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Title	Cardio-Oncology Nursing Education (CONE): an innovative educational program for nurses caring for patients with cancer and concurrent cardiovascular disease
Authors	Fadol, Anecita;Nodzon, Lisa;Reehal, Priya;Younus, Asma Mouhammad;Kriesberg, Chelsea Patricia;Stuart, Mary;Pituskin, Edith;Lee, Geraldine
Publication date	2026-05-27
Original Citation	Fadol, A, Nodzon, L, Reehal, P, Younus, A M, Kriesberg, C P, Stuart, M, Pituskin, E & Lee, G 2026, 'Cardio-Oncology Nursing Education (CONE): an innovative educational program for nurses caring for patients with cancer and concurrent cardiovascular disease', Cardio-Oncology, vol. 12, no. 1, 98, pp. 1-6. https://doi.org/10.1186/s40959-026-00516-9
Type of publication	Review
Link to publisher's version	https://www.scopus.com/pages/publications/105046121271 - 10.1186/s40959-026-00516-9
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Download date	2026-11-01 00:04:52
Item downloaded from	https://hdl.handle.net/10468/19208



University College Cork, Ireland
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Cardio-Oncology

REVIEW

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Cardio-Oncology Nursing Education (CONE): an innovative educational program for nurses caring for patients with cancer and concurrent cardiovascular disease

Anecita Fadol[1*], Lisa Nodzon[2], Priya Reehal[3], Asma Mouhammad Younus[4], Chelsea Patricia Kriesberg[5], Mary Stuart[6], Edith Pituskin[7] and Geraldine Lee[8]

Abstract

Background Cardio-oncology addresses the cardiovascular health of patients with cancer, an area of growing importance as cancer survival rates improve. Nurses play a central role in monitoring, educating, and coordinating care, yet a structured, standardized, competency-based education is lacking. This article describes the development, structure, and implementation of the Cardio-Oncology Nursing Education (CONE) program, a global educational initiative designed to equip nurses with specialized knowledge and skills to manage cardiovascular complications in patients with cancer.

Methods The CONE curriculum was developed by an international, multidisciplinary committee, informed by a global nursing learning-needs assessment. It comprises 27 virtual modules, providing 18.25 nursing contact hours, including 10.25 pharmacotherapeutics credits accredited by the American Nurses Credentialing Center, aligned with contemporary evidence-based guidelines. Modules cover cardiovascular risk assessment, therapy-related toxicity, survivorship, and multidisciplinary care coordination.

Conclusions The CONE program provides a standardized, evidence-based framework for cardio-oncology nursing education, promoting nurse-led, patient-centered care and improving outcomes for cancer survivors. The asynchronous, flexible curriculum addresses global accessibility barriers and supports learner-directed professional development. Future directions include hybrid learning, simulation-based education, and competency-based certification to formalize nursing roles globally.

Keywords Cardio-Oncology, Nursing Education, Cardiotoxicity, Cancer, Cardiovascular Disease

*Correspondence:
Anecita Fadol
afadol@mdanderson.org
[1]Departments of Nursing and Cardiology, The University of Texas MD Anderson Cancer Center, Houston, TX, USA
[2]Moffitt Cancer Center, Department of Malignant Hematology, Tampa, FL, USA
[3]Royal Brompton Hospital, Cardio-Oncology Centre of Excellence, Sydney Street, London SW3 6NP, UK
[4]Hamad Medical Corporation- National Center for Cancer Care and Research, Doha, Qatar
[5]Pediatric Nurse Practitioner Division of Pediatric Cardiology, Advocate Children's Hospital, Oak Lawn, IL, USA
[6]IWK Health Centre, Halifax, Nova Scotia, Canada
[7]Faculty of Nursing, University of Alberta, Canada, USA
[8]Nursing and Chair of Health Service Research, School of Nursing & Midwifery, University College Cork, Cork T12 AK54, Ireland

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Introduction and background

Cardio-oncology has emerged as a critical subspecialty at the intersection of oncology and cardiovascular medicine. Advances in cancer therapies have improved patient outcomes, resulting in the largest population of cancer survivors in history. In the United States, approximately 18.6 million people have a history of cancer, projected to exceed 22 million by 2035 [33]. Globally, there are an estimated 50 million cancer survivors, with roughly 80% aged 60 years and older, highlighting the growing overlap of cancer and cardiovascular disease in an aging population [33].

Cancer and cardiovascular diseases share common risk factors, including advancing age, smoking, alcohol use, sedentary lifestyle, and obesity, contributing to the rising prevalence of both conditions [2]. Although novel cancer therapeutics have improved survival, these treatments are associated with acute and chronic cardiovascular toxicities, such as heart failure, arrhythmias, hypertension, vascular complications, and immune-mediated myocarditis [11, 20]. Consequently, addressing the complex cardiovascular needs of patients with cancer has become increasingly important, contributing to the emergence of cardio-oncology as a specialized field and the establishment of the International Cardio-Oncology Society (IC-OS).

The increasing population of cancer survivors, many with preexisting cardiovascular risk factors, underscores the need for coordinated, multidisciplinary management across the cancer care continuum [2, 20]. Despite recognition of cancer therapy–related cardiovascular toxicity, structured, competency-based education in cardio-oncology is inconsistently integrated into oncology and cardiology nursing curricula. Yet nurses play a critical role in cardiovascular surveillance, early symptom identification, patient education, and coordination of multidisciplinary care [7]. This article describes the development, structure, and implementation of the Cardio-Oncology Nursing Education (CONE) program, a global educational initiative aimed at strengthening nursing competency in cardio-oncology practice.

Learning needs assessment for cardio-oncology nursing

Contemporary cardiology and oncology guidelines provide recommendations for toxicity monitoring and risk stratification [20]. However, translation of these guidelines into structured nursing curricula and continuing education remains deficient. Addressing this gap requires a formalized educational framework grounded in current evidence and interdisciplinary collaboration. The limited availability of dedicated cardio-oncology training pathways raises concerns regarding accessibility to specialized education and the preparedness of healthcare providers, particularly nurses [23].

While the need for multidisciplinary cardio-oncology care has been increasingly recognized, educational initiatives have largely focused on physician training. Previous surveys have identified gaps in knowledge and training among cardiologists and oncologists, yet nurses were largely excluded from these assessments [2, 13, 15, 28, 32]. This highlights a critical need for nursing-specific educational resources to support the care of patients at the intersection of cancer and cardiovascular disease.

To better understand these needs, the International Cardio-Oncology Society (IC-OS) Nursing Leadership Working Group conducted a global assessment of nurses' learning needs in clinical cardio-oncology settings. Survey results demonstrated substantial variability in nursing knowledge, confidence, and preparedness, revealing persistent educational gaps across practice environments [6]. These findings provided the impetus for the development of the Cardio-Oncology Nursing Education (CONE) program as a formal training pathway, empowering nurses to support patients through cancer treatment and survivorship.

The CONE program aims to enable learners to:

1. Identify common cardiovascular toxicities associated with traditional chemotherapeutics and novel cancer therapies.
2. Review shared risk factors and links between cancer, oncologic treatments, and cardiovascular disease.
3. Discuss management strategies for cancer therapy–related cardiac dysfunction (CTRCD).
4. Illustrate essential components of cardio-oncology programs, including supportive care, survivorship planning, and integration of cardiovascular risk management.
5. Discuss the role of supportive care in managing cardio-oncology patients and survivors.

Nursing education model of the CONE curriculum

Developing a nurse education program requires a clearly defined theoretical and conceptual framework to ensure coherence between curriculum content, teaching strategies, and expected outcomes. Knowles' Adult Learning Theory (Andragogy) emphasizes that adult learners are self-directed, bring prior experience to learning, and are motivated by relevance to practice [14]. Applying these principles promotes active engagement, problem-solving, and reflective practice—core competencies for safe and effective nursing care. The CONE program leverages these principles to support real-world application in the care of cardio-oncology patients.

Cardio-oncology nursing requires integrating knowledge and clinical skills from both cardiology and

oncology, highlighting the need for an advanced practice framework. According to the International Council of Nurses [30], an advanced practice nurse is a registered nurse with expert knowledge, complex decision-making skills, and clinical competencies for expanded practice. Integrating Knowles' principles with the ICN framework highlights the importance of specialized education that supports advanced assessment, clinical reasoning, leadership, and system-level contributions within this emerging specialty. This provides a conceptual foundation for the CONE curriculum to prepare nurses to apply evidence-based care, clinical reasoning, and leadership skills in interdisciplinary practice.

Importance of the Multidisciplinary Team (MDT) and the role of nurses

Cardio-oncology care is inherently complex, necessitating multidisciplinary collaboration as outlined in the European Society of Cardiology (ESC) cardio-oncology guidelines [16, 20]. The ESC cardio-oncology guidelines emphasize the need for structured, multidisciplinary collaboration among cardiologists, oncologists, nurses, pharmacists, and allied health professionals to optimize patient outcomes throughout the cancer care continuum [16, 20]. Effective cardio-oncology management extends beyond the treatment of cardiovascular complications. Patients often require lifestyle counseling, pharmacotherapy, and enhanced cardiovascular surveillance, involving nurses, pharmacists, physiotherapists, and other allied health professionals [3, 27]. Despite recognition of the importance of these collaborative models, the specific roles and contributions of allied health professionals within cardio-oncology services remain incompletely defined [3].

Nurses play a central role in cardiovascular surveillance, symptom management, patient education, and care coordination. Survey data indicate gaps in knowledge and preparedness among cardiologists and nurses when managing cardiovascular complications in patients receiving cancer therapy [1, 4, 6]. These findings underscore the need for formalized education and training pathways that support cross-disciplinary competencies among healthcare providers working in cardio-oncology settings. In response, professional organizations such as the ESC have developed core curricula and certification programs for physicians. However, equivalent educational structures for nurses remain less well established. Educational initiatives such as the Cardio-Oncology Nursing Education (CONE) program aim to strengthen the knowledge and competencies required for nurses to effectively participate in multidisciplinary cardio-oncology teams and advance the delivery of integrated cardiovascular and oncologic care.

Quality indicators for cardio-oncology care emphasize the importance of multidisciplinary collaboration and standardized care pathways to improve patient outcomes [18]. Education and professional development for healthcare providers have been shown to positively influence clinical practice and patient outcomes across healthcare settings [12]. Consequently, strengthening educational opportunities for nurses and allied health professionals is essential to support effective implementation of multidisciplinary cardio-oncology care models.

Furthermore, evaluating the impact of multidisciplinary cardio-oncology care on patient outcomes remains an important area for future research. Patient-reported outcomes, including quality of life, treatment experience, and patient satisfaction, are increasingly recognized as critical measures of quality of care [19]. Given the complexity of clinical decision-making in cardio-oncology, particularly when cardiotoxicity may require modification or interruption of cancer treatment, shared decision-making and patient-centered communication are essential components of care [10].

Development of the CONE committee and working group

The Cardio-Oncology Nursing Education (CONE) initiative was developed by a multidisciplinary global committee, including oncology and cardiology nurse practitioners, nurse educators, nurse navigators, and advanced specialty nursing roles, in collaboration with international partners. Representation included academic medical centers, community oncology programs, cardiology practices, and international cardio-oncology programs, ensuring broad relevance across diverse healthcare systems. The committee structure reflects contemporary cardio-oncology practice models that emphasize interdisciplinary collaboration and shared accountability [11]. Through this collaborative approach, the working group aimed to develop an educational framework that addressed the practical needs of nurses providing care across the cancer continuum.

Curriculum priorities were informed by findings from the international learning needs assessment, which highlighted substantial variability in nursing knowledge and confidence regarding cardio-oncology management [6]. Using an iterative consensus process, the working group defined core competencies, refined learning objectives, and determined the appropriate depth and content for foundational and advanced learners.

Topic selection prioritized therapies commonly associated with cardiovascular toxicity, evidence-based risk stratification frameworks, recommended surveillance strategies, and approaches to long-term cardiovascular risk reduction among cancer survivors. Content areas were reviewed through multiple rounds of expert

discussion to ensure alignment with real-world nursing practice across inpatient, outpatient, infusion, and survivorship care settings.

Curriculum design

The CONE curriculum integrates evidence-based guidelines from the 2022 ESC Guidelines on cardio-oncology, the American Heart Association (AHA) scientific statement on cardio-oncology, and disease-specific National Comprehensive Cancer Network (NCCN) Clinical Practice Guidelines [11, 21, 25]. Topics include high-prevalence cardiotoxic therapies, cardiovascular risk stratification, surveillance strategies, and survivorship-focused prevention.

The program consists of 27 virtual modules, providing 18.25 nursing contact hours, including 10.25 pharmacotherapeutics credits accredited by the American Nurses Credentialing Center (ANCC). Modules progress from foundational concepts—such as pathophysiology, shared risk factors, baseline cardiovascular assessment, and multidisciplinary care coordination—to complex clinical applications. Subsequent modules cover treatment-related cardiovascular toxicities. Emphasis is placed on mechanisms of cardiovascular injury, risk stratification, and evidence-based surveillance strategies in accordance with contemporary guidelines [20].

Longitudinal survivorship and cardiovascular risk reduction are integrated throughout the curriculum. Topics include hypertension and lipid management, lifestyle modification counseling, and structured long-term cardiovascular surveillance [20]. Pediatric cardio-oncology principles and transition-of-care strategies are also incorporated to address lifelong implications of cardiotoxic exposure among childhood cancer survivors.

Collectively, the curriculum outlines key competencies for cardio-oncology nursing practice, including cardiovascular surveillance, patient education, symptom assessment and triage, pharmacologic monitoring, interdisciplinary coordination, and survivorship care planning [29]. These competencies reinforce the role of nurses as central contributors to the multidisciplinary cardio-oncology care model.

Teaching modalities

Educational strategies include asynchronous e-learning modules, recorded expert-led lectures, and case-based clinical scenarios designed to promote applied clinical reasoning. Case discussions reflect real-world oncology and cardiology practice settings. Knowledge assessments are integrated to reinforce learning objectives and support competency development. Faculty contributors include cardiologists, cardiology nurse practitioners, oncology nurse practitioners, physician assistants, nurse educators, and nurse scientists. This interdisciplinary representation models multidisciplinary collaborative care delivery and reinforces shared responsibility in managing cardiovascular toxicities among patients with cancer.

Global engagement and accessibility

Recognizing variability in cardio-oncology infrastructure, the CONE initiative was designed for a global nursing audience. Nurses from academic medical centers, community oncology programs, outpatient cardiology clinics, and survivorship practices were targeted. To accommodate international time zones and clinical schedules, the program was structured as asynchronous e-learning modules, recorded expert-led lectures, and case-based clinical scenarios to promote applied clinical reasoning and equitable global access, while also supporting flexible participation.

The CONE program is offered as enduring material and remains available through November 18, 2027. Its modular structure accommodates varying clinical schedules and global time zones, enabling participation across healthcare systems. Learners may complete the curriculum in a structured sequence or select modules aligned with individual learning goals, facilitating flexible yet comprehensive professional development in cardio-oncology nursing. Its flexible virtual format supports global participation and ongoing professional development in cardio-oncology nursing.

Implementation of the CONE program

The CONE program was designed to provide a foundational, adaptable, and scalable framework for global cardio-oncology nursing education [34]. Using learner-directed formats and asynchronous virtual modules, the program addresses logistical challenges such as time zones, clinical schedules, infrastructure, and financial barriers. The launch was communicated through international cardiology and oncology professional organizations, social media, nursing educational programs, and IC-OS membership channels.

Barriers to cardio-oncology nursing training

Barriers to nurse education in cardio-oncology include gaps in basic nursing curricula, limited faculty expertise, undefined nurse roles within the multidisciplinary team, and funding constraints [6, 8, 26]. Surveys indicate that approximately 88% of nurses caring for cancer patients and survivors have received no formal cardio-oncology training [6]. These barriers are particularly pronounced in regions with limited specialist access, such as in Africa, where only approximately 2,000 cardiologists serve the entire continent [26]. The CONE program addresses these gaps by providing structured, accessible education to nurses globally.

Evaluation and outcomes

Effective professional development requires flexible, tailored content to meet learner needs [9, 24]. The CONE webinars incorporate pre- and post-testing, which identify baseline knowledge and measure knowledge acquisition after module completion [5, 17, 22]. These assessments support evidence-based learning, reinforce foundational practices, and promote retention.

The overarching goal is to empower nurses to preserve cardiovascular health in oncology patients, facilitate timely consultation and testing, prevent cardiotoxicity, and support survivorship care. Nurses are positioned at the forefront of patient care, coordinating early identification, monitoring, and management of cardiovascular complications throughout the cancer continuum [7]. Future evaluations will include participant feedback and satisfaction surveys to measure the program's impact on clinical practice and knowledge translation.

Future directions

To our knowledge, the CONE program is the first cardio-oncology education developed by nurses for nurses, guided by an initial needs assessment on learning, topics and delivery format [6]. As cardio-oncology continues to evolve, the need for specialized nursing education will expand alongside growing numbers of cancer survivors with cardiovascular comorbidities. Future directions for the CONE program and the field of cardio-oncology nursing include:

1. Expansion of hybrid and simulation-based learning to incorporate acute and chronic patient scenarios, enhancing clinical reasoning and hands-on skills.
2. Integration of patient-reported outcomes to evaluate the impact of nurse-led interventions on quality of life, satisfaction, and treatment adherence.
3. Global dissemination through translation, adaptation, and partnership with international nursing organizations to ensure equitable access across diverse healthcare systems.
4. Certification and credentialing pathways for cardio-oncology nursing, formalizing the specialty and recognizing advanced competencies.
5. Ongoing research to evaluate the effect of structured education on patient outcomes, multidisciplinary team functioning, and survivorship care metrics.

By pursuing these directions, the CONE program can continue to position nurses at the forefront of cardio-oncology care, equipping them with the knowledge and skills necessary to provide integrated, patient-centered care across the cancer continuum. Strategic investment in nursing education is essential to meet the anticipated growth in demand for cardio-oncology services and to optimize outcomes for cancer survivors worldwide [31].

Conclusion

The development and implementation of the CONE program provide a structured, evidence-based curriculum that equips nurses with the knowledge and skills to deliver integrated cardio-oncology care. By combining oncology and cardiology expertise, the CONE program prepares nurses to assess cardiovascular risk, identify therapy-related complications, coordinate multidisciplinary care, and support survivorship planning. Standardizing education through accessible, accredited online training ensures that nurses are at the forefront of this emerging specialty, enabling safe, patient-centered care and promoting optimal outcomes for cancer survivors [7, 31].

Abbreviations

AHA	American Heart Association
ANCC	American Nurses Credentialing Center
CTCRD	Cancer Therapy–Related Cardiac Dysfunction
CONE	Cardio-Oncology Nursing Education
ESC	European Society of Cardiology
ICN	International Council of Nurses
IC-OS	International Cardio-Oncology Society
MDT	Multidisciplinary Team
NCCN	National Comprehensive Cancer Network

Acknowledgements

Not applicable

Authors' contributions

AF contributed to the conception of the manuscript, writing and editing of the original draft. LN, PR, AY, CK, MS, EP and GL contributed to writing, review and editing. All authors read and approved the final manuscript.

Funding

Not applicable.

Data availability

No datasets were generated or analysed during the current study.

Declarations

Ethics approval and consent to participate

Not applicable.

Consent for publication

Not applicable.

Competing interests

The authors declare no competing interests.

Received: 10 April 2026 / Accepted: 18 May 2026
Published online: 27 May 2026

References

1. Asteggiano R, Aboyans V, Lee G, Salinger S, Richter D. Cardiology care delivered to cancer patients. Eur Heart J. 2020;41(2):205–6. https://doi.org/10.1093/eurheartj/ehz935.
2. Badreldin HA, Alsuhebany N, Alfehaid L, Alzahrani M, Aldoughaim M, Alrajhi AM, et al. Assessment of cardio-oncology knowledge and practice among

healthcare providers in Saudi Arabia: a comprehensive nationwide survey. Cardiooncology. 2024;10(1):93. https://doi.org/10.1186/s40959-024-00299-x.
3. Bennetts JD, Williams TD, Beavers CJ, Moore HN, Robson C, Warner T, et al. The cardio-oncology multidisciplinary team: beyond the basics. Cardiooncology. 2025;11(1):69. https://doi.org/10.1186/s40959-025-00369-8.
4. Boriani G, Lee G, Parrini I, Lopez-Fernandez T, Lyon AR, Suter T, et al. Anticoagulation in patients with atrial fibrillation and active cancer: an international survey on patient management. Eur J Prev Cardiol. 2021;28(6):611–21. https://doi.org/10.1093/eurjpc/zwaa054.
5. Carpenter J, Toftness B. Pre- and post-assessment in video-based learning: evidence and strategies. Nurse Educ Today. 2017;50:68–73. https://doi.org/10.1016/j.nedt.2016.12.008.
6. Fadol A, Lee G, Shelton V, Schadler KC, Younus AM, Stuart M, et al. Nursing knowledge in cardio-oncology: results of an international learning needs-assessment survey. Cardiooncology. 2025;11(1):4. https://doi.org/10.1186/s40959-025-00304-x.
7. Fadol A, Nodzon L, Lee G. The role of nursing in the delivery of cardio-oncology. Curr Treat Options Oncol. 2024;25(10):1268–75. https://doi.org/10.1007/s11864-024-01241-0.
8. Galassi A, Anwarali S, Challinor J. Global challenges and initiatives in oncology nursing education. Ann Palliat Med. 2023;12(3):633–45. https://doi.org/10.21037/apm-22-1120.
9. Healy G. Barriers to professional development in healthcare. Nurs Manage. 2009;16(8):30–5. https://doi.org/10.7748/nm2009.06.16.8.30.c7111.
10. Hendriks JM, Lee G. Shared decision-making: the patient on the forefront of care coordination. Eur Heart J Qual Care Clin Outcomes. 2020;6(4):231–3. https://doi.org/10.1093/ehjqcco/qcaa039.
11. Herrmann J, Lenihan D, Armenian S, Barac A, Blaes A, Cardinale D, et al. Defining cardiovascular toxicities of cancer therapies: an International Cardio-Oncology Society (IC-OS) consensus statement. Eur Heart J. 2022;43(4):280–99. https://doi.org/10.1093/eurheartj/ehab674.
12. Horsom DM, Keogh N, Lee G, Saab MM. The effect of education on evidence-based practice implementation among nurse leaders: a mixed-methods systematic review. Int Nurs Rev. 2026;73(1):e70169. https://doi.org/10.1111/inr.70169.
13. Ivanescu AC, Nitipir C, Bumbea H, Badila E, Dan GA. Current knowledge and implementation of therapeutic strategies in cardio-oncology: a national physician-based survey. Am J Ther. 2025;32(3):e223–33. https://doi.org/10.1097/MJT.0000000000001970.
14. Knowles MS. Andragogy in action: applying modern principles of adult learning. 1st edition. Jossey-Bass. Wiley. 1984. ISBN: 978-0875896212.
15. Koop Y, Teske AJ, Wanders I, Meijer H, Kaanders J, Manintveld OC, et al. Future steps in cardio-oncology-a national multidisciplinary survey among healthcare professionals in the Netherlands. J Cancer Surviv. 2023;17(4):1131–8. https://doi.org/10.1007/s11764-022-01163-6.
16. Lancellotti P, Suter TM, Lopez-Fernandez T, Galderisi M, Lyon AR, Van der Meer P, et al. Cardio-oncology services: rationale, organization, and implementation. Eur Heart J. 2019;40(22):1756–63. https://doi.org/10.1093/eurheartj/ehy453.
17. Latimier A, Riegert A, Peyre H, Ly ST, Casati R, Ramus F. Does pre-testing promote better retention than post-testing? NPJ Sci Learn. 2019;4:15. https://doi.org/10.1038/s41539-019-0053-1.
18. Lee GA, Aktaa S, Baker E, Gale CP, et al. European Society of Cardiology quality indicators for the prevention and management of cancer therapy-related cardiovascular toxicity in cancer treatment. Eur Heart J Qual Care Clin Outcomes. 2023;9(1):1–7.
19. Lee GA, Liu X, Wang X. A multidisciplinary approach in cardio-oncology: the impact of the nurse in the patient pathway. Journal of Multidisciplinary Care. Under review. 2026.
20. Lyon AR, Lopez-Fernandez T, Couch LS, Asteggiano R, Aznar MC, Bergler-Klein J, et al. 2022 ESC guidelines on cardio-oncology developed in collaboration with the European Hematology Association (EHA), the European Society for Therapeutic Radiology and Oncology (ESTRO) and the International Cardio-Oncology Society (IC-OS). Eur Heart J Cardiovasc Imaging. 2022;23(10):e333–465. https://doi.org/10.1093/ehjci/jeac106.
21. Lyon AR, Lopez-Fernandez T, Couch LS, Asteggiano R, Aznar MC, Bergler-Klein J, et al. 2022 ESC guidelines on cardio-oncology developed in collaboration with the European Hematology Association (EHA), the European Society for Therapeutic Radiology and Oncology (ESTRO) and the International Cardio-Oncology Society (IC-OS). Eur Heart J. 2022;43(41):4229–361. https://doi.org/10.1093/eurheartj/ehac244.
22. Majika C. Pre- and post-testing in professional education: methodologies and outcomes. Nurse Educ Today. 2024;124:105–12. https://doi.org/10.1016/j.nedt.2024.105112.
23. Manderlier B, von Kemp B, Beeckman K, Cosyns B, Van den Bussche K, cardio-oncology expert p. Core outcome set for cardio-oncology: development of a set of outcomes for the cardiovascular assessment and monitoring of cancer patients and survivors. Eur Heart J Qual Care Clin Outcomes. 2025;11(4):367–77. https://doi.org/10.1093/ehjqcco/qcae038.
24. McKibbin G, Humphreys C. Frontline workers' response to harmful sexual behavior: building blocks for promising practice. Trauma Violence Abuse. 2023;24(2):597–612. https://doi.org/10.1177/15248380211036077.
25. NCCN Clinical Practice Guidelines in Oncology: Cardio-oncology. National Comprehensive Cancer Network. 2025.
26. Nkrumah-Boating E. Faculty limitations in specialty nursing education: global perspectives. Int J Nurs Stud. 2025;136:104–12. https://doi.org/10.1016/j.ijnurstu.2025.104112.
27. Parent S, Pituskin E, Paterson DI. The cardio-oncology program: a multidisciplinary approach to the care of cancer patients with cardiovascular disease. Can J Cardiol. 2016;32(7):847–51. https://doi.org/10.1016/j.cjca.2016.04.014.
28. Peng J, Rushton M, Johnson C, Brezden-Masley C, Sulpher J, Chiu MG, et al. An international survey of healthcare providers' knowledge of cardiac complications of cancer treatments. Cardiooncology. 2019;5:12. https://doi.org/10.1186/s40959-019-0049-2.
29. Reehal P, Lyon AR, Lee G. The role of a cardio-oncology clinical nurse specialist in the United Kingdom. Asia Pac J Oncol Nurs. 2025;12:100640. https://doi.org/10.1016/j.apjon.2024.100640.
30. Schober M, Rogers M, Stelnke M, Turale S, Pulcini J, Roussel J, Stewartd D. International Council of Nurses: guidelines on advanced practice nursing. International Council of Nurses: Geneva, Switzerland; 2020. ISBN: 978-92-95099-71-5.
31. Snively M. Standardization and certification in cardio-oncology nursing. Cardiooncology. 2025;11(4):112–20. https://doi.org/10.1186/s40959-025-00159-2.
32. Szmit S, Kepski J, Ksiazczyk M, Krzakowski M & Lelonek M. Understanding Cardio-Oncology: A Survey-Based Study Conducted by the Heart Failure Association of the Polish Cardiac Society and the Polish Society of Clinical Oncology. J Clin Med. 2026; 15(3). https://doi.org/10.3390/jcm15031240
33. Wagle NS, Nogueira L, Devasia TP, Mariotto AB, Yabroff KR, Islami F, et al. Cancer treatment and survivorship statistics, 2025. CA Cancer J Clin. 2025;75(4):308–40. https://doi.org/10.3322/caac.70011.
34. Wilson JM, Lushington J, Gray R, Silva CC, Flores CH, Martinez DS, et al. Global disparities and future directions in cardio-oncology training: an international survey of cardiology trainees from the International Cardio-Oncology Society. Cardiooncology. 2026;12(1):2. https://doi.org/10.1186/s40959-025-00419-1.

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