

## Consensus Statement

# Cardio-Oncology Training: A Proposal From the International Cardioncology Society and Canadian Cardiac Oncology Network for a New Multidisciplinary Specialty

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## ABSTRACT

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. Although there is an emerging expertise in this area, known as cardio-oncology, there is a lack of organization in the essential components of contemporary training. This proposal, an international consensus statement organized by the International Cardioncology Society and the Canadian Cardiac Oncology Network, attempts to marshal the important ongoing efforts for training the next generation of cardio-oncologists. The necessary elements are outlined, including the expectations for exposure necessary to develop adequate training. There should also be a commitment to local, regional, and international education and research in cardio-oncology as a requirement for advancement in the field. (*J Cardiac Fail* 2016;22:465–471)

**Key Words:** Cardio-oncology, training, cardiotoxicity, survivorship.

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There is an increasing need to focus on the cardiac health of patients who are undergoing or have previously survived cancer treatment.<sup>1,2</sup> To optimize outcomes for patients undergoing contemporary cancer therapy, the potential adverse

impact on cardiovascular structures needs to be considered and minimized.<sup>3–6</sup> A detailed knowledge and understanding of both the cardiology and oncology issues germane to this patient population is required to achieve this. The demographic profile of patients with cancer is quite similar to those with cardiac disease,<sup>7</sup> and as a result, cardiac conditions may coexist in patients with cancer and are frequent complicating factors during complex and aggressive cancer treatments. Furthermore, many of the newer targeted oncology therapies may also affect the heart in new, unexpected, and potentially serious ways.<sup>8–10</sup> As the complexity of cancer treatments has increased, so have the tools available to monitor the impact on the heart. Familiarity with the strengths and limitations of these techniques and their appropriate utilization, in conjunction with advanced therapies for severe cardiac damage when identified, enhances the goal of optimal cardiac safety during and after cancer treatment.

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A recent survey sent to 106 adult and pediatric division chiefs, fellowship program directors, and specialists, revealed that 2 out of 3 hospital centers across the nation have added cardio-oncology services to help cancer patients maintain their heart health during and after treatment. Additionally, the survey highlighted that 43% of centers did not offer formal training to fellows or house-staff in the growing discipline of cardio-oncology. That survey illustrates the growing national trend in cardio-oncology programs across the country and emphasizes that the time has come to establish a formal structure to train the future generation of cardio-oncologists. The present document, a combined effort of the International Cardioncology Society (ICOS) and the Canadian Cardiac Oncology Network (CCON) outlines current expertise-based thoughts pertaining to clinical cardio-oncology program development and recommendations to establish cardio-oncology training.

## Methods

An expert group of practitioners were commissioned from the executive board of ICOS and included representative members of ICOS and CCON from academic and referral practice facilities that have a demonstrated interest in the discipline of cardio-oncology and have contributed to the medical literature in this area. All members are directly involved with training of students, residents, or fellows or are part of training programs at the present time. Monthly webinars were held over a 1-year period during the calendar year 2014, and final document approval webinars took place in 2015. A comprehensive literature review was performed for the seminal publications relevant to the discipline and were considered in the foundational knowledge for cardio-oncology. All members actively participated in the document construction and the final recommendations were unanimously agreed upon.

## Defining Cardio-Oncology

### What Is Cardio-Oncology?

Cardio-oncology is an inclusive discipline focused on the cardiovascular health of cancer patients and cancer survivors. Providers are charged with developing and using diagnostic and therapeutic strategies that permit optimal cancer treatment with a focus to limit collateral cardiac damage, thereby leading to improved outcomes in cancer survivors.<sup>11</sup>

### Who Is a Cardio-Oncologist?

A cardio-oncologist is a health care provider who is focused on the prevention, early detection, and management of, and recovery from, cardiac injury that may stem from cancer or cancer therapies. Such a provider strives to improve the cardiac clinical care, promote education, and facilitate research for patients with cancer or a history of cancer in an interdisciplinary fashion.

## Would Dedicated Training for Cardio-Oncology Advance the Field and Improve Patient Care?

There have been dramatic advances in anti-cancer therapy and enhanced supportive care over the past 2 decades, such that there are increasing numbers of long-term adult and pediatric cancer survivors: an estimated 14.5 million in the United States alone.<sup>12,13</sup> Cardiotoxicity may develop during the acute management of cancer, but patients remain at risk for cardiac deterioration years after treatment has been completed.<sup>14</sup> At present, it is clear that the potential for cardiotoxicity in cancer patients and survivors is underappreciated and that surveillance for the development of cardiac dysfunction is not common.<sup>15,16</sup> Consequently, cardiac dysfunction may be largely undetected until many years have passed.<sup>17</sup> Additionally, overt cardiotoxicity during treatment may require limiting effective cancer therapy, which could have a detrimental impact on cancer outcomes. Therefore, a multidisciplinary comprehensive approach that harnesses both cardiology and oncology expertise in a collaborative effort is critical to optimizing patient outcomes.<sup>18-21</sup>

Translational research is a key component of understanding the potential for cardiotoxicity associated with new and existing agents. Through an understanding of the biologic pathways affected by anticancer agents and their cardiometabolic consequences, such research can inform the development of screening tools to detect cardiac toxicity as well as prevention and treatment strategies in cancer patients and survivors at risk for cardiac diseases at all stages of cancer treatment.<sup>9,22-24</sup> Validation of monitoring and cardioprotective strategies through well designed prospective clinical trials with preidentified cardiac end points and adequate follow-up to detect cardiac sequelae in patients who are undergoing active cancer therapy logically follows. Applying knowledge from translational and clinical research to the clinical care of individual patients throughout and following cancer treatment is best accomplished through considered discussion among all health care providers and allied health care professionals. The goal is to promote optimal cancer treatment outcomes without producing serious cardiac toxicities that limit quality of life or introduce a competing cause of mortality. To achieve this goal, there needs to be adequate training for health care providers involved in the care of cancer patients. In a manner analogous to the development of advanced heart failure and transplantation as a subspecialty of cardiology, there needs to be an organized effort to understand the scope and expectations needed for this burgeoning discipline.<sup>25,26</sup> Below, we propose a conceptual framework (summarized in [Table 1](#)) for a cardio-oncology training program.<sup>27</sup>

## The Goals for a Cardio-Oncology Training Program

The goals for a cardio-oncology program are summarized in [Table 1](#). The primary focus is to improve the

**Table 1.** Goals of the Cardio-Oncology Fellowship Training

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Improve the care of oncology patients by increasing our understanding and ability to modify the interactions between cancer and cardiovascular health.
Understand the cardiac complications of cancer therapy.
Optimize prevention and early detection of cardiac toxicity during and after active therapy for cancer.
Implement effective treatments to reduce and treat cardiac sequelae of cancer treatment.
Facilitate education of health care providers to optimize cancer treatment while avoiding cardiac toxicity.
Promote translational and clinical research and basic understanding of the interactions of the heart with cancer and cancer therapy.

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cardiology-based care of patients currently being treated or previously treated for cancer. It is important to increase our collective understanding and ability to modify the interactions between cancer and cardiovascular health. This can be done by enhancing our knowledge of potential mechanisms and of the nature of cardiac side effects, and by improving our awareness of new and evolving cancer therapeutics. Furthermore, we can optimize the prevention and early detection of cardiotoxicity during and after active therapy for cancer by improving our understanding and modification of cardiovascular risk factors as well as by using the relevant cardiac imaging tools and biomarkers that may aid in the detection of cardiotoxicity from anticancer agents.<sup>28,29</sup> It has become essential that we develop individual patient-centered cardiac monitoring programs, depending on cancer and types of cancer treatment, as well as extended surveillance mechanisms for cardiac sequelae of cancer therapy in cancer survivors. Implementing effective treatments to reduce and treat cardiac sequelae of cancer treatment, facilitating education of health care providers, and promoting translational and clinical research as well as improving our basic understanding of the interactions of the heart with cancer and cancer therapy, through an organized training program, will dramatically improve patient care.

### Expectations and Structural Components for Training in Cardio-Oncology

A cardio-oncology program should be offered in institutions that provide both cardiology and oncology clinical care. There must be a cultural acceptance that cooperation between disciplines is essential and will be practiced routinely.<sup>30</sup>

**Facilities.** Cardio-oncology programs preferably would be developed in institutions that provide the following types of cancer treatment modalities: radiation therapy, chemotherapy, targeted cancer therapeutics, and bone marrow transplantation. The practice of cardio-oncology places specific unique demands on cardiovascular imaging, electrocardiography (ECG), and cardiac-specific biomarker testing and their integration into clinical practice. Furthermore, because left ventricular dysfunction is a common manifestation of cardiotoxicity, direct involvement by experts in myocardial dysfunction is desirable. These clinical tools should be available for patient management. High-quality reproducible echocardiographic measures of cardiac function are necessary, and the facility should have a clear understanding of the technical reproducibility of such

testing in their laboratory. Preferably, this should include 3-dimensional echocardiography and measures of ventricular strain, both of which are helpful to actively guide treatment in a way that is unique to the discipline of cardio-oncology.<sup>31-35</sup> Access to additional imaging modalities, such as cardiac magnetic resonance imaging, would be advisable if locally available.<sup>36</sup> A research infrastructure, either for clinical or basic research, should be strongly encouraged according to availability.<sup>37</sup>

**Clinical Personnel.** An effective cardio-oncology program requires the participation of many types of health care providers. Personnel should include hematologist-oncologists with clinical expertise to deliver the most contemporary and effective cancer treatment. Cardiologists with sustained interest and a dedicated practice for cardio-oncology are expected to be immediately available to offer advice on management strategies to best ensure cardiac safety. Close interaction with the hematologist-oncologists is important to develop uniform programs of ancillary care. There must be an effective method of communication using all of the local tools (eg, e-mail, text, telephone) to promote communication between cardiologists, hematologists/oncologists, and primary care providers to result in a true multidisciplinary approach to patient care. Cardiology input for tumor board or bone marrow transplantation committee meetings, when complex cases are discussed, is essential and should be expected. Hematology/oncology input into advanced heart failure/transplantation committee meetings should be encouraged when appropriate. Interdisciplinary education should include but not be limited to: case conference, grand rounds, and patient care-based meetings. Comprehensive cancer care should include other health care providers, such as nurses, a nutritionist, geneticist, lymphedema specialist, psychiatrist/psychologist, pharmacist, palliative care provider, and exercise physiologist, and other ancillary expertise. Availability of an advanced cardiac imaging team as well as advanced heart failure and cardiac transplantation team is an advantage, and relationships should be established with such teams locally if not available on site.<sup>38</sup> The cardio-oncologist needs to have sufficient understanding of cardiac imaging to ensure that these imaging techniques have been performed in a high-quality manner to allow appropriately justified decisions based on the findings.

**Volume.** A cardio-oncology program should include a significant volume of patients (a minimum of 100 unique patient encounters per year who are survivors of cancer treatment or undergoing active cancer therapy).

## What are the General Principles to be Taught and What Are the Levels of Cardio-Oncology Training?

Level 3 cardio-oncology training, which is the highest level and is considered to be a fellowship, requires a minimum of 1 year of dedicated exposure.<sup>39</sup> This training would result in significant exposure to clinical cardio-oncology based patient evaluations, contributions to cardio-oncology based clinical research and education, and an advanced knowledge of relevant cardio-oncology based clinical trials. The other levels of cardio-oncology training are summarized in Table 2. Because an expert in cardio-oncology may potentially have another specialist background, such as hematology/oncology, there are specific goals and principles of training that are tailored to previous expertise. A hematologist/oncologist would need to achieve a basic understanding of cardiovascular (CV) risk factors and pathophysiology of common conditions resulting from cancer therapies (such as heart failure, hypertension, arrhythmias, or vascular problems) as well be very comfortable with CV diagnostic testing (ECG, echocardiography, stress testing, biomarkers) and have a basic understanding of CV management and pharmacology. The hematologist/oncologist would have an advanced knowledge of oncologic pharmacology and the effects on the CV system. In contrast, the cardiologist would have an advanced understanding of CV physiology, at both cellular and organ levels, focusing also on common cellular pathways shared by cancer and cardiac cells. The cardiology-based trainee would need a basic understanding of oncogenic cellular transformation, tumor growth, and disease progression. Such a trainee would also have knowledge of common oncologic therapies and molecular targets (especially those shared with cardiomyocyte survival mechanisms) and a basic knowledge of epidemiology, staging, and prognosis of common malignancies. A cardiologist would be expected to have an advanced knowledge of oncologic emergencies and pharmacology that affect the CV system as well as advanced knowledge of cardiac imaging tools and biomarkers used to detect and monitor for cardiac effects of cancer therapy. Level 2 training could be obtained by a primary care provider, such as an internal medicine or family medicine specialist, and would include a general understanding of the potential cardiac complications of cancer therapies both in the acute treatment setting and long term. In addition, these providers would be familiar with oncologic emergencies that affect the cardiovascular system and have an awareness of cardiovascular issues that require particular vigilance in patients during cancer therapy or in survivorship care, such as accelerated coronary artery disease, heart failure, dyslipidemias, and hypertensive heart disease. In particular, level 2 training would include a knowledge of when to refer to a health care provider with more advanced cardio-oncology expertise. Level 1 training represents formal education with the specific concerns that are relevant to cardio-oncology.

## Future Directions

There is no question that the subspecialty of cardio-oncology is rapidly growing and increasingly being recognized in the cardiology and oncology communities. This is reflected by the exponentially increasing publications about cardio-oncology, the creation of a Cardio-oncology Council by the American College of Cardiology in 2015, the emergence of the *Cardio-Oncology Journal*, the beginnings of an international patient-based data registry, the growth of the ICOS, and the ever-expanding international conferences dedicated to this specialty. Ongoing major research studies around the world have incorporated cardiac safety within the context of cancer treatment in an extensive manner to help minimize cardiotoxicity. Cardio-oncology's future direction is to continue to grow each of the preceding anchors of current success and to push recognition of the specialty by the other constituent specialty societies, eg, American Heart Association (AHA), European Society of Cardiology (ESC), Heart Failure Society of America (HFSA), American Society of Clinical Oncology (ASCO), European Society of Medical Oncology (ESMO), and the American Society of Hematology (ASH), by the creation of working groups, dedicating agenda time at their annual scientific sessions, and expansion of their representation within ICOS activities, eg, guideline and state of the art writing groups. It is recognized by our group and others that cost-effective guidelines/practice recommendations regarding cancer treatment cardiac risk assessment, cardioprotection during and after treatment, and evidence-based direction for monitoring cardiotoxicity with the use of advanced imaging techniques, if appropriate, at every level along the spectrum of cancer care are desperately needed. Our ultimate goal is universal adoption of some version of the training suggestions presented in this manuscript with the future possibility of board certification. Everything we do is focused on improving the cardiac care of patients with cancer and providing those patients with established cardiac issues the opportunity to receive the best available treatment for their cancer.

## Conclusion

There has been a tremendous interest in the area of cardio-oncology that has developed over the past decade. The complexity of medical care for these patients requires that a multidisciplinary team be constructed at each institution to provide the optimal care. Owing to the rapidly rising number of cancer survivors and the increasing complexity of cancer therapeutics, a focused educational program for trainees is essential. Our proposal, based on the input of health care providers with expertise in cardio-oncology, outlines the basic structure for a cardio-oncology training program. Further developments in the field will necessitate ongoing adjustments to such a program.

**Table 2.** Specific Structure of Cardio-Oncology Training

		Level of Training		
		Level 1	Level 2	Level 3
Target trainee	Medical students	Residents and fellows; primary care physicians or internists	Cardiovascular disease fellows	Hematology and oncology fellows
Length of training	2 weeks	4 weeks	52 weeks	
Training goals			Advanced understanding of cardiovascular physiology, with a focus on common molecular pathways shared by both cancer and cardiac cells.	Basic understanding of cardiovascular physiology, with a focus on common molecular pathways shared by both cancer and cardiac cells.
			Basic understanding of oncogenic cellular transformation, tumor growth, metastasis, and disease progression, with a special focus on those affecting the cardiovascular system.	Advanced understanding of oncogenic cellular transformation, tumor growth, metastasis, and disease progression, with a focus on those affecting the cardiovascular system.
	Basic knowledge of cardiovascular epidemiology, with a focus on risk factors exacerbated by cancer or cancer therapies.		Basic knowledge of epidemiology, staging, and prognosis of common malignancies, with a focus on those affecting the cardiovascular system, either directly or by means of its therapies.	Advanced knowledge of epidemiology, staging, and prognosis of common malignancies, with a focus on those affecting the cardiovascular system, either directly or by means of its therapies.
			Advanced knowledge of pathophysiology, diagnosis, management, and prognosis of cardiovascular conditions, with a focus on those resulting from cancer or cancer therapies.	Basic knowledge of pathophysiology, diagnosis, management, and prognosis of cardiovascular conditions, with a focus on those resulting from cancer or cancer therapies.
	Basic knowledge of symptoms and clinical findings, with a focus on cardiovascular and oncologic evaluation.		Basic knowledge of the pathophysiology, diagnosis, management, and prognosis of common malignancies, and related complications.	Advanced knowledge of the pathophysiology, diagnosis, management, and prognosis of common malignancies, and related complications.
			Advanced knowledge of symptoms and clinical findings, with a focus on cardiovascular and oncologic evaluation.	
		Basic knowledge of the rationale, utility, appropriate use, and interpretation of cardiovascular diagnostic testing strategies.	Advanced knowledge of the rationale, utility, appropriate use, and interpretation of cardiovascular diagnostic testing strategies.	Basic knowledge of the rationale, utility, appropriate use, and interpretation of cardiovascular diagnostic testing strategies.
		Basic knowledge of cardiovascular pharmacology, with a special focus on those drugs that interact adversely with cancer patients or cancer drugs.	Advanced knowledge of cardiovascular pharmacology, with a special focus on those drugs that interact adversely with cancer patients or cancer drugs.	
		Basic knowledge of the rationale, effectiveness, and appropriate use of oncological therapies with known cardiovascular effects.	Advanced knowledge of the rationale, effectiveness, and appropriate use of oncological therapies with known cardiovascular effects.	
	Basic knowledge of the strategies to minimize cardiovascular toxicity associated with cancer therapies.		Advanced knowledge of the strategies to minimize cardiovascular toxicity associated with cancer therapies.	
		Basic knowledge of oncologic emergencies that affect the cardiovascular system.	Advanced knowledge of oncologic emergencies that affect the cardiovascular system.	
	Basic knowledge of cardiovascular risk factors and risk stratification for negative outcomes after cancer-related procedures and therapies.		Advanced knowledge of cardiovascular risk factors and risk stratification for negative outcomes after cancer-related procedures and therapies.	
		Basic knowledge of the pathophysiology, diagnosis, management, and prognosis of cardiac tumors.	Advanced knowledge of the pathophysiology, diagnosis, management, and prognosis of cardiac tumors.	
		Basic knowledge of the pathophysiology, diagnosis, management, and prognosis of other cancer-related cardiovascular diseases (cardiac amyloidosis, carcinoid heart disease, etc).	Advanced knowledge of the pathophysiology, diagnosis, management, and prognosis of other cancer-related cardiovascular diseases (cardiac amyloidosis, carcinoid heart disease, etc).	
		Basic knowledge of cardio-oncology clinical trials.	Advanced knowledge of cardio-oncology clinical trials.	
	Basic knowledge of the rationale, utility, and appropriate use of palliative and supportive care for the cardio-oncology patient and family.		Advanced knowledge of the rationale, utility, and appropriate use of palliative and supportive care for the cardio-oncology patient and family.	
		Ability to promote comprehensive strategies for cardiovascular and cancer prevention.		
		Ability to initiate individualized monitoring strategies based on the cardio-oncology patient risk and potential toxicity of a given therapy.		
			Ability to integrate cardiovascular and oncologic prognoses, the impact of cardiovascular and oncologic therapies on clinical outcomes, and their related complications to individualize prognosis and optimize management strategies.	
			Ability to discern the optimal timing and appropriateness for clinical subspecialty referral.	
			Involvement in academic endeavors, such as national and international cardio-oncology meetings, basic, translational, and clinical research, and dissemination of knowledge.	
			Ability to provide cardio-oncologic training to other health care providers and students.	
Training venues	Outpatient cardio-oncology and survivorship clinics. Inpatient cardio-oncology consultation.		Inpatient oncologic consultation. Solid and liquid malignancy clinics. Oncologic diagnostic centers (positron-emission tomography, computerized tomography, magnetic resonance imaging, etc).	Cardiovascular disease subspecialty clinics Cardiovascular diagnostic centers (echocardiography, electrophysiology, and catheterization laboratories, cardiac magnetic resonance, etc).
			Multidisciplinary tumor board conferences. Other multidisciplinary conferences (amyloidosis, carcinoid, etc)	

## Disclosures and Expertise

Name	Affiliation	Cardio-Oncology Area of Expertise	Any Role in Training	Conflict of Interest
Robert F. Cornell	Vanderbilt	Medical oncology	MS/R/F	None
Guilherme H. Oliveira	University Hospitals, Case Western Reserve University	Heart failure/transplant	PD, Heart Failure and Transplant Fellowship	None
Ronald Witteles	Stanford University School of Medicine	Cardio-oncology and amyloidosis	MS/R/F; Tr/PD, Internal Medicine Residency Training Program at Stanford University.	Adjudicator for cardiac events for trastuzumab emtansine clinical trials (Roche)
Jeanne DeCara	University of Chicago Medicine	Cv imaging	Fellow Mentor	None
Susan Dent	Ottawa Hospital Cancer Center	Medical oncology; Dir of Ottawa Cardio-oncology; President of Canadian Cardiac Oncology Network (CCON)	MS/R/F	Consultant: Roche, Amgen, Novartis, Pfizer
Javid Moslehi	Vanderbilt	Cardio-oncology (translational research)	F; Tr, Brigham/Dana-Farber	Consultation: Novartis, Pfizer, Bristol-Myers Squibb, Takeda/Millennium, Ariad, Acceleron, Vertex, Incyte
Eric Harrison	Univ South Florida	Advanced cardiac imaging	MS/R/F	None
Gillian Murtagh	Abbott Diagnostics	Biomarkers and imaging	None	Employed by Abbott Diagnostics
Anne Blaes	Univ Minnesota	Medical oncologist; health outcomes; children's oncology group survivorship committee	MS/R/F; Tr	None
Zaza Iakobishvili	Tel Aviv University	Cardio-oncology	MS/R/F	None
Michael J. Fisch	AIM Specialty Health	Medical oncology	Oncology fellows	Employment and stock: Anthem
Susmita Parashar	Emory Univ	Cardiology	MS/R/F	None
Ronald Krone	Washington Univ	Interventional cardiology	MS/R/F	None
Mike Fradley	Moffitt Cancer Center; Univ South Florida	Cardiology (ep); cardio-oncology program	Tr/PD	None
Joseph Carver	Abramson Cancer Center of Univ Pennsylvania	Cardio-oncology	R/F; Tr/PD Cardio-oncology	Consultant: Onyx
Daniel Lenihan	Vanderbilt	Cardio-oncology; advanced heart failure/transplant	MS/R/F; Tr/PD, (advanced heart failure fellowship)	Consultant: Roche, Onyx, BMS; research funding: Takeda, Acorda
Emanuel Finet	Indiana Univ	Advanced heart failure and transplant	MS/R/F	None
Pamela S Douglas	Duke Univ	Cardiac imaging	MS/R/F/Tr	None
Carrie Geisberg Lenneman	Univ Louisville	Cardio-oncology	MS/R/F; Associate PD, CVM	Consultant: Parexel
Charles B. Porter	Univ Kansas Hospital and Medical Center.	Cardiology, heart failure	Tr, cardio-oncology; MS/R/F	None
Alexander Lyon	NIHR Cardiovascular Biomedical Research Unit, Royal Brompton Hospital and Imperial College London	Heart failure/cardio-oncology	MS/R/F/Tr	Consultant: Servier, Novartis, AMGEN, Onyx Ferring, Eli-Lilly, Stealth peptides; research grants: Pfizer, Servier, Celladon
Aarti A. Patel	Univ South Florida	Cardio-oncology, advanced cardiac imaging	MS/R/F	None
Giuseppe Curigliano	Istituto Europeo di Oncologia	Medical oncology, clinical research, cardiac toxicity induced by anticancer agents, early drug development, and cardiac toxicity assessment	MS/R/F	Roche, Pfizer, Novartis, Celgene (all modest, <3000 dollars)
Gary Zeevi	Bon Secours Virginia Health System	Cardio-oncology, heart failure	R	None
Andreia Magalhaes	Santa Maria University Hospital, Lisbon	Cardio-oncology	MS/R	None

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