

Roadmap for cardiovascular education across the European Society of Cardiology: inspiring better knowledge and skills, now and for the future

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**Title: Roadmap for cardiovascular education across the
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Brief Title: ESC Education Roadmap

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Abstract

Aim: The provision of high-quality education allows the European Society of Cardiology (ESC) to achieve its mission of better cardiovascular practice and provides an essential component of translating new evidence to improve outcomes.

Methods: The 4th ESC Education Conference, held in Sophia Antipolis (December 2016), brought together ESC education leaders, National Directors of Training of 43 ESC countries, and representatives of the ESC Young Community. Integrating national descriptions of education and cardiology training, we discussed innovative pathways to further improve knowledge and skills across different training programmes and healthcare systems.

Results: We developed an ESC roadmap supporting better cardiology training and continued medical education (CME), noting: (1) The ESC provides an excellent framework for unbiased and up-to-date cardiovascular education in close cooperation with its National Societies. (2) The ESC should support the harmonisation of cardiology training, curriculum development, and professional dialogue and mentorship. (3) ESC congresses are an essential forum to learn and discuss the latest developments in cardiovascular medicine. (4) The ESC should create a unified, interactive educational platform for cardiology training and continued cardiovascular education combining Webinars, eLearning Courses, Clinical Cases, and other educational programmes, along with ESC Congress content, Practice Guidelines and the next ESC Textbook of Cardiovascular Medicine. (5) ESC-delivered online education should be integrated into National and regional cardiology training and CME programmes.

Conclusion: These recommendations support the ESC to deliver excellent and comprehensive cardiovascular education for the next generation of specialists. Teamwork between international, national and local partners is essential to achieve this objective.

Introduction

The European Society of Cardiology (ESC) supports education and training of both practising and future cardiologists, alongside innovation and coordination of new research, clinical practice guidelines to aid delivery of healthcare, and advocacy to help shape health policy. The ESC also recognises the need to provide lifelong learning programmes for cardiology professionals in close collaboration with the National Cardiac Societies, creating a strong, evidence-based foundation underpinning the best care of patients.

Recent years have seen many advances in education across the ESC, including high-quality courses offered on the ESC eLearning platform (ESCeL)¹, Webinars, a Clinical Case Gallery, and the European Exam in General Cardiology and various sub-specialties. To align these developments with the needs of cardiology education and training in the member countries of the ESC, the Education Committee hosts an annual conference for the Directors of Training for all National Cardiac Societies. In this paper, we report on the major outcomes of the 4th ESC Education Conference, held at the European Heart House in Sophia Antipolis on 14 and 15 December 2016, which focused on knowledge and skills assessment for cardiology trainees and cardiologists. With in-depth discussion of the strengths and challenges in education and assessment across the 56 countries of the ESC, our aim was to develop a roadmap for comprehensive cardiovascular education.

Methods

Participants and meeting format

The 4th ESC Education Conference was attended by 77 participants, representing 43 countries, including representation from the ESC Young Community (full list of delegates presented in the **Appendix**). Major activities of the ESC, and its involvement in education and assessment, were delivered by keynote speakers.

Mapping the current status of cardiology education in the ESC member countries

Prior to the conference, all National Training Directors were asked to prepare summaries of the current state of cardiology training and education in their respective countries. During the conference, six semi-structured workshops and plenary sessions discussed the assessment of knowledge and skills for cardiology trainees and continuing medical education (CME) for certified cardiologists. Immediately following the conference, all participants were invited to complete a structured online survey. The outcomes were mapped onto existing educational activities in the ESC to develop a roadmap to improve cardiovascular education.

Survey of Cardiology Training in individual ESC Countries

An online survey of cardiology training was completed by 40 National Cardiac Societies, with data validation by ESC staff and country representatives. For this conference, we focused on results pertaining to knowledge assessment (availability of a national curriculum for training and whether the training programme was organised in accordance with the ESC core curriculum), and skills assessment (use of direct observation of procedural skills (DOPS) during general cardiology training).

Results

1. Cardiology Training: Challenges and opportunities for assessing knowledge and skills

Figure 1 summarises the key messages from the ESC Education Conference in respect to assessment of knowledge and skills for cardiologists in-training.

Assessment of knowledge

Publicly available curricula are the basis for adequate assessment of knowledge for cardiologists in-training, providing the structure of key learning outcomes and organisation of the training programme.² An important component of what is currently going well throughout the ESC countries is the provision of training organised at National levels in most countries, usually with accreditation of training centres. The majority also follow the ESC Core Curriculum³, either explicitly through direct adoption, or indirectly after translation to local needs and language. In the 2016 survey of the National Cardiac Societies, 35/40 (88%) of ESC countries who responded had a National Curriculum for training in Cardiology, and 37/40 (93%) organised their training programme, at least partly, in accordance with recommendations from the ESC Core Curriculum (**Figure 2**). Challenges in curriculum design and implementation remain, particularly for smaller countries, where links with training programmes in larger countries enable trainees to follow fully developed national training curricula.

There is a clear need to provide curricula that cover more specialised knowledge. Whereas ESC associations have published sub-speciality curricula^{4,5} and run certification exams, and the ESC Core Curriculum provides blueprint recommendations³, practical guidance for trainees and trainers is still lacking at National levels in many countries. This limits an ESC-wide ‘minimum acceptable knowledge’ level for those pursuing specialist training in acute care, specialised cardiac imaging, coronary and structural cardiovascular interventions, advanced heart failure

management, or arrhythmia management.

Assessment of knowledge linked to areas of the curricula are often embedded within training programmes (for example, see representative countries in **Table 1**), and these are often supported by the National Cardiac Societies by the provision of courses and local meetings. However, for the individual trainee, assessment is variable, both within and between ESC countries.

An important strength of knowledge assessment across the ESC is that design of examinations frequently involves the National Cardiac Societies. The European Exam in General Cardiology is used in 8 countries (Greece, Ireland, Malta, the Netherlands, Portugal, Spain, Switzerland and the UK), and more countries are considering joining (Cyprus, Finland, Germany, Sweden). The exam is overseen by the National Cardiac Societies of participating countries, the ESC Education Committee and the Union Européenne des Médecins Spécialistes (UEMS) Cardiac Section. The ESC Young Community representatives expressed a desire to offer the exam in other ESC countries to harmonise assessment and training. There are also subspecialty exams made available by the ESC Associations. Delegates also discussed the benefit from more personalised feedback in the form of peer-review, mentorship from senior colleagues, and multidisciplinary opinion from healthcare professionals. The latter, often called ‘360-degree’ feedback, can address competencies such as professionalism and interpersonal skills and involves input from different stake holders (other trainees, supervisors, trained cardiologists, other health care professionals and patients).⁶ Very few countries used this method for trainee development, but where instituted, delegates felt it to be a method of assessment that resulted in individual benefit for trainees.

Assessment of skills

Assessment of skills for trainees was more varied. Logbooks of directly-observed procedural skills (DOPS; both paper and electronic) are commonplace across the ESC countries (**Figure 2**)

and are often monitored by clinical tutors allowing personal feedback and improvement in skills. A minority of countries also had skill labs and patient simulators. While these are resource-intensive, they were felt to contribute to training of practical procedures, complementary to traditional courses, and to allow skills evaluation, which is complex to assess at the bedside. There were many challenges identified by the delegates, in particular that assessment of skills is much more difficult and time-intensive than knowledge assessment. There was also discussion on how to assess skills, where it was felt that assessment of competence would be more desirable than a mere count of procedure numbers. Competence assessment would require close and consistent mentoring, which is expected to have further positive effects on the clinical and educational progress of the trainee. Finally, delegates identified a lack of feedback structures to assess and improve the quality of cardiology training.

2. Continued Cardiovascular Education: Challenges and opportunities for assessing knowledge and skills

Figure 3 summarises the key messages from the ESC Education Conference in respect to assessment of knowledge and skills for continued cardiovascular education of cardiologists and other cardiovascular specialists.

Assessment of knowledge

An up-to-date and well-informed workforce is the key to continued improvements in the management of cardiovascular disease in view of the rapid advances in cardiovascular medicine. However, the continued training and education of certified cardiologists is much less structured than that of cardiology trainees. While continued medical education and professional development are required for certified cardiologists in almost all ESC countries, assessment is

often undertaken indirectly by measuring cardiologists' attendance at educational events.

Efficient CME systems are in place in some countries, but there are variable national requirements. For example, evidence of CME is required for revalidation or recertification of cardiologists in Ireland, the Netherlands and the UK, but there are no formal requirements for CME in Finland, Greece, Israel or Poland (**Table 1**). In general, practising cardiologists are much more likely than trainees to receive knowledge training through industry-funded or even industry-delivered events. The delegates felt that the potential bias of industry-delivered educational programmes was an under-recognised limitation of current education for practising cardiologists.

There is an important role for professional societies such as the ESC and its constituent National Societies to provide balanced, high-quality cardiology education for cardiologists. Assessment of professionalism (e.g. through structured appraisals) is not common, and there is a lack of opportunity for research (both in time and funding) that could potentially underpin high-quality continued cardiovascular education and support innovation. The ESC recognises the need for training in research methodology not only for research-active cardiologists, but also for practising cardiologists to allow better understanding of new evidence and appropriate integration into clinical practice. This will particularly affect the future development of stratified approaches to cardiovascular medicine.⁷⁻⁹ The ESC is also reviewing industry involvement with CME and will report soon on findings and recommendations.

Assessment of skills

While daily clinical work provides indirect feedback on the quality of decisions and the relevant knowledge or evidence gaps, formal skills assessment for certified cardiologists is rare outside specific mentoring programmes for advanced interventional techniques (e.g. transcatheter valve replacement, device implantation, specific coronary interventions, or catheter ablation). In particular, concerns were raised about office-based cardiologists, who lack the informal ways of

improving knowledge and skills, and are thus disadvantaged compared to hospital-based cardiologists with frequent peer-interaction. A lack of training for trainers was also identified.

3. Approaches to improve knowledge and skills in Cardiology across the ESC

Considering the challenges and opportunities identified above, the delegates discussed the following approaches to improve knowledge and skills in cardiology:

- i. Coordinate all ESC educational tools to reinforce the circle of research, guidelines, education and registries of clinical practice (the “Virtuous Circle”), underpinning consistent implementation of new evidence and quantification of changes in behaviour and outcomes, and improve visibility and ease-of-use (**Figure 4**).
- ii. Maintain and improve existing materials for training in general cardiology and in the subspecialties.
- iii. Advocacy to coordinate and harmonize cardiology training programmes at a national and European level.
- iv. Support National Training Directors to network.
- v. Facilitate exchange of trainees and mentors across countries.
- vi. Promote the translation of educational material and guidelines in cooperation with National Cardiac Societies.
- vii. Enhance the availability of the European Exam in General Cardiology for trainees, and identify opportunities to collect and report CME for cardiologists.
- viii. Make available ESC grants to support research, education and attendance at educational events.

Table 2 highlights the educational tools available across the ESC at present, and the development of an education ‘roadmap’ as a result of the challenges identified during the 2016 ESC Education Conference. In brief, the ESC, closely aligned with its constituent bodies, will progress on multiple fronts to improve the provision and quality of education across the countries of the ESC, with a clear focus on:

- i. Synergy across ESC educational platforms by using a single topic list; hence, users will be able to find topics under the same headings in conferences, ESCeL and other ESC educational material.
- ii. More variety in educational material using different formats, including webinars, clinical cases and the ESC Journal Family, and the best use of guidelines.
- iii. Implementation of the ESC Strategic Plan for 2016-2020, including the European Heart Agency (the ESC’s office in Brussels) and the European Heart Academy (providing academic degrees in partnership with European universities).
- iv. An ESC Education newsletter to keep National Training Directors informed and provide a platform for networking and exchange.
- v. Collaboration between National Cardiac Societies and the ESC Practice Guidelines team to produce and promote guidelines and support educational tools in different languages.
- vi. Expansion and improvement of the European Exam in General Cardiology and implementation of an ESC-wide CME diary.
- vii. Systematically perform needs assessments and adaptation of educational programmes.
- viii. Expansion of ESC Fellowships, with a focus on promoting innovation and job mobility within Europe.
- ix. ESC research grants and training in research methodology, including the advocacy of clinician-scientists who are able to apply innovation and more rigorous methodology to their clinical work.

Discussion

The ESC, with its large membership and broad geographical footprint, is ideally placed to improve cardiology education and training. Lifelong high-quality learning, from the cardiology trainee to the practising cardiologist, has the potential to encourage a strong, evidence-based foundation for the care of patients that can result in better outcomes. The ESC is committed to working with National Cardiac Societies to enhance education¹⁰, and the yearly conferences for National Training Directors provides an opportunity to interact and influence the direction of education at the ESC level.

Recent decades have seen huge shifts in medical education, with a greater focus on the human aspects of medical training, including medical ethics, communication skills and the consideration of outcomes relevant to patients.^{11, 12} Graduate medical training has also been forced to react quickly to the changing nature of healthcare provision, including the need for more robust certification of junior doctors and assessment of competency.^{13, 14} In parallel, tools for online education and training have been generated and are providing new opportunities for high-quality cardiovascular education. Whilst the ESC Education Conference focused on knowledge and skills, we recognise the vital importance of general professionalism, supporting trainees to become “good doctors” but equally applicable to all stages of continuous education.¹⁵ This includes respect and empathy for patients, providing global care with good communication and management skills, and working within a well-functioning team of fellow healthcare professionals.¹⁶ Providing CME to certified physicians is unlikely to change practice or improve patient outcomes in isolation, and there is evidence that some form of reinforcement of knowledge is required, based on clear learning objectives.¹⁷⁻¹⁹ Hence, whatever the stage of learning, from medical students to certified cardiologists, the assessment of training and educational needs requires the development of structured and individualised programmes which are the key to successful medical education. Although there are numerous challenges to

implementation, these can be resolved by assessing the outcomes of targeted educational programmes, using education and enhanced professional skills to translate new evidence into better cardiovascular outcomes (**Figure 4**).

Another important development has been the formation of the ESC Young Community, with representatives in each training subspecialty working closely with the ESC associations. This has provided the opportunity to network with peers and work in different countries, developing expertise and competence for their future careers. Through the ESC education program, young colleagues can increase their participation and contribution to ESC meetings, publish clinical cases and obtain training or research grants. The ESCeL platform and webinars provide high-quality and unbiased education to those who are not able to travel to congresses or other in-person educational events. The ESC offers mentorship opportunities and access to training in skills not available in their own countries. Indeed, as a result of the ESC Education Conference, we have now instituted a database for National Training Directors to network and provide exchange opportunities. Our aim is to provide a framework of high-quality education for the next generation of cardiologists, coordinated by specific taskforces within the ESC Education Committee.

One area not addressed during the 2016 ESC Education Conference was the impact of new technology on physician education and CME, in particular advances in digital platforms²⁰ and social networking.²¹ Targeting of educational material needs to be accompanied by clear learning objectives and the provision of supportive educational reinforcement within a protective framework. The huge progress in digital learning, and how to train the cardiologist of the future, will be the focus topic for the next ESC Education Conference to take place in January 2018.

In conclusion, there are important opportunities to improve education for cardiologists in the ESC, such as the forthcoming ESC Textbook of Cardiovascular Medicine (3rd Edition), a topic list that will unify the indexing of ESC educational activities, and improved interactive online technology enabling tailor-made interactive online education. With a clear Strategic Plan²², the ESC is in an excellent position to lead the provision of high-quality, evidence-based education to improve patient outcomes.

Conflicts of interest

All authors have completed disclosure statements via the ESC disclosure system. Statements are available for review at the www.escardio.org website (ESC Education section).

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References

1. European Society of Cardiology. ESCeL: ESC eLearning Platform. <http://learn.escardio.org> [Accessed 20 October 2017]
2. Prideaux D. ABC of learning and teaching in medicine. Curriculum design. *BMJ*. 2003;**326**:268-270
3. Gillebert TC, Brooks N, Fontes-Carvalho R, Fras Z, Gueret P, Lopez-Sendon J, Salvador MJ, van den Brink RB, Smiseth OA, Gribenow R. ESC core curriculum for the general cardiologist (2013). *Eur Heart J*. 2013;**34**:2381-2411
4. McDonagh TA, Gardner RS, Lainscak M, Nielsen OW, Parissis J, Filippatos G, Anker SD. Heart failure association of the European society of cardiology specialist heart failure curriculum. *Eur J Heart Fail*. 2014;**16**:151-162
5. Merino JL, Arribas F, Botto GL, Huikuri H, Kraemer LI, Linde C, Morgan JM, Schalij M, Simantirakis E, Wolpert C, Villard MC, Poirey J, Karaim-Fanchon S, Deront K. Core curriculum for the heart rhythm specialist. *Europace*. 2009;**11 Suppl 3**:iii1-26
6. Hammerly ME, Harmon L, Schwaitzberg SD. Good to great: using 360-degree feedback to improve physician emotional intelligence. *J Healthc Manag*. 2014;**59**:354-365
7. Kotecha D, Breithardt G, Camm AJ, Lip GYH, Schotten U, Ahlsson A, Arnar D, Atar D, Auricchio A, Bax J, et al. Integrating new approaches to atrial fibrillation management: The 6th Joint AFNET/EHRA Consensus Conference. *Europace*. 2017: 10.1093/europace/eux1318
8. Fabritz L, Guasch E, Antoniades C, Bardiniet I, Benninger G, Betts TR, Brand E, Breithardt G, Bucklar-Suchankova G, Camm AJ, Carlidge D, Casadei B, Chua WW, Crijns HJ, Deeks J, Hatem S, Hidden-Lucet F, Kaab S, Maniadakis N, Martin S, Mont L, Reinecke H, Sinner MF, Schotten U, Southwood T, Stoll M, Vardas P, Wakili R, West A, Ziegler A, Kirchhof P. Expert consensus document: Defining the major health modifiers causing atrial fibrillation: a roadmap to underpin personalized prevention and treatment. *Nat Rev Cardiol*. 2016;**13**:230-237
9. Kirchhof P, Sipido KR, Cowie MR, Eschenhagen T, Fox KA, Katus H, Schroeder S, Schunkert H, Priori S, Esc Crt R, European Affairs Work Shop on Personalized M. The continuum of personalized cardiovascular medicine: a position paper of the European Society of Cardiology. *Eur Heart J*. 2014;**35**:3250-3257
10. Fox KF, Mills P. The role of the ESC in education. *Eur Heart J Cardiopulse*. 2016;**37**:3364-3366
11. Bates V. Yesterday's Doctors: The Human Aspects of Medical Education in Britain, 1957-93. *Med Hist*. 2017;**61**:48-65
12. Shelton PG, Corral I, Kyle B. Advancements in Undergraduate Medical Education: Meeting the Challenges of an Evolving World of Education, Healthcare, and Technology. *Psychiatr Q*. 2016;10.1007/s11126-016-9471-x
13. Hernandez RG. What's new in graduate medical education? *Cardiol Young*. 2016;**26**:1459-1464

14. Linville MD, Jr., Bates JE. Graduate Medical Education-Accelerated Change. *Am J Med Sci.* 2017;**353**:126-131
15. Doctors in society. Medical professionalism in a changing world. *Clin Med (Lond).* 2005;**5**:S5-40
16. Frank JR, Snell L, Sherbino J, eds. *CanMEDS 2015 physician competency framework*. Ottawa: The Royal College of Physicians and Surgeons of Canada; 2015.
17. Davis DA, Thomson MA, Oxman AD, Haynes RB. Changing physician performance. A systematic review of the effect of continuing medical education strategies. *Jama.* 1995;**274**:700-705
18. Bloom BS. Effects of continuing medical education on improving physician clinical care and patient health: a review of systematic reviews. *Int J Technol Assess Health Care.* 2005;**21**:380-385
19. Lee BC, Ruiz-Cordell KD, Haimowitz SM, Williams C, Stambler BS, Mandarakas A. Personalized, assessment-based, and tiered medical education curriculum integrating treatment guidelines for atrial fibrillation. *Clin Cardiol.* 2017;10.1002/clc.22676
20. Kotecha D, Chua W, Fabritz L, Hendriks J, Casadei B, Schotten U, Vardas P, Heidbuchel H, Dean V, Kirchhof P, on behalf of the ESC AF Guidelines Taskforce; the CATCH ME consortium; and EHRA. European Society of Cardiology (ESC) smartphone and tablet applications for patients with atrial fibrillation and their healthcare providers. *Europace.* 2017; 10.1093/europace/eux299
21. Flynn S, Hebert P, Korenstein D, Ryan M, Jordan WB, Keyhani S. Leveraging Social Media to Promote Evidence-Based Continuing Medical Education. *PLoS One.* 2017;**12**:e0168962
22. European Society of Cardiology. ESC Strategic Plan 2016-2020. <https://www.escardio.org/The-ESC/About/esc-strategic-plan-2016-2020> [Accessed 20 October 2017]

Table 1: Assessment of knowledge and skills in eight representative ESC countries

	Finland	Greece	Ireland	Italy	Israel	Netherlands	Poland	United Kingdom
Knowledge	<ul style="list-style-type: none"> • ESC core curriculum • NCS courses and meetings • Written exam at exit (EEGC from 2018 as option) 	<ul style="list-style-type: none"> • Each University Clinic organizes Cardiology Board Examinations • EEGC recommended but not mandatory • NCS educational courses 	<ul style="list-style-type: none"> • Annual formal assessment • EEGC mandatory in year 3 • NCS Education Days 	<ul style="list-style-type: none"> • National core curriculum • Each University Clinic organizes yearly exams 	<ul style="list-style-type: none"> • ESC-based core curriculum • National board examination at exit of training • NCS courses 	<ul style="list-style-type: none"> • Electronic portfolio with matrix assessment • EEGC exam • NCS Training program 	<ul style="list-style-type: none"> • ESC-based core curriculum • National board examination at exit of training • NCS courses 	<ul style="list-style-type: none"> • Electronic portfolio matched to core & speciality curricula • Supported by active NCS • EEGC mandatory exit exam
Skills	<ul style="list-style-type: none"> • Logbook of skills supervised by senior cardiologist 	<ul style="list-style-type: none"> • No logbook assessment 	<ul style="list-style-type: none"> • Supervised DOPs throughout training 	<ul style="list-style-type: none"> • Paper-based log-book and DOPs 	<ul style="list-style-type: none"> • Logbooks certified by local directors, supported by NCS 	<ul style="list-style-type: none"> • Structured skills assessment and DOPs 	<ul style="list-style-type: none"> • Logbooks certified by local directors, supported by NCS 	<ul style="list-style-type: none"> • Mandatory DOPs: clinical and educational mentors
Continued medical education	<ul style="list-style-type: none"> • No formal CME requirements in Cardiology 	<ul style="list-style-type: none"> • No structured CME process 	<ul style="list-style-type: none"> • Legal requirement to register & comply with CME 	<ul style="list-style-type: none"> • Periodic assessment of obligatory CME credits 	<ul style="list-style-type: none"> • No formal requirements, but courses offered by NCS 	<ul style="list-style-type: none"> • CME required to stay registered as cardiologist 	<ul style="list-style-type: none"> • No formal CME requirements in Cardiology 	<ul style="list-style-type: none"> • CME peer-assessed yearly & 5-yearly national validation

CME = Continued medical education; EEGC = European Exam in General Cardiology; ESC = European Society of Cardiology; NCS = National Cardiac Society.

Table 2: Roadmap for cardiovascular education across the ESC

	How can the ESC help with education?	Where are we now?	Where are we going?
For all in cardiology	Synergy across different educational platforms.	ESC congresses, the ESC textbook (2nd edition), the ESC eLearning (ESCeL) platform, the ESC Journal Family and practice guidelines are currently the major educational tools provided by the ESC, however the links between them are incomplete.	An ESC topic list has been created to index, tag and cross-reference educational content across the ESC, including conferences, the new ESC textbook (3rd edition) and the online programmes offered on ESCeL.
	Improving access to online education.	ESCeL currently provides access to hundreds of courses, including general cardiology and subspecialties such as cardiac imaging, intervention, heart failure and arrhythmias.	Enhance the usability of ESCeL and increase its educational content with an improved interface, a search function, integration with the new ESC textbook, update of the general cardiology curriculum, the addition of more courses and structuring according to the new ESC topic list.
	Keeping educational material up-to-date, including webinars and clinical cases.	A wide variety of webinars and clinical cases are available every week on the ESC website and recorded for future reference.	Shorter, more interactive and up-to-date webinars with an enhanced Clinical Case Gallery.
	Practice guidelines as a learning tool.	‘Guidelines into Practice’ tracks provide a list of key presentations related to an ESC guideline and the ESC congress.	Plans to improve and update the educational resources associated with each guideline, and provide more timely and cross-linked educational material.
	Translation of educational material (especially guidelines).	The ESC relies on National Cardiac Societies to provide relevant translations.	Improve visibility and access to translated documents, including guidelines, in close cooperation with National Cardiac Societies.
	Assessment and evaluation mechanisms to engage learners in their training and continued professional development.	The ESC has developed a series of assessments as well as a range of online courses with self-assessment, an educational blueprint for live events and pre/post-test methodology.	Generalise the assessment and evaluation mechanism and engage with state-of-the art instructional design and adult learning science.
	Provide a list of ESC endorsed live events.	The ESC endorses several live events with dedicated guidelines-orientated sessions.	To promote live events with alerts on social media and better define the educational value of ESC endorsed events.

Cardiologists in-training	ESC advocacy: lobby and influence training programmes at a national and European level.	The ESC Brussels office engages with stakeholders, policy makers and other professional organisations to improve cardiovascular training and education.	Advocacy and Education are major pillars of the ESC Strategic Plan for 2016-2020.
	Opportunity to identify centres that are interested in exchange of trainees.	No facility at present.	ESC Education newsletter (3 x yearly) with dedicated slots showcasing National Training Directors will allow National Training Directors to network and offer trainee exchanges.
	Sub-specialty curricula.	Curricula are currently published by ESC associations, such as the European Heart Rhythm Association (EHRA), the Heart Failure Association (HFA) and the Council on Cardiovascular Nursing and Allied Professions (CCNAP).	Improve visibility and access to subspecialty curricula by working with the ESC Associations, Working Groups and Councils.
	Increase access to the European Exam in General Cardiology (EEGC).	The EEGC is overseen by a Board with joint input from the UEMS cardiology section and the ESC Education Committee, and is currently used in Spain, UK, Ireland, Netherlands, Portugal, Greece and Malta.	Switzerland will begin using the EEGC in 2017 and further engagement with National Cardiac Societies to expand its use.
Cardiologists in-practice	Support needed on collection and reporting of Continued Medical Education (CME).	Currently very variable across the ESC, with limited access to online CME tools.	ESC will assess the feasibility of an ESC CME diary for attendance (including automated logging of programmes provided or endorsed by ESC) and for self-recording of personal/national CME.
	ESC grants to support research, education and attendance at events, as well as the Masters and diploma programmes.	ESC Training grants, Nursing grants and Educational grants are currently available, in addition to grants from the subspecialty associations.	Expansion of ESC research grants and Fellowships.
	Opportunities for external networking and exchange of mentors.	No facility at present.	ESC Education team will provide a database for National Training Directors to network and offer mentorship opportunities.
	Support needed to ensure better translation into practice of ESC Practice Guidelines.	ESC offers a range of educational tools to support knowledge transfer.	Implementation of collaboration between guidelines, education, congresses, registries and publications (the 'Virtuous Circle') to facilitate evidence-based, needs-driven educational programmes that lead to better patient outcomes.

Figure legends

Figure 1: Cardiology Training: Key messages on assessment of knowledge and skills

Workshop debrief from the National Cardiac Society representatives about cardiologists in training.

Figure 2: Knowledge and skills assessment: The 2016 ESC Cardiology Survey

Results of the 2016 ESC Survey on National Medical & Cardiology Training.

Figure 3: Continued Cardiovascular Education: Key messages on assessment of knowledge and skills

Workshop debrief from the National Cardiac Society representatives about cardiologists in-practice.

Figure 4: Cardiovascular education in the context of guidelines and registries to improve cardiovascular outcomes

Illustrates the “virtuous circle” that underpins the strategic development of ESC education in the context of new evidence, assessment of educational gaps and needs, development of tailor-made educational programmes, and assessment of their effectiveness in observational research activities.

Figure 1: Cardiology Training: Key messages on assessment of knowledge and skills

Assessment of knowledge & skills for **cardiologists in-training** across the ESC

What goes well?

Knowledge

- National training programmes for Cardiology are available in the majority of countries
- Most follow the ESC Core Curriculum and involve the National Cardiac Society
- Training centres are usually accredited at a national level

Skills

- Paper and electronic portfolios to record practical procedures
- Specific skills-based assessments in some countries, including labs and simulators
- Several larger countries have a mentorship system with positive results for trainees

Where are the limitations?

Knowledge

- Subspecialty curricula and assessment are often not available
- Lack of widespread 360 degree feedback (from peers and other healthcare workers)
- Many countries lack opportunities for mentorship, simulation or further research

Skills

- Assessment of skills in practice is challenging
- Debate over numbers of procedures completed versus the quality of the skill obtained
- Lack of systems in place for quality control of training

Figure 2: Knowledge and skills assessment: The 2016 ESC Cardiology Survey

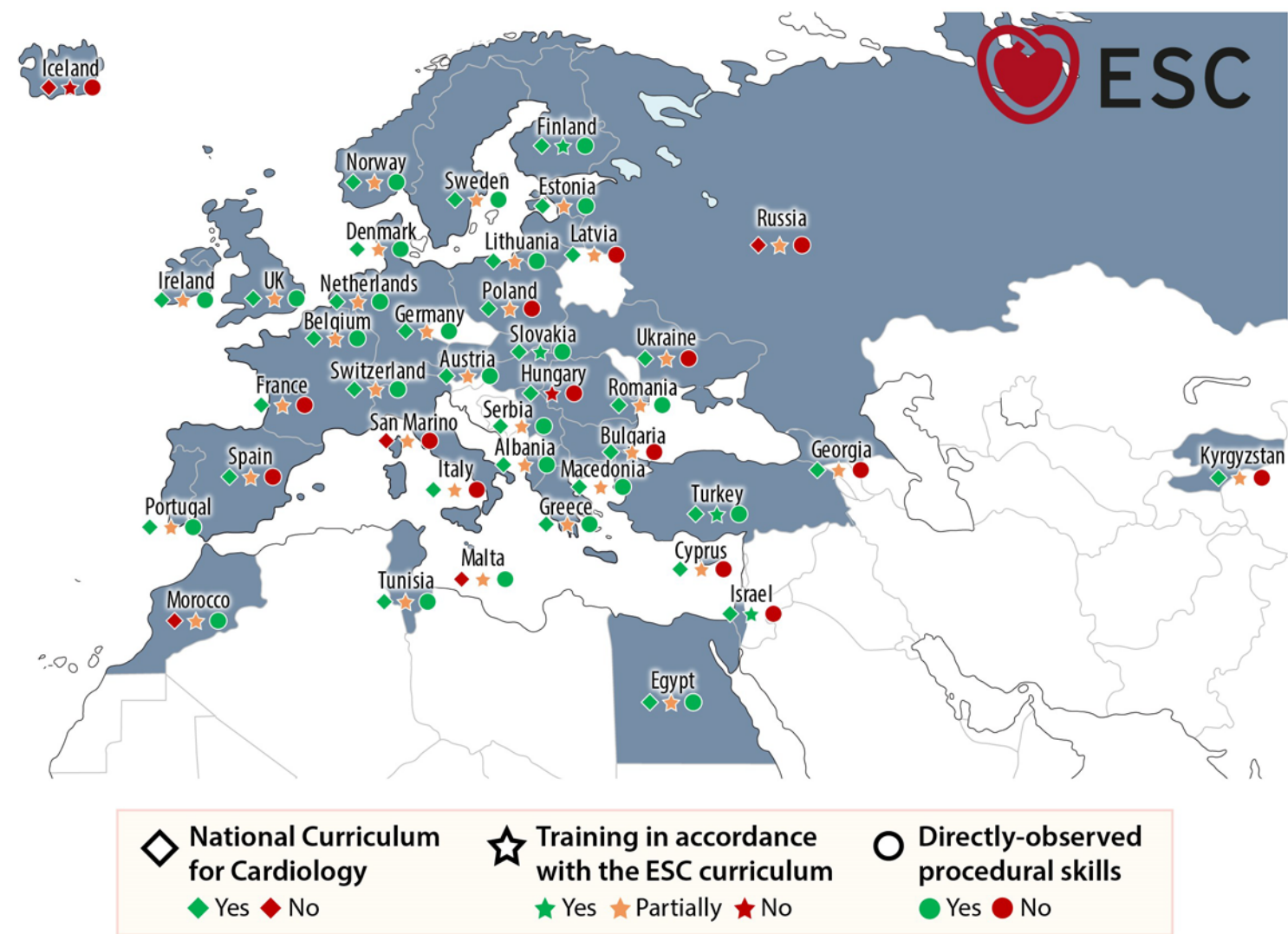


Figure 3: Continued Cardiovascular Education: Key messages on assessment of knowledge and skills

Assessment of knowledge & skills for **cardiologists in-practice** across the ESC

What goes well?

Knowledge

- In some countries, there is efficient recording of continued medical education (CME)
- There are variable national requirements, but in some countries evidence of CME is required for revalidation and/or recertification of cardiologists

Skills

- Proctoring for speciality skills and interventions (for example, transcatheter valve implantation and advanced percutaneous coronary intervention)
- Review of cases and problems by peers in a multi-disciplinary setting

Where are the limitations?

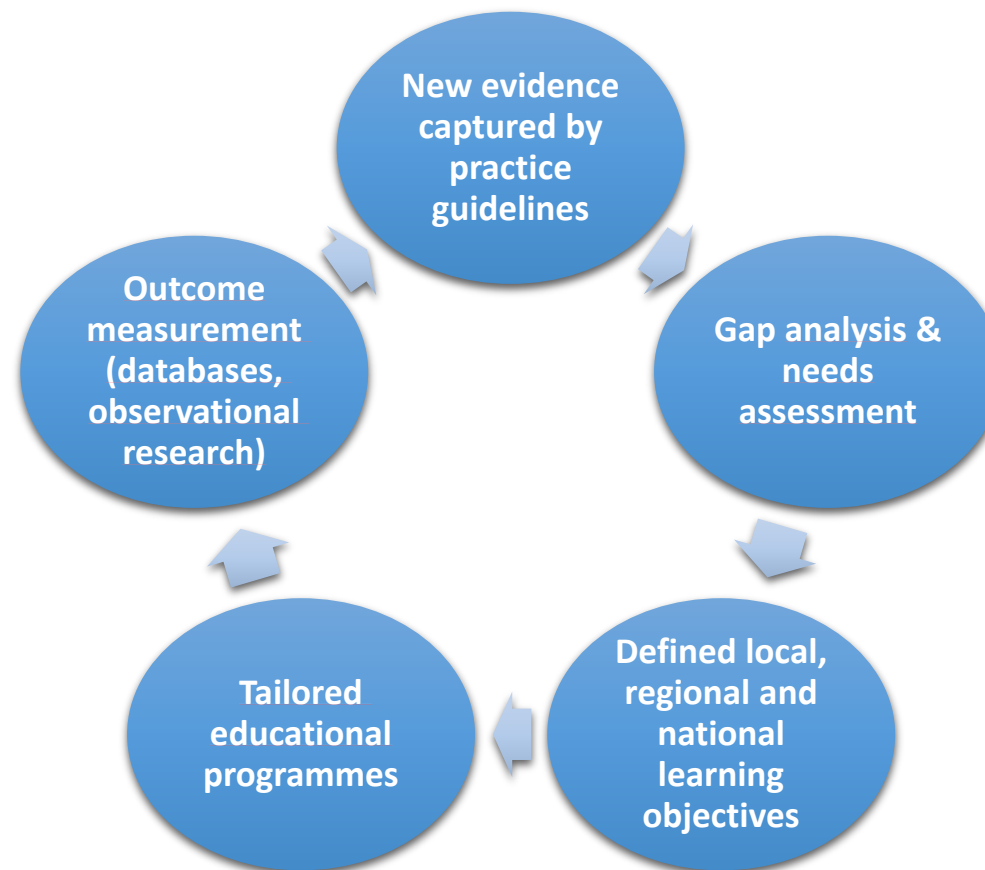
Knowledge

- Lack of consistency and control of CME, or the ability to easily record activities
- Practicing cardiologists more likely to receive biased or industry-based knowledge
- Few countries have requirements for assessment of cardiologists once qualified

Skills

- Difficulty maintaining skills without peer-interaction for office-based cardiologists
- Lack of peer to peer assessment, recertification and training for trainers
- Working time directive/regulation constraints on service provision to training ratio

Figure 4: Cardiovascular education in the context of guidelines and registries to improve cardiovascular outcomes



Appendix: Participants of the 4th ESC Education Conference (December 2016)

National Cardiac Society	Representative(s) and Position	National Cardiac Society	Representative(s) and Position
Albanian Society of Cardiology	Aurel Demiraj, National Director of Training	Israel Heart Society	Ronen Beeri, National Director of Training
Austrian Society of Cardiology	Julia Mascherbauer, National Director of Training	Italian Federation of Cardiology	Paolo Calabrò, National Director of Training
	Franz Weidinger, Member of ESC Board		Flavio D'Ascenzi, EAPC Young Community
Belgian Society of Cardiology	Agnès Pasquet, Belgium representative	Kyrgyz Society of Cardiology	Alina Kerimkulova, National Director of Training
	Tom De Potter, EHRA Young EP Committee	Latvian Society of Cardiology	Andrejs Erglis, National Director of Training
Association of Cardiologists of Bosnia and Herzegovina	Šekib Sokolović, National Director of Training		Iveta Bajare, Latvia representative
British Cardiovascular Society	Russell Smith, National Director of Training	Lithuanian Society of Cardiology	Ausra Kavoliuniene, National Director of Training
	Afzal Sohaib, Cardiologists of Tomorrow	Macedonian FYR Society of Cardiology	Lidija Poposka, National Director of Training
Bulgarian Society of Cardiology	Elena Kinova, National Director of Training	Maltese Cardiac Society	Alexander Borg, National Director of Training
Croatian Cardiac Society	Davor Milicic, National Director of Training	Moldavian Society of Cardiology	Dorin Lisii, National Director of Training
Cyprus Society of Cardiology	Joseph Moutiris, National Director of Training	Moroccan Society of Cardiology	Latifa Oukerraj, National Director of Training
Danish Society of Cardiology	Jesper Kjaergaard, Denmark representative	Netherlands Society of Cardiology	Patrick Verhorst, Netherlands representative
Egyptian Society of Cardiology	Gamela Nasr, National Director of Training	Norwegian Society of Cardiology	Svein Rotevatn, National Director of Training
	Gamal Shaban, Egypt representative	Polish Cardiac Society	Andrzej Budaj, National Director of Training
Estonian Society of Cardiology	Jaan Eha, National Director of Training		Katarzyna Czerwińska-Jelonkiewicz, ACCA Young Community
Finnish Cardiac Society	Juha Hartikainen, National Director of Training	Portuguese Society of Cardiology	Nuno Bettencourt, National Director of Training
French Society of Cardiology	Richard Isnard, National Director of Training	Romanian Society of Cardiology	Carmen Ginhina, National Director of Training
Georgian Society of Cardiology	Rusudan Agladze, National Director of Training	Russian Society of Cardiology	Yulia Balanova, Russia representative
German Cardiac Society	Norbert Frey, National Director of Training	San Marino Society of Cardiology	Marco Zavatta, National Director of Training
	Stefan D. Anker, Member of ESC Board	Cardiology Society of Serbia	Milica Dekleva, National Director of Training
Hellenic Society of Cardiology	Anastasia Kitsiou, National Director of Training	Slovak Society of Cardiology	Robert Hatala, National Director of Training
	Costas Tsioufis, Greece representative	Spanish Society of Cardiology	Manuel P. Anguita, National Director of Training
	Christina Chrysoou, Greece representative	Swedish Society of Cardiology	Anna Freyschuss, National Director of Training
Hungarian Society of Cardiology	Zoltan Csanádi, National Director of Training	Swiss Society of Cardiology	David Carballo, National Director of Training
Icelandic Society of Cardiology	Thordis Hrafnkelsdóttir, National Director of Training	Tunisian Society of Cardiology and Cardio-Vascular Surgery	Mohamed Sami Mouri, National Director of Training
	Thorarinn Gudnason, Iceland representative	Turkish Society of Cardiology	Armagan Altun, National Director of Training
Irish Cardiac Society	Brendan McAdam, National Director of Training	Ukrainian Association of Cardiology	Elena Nesukay, National Director of Training
	Barbra Dalton, Ireland representative		