C-O congresses or symposiums. In the next future, a course within the ESC might be envisaged.

Also, the patients should receive proper education about C-O issues in order to (i) improve the patient's understanding of their disease, (ii) motivate them for prescribed medication adherence, and (iii) help them to promptly identify and report the symptoms and signs indicating progression of any CV disease. Meetings and conferences could be organized during hospital stay, considering the help of trained nurses or personnel. Booklets and dedicated informative materials will be designed and validated across the C-O network. Similar to other chronic conditions however, it will be essential to do periodic recall and refreshments of the C-O issues.

### Registries and clinical trials

Research is an important pillar of modern C-O to help develop the scientific evidence upon which to base clinical decision-making. C-O Services should engage in local, regional, national, and international networks to collect data in registries such as the EuroObservational Research Program C-O registry for breast cancer patients receiving trastuzumab, and research networks to deliver clinical trials.<sup>19,20</sup> A common database might be set up among the various C-O Services.

Another essential issue of large C-O Services is to increase the role of cardio-oncologists in the follow-up of patients included in oncology trials.

## Funding and organizational issues

Common obstacles identifiable in the implementation of C-O Services are related to the following: (i) the dedicated staff nature, (ii) the lack of MDT training, (iii) the absence of organization manuals, and (iv) the lack of funding (Table 5).

While the strategy of C-O Service seems to be cost-effective, it is time and resources consuming (professional time, cardiac imaging techniques, laboratory resources, etc.). Recognition by National and European Health Authorities with appropriate funding and also legislative identification is essential to permit appropriate resource allocation for C-O Services. Cardiology and oncology scientific societies play an essential role, providing scientific evidences, epidemiologic data, and population forecast to support this recognition requirement.

## Knowledge translation and future outlook

Cardio-Oncology practice requires complex organization that impacts overall outcomes of cancer patients. Actually it may differ substantially among hospitals and communities. The aim of this document is to define basic goals of C-O Services to optimize the existing ones and to help the organization and implementation of C-O practice.

In the near future, C-O will be able to facilitate the transfer of research evidence into clinical practice and policy development. Several ways will be used to promote knowledge translation through the C-O network (e.g. dedicated ESC Cardio-Oncology Council, website with teaching courses, specific guidelines, scientific papers, results of registries, or prospective studies).

## Conclusion

There is an increasing awareness and clinical interest in cardiac safety during cancer therapy as well as in optimally addressing cardiac issues in cancer survivors. Multidisciplinary C-O programs have recently been organized in dedicated C-O Services to diagnose and prevent cardiotoxicity and to improve cancer patient care, well-being, and long-term outcomes. Whilst many cardiology departments still do not have a dedicated C-O Clinic, C-O is likely to become an increasingly relevant sub-speciality. Every large hospital should have C-O facilities. Small community hospitals should also have a C-O Team with the possibility to follow and address at least the main cardiac issues related to oncology treatment of cancer patients. The long-term follow-up is an essential issue in this setting and requires a large, well-organized network among the different actors in charge of cancer patients' care.

**Conflict of interest:** none declared.

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