

2020 SCCT Guideline for Training Cardiology and Radiology Trainees as Independent Practitioners (Level II) and Advanced Practitioners (Level III) in Cardiovascular Computed Tomography: A Statement from the Society of Cardiovascular Computed Tomography.

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SCCT Guideline for Training Cardiology and Radiology Trainees as Independent Practitioners
(Level II) and Advanced Practitioners (Level III) in Cardiovascular Computed Tomography: A
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January-February 2021 14 8 2020 15 1 363317 2 15 14 08 2020 14 08 2020 06 09 2024 Crown Copyright © 2020 Published by Elsevier Inc. on behalf of Society of Cardiovascular Computed Tomography. All rights reserved. 2020 Since January 2020 Elsevier has created a COVID-19 resource centre with free information in English and Mandarin on the novel coronavirus COVID-19. The COVID-19 resource centre is hosted on Elsevier Connect, the company's public news and information website. Elsevier hereby grants permission to make all its COVID-19-related research that is available on the COVID-19 resource centre - including this research content - immediately available in PubMed Central and other publicly funded repositories, such as the WHO COVID database with rights for unrestricted research re-use and analyses in any form or by any means with acknowledgement of the original source. These permissions are granted for free by Elsevier for as long as the COVID-19 resource centre remains active. Cardiovascular computed tomography (CCT) is a well-validated non-invasive imaging tool with an ever-expanding array of applications beyond the assessment of coronary artery disease. These include the evaluation of structural heart diseases, congenital heart diseases, peri-procedural electrophysiology applications, and the functional evaluation of ischemia. This breadth requires a robust and diverse training curriculum to ensure graduates of CCT training programs meet minimum competency standards for independent CCT interpretation. This statement from the Society of Cardiovascular Computed Tomography aims to supplement existing societal training guidelines by providing a curriculum and competency framework to inform the development of a comprehensive, integrated training experience for cardiology and radiology trainees in CCT.

The field of cardiovascular computed tomography (CCT) has seen considerable growth over the past decade. Driven in large part by a growing body of evidence and significant advancements in scanner technology, societal guidelines internationally now strongly recommend CCT, as the preferred first-line test in patients without known coronary artery disease. 1, 2, 3 The recently updated National Institute for Health and Care Excellence (NICE) guidelines in the United Kingdom (UK) recommend CCT as the preferred testing strategy for stable chest pain patients without known CAD, citing accuracy of diagnosis, as well as economic and prognostic advantages. 4, 5 One challenge facing this increased utilization of CCT in the UK is the need for more independent CCT practitioners and/or advanced practitioners capable of leading a CCT laboratory. 6 In the US, data from recent clinical trials, and an increased emphasis on value based care are contributing to a similar shift toward increased utilization of CCT, and thus a similar need for a higher number of independent CCT readers. 7, 8, 9 This is expected to drive a similar need for more independent and advanced CCT practitioners.

In addition to the evaluation of CAD, the role for CCT in the evaluation of structural cardiac disease continues to expand rapidly, is now a prerequisite imaging study for the optimal planning of transcatheter, surgical and congenital therapies, and is expected to further evolve in the future. 10, 11 The modern cardiology and radiology trainee pursuing CCT training should be comfortable with the scope and fundamentals of these various non-coronary applications. In the United States, societal training guidelines from the American College of Cardiology (ACC) and American College of Radiology (ACR) inform the case volume and clinical skills that are required to become accredited as an independent reader or as a laboratory director. 12, 13

Internationally, several training statements incorporate CCT training. The 2014 Royal College of Radiologists/British Society of Cardiovascular Imaging document addresses the safe practice of CT coronary angiography. 14 The European Association of Cardiovascular Imaging developed a CCT Core Syllabus in 2015 that gives a broad overview to educational topics that constitute competency for CCT practice. 15 Recently, the Royal College of Radiology Clinical Radiology Specialty Training Curriculum 2020 has incorporated CCT training. 16 The Society of Cardiovascular Computed Tomography (SCCT) published a statement in 2015 outlining a comprehensive curriculum for cardiology and radiology program directors to design an educational experience in the basic, foundational (level I) aspects of CCT. 17 To complement these statements, there is a need to assist program directors in designing a comprehensive academic curriculum to address advanced level trainees capable of performing and interpreting complex studies, lead a research program, direct a CCT laboratory and/or train others in CCT.

This document strives to provide guidance for program directors (PD) charged with designing a curriculum for the training of Independent Practitioner (IP; Level II) and/or Advanced Practitioner (AP; Level III) (Table 1). In the U.S. the Accreditation Council for Graduate Medical Education (ACGME) adopted a set of 6 core competencies that make up the cornerstone trainee education and assessment: 1) medical knowledge; 2) practice-based learning and improvement (PBLI); 3) patient care and procedural skills; 4) systems-based practice; 5) interpersonal and communication skills; and 6) professionalism. Table 1 Summary of Independent Practitioner (IP) and Advanced Practitioner (AP) capabilities upon completion of training.

Achieved competency to independently interpret cardiac findings on non-contrast and predominantly contrast-enhanced cardiac CT

Achieved competency to independently evaluate patient selection, preparation, scan protocol selection, dose modulation, post-processing, and image interpretation

Achieved competency in all of the common cardiac CT applications to include evaluation of coronary pathology, coronary anatomy, basic structural HD assessment, EP procedural planning, basic congenital HD, and functional CT

Achieved competency in all capabilities ascribed to IP level of training

Achieved advanced skills and knowledge beyond IP, including evaluation of complex coronary artery disease, competency in structural heart planning and a wider spectrum of congenital heart disease

Achieved competency in laboratory accreditation requirements and maintenance

Achieved competency in equipment purchasing, maintenance, and acquisition

Actively involved in quality improvement, performance improvement, and/or CT-specific research endeavors

Achieved competency in business aspects (billing, coverage, reimbursement, and prior authorization) of CT laboratory administration

Furthermore, this document uses the framework of the ACGME core competencies as a global document to enable the assessment and education of trainees across these core competencies to reproducibly train graduating fellows and residents fully qualified to care for patients utilizing CCT. Thus, this document aims to reinforce learning competencies utilized regularly in clinical practice through daily case volume. It also aims to provide a guide for necessary medical knowledge and online case volume supplementation needed to expose the trainee to less frequently encountered CCT applications.

CCT trainees emerge from two principle training backgrounds: radiology or cardiology. Importantly, it is not so much what specialty a prospective CCT reader originates from, but rather the quality of dedicated training that they obtain that ultimately defines competency level and expertise in the advanced field of CCT. Indeed, the strong collaboration between radiologists and cardiologists—in clinical practice, research, and in training—has fueled many of the advances in the field of CCT. 18 The challenge for radiology and cardiology PDs is to identify training gaps in their respective curriculum and augment the training experience to incorporate all necessary learning objectives, regardless of local expertise, case diversity, or case volume.

Additionally, consideration should be given to tailoring a training curriculum based specifically on augmenting known knowledge gaps. Cardiology fellows, as an example, may require a training curriculum weighted more heavily in CT physics, protocol optimization, and extra-cardiac anatomy, and pathology. Conversely, radiology residents may benefit from a training curriculum focused more on cardiac anatomy, clinical outcomes data, clinical practice guidelines, management of cardiovascular disease, and cardiac pathophysiology. Fig. 1 outlines potential CCT training pathways for both cardiology fellows and radiology residents. Given local variations in case volume, diversity, and supervisor expertise, training duration for IP/Level II trainees may vary. Fig. 1 Recommended Pathways to Independent Practitioner & Advanced Practitioner from Cardiology or Radiology Training Backgrounds Local variations in case volume, diversity, and supervisor expertise may allow for completion of IP case volume and requirements as early as the second year of cardiology fellowship. Less variability typically exists with respect to IP training for radiology residents. General curriculum requirements are completed during the first 3 years of training and IP requirements are accomplished during focused cardiac imaging training, typically during the fourth year of training. AP training requires additional fellowship training in advanced cardiac imaging.

Less variability typically exists with respect to IP training for radiology residents. General curriculum requirements are completed during the first 3 years of training and IP requirements are accomplished during focused cardiac imaging training, typically during the fourth year of training. For radiology and nuclear medicine residents, the American College of Radiology (ACR) released an update to CT accreditation program requirements in July 20, 2015.¹⁹ The ACR statement lays out minimum initial requirements with respect to CCT case volume, board certification and/or training, and additional education in cardiac structure and function in order to interpret and supervise CCT examinations.

More recently in 2016, a joint practice parameter collaboratively revised by ACR in concert with the North American Society of Cardiovascular Imaging (NASCI) and the Society of Pediatric Radiology (SPR) was published that differs slightly from the 2015 ACR statement.¹³ The joint 2016 practice parameter lowered the number of dedicated cardiac CT examinations performed to 50 studies over a 36 month period (compared with 75 in the 2015 ACR CT accreditation requirements statement) while also lowering the required continuing medical education (CME) hours to 30 (from 40 ■h); while maintaining board certification and training program accreditation standards established in the 2015 ACR statement. Importantly, the 2016 joint practice parameter also outlined qualifications required to assume responsibility of a cardiac CT imaging program or laboratory. In addition to the previously discussed requirements, an additional 450 supervised thoracic CT or CT angiography cases, excluding CAC scoring, are required and an additional 200 ■h of CT-specific CME.

Nuclear medicine training is much more variable as trainees can emerge from both internal medicine and radiology. Thus, these trainees should follow guidance found in the ACR statement.¹⁹ In brief, radiology trainees are required to successfully complete board certification through a recognized governing body (i.e. American Board of Radiology, Royal College of Physicians and Surgeons of Canada, etc). Importantly, no distinction is made between IP and AP levels of competency.

Cardiology fellows training at high volume centers may complete IP case volume requirements within a shorter period of time when compared to cardiology fellows at lower volume centers. CCT training may be incorporated into multimodality imaging rotations to complete IP requirements. Adding to the variability is the fact that general cardiology fellowship training can vary in duration (as short as 24 months of clinical rotations up to 36 months), thus potentially shortening the time available to train IP-level trainees.²⁰ While the 2015 ACR statement mentions training recommendations for IPs originating from a cardiology background, training requirements for various levels of competency for cardiology fellows are governed by the Core Cardiovascular Training Statement (COCATS) published by the American College of Cardiology.¹² COCATS 4 provides a case-volume recommendations, in addition to general ACGME core competency-based training objectives ("milestones") for both Level I and Level II general cardiology fellows.¹² Training requirements highlighted in COCATS 4 call for significant hands-on time spent with

contrast-enhanced CCT dataset acquisition and patient preparation with a focus on mentored case review at a 3-dimensional (3D) workstation. In general, level I concepts should be met within the first 2 years of fellowship training with more focused case exposure and didactic training required in the 3 year of training to achieve Level II competency during a standard general cardiology fellowship.

AP learners requires additional training in hybrid imaging modalities, participation in the various aspects of laboratory administration, education of cardiology and/or radiology trainees, and participation in CCT-specific research. In addition to devoted training in CCT, an AP trainee is required to achieve advanced training in at least 1 additional imaging modality. Given these extensive requirements, COCATS recommends additional training beyond the standard 3-year fellowship, though this is not explicitly required. In the U.S. multiple cardiovascular imaging fellowships are available that enable trainees to acquire advanced knowledge and skills that enable trainees to achieve level II or level III in multiple imaging modalities. Around the world CCT is an important component of standard cardiology curriculum. For example in the UK, the Joint Royal Colleges of Physicians Training Board incorporates CCT in its specialty training curriculum for cardiology trainees.²¹ In addition, the length of cardiology training varies widely, and additional training in CCT may be required to achieve AP level.

Taking this background into account, the purpose of this statement is threefold. First, we seek to expand upon the SCCT general (Level I) curriculum guideline statement by providing knowledge and skills required for IP and AP trainees. Second, we seek to provide enhanced granularity and standardization across advanced imaging fellowship curricula and across a broad range of training backgrounds (radiology and cardiology). Finally, we seek to fill in identified gaps in currently published training recommendation statements and emphasize that background knowledge and procedural skill are important requirements delineated in the COCATS and ACR statements. Specifically, this document delineates a suggested minimum threshold for AP case volumes to achieve the milestones outlined. This guideline is not meant to supersede the existing COCATS and ACR statements, but rather complement those documents to encompass the most recent advancements in the field of CCT.

As this document builds upon the curriculum previously outlined in the 2015 SCCT Level I curriculum guideline,¹⁷ a comprehensive training curriculum with a goal of producing competent IP and AP imagers should be tailored to the specific strengths and limitations of training background (cardiology, radiology, or nuclear medicine), total laboratory case volume, and case diversity. Building an initial curriculum or revamping an existing curriculum for IP and AP trainees is a complex undertaking. Radiology residents/trainees may have a stronger foundation in CT scanner strengths, limitations, protocol selection, post-processing, and image manipulation. Cardiology fellows/trainees may have a deeper understanding of cardiac anatomy, physiology, pathologic disease states, and the clinical applicability of these various findings, but minimal exposure to CT as an imaging modality. A team-based approach to the hands-on scanner training experience, which could involve technologist, medical physics, and the laboratory director, could also increase the level of understanding and depth of knowledge. In addition, AP trainees may require exposure to multiple scanner platforms and to a diverse case volume that should involve multi-disciplinary image interpretation and clinical correlation of findings.

Understanding that a critical review and potential revision of a CCT training curriculum can be time consuming, this document seeks to ease this transition in several ways. First, recommended learning objectives are found in Table 2 and are arranged by ACGME core competency and further broken down by core CCT domain for both IP and AP trainees. The ACGME core competencies were used to allow for PDs to more easily develop trainee evaluations to ensure learners are meeting specific milestones and to identify knowledge gaps earlier in training where they can more easily be addressed. Table 2 ACGME core competency-based cardiac CT training curriculum knowledge bullet points.

ECG ■= ■Electrocardiogram; 3D ■= ■3-Dimensional; CAD-RADS ■= ■Coronary Artery Disease-Reporting and Data System; CAC= Coronary artery calcium; TAVR ■= ■Transcatheter Aortic Valve Replacement; TMVR ■= ■Transcatheter Mitral Valve Repair; LAA ■= ■Left Atrial Appendage; VAD = Ventricular Assist Device. CHD = Congenital Heart Disease. BAV = Bicuspid aortic valve; ASD ■= ■Atrial Septal Defect; PFO = Patent Foramen Ovale; VSD = Ventricular Septal Defect; TOF ■= ■Tetralogy of Fallot; TGA ■= ■Transposition of the Great Arteries; TA ■= ■Tricuspid Atresia; CMR = Cardiovascular Magnetic Resonance. CTP = Computed Tomography Perfusion. FFR = Fractional Flow Reserve.

* denotes in the “New” column annotated learning objectives that are new to this document and not previously recommended in SCCT Level I Curriculum 17 , COCATS 4 12 or by the ACR. 19 CCT = cardiac computed tomography; IP=Independent Practitioner; AP = Advanced Practitioner.

Case volume and diversity are important aspects for potential IP & AP trainees, as there is data linking increasing case volumes with successful completion of board certification examinations. 22 Of greater importance, the case volumes discussed within this document serve as a starting point for competency that must be assessed and verified by CCT advanced practitioners. This can be learned and evaluated during live case manipulation at a dedicated 3D workstation. It is important that IP & AP trainees be directly mentored by a supervising faculty with routine involvement in image acquisition and protocol selection at the scanner. In many institutions, though, there is limited case volume and diversity that is reliably available for all trainees and thus alternative training resources are needed. Supplementation with electronic teaching files and/or online resources with emphasis on maximal exposure to 3D workstation functionality may assist with bridging this gap.

Integration and leveraging of expertise from cardiology and radiology resources within a training center can significantly augment an IP and AP training curriculum(18). PDs are strongly encouraged to coordinate with these other departments to arrange for multidisciplinary conferences, multimodality imaging correlations, and joint live interpretation at the 3D workstation. With regard to minimum case volumes for IP and AP competency (Table 3 , Table 4 , Table 5), the writing group arrived at these recommendations through unanimous consensus. Table 3 Minimum case volumes for demonstration of Independent Practitioner and Advanced Practitioner competencies.

Based on American College of Cardiology 2015 COCATS IV Document for Level II Competency.

The time frame of 8 and 24 weeks do not need to be consecutive. It is possible for trainees in high volume centers to achieve competency in a shorter time frame provided that all milestones are achieved. Training in cardiac computed tomography may be counted as part of a dedicated multimodality cardiac imaging training experience.

Independent Practitioner competency may include review of studies from an established teaching file, previous CCT cases, journals and/or textbooks, and electronic/online courses/continuing medical education. Trainees may be present at the scanner or via telemedicine to engage directly with patient preparation, data acquisition and image reconstruction. A simulation environment may offer opportunities to supplement engagement with the recommended number of live cases.

Minimum case volumes for demonstration of Structural Heart Disease competency a .

Trainees are also directed to Table 8 for a discussion on potential future curriculum competencies in this rapidly evolving field.

While case volume and didactics can provide an initial training experience, demonstrated Independent (IP) and Advanced Practitioner (AP) competency in structural heart disease requires engagement at an institution with a multi-specialty heart team.

Emphasis for Independent Practitioner includes achieving basic competency in uncomplicated TAVR planning with exposure to the other clinical scenarios.

Demonstration of Advanced Practitioner Structural Heart Competency may not be sufficient for the comprehensive, expert level practice of all complex structural heart imaging studies, such as, but not limited to TMVR, paravalvular leak and other high-risk structural procedures.

Minimum case volumes for demonstration of Congenital Heart Disease competency a .

While case volume and didactics can provide an initial training experience, demonstrated Independent Practitioner and Advanced Practitioner competency in congenital heart disease requires engagement at an institution with expertise in the unique care needs of patients with congenital heart disease.

Emphasis for Independent Practitioner is achieving basic competency in simple congenital heart disease with exposure to complex congenital heart disease.

Demonstration of Advanced Practitioner Congenital Heart Disease Competency may not be sufficient for the comprehensive, expert level practice of all complex congenital heart cardiac CT imaging.

The widespread adoption of transcatheter aortic valve replacement (TAVR) has driven a strong interest in the field of structural heart disease. During the development of TAVR, CCT has become integral to the preprocedural planning of these procedures which has increased the need for competent IPs and APs with specific expertise and dedicated training in SHD. 10 , 23 , 24 , 25 , 26 , 27 Furthermore, the role of CCT in newer technologies such as left atrial appendage (LAA) occlusion device implantation and the systematic evaluation of left ventricular assist devices (LVADs) continues to expand due to the distinct advantages from a spatial resolution perspective. 28 , 29 , 30 , 31 Within the realm of transcatheter mitral valve replacement (TMVR), pre procedural CCT is a requirement in device selection, left ventricular outflow tract obstruction prediction risk, and intraprocedural fusion road mapping. 27 , 32 , 33

The application of CCT in structural heart disease is not significantly addressed in any prior societal training guidelines. 26 However, it is important that all IP and AP trainees receive at least introductory exposure to this field with didactic content incorporating learning objectives from Table 2 including an understanding of vascular access. While case volume and didactics can provide an initial training experience to structural heart disease, more advanced training requires dedicated time with regular attendance at multi-specialty heart team conferences to fully understand the procedure, potential complications/pitfalls, and minimum equipment requirements as part of a 360-degree learning experience. Multi-specialty “heart team” conferences typically include an expert in CCT imaging, interventional cardiology, cardiothoracic (CT) surgery, interventional imagers, cardiac anesthesia, and other members of the cardiovascular team.

CCT provides detailed information on the anatomy of the entire thorax and, in contrast to other modalities, is superior for evaluating vascular/soft tissue structures in the setting of CHD. 34 While true expertise in the nuances of congenital heart disease require specific training and time dedicated to this area, all IP and AP trainees should have a robust understanding of the distinct advantages/limitations of CCT, as well as other imaging technologies, as part of a multimodality approach to CHD. IP trainees, and more importantly AP trainees, should spend significant time with protocol development and image acquisition as part of the CHD curriculum as standardized coronary protocols may not adequately answer the clinical question. 35 , 36 Additionally, a robust didactic curriculum utilizing learning objectives from Table 2 provide a needed knowledge foundation of simple and complex congenital lesions and repairs. It is strongly encouraged to further solidify these learning objectives in a multi-specialty setting involving case review with adult CHD specialist or pediatric cardiologist, other non-invasive imaging specialists (particularly

echocardiography and cardiac MR), and a congenital heart disease surgeon, when available. In addition to increasing medical knowledge and improving patient care amongst trainees, multi-specialty learning opportunities teach effective communication skills amongst members of the CHD team.

In addition to CCTs ability to diagnose coronary atherosclerosis anatomically, there are emerging CCT applications that allow for functional assessment of ischemia, most notably CT perfusion (CTP) and CT-based fractional flow reserve (FFR-CT). 37 Ideally, a multi-disciplinary heart team conference will leverage local expertise amongst CCT, nuclear cardiology, cardiac MR, echocardiography, and interventional cardiology to provide a valuable forum for open discussion on strengths, weaknesses, and appropriate use of the respective modalities. 38 Table 2 outlines important learning objectives pertaining to functional assessment by CCT. In general, both IP and AP trainees should demonstrate understanding of the current clinical role, supporting data, techniques, strengths, and weaknesses of CT-based techniques for functional assessment of CAD lesions, and how these tests may compare with other imaging techniques. As many training centers may not have readily available access to specific functional CT techniques, including CTP or FFR-CT, hands-on experience during training is not required to meet competency objectives for IP or AP trainees.

While a large proportion of the IP & AP training curriculum can be administered in conjunction with live case review, a full didactic curriculum is vital to supplement where gaps in training supervisor or case diversity exist. A didactic curriculum should incorporate multispecialty lectures from local experts complimented with webinars, societal educational offerings, and attendance at annual scientific meetings. Fig. 2 , Fig. 3 highlight the comprehensive, multi-faceted approach that is needed to meet the needs of an IP and AP learner in the current era of CCT. Table 6 lists supplemental reading of societal guidelines, appropriate use criteria and key articles germane to an understanding of CCT for IP and AP trainees. Online training, webinars and simulation environments may be a useful learning adjunct in lower volume or smaller programs to supplement lower volume centers and less common CCT applications. Fig. 2 Comprehensive Independent Practitioner Training Curriculum in CCT The CCT PD must have attained IP status and critically evaluated individual institution case volume, case diversity, supervisor expertise, and trainee needs prior to curriculum planning. Key components of IP training are highlighted in various shading: post-processing, 3D workstation image manipulation, patient preparation, image acquisition, and didactics. Online training and webinars may be needed to supplement local resources, particularly in low volume institutions.

Comprehensive Advanced Practitioner Training Curriculum in CCT . AP training builds on IP skills, but pivots toward more complex applications of CCT and more complex cardiac disease. Integration of multidisciplinary resources into training by leveraging the advanced skills of both cardiology and radiology is needed. Direct trainee mentorship by the laboratory director or other AP supervisor is also imperative.

Recommended supplementary reading for Independent Practitioner & Advanced Practitioner curriculum.

With respect to the AP trainee curriculum (Fig. 3), the didactic training focus should pivot toward more complex applications of CCT and complex cardiac disease. Additionally, a broader focus on integrating into a multidisciplinary team and leveraging the advanced skills of both cardiology and radiology is needed. Finally, a comprehensive AP curriculum should involve direct mentorship by the laboratory director or other AP supervisors so that education in the business and administrative aspects of leading a CCT lab are incorporated. AP trainees, in addition to a comprehensive understanding of the learning objectives, require a curriculum incorporating mentorship opportunities with the laboratory director. This could include involvement with new equipment purchases, personnel management, protocol development, and performance improvement (PI)/quality assessment (QA). Particularly with the changing landscape of medical reimbursement and payer structures, a strong foundation in quality and appropriate use is vital to a future

laboratory director or PD. Specific to the ACGME, requirements have been put in place for residencies and fellowships to actively participate in PI or QA projects as part of graduation requirements. Table 7 lists several recommendations for CCT-specific QA/PI projects. Table 7 Suggested Independent Practitioner & Advanced Practitioner trainee quality improvement (QI) projects.

Is the utilization of prospective and retrospective ECG-gating appropriate for the clinical question?

What is the understanding of various CT artifacts that can be fixed by post-processing like ECG-gating artifacts?

Does the CCT report communicate findings to the ordering physicians in a clear and consistent fashion?

Does the CCT report make suggestions for further management?

Increased compliance with guideline-based primary prevention therapy

Increased appropriate ischemic testing, revascularization

Decreased normal, nonobstructive invasive angiograms

Are radiation dose reduction principles being applied to CCT scans by accreditation standards while maintaining appropriate diagnostic quality?

Measure and reduce measured radiation dose by 30%

The rapid growth and expansion of CCT requires training programs to adopt a comprehensive training curriculum in order to meet the growing need for IP and AP that possess a minimum experience and core understanding of all aspects of CCT. As new technologies continue to emerge (Table 8) with sufficient evidence for efficacy and meaningful impact on clinical management, it is expected that the curricular needs of trainees will evolve. The core elements of this document are expected to remain foundational for IP and AP competency, while future updates to this training curriculum may be issued through both traditional and emerging digital publication formats. A curriculum based solely on case volume is insufficient to bridge the substantial knowledge gap, particularly among IP graduates given the diversity of training backgrounds, local volume, and supervisor expertise and so the recommended case volumes serve as a minimum floor to assess competency. To build from the 2015 SCCT Level I Curriculum Guideline, we encourage adoption of these training curriculum recommendations as a supplement to the current societal statements that include ACR, COCATS 4 and other global documents, to develop a training experience that produces a more uniform level of competence for both cardiology and radiology trainees. Additionally, better baseline training in CCT may promote more appropriate implementation of CCT into clinical practice after graduation and/or encourage more trainees to pursue advanced fellowships in CCT. Table 8 Potential future curriculum competencies in cardiac CT utilizing emerging technologies and clinical indications.

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