

# 1 EAPC Core Curriculum for Preventive Cardiology

2 Matthias Wilhelm<sup>1\*</sup>, Ana Abreu<sup>2</sup>, Paolo Emilio Adami<sup>3</sup>, Marco Ambrosetti<sup>4</sup>, Maria Antonopoulou<sup>5</sup>,  
3 Flavio D'Ascenzi<sup>6</sup>, Alessandro Biffi<sup>7</sup>, Elena Cavarretta<sup>8</sup>, Irene Gibson<sup>9</sup>, Diederick E. Grobbee<sup>10</sup>, Marie-  
4 Christine Iliou<sup>11</sup>, Konstantinos Koskinas<sup>1</sup>, Pedro Marques-Vidal<sup>12</sup>, Uwe Nixdorff<sup>13</sup>, Michael  
5 Papadakis<sup>14</sup>, Massimo Piepoli<sup>15</sup>, Vass Vassiliou<sup>16</sup>, David Wood<sup>17</sup>, Paul Dendale<sup>18</sup> and Martin Halle<sup>19\*</sup>

6

7 <sup>1</sup>Department of Cardiology, Inselspital, Bern University Hospital, University of Bern, Switzerland

8 <sup>2</sup>Servico de Cardiologia, Hospital Universitario de Santa Maria/Centro Hospitalar Universitario Lisboa Norte (CHULN),  
9 Centro Academico de Medicina de Lisboa (CAML), Centro Cardiovascular da Universidade de Lisboa (CCUL), Portugal

10 <sup>3</sup>Health and Science Department, World Athletics, Monaco, Monaco Principality

11 <sup>4</sup>Cardiac Rehabilitation Unit, ASST Crema, Italy

12 <sup>5</sup>Spili Primary Care Centre, Regional Health System of Crete, Greece

13 <sup>6</sup>Department of Medical Biotechnologies, Division of Cardiology, University of Siena, Siena, Italy

14 <sup>7</sup>Med-Ex Medicine & Exercise, Medical Partner Scuderia Ferrari, Rome, Italy

15 <sup>8</sup>Department of Medical-Surgical Sciences and Biotechnologies, Sapienza University of Rome, Latina, Italy, and  
16 Mediterranea Cardiocentro, Naples, Italy

17 <sup>9</sup>National Institute for Prevention and Cardiovascular Health, Galway Ireland

18 <sup>10</sup>Julius Center for Health Sciences and Primary Care, and University Medical Center Utrecht, Utrecht, The Netherlands

19 <sup>11</sup>Cardiac Rehabilitation and Secondary Prevention Department. Corentin Celton Hospital. Assistance Publique Hopitaux de  
20 Paris Centre Université de Paris

21 <sup>12</sup>Department of Medicine, Internal Medicine, Lausanne University Hospital (CHUV), Lausanne, Switzerland

22 <sup>13</sup>European Prevention Center c/o Medical Center Düsseldorf, Düsseldorf, Germany

23 <sup>14</sup>Cardiovascular clinical academic group, St George's, University of London

24 <sup>15</sup>Cardiac Unit, Guglielmo da Saliceto Hospital, Univeristy of Parma, Piacenza, Italy

25 <sup>16</sup>University of East Anglia, UK

26 <sup>17</sup>National Institute for Prevention and Cardiovascular Health, National University of Ireland Galway, Republic of Ireland  
27 and National Heart and Lung Institute, Imperial College London, UK

28 <sup>18</sup>Heart Centre Hasselt and Hasselt University, Hasselt, Belgium

29 <sup>19</sup>Department of Prevention, Rehabilitation and Sports Medicine, Technical University Munich, Germany

## 30 **\*Corresponding authors:**

31 Matthias Wilhelm ([matthias.wilhelm@insel.ch](mailto:matthias.wilhelm@insel.ch)), +41 31 632 8970

32 Martin Halle ([martin.halle@mri.tum.de](mailto:martin.halle@mri.tum.de)), +49 89 289 244 41

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34 **EAPC Core Curriculum Task Force:**

35 Chair: Matthias Wilhelm

36 Ana Abreu, Paolo Emilio Adami, Flavio D'Ascenzi, Alessandro Biffi, Elena Cavarretta, Paul Dendale,  
37 Irene Gibson, Diederick E. Grobbee, Martin Halle, Konstantinos Koskinas, Uwe Nixdorff, Michael  
38 Papadakis, Massimo Piepoli, Vass Vassiliou, David Wood

39

40 **EAPC Core Curriculum Writing Group:**

41 Population Science and Public Health Section: Konstantinos Koskinas, Pedro Marques-Vidal, Vass  
42 Vassiliou

43 Primary Care and Risk Factor Management Section: Maria Antonopoulou, Alessandro Biffi, Irene  
44 Gibson

45 Secondary Prevention and Rehabilitation Section: Ana Abreu, Marco Ambrosetti, Marie-Christine  
46 Iliou

47 Sports Cardiology and Exercise Section: Paolo Emilio Adami, Elena Cavarretta, Michael Papadakis

48 Young Community: Flavio D'Ascenzi

49

50 **EAPC Board Reviewers:**

51 Silvia Castelletti, Emeline Van Craenenbroeck, Constantin Davos, Nicolle Kraenkel, Trine Moholdt,  
52 Josef Niebauer

53

54 **ESC Education Committee Reviewers:**

55 Nick Brooks, Agnès Pasquet, Felix Tanner

56

57 **Authorship:**

58 The members of the task force (MW, AA, PA, FA, AB, EC, PD, IG, DG, MH, KK, UN, MP, MP, VV, DW)  
59 contributed to the conception of the EAPC Core Curriculum and design of the entrustable  
60 professional activities. The members of the writing group (KK, PM, VV, MA, AB, IG, AA, MA, MI, PA,  
61 EC, MP, FA, MW) contributed to the design and content of the entrustable professional activities.  
62 MW drafted the first manuscript. The members of the task force and writing group critically revised  
63 the manuscript. All authors gave final approval and agree to be accountable for all aspects of work  
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67 **Structured abstract**

68 Preventive cardiology encompasses the whole spectrum of cardiovascular disease (CVD) prevention,  
69 at individual and population level, through all stages of life.

70 This includes promotion of CV health, management of individuals at risk of developing CVD, and  
71 management of patients with established CVD, through interdisciplinary care in different settings.

72 Preventive cardiology addresses all aspects of CV health in the context of the social determinants of  
73 health, including physical activity, exercise, sports, nutrition, weight management, smoking  
74 cessation, psychosocial factors and behavioural change, environmental, genetic and biological risk  
75 factors, and CV protective medications.

76

77 This is the first European Core Curriculum for Preventive Cardiology, which will help to standardize,  
78 structure, deliver, and evaluate training in preventive cardiology across Europe. It will be the basis for  
79 dedicated fellowship programmes and a European Society of Preventive Cardiology (EAPC)  
80 subspecialty certification for cardiologists, with the intention to improve quality and outcome in CVD  
81 prevention.

82

83 **Key Words**

84 Population science, prevention of CVD, cardiovascular rehabilitation, sports cardiology, exercise  
85 testing

86

87 **Graphical abstract**

88 See Figure 1

## EAPC Core Curriculum for Preventive Cardiology

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119 **List of abbreviations**

120	6MWT	Six-Minute Walk Test
121	ACS	Acute Coronary Syndrome
122	AHA	American Heart Association
123	ACC	American College of Cardiology
124	CABG	Coronary Artery Bypass Graft
125	CIED	Cardiac Implantable Electrical Devices
126	CCS	Chronic Coronary Syndrome
127	CCTA	Cardiac Computed Tomography Angiography
128	CMR	Cardiac Magnetic Resonance
129	CVD	Cardiovascular Disease
130	CV	Cardiovascular
131	CT	Computed Tomography
132	CPET	Cardiopulmonary Exercise Testing
133	DOPS	Direct Observation of Procedural Skills
134	EAPC	European Association for Preventive Cardiology
135	EBSC	European Board for the Specialty of Cardiology
136	ECG	Electrocardiogram
137	EPA	Entrustable Professional Activity
138	ESC	European Society of Cardiology
139	LVAD	Left Ventricular Assist Device
140	Mini-CEX	Mini Clinical Evaluation Exercise
141	MCQ	Multiple Choice Questions
142	PPE	Pre-participation Evaluation

## 143 **Definition of preventive cardiology**

144 Preventive cardiology encompasses the whole spectrum of cardiovascular disease (CVD) prevention,  
145 at individual and population level, through all stages of life.

146 This includes promotion of CV health, management of individuals at risk of developing CVD, and  
147 management of patients with established CVD, through interdisciplinary care in different settings.

148 Preventive cardiology addresses all aspects of CV health in the context of the social determinants of  
149 health, including physical activity, exercise, sports, nutrition, weight management, smoking  
150 cessation, psychosocial factors and behavioural change, environmental, genetic and biological risk  
151 factors, and CV protective medications.

## 152 **Preventive cardiology – towards a sub-specialty of cardiology**

153 Scientific advances have led to a substantial decline of death from CVD over the last decades.<sup>1</sup>  
154 However, CVD morbidity remains high and CVD are still the most common cause of death across  
155 European Society of Cardiology (ESC) member countries.<sup>2</sup> While positive trends have been observed  
156 for medical management of arterial hypertension and dyslipidaemias, the prevalence of obesity has  
157 more than doubled and the prevalence of diabetes mellitus has tripled in Europe.<sup>2</sup> More recent  
158 declines in the age-standardized incidence of CVD across ESC member countries have been small or  
159 absent.<sup>2</sup> The incidence of CVD's major components, ischaemic heart disease, and stroke, have both  
160 shown a downward trend but changes in prevalence have been small.<sup>2</sup> In a European Heart Network  
161 study, CVD was estimated to cost the European Union economy 210 billion Euro a year in 2015, of  
162 which 53% (111 billion Euro) was due to healthcare costs.<sup>2</sup>

163 The cardiology community has started a transition from predominantly treatment to prevention of  
164 CVD.<sup>3</sup> A large body of scientific evidence has been generated and appropriate guidelines and position  
165 papers are available in the four domains of preventive cardiology: Population science and public  
166 health,<sup>4,5</sup> primary prevention and risk factor management,<sup>3,6-8</sup> secondary prevention and  
167 cardiovascular rehabilitation,<sup>3,9-14</sup> and sports cardiology and exercise.<sup>15-21</sup> The European Association  
168 for Preventive Cardiology (EAPC) has recently started centre accreditation in these domains to  
169 standardise and optimise care.<sup>22</sup>

170 Historically, CV prevention has been classified into primordial prevention (population-based  
171 measures to prevent risk factor development), primary prevention (management of individuals  
172 without clinically manifest disease but at risk of developing CVD, with the aim of delaying or  
173 preventing the onset of disease), and secondary prevention (focusing on people with established  
174 CVD). While preventive measures indeed differ in various ways for these three categories, this Task  
175 Force also acknowledges that CV risk is a continuum and that several measures to enhance CV health  
176 are applicable across the spectrum of CV prevention. Moreover, the distinction between primary and  
177 secondary prevention, albeit well-established, may in certain occasions be artificial; while people  
178 with subclinical disease (e.g. evidence of advanced atherosclerosis by imaging, but not yet with  
179 clinically manifest CVD) would formally belong to “primary prevention”, they often qualify for  
180 interventions applicable to the “secondary prevention” setting.

181 Both in high, middle, and low income countries, nine potentially modifiable health behaviours and CV  
182 risk factors account for most of the population attributable risk of myocardial infarction and stroke in

183 both sexes and at all ages.<sup>23,24</sup> Smoking, physical inactivity, unhealthy nutrition patterns, obesity,  
184 psychosocial factors, diabetes mellitus, dyslipidaemias, and arterial hypertension are key targets for  
185 lifestyle interventions, and optimisation of medical therapy. In addition, biomarkers and genetics risk  
186 scores<sup>25</sup> have the potential to further characterize individual CVD risk profiles. Beyond traditional risk  
187 factors, other drivers of residual CV risk have come to the forefront, including inflammatory, pro-  
188 thrombotic, and metabolic pathways that contribute to recurrent events and are often unrecognized  
189 and not addressed in clinical practice.<sup>26</sup>

190 The increasing rates of obesity and diabetes, the suboptimal lifestyle management and  
191 implementation of guideline-directed medical therapy in secondary prevention of CVD,<sup>27</sup> and the  
192 gaps in evidence highlight the need for further investment in preventive cardiology. The level of  
193 profound knowledge, specialised skills, and committed attitudes goes beyond general cardiology  
194 training and justifies sub-specialty training. In addition to expertise in a single CVD risk factor (e.g.  
195 diagnosis and management of dyslipidaemias), competencies are required to evaluate and manage  
196 single risk factors in the individual's overall risk profile, take environmental, genetic, lifestyle and  
197 psychosocial aspects into account, integrate guideline-directed medical therapy, and propose a  
198 holistic management plan including attainable and realistic short-, mid-, and long-term goals.  
199 Motivational interviewing skills are required to gain the patient's willingness to adhere to lifestyle  
200 changes and guideline-directed medical therapies in order to reach these goals. Leadership and  
201 communication skills are required to cooperate with interdisciplinary healthcare teams and other  
202 partners. Beside classical patient groups (individuals with CV risk factors, patients after acute  
203 coronary syndromes, or with chronic coronary syndromes, heart failure, implantable devices,  
204 peripheral artery disease), preventive cardiology can contribute to CV risk factor management in  
205 different patient populations, e.g. diabetes,<sup>6</sup> atrial fibrillation,<sup>28</sup> and cancer.<sup>29,30</sup> Moreover, specific  
206 aspects of sports cardiology will have to be covered (Figure 1).

207 As a sub-specialty, a broader perspective of CVD prevention is necessary. Pregnancy, infancy,  
208 adolescence, early adulthood, adult and elderly life are distinct periods with individual potential  
209 opportunities for prevention. Pre-conception and pregnancy are important phases for the next  
210 generation, while post-mortem autopsy may reveal relevant information for living relatives (Figure  
211 2).<sup>31</sup> Precision medicine and digital health start to play a role in CVD prevention and have the  
212 potential to improve phenotyping of patients for more personalised and tailored therapies, and  
213 better outcomes.<sup>32,33</sup> Emerging concepts inform new collaborations in the future and an expansion of  
214 the field of preventive cardiology.

215 A common European core curriculum for preventive cardiology will help to standardize, structure,  
216 deliver, and evaluate training of cardiologists in preventive cardiology across Europe. This will be the  
217 basis for dedicated fellowship programmes and an EAPC sub-specialty certification, contributing to  
218 improvements of quality and outcome in CVD prevention. Similar initiatives have been launched in  
219 the United States of America.<sup>34-36</sup> In the evolving field of preventive cardiology, the core curriculum  
220 will have to be updated at regular intervals to include emerging concepts and new scientific  
221 evidence.

## 222 **The concept of the core curriculum for preventive cardiology**

223 The changing nature of our profession and the changing environment of healthcare has led to  
224 specific requirements in the field of cardiology. In 2007, the European Board for the Specialty of  
225 Cardiology (EBSC) published recommendations for sub-specialty accreditation in cardiology.<sup>37</sup> A sub-  
226 specialty is defined as a specific field of cardiology, where knowledge and skills go beyond the basic  
227 requirements of general cardiology and additional training is necessary. Sub-specialty training should  
228 be based on a published core curriculum.<sup>37</sup> The core curriculum should include a formal education  
229 plan intended to bring expected learning outcomes. It should include the rationale, aims, and  
230 objectives, expected learning outcomes, education content, teaching and learning strategies, and  
231 assessment procedures. The syllabus should be part of the curriculum and is a listing of subject  
232 matters to be covered in a training programme.<sup>37</sup>

233 Over the last decades, sub-specialty curricula have been developed and published by most ESC  
234 associations (Acute Cardiovascular Care, Arrhythmias & Cardiac Pacing, Heart Failure, Cardiovascular  
235 Imaging, Percutaneous Cardiovascular Interventions).<sup>38</sup> In the field of preventive cardiology, the  
236 American College of Cardiology (ACC)/American Heart Association (AHA) published a competence  
237 and training statement in 2009.<sup>34</sup> More recent proposals for sports cardiology qualification are  
238 available from the ACC and EAPC.<sup>16, 39</sup>

239 This document is the first common European core curriculum for preventive cardiology, covering all  
240 aspects of the field, including prevention, rehabilitation, and sports cardiology. It should serve as a  
241 framework for the sub-specialty qualification of cardiologists in preventive cardiology. The  
242 description of practical educational programmes, requirements for training centres and trainers is  
243 out of the scope of this document, and will be addressed in future documents. Advanced  
244 competencies in sports cardiology may be required in dedicated referral centres, addressed by a  
245 specific additional curriculum.

246 A core curriculum task force was established in 2019, including members of the EAPC Education  
247 Committee, the EAPC Board, and the EAPC Young Community. A writing group, including  
248 representatives of the four EAPC sections contributed to the drafting of the entrustable professional  
249 activities (EPAs).<sup>40</sup> Their views and comments were captured in an iterative process employing  
250 teleconferences, in-person discussions, an online Delphi survey, and workshops at EAPC meetings.

251 The document was developed in cooperation with the task force of the ESC Core Curriculum for the  
252 Cardiologist.<sup>41</sup> Key competencies from the field of preventive cardiology are important for the  
253 general cardiologist and covered in Chapter 8 on prevention, rehabilitation, and sports.<sup>41</sup> This chapter  
254 was used during the drafting process of this document, and served as a guideline to harmonise  
255 structure and content. The intention of this core curriculum is to describe the additional knowledge,  
256 skills, and attitudes necessary for sub-specialty qualification in preventive cardiology. The final  
257 document was approved by the EAPC Board in October 2020, and reviewed by the ESC Education  
258 Committee.

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## 260 **1. CanMEDS roles**

261 The Royal College of Physicians and Surgeons of Canada have produced a widely accepted  
262 standard framework of physician roles, CanMEDS.<sup>42</sup> This framework was built to identify and  
263 describe the abilities physicians require to effectively meet the health care needs of the people  
264 they serve (Table 1).<sup>42</sup> The ESC has adopted the CanMEDS roles in the ESC Core Curriculum for  
265 the Cardiologist.<sup>41</sup>

266 CanMEDS roles can be assessed and taught individually, and they are all represented to a  
267 different extent in each of the EPAs of the Core Curriculum for Preventive Cardiology as outlined  
268 in chapters 1 to 5. While EPAs are proposed as the preferred method of assessing specialty  
269 competencies, the CanMEDS roles can be viewed as generic competencies of physicians.

270 In the field of preventive cardiology, physicians work in interdisciplinary teams and the scope of  
271 cardiovascular prevention goes beyond patient care. Thus, the CanMEDS roles of communicator,  
272 collaborator, and health advocate are of particular importance.

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## 274 **2. Clinical competencies**

275 The conceptualization, organization, and administration of preventive cardiology involves  
276 different groups of health care professionals. In the context of this curriculum, we focus on the  
277 competencies of the cardiologist to administer of preventive cardiology in clinical practice.

278 In addition to the clinical competencies acquired during general cardiology training,<sup>41</sup> the sub-  
279 specialty of preventive cardiology requires specific knowledge, skills and appropriate attitudes in  
280 primary prevention, risk factor assessment and management, population science, public health,  
281 secondary prevention, rehabilitation, sports cardiology, and exercise testing and training.

282 The number of clinical competencies calls for assessment throughout sub-specialty training.  
283 Within the process of continuous professional development, this may encourage continuous  
284 learning which will continue after sub-specialist certification. To enable these goals, the core  
285 curriculum consists of EPAs (see below). To make knowledge accessible, each EPA contains a  
286 detailed map linking to contemporary guidelines and position papers and the ESC topic list,  
287 thereby enabling cross-linking with knowledge and training databases including textbooks,  
288 structured and case-based learning courses, congress programmes, and online materials.<sup>41</sup>

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## 290 **3. Entrustable professional activities**

291 Trust is not only central for the relationship between trainers and trainees, but also in the  
292 shared-decision-making process between physicians and their patients, and in the interaction  
293 with other health care professionals.<sup>41</sup> An EPA is a key task of a discipline that an individual can  
294 be trusted to perform in a given health care context, once sufficient competence has been  
295 demonstrated.<sup>40</sup> The EPA concept allows trainers to make competency-based decisions about the  
296 level of supervision required by trainees.<sup>40</sup> Competency-based education targets standardized  
297 levels of proficiency to guarantee that all learners have a sufficient level of proficiency at the  
298 completion of training.<sup>40</sup> EPAs are not an alternative for competencies, but a means to translate  
299 competencies into clinical practice. While competencies are descriptors of physicians, EPAs are  
300 descriptors of work. EPAs usually require multiple competencies in an integrative holistic

301 nature.<sup>40</sup> EPAs are observable and measurable and can be mapped to competencies and  
302 milestones across the entire landscape of physician activities. They can be monitored,  
303 documented, and certified.<sup>41</sup>  
304 The American Board of Pediatrics was one of the first certifying agencies that introduced the  
305 concept of EPAs in their revised training guideline for the sub-specialty of paediatric cardiology in  
306 2015.<sup>43</sup> The ESC has introduced EPAs in the 2020 update of the ESC Core Curriculum for the  
307 Cardiologist, containing one chapter on prevention, rehabilitation, and sports with seven EPAs.<sup>41</sup>  
308 The nine EPAs of the EAPC Core Curriculum for Preventive Cardiology describe the additional  
309 competencies necessary for the sub-specialty of preventive cardiology and are grouped in  
310 chapters, according to specific domains of preventive cardiology (Table 2).

311 All EAPC sections were involved in the definition of the content. The EPA 2.2, *Manage a patient*  
312 *with non-traditional cardiovascular risk factors*, builds upon the competencies required for EPA  
313 2.1, *Manage individuals with multifactorial cardiovascular risk profiles*, and the knowledge, skills,  
314 and attitude sections emphasise additional and particularly relevant aspects only. The same  
315 applies to EPA3.2, *Manage a prevention and rehabilitation programme for a cardiovascular*  
316 *patient with significant comorbidities, frailty, and/or cardiac devices*, and EPA 3.1, *Manage a*  
317 *prevention and rehabilitation programme for a cardiovascular patient*. The EPA 5.1, *Use*  
318 *cardiopulmonary exercise testing for diagnosis, risk stratification and exercise prescription*, deals  
319 with a testing modality, specific for preventive cardiology, since independent execution and  
320 interpretation is not required for the general cardiologist.<sup>41</sup> This EPA is relevant in all domains of  
321 preventive cardiology.

322 All EPAs of this core curriculum share a common structure. The clinical competence is defined in  
323 the title, followed by a description of scope and timeframe, setting, including and excluding  
324 situations and procedures. Relevant roles of the CanMEDS Physician Competency Framework are  
325 mentioned.<sup>42</sup> Knowledge, skills, and attitudes are formulated as learning outcomes, and  
326 assessment tools are recommended. The required level of independence is mentioned. Related  
327 ESC Guidelines and EAPC Position Papers are included as primary sources of knowledge. Relevant  
328 topics from the ESC topic list for each EPA are summarized in a supplemental data file.

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#### 331 **4. Level of independence**

332 The level of entrustment or independence for executing an EPA will change during the training  
333 period (Table 3). At a certain time of the training, trainees may have different levels of  
334 independence in different EPAs.<sup>41</sup> Given the broad spectrum of CVD prevention, sub-specialty  
335 training is not intended to achieve level of independence of 5 in all EPAs. For the following three  
336 EPAs, a lower level of independence is recommended.

- 337 1.1 Design, implement and evaluate preventive interventions at the population level
- 338 2.2 Manage a patient with non-traditional cardiovascular risk factors
- 339 4.2 Manage the work-up of an athlete with suspected or known cardiovascular disease

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## **5. Assessment of clinical competences using EPA's**

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One important aspect in the concept of EPAs is the assessment of clinical competencies. EPAs provide a framework for trainers to perform easy, formative and repeated assessments of trainees during their sub-specialty training, which help to adjust the trainee's level of independence.<sup>41</sup> Optimally, these assessments should be integrated into routine clinical care. The competencies of the trainees will further increase after completing the training in line with their continuous professional development. Consulting more experienced colleagues or other experts in complex cases should not be judged as need for supervision, but as a clinical reality in times of rapid increasing medical knowledge. When a trainee is able to execute an EPA in routine cases in an independent manner and to assume the expected professional responsibilities, the highest level of independence is achieved.

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Suitable tools for the assessment of EPAs depend on the nature of the activity and are proposed in the assessment section of each EPA (Table 3).<sup>41</sup>

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### **Sources of knowledge in preventive cardiology**

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In addition to specific guidelines and position papers provided at the end of each EPA, the ESC has published four textbooks in the field of preventive cardiology as additional source of comprehensive knowledge.<sup>44</sup>

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- ESC Textbook of Preventive Cardiology 2015
- ESC Handbook of Preventive Cardiology 2016
- ESC Textbook of Sports Cardiology 2019
- ESC Handbook of Cardiovascular Rehabilitation 2020

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365 **Table 1** CanMEDS Physician Competency Framework, modified and adopted from the Royal College  
 366 of Physicians and Surgeons of Canada, with permission<sup>42</sup>  
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Role	Description	Key Competencies
<b>Medical Expert</b>	As medical experts, physicians integrate all of the CanMEDS roles, applying medical knowledge, clinical skills, and professional values in their provision of high-quality and safe patient-centred care. Medical expert is the central physician role in the CanMEDS framework and defines the physician’s clinical scope of practice.	<ul style="list-style-type: none"> <li>• Practise medicine within their defined scope of practice and expertise</li> <li>• Perform a patient-centred clinical assessment and establish a management plan</li> <li>• Plan and perform procedures and therapies for the purpose of assessment and/or management</li> <li>• Establish plans for ongoing care and, when appropriate, timely consultation</li> <li>• Actively contribute, as an individual and as a member of a team providing care, to the continuous improvement of health care quality and patient safety</li> <li>• Apply novel digital methods of diagnosis, treatment communication and process to achieve optimal clinical outcomes</li> </ul>
<b>Communicator</b>	As communicators, physicians form relationships with patients and their families that facilitate the gathering and sharing of essential information for effective health care.	<ul style="list-style-type: none"> <li>• Establish professional therapeutic relationships with patients and their families (in-person and virtual communication)</li> <li>• Elicit and synthesize accurate and relevant information, incorporating the perspectives of patients and their families</li> <li>• Share health care information and plans with patients and their families</li> <li>• Engage patients and their families in developing plans that reflect the patient’s health care needs and goals</li> <li>• Document and share written and electronic information about the medical encounter to optimize</li> </ul>

		clinical decision-making, patient safety, confidentiality, and privacy
<b>Collaborator</b>	As Collaborators, physicians work effectively with other health care professionals to provide safe, high-quality, patient-centred care.	<ul style="list-style-type: none"> <li>• Work effectively with physicians and other colleagues in the health care professions</li> <li>• Work with physicians and other colleagues in the health care professions to promote understanding, manage differences, and resolve conflicts</li> <li>• Hand over the care of a patient to another health care professional to facilitate continuity of safe patient care</li> </ul>
<b>Leader</b>	As Leaders, physicians engage with others to contribute to a vision of a high-quality health care system and take responsibility for the delivery of excellent patient care through their activities as clinicians, administrators, scholars, or teachers	<ul style="list-style-type: none"> <li>• Contribute to the improvement of health care delivery in teams, organizations, and systems</li> <li>• Engage in the stewardship of health care resources</li> <li>• Demonstrate leadership in professional practice</li> <li>• Manage career planning, finances, and health human resources in a practice</li> </ul>
<b>Health Advocate</b>	As Health Advocates, physicians contribute their expertise and influence as they work with communities or patient populations to improve health. They work with those they serve to determine and understand needs, speak on behalf of others when required, and support the mobilization of resources to effect change.	<ul style="list-style-type: none"> <li>• Respond to an individual patient’s health needs by advocating with the patient within and beyond the clinical environment</li> <li>• Respond to the needs of the communities or populations they serve by advocating with them for system-level change in a socially accountable manner</li> </ul>
<b>Scholar</b>	As Scholars, physicians demonstrate a lifelong commitment to excellence in practice through continuous learning and by teaching others, evaluating evidence, and contributing to scholarship.	<ul style="list-style-type: none"> <li>• Engage in the continuous enhancement of their professional activities through ongoing learning</li> <li>• Teach students, residents, the public, and other health care professionals</li> <li>• Integrate best available evidence into practice</li> </ul>

		<ul style="list-style-type: none"> <li>• Contribute to the creation and dissemination of knowledge and practices applicable to health</li> </ul>
<b>Professional</b>	As Professionals, physicians are committed to the health and well-being of individual patients and society through ethical practice, high personal standards of behaviour, accountability to the profession and society, physician-led regulation, and maintenance of personal health	<ul style="list-style-type: none"> <li>• Demonstrate a commitment to patients by applying best practices and adhering to high ethical standards</li> <li>• Demonstrate a commitment to society by recognizing and responding to societal expectations in health care</li> <li>• Demonstrate a commitment to the profession by adhering to standards and participating in physician-led regulation</li> <li>• Demonstrate a commitment to physician health and well-being to foster optimal patient care</li> </ul>

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370 **Table 2** Comparison of Entrustable Professional Activities between the 2020 ESC Core Curriculum for  
371 the Cardiologist and the 2021 EAPC Core Curriculum for Preventive Cardiology.

<b>Preventive cardiology domains</b>	<b>ESC Core Curriculum for the Cardiologist</b>	<b>EAPC Core Curriculum for Preventive Cardiology</b>
Population science and public health		- Design, implement and evaluate preventive interventions at the population level
Primary prevention and risk factor management	<ul style="list-style-type: none"> <li>- Manage a patient with hypertension</li> <li>- Manage a patient with dyslipidaemia</li> <li>- Manage cardiovascular aspects in a diabetic patient</li> <li>- Manage a cardiac patient in primary prevention</li> </ul>	<ul style="list-style-type: none"> <li>- Manage individuals with multifactorial cardiovascular risk profiles</li> <li>- Manage a patient with non-traditional cardiovascular risk factors</li> </ul>
Secondary prevention and cardiovascular rehabilitation	<ul style="list-style-type: none"> <li>- Manage a cardiac patient in secondary prevention</li> <li>- Prescribe a prevention and rehabilitation programme for a cardiovascular patient</li> </ul>	<ul style="list-style-type: none"> <li>- Manage a prevention and rehabilitation programme for a cardiovascular patient</li> <li>- Manage a prevention and rehabilitation programme for a cardiovascular patient with</li> </ul>

		significant comorbidities, frailty, and/or cardiac devices  - Manage a cardiovascular prevention and rehabilitation programme for an oncology patient
Sports cardiology and exercise	- Manage cardiovascular aspects in an athlete	- Manage pre-participation screening in a competitive athlete  - Manage the work-up of an athlete with suspected or known cardiovascular disease
All		- Use cardiopulmonary exercise testing for diagnosis, risk stratification and exercise prescription

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374 **Table 3** Level of independence for a profession activity, adopted from<sup>41</sup>

<b>Level 1</b>	Trainee is able to <b>observe</b>
<b>Level 2</b>	Trainee is able to <b>perform the activity</b> under <b>direct supervision</b> (proactive, supervisor in the room)
<b>Level 3</b>	Trainee is able to <b>perform the activity</b> under <b>indirect supervision</b> (reactive, on-demand supervision, supervisor readily available)
<b>Level 4</b>	Trainee is able to <b>perform the activity</b> under <b>distant supervision</b> (reactive, supervision available remotely or post-hoc)
<b>Level 5</b>	Trainee is able to <b>perform the activity without supervision</b> and to <b>supervise others</b>

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377 **Table 3** Tools for the assessment of clinical competencies, adopted from the ESC Core Curriculum for  
378 the Cardiologist<sup>41</sup>

<b>Knowledge</b>	<ul style="list-style-type: none"> <li>• Self-assessment with multiple choice questions (MCQs), e.g. provided after a webinar</li> </ul>
<b>Skills</b>	<ul style="list-style-type: none"> <li>• Case-based discussions</li> <li>• Direct observation of procedural skills (DOPS)</li> <li>• Workplace-based Assessments</li> <li>• Mini clinical evaluation exercise (mini-CEX)</li> </ul>
<b>Attitudes</b>	<ul style="list-style-type: none"> <li>• Multiple consultant reports</li> <li>• Multi-source feedback</li> </ul>

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380 **Chapter 1: Population science and public health**

381 **1.1 Design, implement and evaluate preventive interventions at the**  
 382 **population level**

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<p><b>Description</b></p> <p><b>Scope and timeframe:</b>          All public health interventions in the field of CVD prevention          From identifying the need for interventions to evaluating the effect of the interventions in populations</p> <p><b>Setting:</b>          Community setting</p> <p><b>Including:</b>          Identification of potential needs of a population and preventive interventions          Review of past and ongoing community cohorts          Selection of the appropriate lifestyle and pharmacological interventions          Setting up budget, timeframe, milestones and main outcomes for the interventions          Setting up the criteria for the evaluation of the interventions          Setting up occupational health programs          Setting up population screening programs (e.g. schools, workplaces)          Implementing the interventions          Collecting information regarding outcomes/milestones as well as cost-effectiveness          Synthesizing the results and disseminating to stakeholders / collaborators / general population</p> <p><b>Excluding:</b>          Interventions with limited follow up or in selected populations only</p>
<p><b>CanMEDS-Roles</b></p> <ul style="list-style-type: none"> <li>• Medical Expert</li> <li>• Communicator</li> <li>• Collaborator</li> <li>• Leader</li> <li>• Health Advocate</li> <li>• Scholar</li> <li>• Professional</li> </ul>
<p><b>Knowledge</b></p> <ul style="list-style-type: none"> <li>• Identify target populations and preventive interventions, including groups currently underrepresented in clinical studies (women, older people, ethnic minorities, migrants)</li> <li>• Appraise the evidence regarding population-based approaches to prevention (e.g. epidemiology, randomised controlled trials, and cost effectiveness studies)</li> <li>• Be aware of potential stakeholders and collaborators</li> <li>• Design studies to check safety and success of interventions</li> <li>• Describe research methodology to collect data / run analysis / synthesize results of study outcomes / use audit tools</li> </ul>

<b>Skills</b>
<ul style="list-style-type: none"> <li>• Build a network of collaborators to identify and engage with key stakeholders, including policy makers, health services, health care professionals, academia and members of the public</li> <li>• Conduct a needs assessment to identify the population priorities based on good knowledge of the local population</li> <li>• Integrate recommended interventions into existing preventive strategies on a population level</li> <li>• Design the interventions</li> <li>• Perform power calculations to determine sample sizes required to evaluate the interventions with confidence</li> <li>• Create, validate and implement data collection tools (questionnaires, instruments to collect clinical data)</li> <li>• Evaluate statistical methods to analyse data taking into account possible biases/ confounders.</li> <li>• Calculate the cost-effectiveness of interventions</li> <li>• Use early public involvement and engagement</li> <li>• Engage communication channels to publicize the interventions</li> <li>• Disseminate results to professionals, the public and politicians</li> <li>• Evaluate effectiveness of implemented interventions, and recommend adjustments in preventive strategy if needed</li> <li>• Manage projects appropriately</li> </ul>
<b>Attitudes</b>
<ul style="list-style-type: none"> <li>• Collaborate/negotiate with other stakeholders in planning of study</li> <li>• Communicate to ensure that the intervention is understood by the target population, the stakeholders and politicians</li> <li>• Consistently evaluate the intervention and adjust it according to the local results</li> </ul>
<b>Assessment tools</b>
<ul style="list-style-type: none"> <li>• MCQs</li> <li>• Case-based discussions, entrustment-based discussions</li> <li>• Multi-source feedback</li> <li>• Simulation of population interventions</li> <li>• Presentation and publication of results of the intervention</li> </ul>
<b>Level of Independence</b>
<ul style="list-style-type: none"> <li>• Level 3 (perform the activity under indirect supervision. In this context this means to contribute to design, implementation and evaluation of preventive interventions, and cooperate with partners from population science and public health, but not necessarily to take the lead in these type of projects)</li> </ul>
<b>Related ESC Guidelines and EAPC Position Papers</b>
<ul style="list-style-type: none"> <li>• Timmis A, Townsend N, Gale CP, et al. European Society of Cardiology: Cardiovascular Disease Statistics 2019. Eur Heart J 2020; 41: 12-85.</li> </ul>

- Arena R, Guazzi M, Lianov L, et al. Healthy lifestyle interventions to combat noncommunicable disease—a novel nonhierarchical connectivity model for key stakeholders: a policy statement from the American Heart Association, European Society of Cardiology, European Association for Cardiovascular Prevention and Rehabilitation, and American College of Preventive Medicine. *Eur Heart J* 2015; 36:2097-2109.
- Jorgensen T, Capewell S, Prescott E, et al. Population-level changes to promote cardiovascular health. *Eur J Prev Cardiol* 2013; 20: 409-421.

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386 **Chapter 2: Primary prevention and risk factor management**

387 **2.1 Manage individuals with multifactorial cardiovascular risk profiles**

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<p><b>Description</b></p> <p><b>Scope and timeframe:</b> For every individual with known or suspected CV risk From first evaluation to follow-up, as advised by the clinical condition</p> <p><b>Setting:</b> Primary care setting (including nursing home care), in-patient setting, out-patient setting, emergency department, community setting, workplace</p> <p><b>Including:</b> Baseline assessment, identification of single or multiple risk factors and multi-morbidity Identification of individualised targets for CVD prevention using basic and advanced tools for investigation Use of risk modifiers, and imaging in intermediate risk individuals Guidance, lifestyle recommendations, guideline-directed medical therapy, referral, follow-up</p> <p><b>Excluding:</b> Performing specialist investigations or interventional or surgical procedures</p>
<p><b>CanMEDS-Roles</b></p> <ul style="list-style-type: none"> <li>• Medical expert</li> <li>• Communicator</li> <li>• Collaborator</li> <li>• Leader</li> <li>• Health advocate</li> <li>• Scholar</li> <li>• Professional</li> </ul>
<p><b>Knowledge</b></p> <ul style="list-style-type: none"> <li>• Discuss the epidemiology of CVD and its associated lifestyle, medical and psychosocial risk factors</li> <li>• Understand specific aspects of groups currently underrepresented in clinical studies (women, older people, ethnic minorities, migrants)</li> </ul>

- Demonstrate an understanding of strategies for the reduction of CV risk across the life course
- Understand the concept of risk and the role of risk estimation tools in CVD prevention
- Understand the concept of precision medicine and deep phenotyping based on panomics and their current relevance for clinical decision making
- Identify what individual/patient groups are at high risk for CVD and how they should be targeted for preventive care
- Describe the key critical success factors for delivering effective CVD prevention programmes
- Demonstrate an understanding of how the social determinants of health influence cardiovascular health and health inequalities
- List the investigations used to diagnose multifactorial risk profiles
- Demonstrate an understanding of lifestyle risk factor management, which includes smoking cessation, diet, and physical activity
- Appraise the latest evidence-based guidelines for managing individuals with multifactorial cardiovascular risk profiles.

### **Skills**

- Obtain a personal and family history
- Explore patient expectations, values and priorities
- Perform a thorough physical examination
- Perform a comprehensive CV risk assessment using appropriate risk calculators and including additional tests, if necessary (blood tests, resting and exercise electrocardiography (ECG), cardiopulmonary exercise testing (CPET), cardiovascular imaging)
- Assess cardiovascular and extracardiac comorbidities
- Interpret the results of examination and tests showing abnormal values
- Determine and compare the benefits of lifestyle interventions, pharmacology of drugs, or both for primary prevention
- Manage CV risk factors in line with level of individual risk and evidence based guidelines and patient preference
- Assess nutritional habits and integrate into nutritional strategy
- Provide personalised lifestyle advice for smoking cessation, physical activity and exercise, nutrition and diet, stress management and psychological health
- Participate as an interdisciplinary team member, working collaboratively with general practitioners, nurses, dietitians, physiotherapists, sports scientists, psychologists, occupational therapists, pharmacists and other professionals involved in CVD prevention
- Apply effective communication and motivational skills to support the patient in making positive lifestyle and behaviour modifications
- Communicate with family and social environment to provide support and enhance changes

### **Attitudes**

- Adopt a non-judgmental attitude regarding individual lifestyle
- Adopt a shared decision approach by actively engaging the patient in management decisions based on individual values, preferences, and associated conditions and co-morbidities
- Adopt a culture of interdisciplinary teamwork

<ul style="list-style-type: none"> <li>Recognise the importance of primary prevention in individuals and patients with multifactorial CV risk</li> </ul>
<b>Assessment tools</b>
<ul style="list-style-type: none"> <li>MCQs</li> <li>Direct observation, workplace-based assessments ( e.g. DOPS, mini-CEX, fieldnotes)</li> <li>Case-based discussions, entrustment-based discussions</li> <li>Multiple consultant reports</li> <li>Multi-source feedback</li> </ul>
<b>Level of Independence</b>
<ul style="list-style-type: none"> <li>Level 5 (perform the activity without supervision, teach and supervise others)</li> </ul>
<b>Related ESC Guidelines and EAPC Position Papers</b>
<ul style="list-style-type: none"> <li>Knuuti J, Wijns W, Saraste A, et al. 2019 ESC Guidelines for the diagnosis and management of chronic coronary syndromes. Eur Heart J 2020; 41: 407-477.</li> <li>Mach F, Baigent C, Catapano AL, et al. 2019 ESC/EAS Guidelines for the management of dyslipidaemias: lipid modification to reduce cardiovascular risk. Eur Heart J 2020; 41: 111-188.</li> <li>Cosentino F, Grant PJ, Aboyans V, et al. 2019 ESC Guidelines on diabetes, pre-diabetes, and cardiovascular diseases developed in collaboration with the EASD. Eur Heart J 2020; 41: 255-323.</li> <li>Williams B, Mancia G, Spiering W, et al. 2018 ESC/ESH Guidelines for the management of arterial hypertension. Eur Heart J 2018; 39: 3021-3104.</li> <li>Piepoli MF, Hoes AW, Agewall S, et al. 2016 European Guidelines on cardiovascular disease prevention in clinical practice: The Sixth Joint Task Force of the European Society of Cardiology and Other Societies on Cardiovascular Disease Prevention in Clinical Practice (constituted by representatives of 10 societies and by invited experts)Developed with the special contribution of the European Association for Cardiovascular Prevention &amp; Rehabilitation (EACPR). Eur Heart J 2016; 37: 2315-2381. <b>Update 2021.</b></li> </ul>

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## 391 2.2 Manage a patient with non-traditional cardiovascular risk factors

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<b>Description</b>
<p><b>Scope and timeframe:</b> For every individual with non-traditional CV risk factors, suitable for CVD prevention From first presentation to follow-up, as advised by clinical condition</p> <p><b>Setting:</b> Primary care setting (including nursing home care), in-patient setting, out-patient setting, emergency department, community settings, workplace</p> <p><b>Including:</b> Assessment of CV risk in patients with abnormal biomarkers, cancer therapy, chronic kidney disease, chronic obstructive pulmonary disease, inflammatory disease, congenital heart</p>

<p>disease, migraine with aura, erectile dysfunction, preeclampsia, gestational diabetes, sleep disorders</p> <p>Identification of residual CV risk and targets for CVD prevention using basic and advanced tools for investigation</p> <p>Guidance, lifestyle recommendations, guideline-directed medical therapy, referral, follow-up</p> <p><b>Excluding:</b></p> <p>Performing specialist investigations or interventional or surgical procedures</p>
<p><b>CanMEDS-Roles</b></p> <ul style="list-style-type: none"> <li>• Medical expert</li> <li>• Communicator</li> <li>• Collaborator</li> <li>• Leader</li> <li>• Health advocate</li> <li>• Scholar</li> <li>• Professional</li> </ul>
<p><b>Knowledge</b></p> <ul style="list-style-type: none"> <li>• List important non-traditional CV risk factors and diseases with elevated CV risk (e.g. abnormal biomarkers, cancer therapy, chronic kidney disease, chronic obstructive pulmonary disease, congenital heart disease, inflammatory disease, migraine with aura, erectile dysfunction, preeclampsia, gestational diabetes, sleep disorders)</li> <li>• Describe the biopsychosocial spectrum of non-traditional CV risk factors and recognize their importance for CVD primary prevention</li> <li>• Explain the use of investigations for and management of individuals with non-traditional CV risk factors</li> <li>• Discuss the management of clinical complications of patients with non-traditional CV risk factors</li> <li>• Outline proper laboratory testing or referral/collaboration with other specialists, in order to assess the CV risk and plan a personal health strategy</li> <li>•</li> </ul>
<p><b>Skills</b></p> <ul style="list-style-type: none"> <li>• Obtain a relevant history</li> <li>• Explore patient expectations, values and priorities</li> <li>• Evaluate non-traditional CV risk factors</li> <li>• Assess pharmacology of approved drugs, interactions, side effects in relation to cardiovascular and extracardiac complications</li> <li>• Interpret biochemical and imaging assessments and appropriately refer for complete and thorough assessment</li> <li>• Implement guidelines and protocols for diagnosis and management plans for non-traditional risk factors</li> <li>• Select the appropriate investigations for refining non-traditional CV risk stratification</li> <li>• Manage lifestyle changes, and pharmacological treatment</li> <li>• Communicate with families, employers, other specialists and general practitioners</li> <li>• Motivate individuals to adopt healthier lifestyles, according to their special needs and preferences or health problems</li> </ul>

<p><b>Attitudes</b></p> <ul style="list-style-type: none"> <li>• Adopt a non-judgmental attitude regarding the individual lifestyle</li> <li>• Adopt a shared decision approach by actively engaging the patient in management decisions based on individual values, preferences, and associated conditions and comorbidities</li> <li>• Adopt a culture of interdisciplinary teamwork</li> <li>• Advocate for an integrated approach to chronic disease management, to include those with both traditional and non-traditional CV risk factors</li> <li>• Advocate for patient education on primary prevention as an essential component of cardiac care</li> <li>• Recognise the importance of primary and secondary prevention in individuals and patients with non-traditional CV risk factors</li> <li>• Advocate for greater public awareness around non-traditional CV risk factors</li> </ul>
<p><b>Assessment tools</b></p> <ul style="list-style-type: none"> <li>• MCQs</li> <li>• Direct observation, workplace-based assessments ( e.g. DOPS, mini-CEX, fieldnotes)</li> <li>• Case-based discussions, entrustment-based discussions</li> <li>• Multiple consultant reports</li> <li>• Multi-source feedback</li> </ul>
<p><b>Level of Independence</b></p> <ul style="list-style-type: none"> <li>• Level 4 (perform the activity under distant supervision. In this context this means to collaborate with experts of the clinical conditions associated with elevated CV risk)</li> </ul>
<p><b>Related ESC Guidelines and EAPC Position Papers</b></p> <ul style="list-style-type: none"> <li>• Regitz-Zagrosek V, Roos-Hesselink JW, Bauersachs J, et al. 2018 ESC Guidelines for the management of cardiovascular diseases during pregnancy. Eur Heart J 2018; 39: 3165-3241.</li> <li>• Piepoli MF, Hoes AW, Agewall S, et al. 2016 European Guidelines on cardiovascular disease prevention in clinical practice: The Sixth Joint Task Force of the European Society of Cardiology and Other Societies on Cardiovascular Disease Prevention in Clinical Practice (constituted by representatives of 10 societies and by invited experts)Developed with the special contribution of the European Association for Cardiovascular Prevention &amp; Rehabilitation (EACPR). Eur Heart J 2016; 37: 2315-2381. <b>Update 2021.</b></li> <li>• Zamorano JL, Lancellotti P, Rodriguez Munoz D, et al. 2016 ESC Position Paper on cancer treatments and cardiovascular toxicity developed under the auspices of the ESC Committee for Practice Guidelines: The Task Force for cancer treatments and cardiovascular toxicity of the European Society of Cardiology (ESC). Eur Heart J 2016; 37: 2768-2801.</li> </ul>

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395 **Chapter 3: Secondary prevention and rehabilitation**

396 **3.1 Manage a prevention and rehabilitation programme for a cardiovascular**  
 397 **patient**

<p><b>Description</b></p> <p><b>Scope and timeframe:</b> All standard patients (outlined below) with an indication for a comprehensive CV prevention and rehabilitation programme From referral to follow-up after a structured programme</p> <p><b>Setting:</b> In-patient, out-patient, home based, community, virtual (including online and tele rehabilitation)</p> <p><b>Including:</b> Management of patients with acute coronary syndromes (ACS), chronic coronary syndromes (CCS), after coronary artery bypass graft (CABG), valve, and large vessel surgery, valve interventions, chronic heart failure, myocardial disease, congenital heart disease Complete evaluation and risk stratification using appropriate tests Lifestyle modification, through smoking cessation, nutritional, physical activity and psycho-social counselling, Exercise prescription, exercise training structuring and supervision Cardiorespiratory performance and interpretation Guideline-directed medical therapy implementation Behavioural change and self-management Organisation and optimisation of a patient and family education programme Organisation of long-term follow-up</p> <p><b>Excluding:</b> Patients with relevant comorbidities, cardiac implantable electrical devices (CIED), left ventricular assist devices (LVAD), heart transplantation (HTX) (see Chapter 3.2) Performing specialist investigations or interventional or surgical procedures, acute or unstable condition, acute settings</p>
<p><b>CanMEDS-Roles</b></p> <ul style="list-style-type: none"> <li>• Medical expert</li> <li>• Communicator</li> <li>• Collaborator</li> <li>• Leader</li> <li>• Health advocate</li> <li>• Scholar</li> <li>• Professional</li> </ul>
<p><b>Knowledge</b></p> <ul style="list-style-type: none"> <li>• Outline indications for comprehensive CV prevention and rehabilitation</li> <li>• Understand specific aspects of groups currently underrepresented in clinical studies (women, older people, ethnic minorities, migrants)</li> <li>• Describe current evidence and expected benefits of comprehensive CV prevention and rehabilitation</li> <li>• Consider appropriate referral and contraindication to comprehensive CV prevention and rehabilitation</li> </ul>

- Outline the main core components of comprehensive CV prevention and rehabilitation programmes
- Discuss the global patient evaluation strategy
- Explain the different modalities of exercise
- Outline the principles of the FITT-VP (frequency, intensity, time, type, volume, progression) model for exercise prescription and of using scales of perceived exertion (e.g. Borg)
- Discuss indications and interpretation of exercise capacity tests (ECG exercise testing, CPET, 6MWT, strength tests)
- Outline indication and mechanisms of guideline-directed medical therapies
- Identify the interaction of pharmacological therapies with exercise
- Identify the principles of counselling for secondary prevention
- Describe psychological profiles and their impact on cardiovascular health
- Describe the patient education management (empowerment, self-management, self-efficacy, adherence promotion)
- Discuss the new technologies and their use for remote monitoring, programme delivery, and education
- Outline the composition and relationships of the interdisciplinary CV prevention and rehabilitation staff
- Outline the role of the family and social support for CVD patients

#### **Skills**

- Perform evaluation including CV risk factors, clinical condition, non-invasive assessment of CV functioning/disease, disabilities, nutrition, psycho-social impact
- Explore patient expectations, values and priorities
- Perform and analyse exercise capacity tests (ECG exercise test, CPET, six minutes walking tests (6MWT), strength tests) for tailored exercise prescriptions
- Prescribe endurance continuous/interval training, resistance/strength training, balance training, and respiratory training
- Coordinate psychosocial, nutrition, and smoking cessation counselling and integrate results in clinical shared decision making
- Optimize and up-titrate guideline-directed medical therapies, under consideration of effects on exercise tolerance
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- Develop exercise training according to settings (residential, ambulatory, community-based, tele-monitoring), patient conditions (age, sex, psychology, comorbidities), and preferences
- Assess nutritional habits and integrate into nutritional strategy
- Conceptualise, organise and drive an educational programme
- Organise a tele monitoring /tele-rehabilitation programme
- Manage comorbidities
- Recognize and treat emergency cases
- Manage patients with residual ischemia (e.g. incomplete optimal revascularization, diffuse atherosclerotic disease)
- Detect post-interventional or post-surgical complications (e.g. early stent thrombosis or restenosis, pericardial tamponade)
- Apply effective communication and behavioural change techniques (e.g. motivational interviewing for smoking cessation and patient education)
- Organise the follow up, links with general practitioners and/or cardiologists, and other health professionals

<b>Attitudes</b>
<ul style="list-style-type: none"> <li>• Adopt a non-judgmental attitude regarding individual lifestyle choices</li> <li>• Be aware of the influence of CV risk factors and diseases in patient prognosis (differentiate mortality and morbidity) and quality of life</li> <li>• Be aware of the importance of CV prevention and rehabilitation in the pathway and care delivery of the CV patient</li> <li>• Work in interdisciplinary teams with health professionals involved in secondary prevention</li> <li>• Deliver education, empathy and encouragement to the patient to reduce their CV risk factors with help of all the professional resources</li> <li>• Educate patients on how his/her entourage can support prevention</li> <li>• Support patients with genetic disorders (psychological counselling, explain consequences for disease management and for relatives)</li> <li>• Motivate patient to sustain long term adherence with lifestyle, exercise training, and medical therapy</li> <li>• Actively involve the patient in shared decision making to promote optimal self-management and long term adherence to behaviour change</li> <li>• Advocate comprehensive cardiovascular prevention and rehabilitation programmes to include all high risk patients</li> </ul>
<b>Assessment tools</b>
<ul style="list-style-type: none"> <li>• MCQs</li> <li>• Direct observation, workplace-based assessments ( e.g. DOPS, mini-CEX, fieldnotes)</li> <li>• Case-based discussions, entrustment-based discussions</li> <li>• Multiple consultant reports</li> <li>• Multi-source feedback</li> </ul>
<b>Level of Independence</b>
<ul style="list-style-type: none"> <li>• Level 5 (perform the activity without supervision, teach and supervise others)</li> </ul>
<b>Related ESC Guidelines and EAPC Position Papers</b>
<ul style="list-style-type: none"> <li>• Ambrosetti M, Abreu A, Corra U, et al. Secondary prevention through comprehensive cardiovascular rehabilitation: From knowledge to implementation. 2020 update. A position paper from the Secondary Prevention and Rehabilitation Section of the European Association of Preventive Cardiology. Eur J Prev Cardiol 2020 Mar 30. DOI: 10.1177/2047487320913379.</li> <li>• Abreu A, Frederix I, Dendale P, et al. Standardization and quality improvement of secondary prevention through cardiovascular rehabilitation programmes in Europe: The avenue towards EAPC accreditation programme: A position statement of the Secondary Prevention and Rehabilitation Section of the European Association of Preventive Cardiology (EAPC). Eur J Prev Cardiol 2020 Jun 1. DOI: 10.1177/2047487320924912.</li> <li>• Scherrenberg M, Wilhelm M, Hansen D, et al. The future is now: a call for action for cardiac telerehabilitation in the COVID-19 pandemic from the secondary prevention and rehabilitation section of the European Association of Preventive Cardiology. Eur J Prev Cardiol 2020 Jul 2 DOI: 10.1177/2047487320939671.</li> </ul>

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- Mezzani A, Hamm LF, Jones AM, et al. Aerobic exercise intensity assessment and prescription in cardiac rehabilitation: a joint position statement of the European Association for Cardiovascular Prevention and Rehabilitation, the American Association of Cardiovascular and Pulmonary Rehabilitation and the Canadian Association of Cardiac Rehabilitation. Eur J Prev Cardiol 2013; 20: 442-467.
- Piepoli MF, Conraads V, Corra U, et al. Exercise training in heart failure: from theory to practice. A consensus document of the Heart Failure Association and the European Association for Cardiovascular Prevention and Rehabilitation. Eur J Heart Fail 2011; 13: 347-357.

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### 3.2 Manage a prevention and rehabilitation programme for a cardiovascular patient with significant comorbidities, frailty, and/or cardiac devices

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Description
<p><b>Scope and timeframe:</b> All complex patients (outlined below) with an indication for a comprehensive CV prevention and rehabilitation programme From referral to follow-up after a structured programme</p> <p><b>Setting:</b> In-patient, out-patient, home based, community, virtual (including online and tele rehabilitation)</p> <p><b>Including:</b> Management of patients with stroke, peripheral artery occlusive disease (PAOD, including amputation), diabetes, chronic kidney disease, chronic obstructive pulmonary disease, rheumatologic disease, orthopaedic disease, and frailty Management of CIED, LVAD, and HTX patients Patient global evaluation and risk stratification using appropriate tests Lifestyle modification, through nutritional, physical activity and psycho-social counselling; Adapted exercise prescription, adapted exercise training structuring and supervision Cardiorespiratory performance and interpretation (identifying those patients who cannot do it) Guideline-directed medical therapy implementation Behavioural change and self-management Organisation and optimisation of a patient education programme, including specific information related to the comorbidity Organisation of long-term follow-up</p> <p><b>Excluding:</b> Performing specialist investigations or interventional or surgical procedures, acute or unstable conditions, acute settings</p>

<b>CanMEDS-Roles</b>
<ul style="list-style-type: none"> <li>• Medical expert</li> <li>• Communicator</li> <li>• Collaborator</li> <li>• Leader</li> <li>• Health advocate</li> <li>• Scholar</li> <li>• Professional</li> </ul>
<b>Knowledge</b>
<ul style="list-style-type: none"> <li>• Discuss the management of individual comorbidities: stroke, PAOD, diabetes, chronic kidney disease, chronic obstructive pulmonary disease, rheumatologic disease, orthopaedic disease, and frailty</li> <li>• Discuss the management of CIED, LVAD and HTX patients</li> <li>• Describe the current evidence and expected benefits of comprehensive CV prevention and rehabilitation</li> <li>• Consider appropriate referral and contraindication to comprehensive CV prevention and rehabilitation programmes</li> <li>• Outline the main core components of comprehensive CV prevention and rehabilitation programmes</li> <li>• Discuss the global patient evaluation strategy</li> <li>• Identify the interaction between pharmacological and CIED therapies with exercise</li> <li>• Explain the different modalities of exercise and how to adapt to specific comorbidities, and frailty</li> <li>• Outline the principles of the FITT-VP (frequency, intensity, time, type, volume, progression) model for exercise prescription and of using scales of perceived exertion (e.g. Borg)</li> <li>• Discuss indications and interpretation of exercise capacity tests (ECG exercise testing, CPET, 6MWT, strength tests)</li> <li>• Know key frailty tests (i.e. timed up and go, walking speed test) and tests for cognitive deficits (mini-mental status test).</li> <li>• Identify the principles of counselling for secondary prevention, specifically including management linked to comorbidities</li> <li>• Describe psychological profiles and their impact on cardiovascular health</li> <li>• Describe the patient education management (empowerment, self-management, self-efficacy, adherence promotion)</li> <li>• Discuss the new technologies and their use for remote monitoring, program delivery, and education</li> <li>• Outline the composition of and relationships between the interdisciplinary CV prevention and rehabilitation staff</li> <li>• Discuss how comorbidities influence CV prevention and rehabilitation delivery and need for adaptation</li> <li>• Discuss the influence of CV risk factors and diseases in patient prognosis (differentiate mortality and morbidity) and quality of life</li> <li>• Outline the importance of comprehensive CV prevention and rehabilitation in the pathway and care delivery of the CV patient without and with comorbidities</li> </ul>
<b>Skills</b>

- Manage specific aspects of individual comorbidities: stroke, PAOD, diabetes, chronic kidney disease, chronic obstructive pulmonary disease, rheumatologic disease, orthopaedic disease, and frailty
- Manage specific aspects of CIED, LVAD and heart transplant patients
- Perform evaluation including CV risk factors, clinical condition, non-invasive assessment of CV functioning/disease, disabilities, nutrition, psycho-social impact
- Explore patient expectations, values and priorities
- Perform and interpret exercise capacity tests (ECG exercise testing, CPET, 6MWT, strength tests) for tailored exercise prescriptions
- Prescribe endurance continuous/interval training, resistance/strength training, and respiratory training
- Develop exercise training according to settings (residential, ambulatory, community-based, tele-monitoring), patient conditions (age, sex, comorbidities, psychologic status), and preferences
- Conceptualise, organise and drive an educational programme with specificities to the different comorbidities
- Organise a tele-monitoring /tele-rehabilitation programme
- Optimise and up-titrate guideline-directed medical therapies, adapted to the exercise tolerance and comorbidities
- Identify and analyse CIED functioning at rest and during effort
- Manage comorbidities under consideration of possible drug interactions and contraindications
- Recognise and treat emergency cases related to comorbidities or devices
- Manage patients with residual ischemia (e.g. incomplete optimal revascularization, diffuse atherosclerotic disease)
- Detect post interventional or post-surgical complications (e.g. early stent thrombosis or restenosis, pericardial tamponade)
- Apply effective communication and behavioural change techniques (e.g. motivational interviewing for smoking cessation and patient education)
- Make end of life discussions possible for terminal patients
- Organise the follow up, links with general practitioners and/or cardiologists, and other health professionals

#### **Attitudes**

- Work with interdisciplinary teams of health professionals involved in secondary prevention and rehabilitation
- Educate and encourage patients to reduce their CV risk factors with help of all the professional resources
- Educate patients on how his/her entourage can support prevention
- Support patients with genetic disorders (psychological counselling, explain consequences for disease management and for relatives)
- Motivate patients to sustain long term adherence with lifestyle, exercise training, and medical therapy, despite their comorbidities
- Actively involve patients in shared decision making to promote optimal self-management and long term adherence to behaviour change
- Advocate for comprehensive CV prevention and rehabilitation programmes to improve referral and uptake

<p><b>Assessment tools</b></p> <ul style="list-style-type: none"> <li>• MCQs</li> <li>• Direct observation, workplace-based assessments ( e.g. DOPS, mini-CEX, fieldnotes)</li> <li>• Case-based discussions, entrustment-based discussions</li> <li>• Multiple consultant reports</li> <li>• Multi-source feedback</li> </ul>
<p><b>Level of Independence</b></p> <ul style="list-style-type: none"> <li>• Level 5 (perform the activity without supervision, teach and supervise others)</li> </ul>
<p><b>Related ESC Guidelines and EAPC Position Papers</b></p> <ul style="list-style-type: none"> <li>• Pedretti RF, Iliou MC, Israel CW et al. Comprehensive Multicomponent Cardiac Rehabilitation in Cardiac Implantable Electronic Devices Recipients. A Consensus Document from the European Association of Preventive Cardiology (EAPC; Section on Secondary Prevention and Rehabilitation) and European Heart Rhythm Association (EHRA). Eur J Prev Cardio 2020. DOI:10.1093/eurjpc/zwaa121.</li> <li>• Ambrosetti M, Abreu A, Corra U, et al. Secondary prevention through comprehensive cardiovascular rehabilitation: From knowledge to implementation. 2020 update. A position paper from the Secondary Prevention and Rehabilitation Section of the European Association of Preventive Cardiology. Eur J Prev Cardiol 2020 Mar 30. DOI: 10.1177/2047487320913379.</li> <li>• Abreu A, Frederix I, Dendale P, et al. Standardization and quality improvement of secondary prevention through cardiovascular rehabilitation programmes in Europe: The avenue towards EAPC accreditation programme: A position statement of the Secondary Prevention and Rehabilitation Section of the European Association of Preventive Cardiology (EAPC). Eur J Prev Cardiol 2020 Jun 1. DOI: 10.1177/2047487320924912.</li> <li>• Scherrenberg M, Wilhelm M, Hansen D, et al. The future is now: a call for action for cardiac telerehabilitation in the COVID-19 pandemic from the secondary prevention and rehabilitation section of the European Association of Preventive Cardiology. Eur J Prev Cardiol 2020 Jul 2. DOI: 10.1177/2047487320939671.</li> <li>• Hansen D, Kraenkel N, Kemps H, et al. Management of patients with type 2 diabetes in cardiovascular rehabilitation. Eur J Prev Cardiol 2019; 26: 133-144.</li> <li>• Kemps H, Krankel N, Dorr M, et al. Exercise training for patients with type 2 diabetes and cardiovascular disease: What to pursue and how to do it. A Position Paper of the European Association of Preventive Cardiology (EAPC). Eur J Prev Cardiol 2019; 26: 709-727.</li> <li>• Vigorito C, Abreu A, Ambrosetti M, Belardinelli R, Corra U, Cupples M, Davos CH, Hofer S, Iliou MC, Schmid JP, Voeller H, Doherty P. Frailty and cardiac rehabilitation: A call to action from the EAPC Cardiac Rehabilitation Section. Eur J Prev Cardiol. 2017;24:577-590.</li> <li>• Piepoli MF, Hoes AW, Agewall S, et al. 2016 European Guidelines on cardiovascular disease prevention in clinical practice: The Sixth Joint Task Force of the European Society of Cardiology and Other Societies on Cardiovascular Disease Prevention in Clinical Practice (constituted by representatives of 10 societies and by invited experts)Developed with the special contribution of the European Association for Cardiovascular Prevention &amp; Rehabilitation (EACPR). Eur Heart J 2016; 37: 2315-2381. <b>Update in 2021.</b></li> <li>• Mezzani A, Hamm LF, Jones AM, et al. Aerobic exercise intensity assessment and prescription in cardiac rehabilitation: a joint position statement of the European Association for Cardiovascular Prevention and Rehabilitation, the American Association of Cardiovascular and Pulmonary Rehabilitation and the Canadian Association of Cardiac Rehabilitation. Eur J Prev Cardiol 2013; 20: 442-467.</li> <li>• Piepoli MF, Conraads V, Corra U, et al. Exercise training in heart failure: from theory to practice. A consensus document of the Heart Failure Association and the European Association for Cardiovascular Prevention and Rehabilitation. Eur J Heart Fail 2011; 13: 347-357.</li> </ul>

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406 **3.3 Manage a cardiovascular prevention and rehabilitation programme for an**  
407 **oncology patient**

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<b>Description</b>
<p><b>Scope and timeframe:</b> Cancer patients, in particular after cardiotoxic cancer therapy, from cancer diagnosis to follow-up surveillance</p> <p><b>Setting:</b> In-patient, out-patient, home based, community, virtual (including online and tele rehabilitation)</p> <p><b>Including:</b> Assessment of the clinical status, identification of risk factors for CVD and cancer, using basic and advanced tools for investigation; pharmacological and non-pharmacological treatment</p> <p><b>Excluding:</b> Performing specialist investigations or interventional or surgical procedures, acute or unstable condition, acute settings</p>
<b>CanMEDS-Roles</b>
<ul style="list-style-type: none"><li>• Medical expert</li><li>• Communicator</li><li>• Collaborator</li><li>• Leader</li><li>• Health advocate</li><li>• Scholar</li><li>• Professional</li></ul>
<b>Knowledge</b>
<ul style="list-style-type: none"><li>• Identify clinical interactions between cancer and CVDs</li><li>• Identify risk factors common to cancer and CVD (e.g. aging, smoking, alcohol abuse, unbalanced diet and physical inactivity)</li><li>• Describe CV toxicity of specific chemo- and radiotherapies in cancer patients undergoing treatment as well as cancer survivors and its influence on exercise capacity and quality of life</li><li>• Describe the prognosis of different cancers</li><li>• Discuss the specific rehabilitation needs of cancer patients with or at risk of CVD (exercise, psychological, prevention, social, education)</li></ul>

<ul style="list-style-type: none"> <li>• Describe the role of exercise in cardio-oncology rehabilitation to minimise the negative effects of cancer therapies (e.g. cardio-toxicity, fatigue, bone loss, lymphedema, autonomic dysfunction, depression, anxiety)</li> <li>• Discuss indications and interpretation of exercise capacity tests (ECG exercise testing, CPET, 6MWT, strength tests)</li> <li>• Describe the role of exercise and cardio-oncology rehabilitation to limit cancer progression and relapses</li> <li>• Discuss the strategies to limit disabilities, impaired quality of life and psychosocial distress induced by cancer and CVD</li> </ul>
<p><b>Skills</b></p> <ul style="list-style-type: none"> <li>• Differentiate cardio-oncology rehabilitation in cancer patients from conventional oncology rehabilitation</li> <li>• Identify cancer patients with expected greater benefits from cardio-oncology rehabilitation</li> <li>• Adapt comprehensive cardio-oncology rehabilitation to the cancer situation (active cancer or cancer survivors)</li> <li>• Perform and interpret exercise capacity tests (ECG exercise testing, CPET, 6MWT, strength tests) for tailored exercise prescriptions</li> <li>• Interpret imaging investigations performed in oncology patients and derive prognostic information</li> <li>• Identify the appropriate cardio-oncology rehabilitation setting (residential, out-patients, centre-based, community-based, home-based) according to patient's preferences and possibilities</li> <li>• Review cancer history, cancer therapies and related side effects, drug interactions</li> <li>• Evaluate the risk of CVD in active cancer and cancer survivors</li> <li>• Establish goals for risk factors control modulated by the presence or history of cancer</li> <li>• Select the appropriate method of functional testing in cancer patients</li> <li>• Evaluate and treat cancer-related cachexia, sarcopenia and anaemia</li> <li>• Adapt type and intensity of training to cancer localization, cancer stages and specific sequelae (e.g. appropriate intensity in case of cachexia or frailty, role of upper body strength training in breast cancer, role of inspiratory muscle training in thoracic cancer)</li> <li>• Interdisciplinary work with the oncology team, and other healthcare professionals</li> <li>• Make end of life discussions possible for terminal patients</li> <li>• Provide view/opinion about return to work</li> </ul>
<p><b>Attitudes</b></p> <ul style="list-style-type: none"> <li>• Aim to decrease the risk of CVD in cancer patients</li> <li>• Consider cardio-oncology rehabilitation as a standard of care for cancer patients and survivors at high risk for CVD</li> <li>• Deal optimistically with cancer</li> <li>• Collaborate with oncologists and other care providers in the field of oncology</li> <li>• Reassure and motivate cancer patients</li> </ul>
<p><b>Assessment tools</b></p>

<ul style="list-style-type: none"> <li>• MCQs</li> <li>• Direct observation, workplace-based assessments ( e.g. DOPS, mini-CEX, fieldnotes)</li> <li>• Case-based discussions, entrustment-based discussions</li> <li>• Multiple consultant reports</li> <li>• Multi-source feedback</li> </ul>
<b>Level of Independence</b>
<ul style="list-style-type: none"> <li>• Level 5 (perform the activity without supervision, teach and supervise others)</li> </ul>
<b>Related ESC Guidelines and EAPC Position Papers</b>
<ul style="list-style-type: none"> <li>• Zamorano JL, Lancellotti P, Rodriguez Munoz D, et al. 2016 ESC Position Paper on cancer treatments and cardiovascular toxicity developed under the auspices of the ESC Committee for Practice Guidelines: The Task Force for cancer treatments and cardiovascular toxicity of the European Society of Cardiology (ESC). Eur Heart J 2016; 37: 2768-2801.</li> </ul> <p><b>Related AHA Scientific Statement</b></p> <ul style="list-style-type: none"> <li>• Gilchrist SC, Barac A, Ades PA, et al. Cardio-Oncology Rehabilitation to Manage Cardiovascular Outcomes in Cancer Patients and Survivors: A Scientific Statement from the American Heart Association. Circulation 2019; 139: e997-e1012.</li> </ul>

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411 **Chapter 4: Sports cardiology and exercise**

412 **4.1 Manage pre-participation evaluation in a competitive athlete**

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<b>Description</b>
<p><b>Scope and timeframe:</b> Competitive athletes, from evaluation to eligibility for competition</p> <p><b>Setting:</b> Out-patient setting</p> <p><b>Including:</b> Evaluation of personal and family history (including habitual physical activity level, sport type, fitness), physical examination, blood pressure measurement, 12-lead ECG, further testing (ambulatory ECG monitoring, echocardiography, advanced imaging, exercise testing, CPET), if appropriate Identification of potential high-risk athletes for sudden cardiac death and for other cardiovascular conditions that may worsen because of intensive athletic training</p> <p><b>Excluding:</b> Performing specialist investigations or interventional or surgical procedures</p>
<b>CanMEDS-Roles</b>
<ul style="list-style-type: none"> <li>• Medical expert</li> </ul>

<ul style="list-style-type: none"> <li>• Communicator</li> <li>• Collaborator</li> <li>• Leader</li> <li>• Health advocate</li> <li>• Scholar</li> <li>• Professional</li> </ul>
<p><b>Knowledge</b></p> <ul style="list-style-type: none"> <li>• Describe physiological adaptations to acute and chronic exercise</li> <li>• Describe physiological adaptations in different situations such as deep sea, high altitude, low or high temperatures</li> <li>• Assess the type of practiced sport (skill, power, mixed, endurance), the specific metabolic features and induced CV remodeling</li> <li>• Describe the physiological CV adaptation induced by regular exercise and the normal versus borderline ECG findings in athletes</li> <li>• Describe the incidence of sudden cardiac death in athletes and the most frequent and emergent CV conditions involved</li> <li>• Describe CV conditions that may worsen because of intensive athletic training and those that will benefit from primary prevention</li> <li>• Describe how to establish a diagnostic flowchart for sudden death prevention in the presence of abnormal findings (including ECG and physical examination findings) during pre-participation evaluation (PPE) in athletes</li> <li>• Describe indications for cardiac multi-modality imaging and genetic testing in PPE</li> <li>• Discuss the CV effects of the main doping substances</li> </ul>
<p><b>Skills</b></p> <ul style="list-style-type: none"> <li>• Obtain a relevant history and perform an appropriate physical examination, including habitual physical activity level and sport type (skill, power, mixed, endurance)</li> <li>• Evaluate the CV risk profile based on appropriate risk calculators and the fitness level of an athlete over 35 years of age and the burden of risk factors for CVD</li> <li>• Understand the results of physical examination and 12-lead ECG showing physiological, borderline or pathological findings</li> <li>• Identify the potential high-risk athletes and further evaluate the risk of sudden cardiac death or acceleration of an inherited predisposition or exacerbation of cardiac damage due to intercurrent illness resulting from intense and prolonged exercise.</li> <li>• Evaluate potential doping issues and substance abuse</li> <li>• Choose the appropriate screening modality in the presence of abnormal findings (e.g. ECG exercise test, CPET, echocardiography, ambulatory ECG monitoring, CCTA, CMR, genetic testing)</li> <li>• Perform and interpret ECG exercise test, CPET, echocardiography, ambulatory ECG monitoring if indicated</li> <li>• Integrate results from advanced cardiovascular imaging and genetic testing in clinical decision making</li> <li>• Advise regarding exercise and exercise training in athletes with cardiac disease according to history, clinical finding, diagnostics and CPET</li> </ul>
<p><b>Attitudes</b></p>

<ul style="list-style-type: none"> <li>• Adopt a non-judgmental attitude to an athlete regarding her/his lifestyle or referred symptoms, if any</li> <li>• Communicate with the athlete, family, and the team physician to optimize the management of potentially abnormal findings during PPE and how this may affect sports eligibility</li> <li>• Communicate concepts of exercise and exercise programme with the athlete</li> <li>• Motivate the athlete to systematically undergo PPE and explain the cost-effectiveness consideration of this model</li> </ul>
<p><b>Assessment tools</b></p> <ul style="list-style-type: none"> <li>• MCQs</li> <li>• Direct observation, workplace-based assessments ( e.g. DOPS, mini-CEX, fieldnotes)</li> <li>• Case-based discussions, entrustment-based discussions</li> <li>• Multiple consultant reports</li> <li>• Multi-source feedback</li> </ul>
<p><b>Level of Independence</b></p> <ul style="list-style-type: none"> <li>• Level 5 (perform the activity without supervision, teach and supervise others)</li> </ul>
<p><b>Related ESC Guidelines and EAPC Position Papers</b></p> <ul style="list-style-type: none"> <li>• Pelliccia A, Sharma S, Gati S, et al. 2020 ESC Guidelines on sports cardiology and exercise in patients with cardiovascular disease. <i>Eur Heart J.</i> 2020 Aug 29. DOI: 10.1093/eurheartj/ehaa605.</li> <li>• Budts W, Pieles GE, Roos-Hesselink JW, et al. Recommendations for participation in competitive sport in adolescent and adult athletes with Congenital Heart Disease (CHD): position statement of the Sports Cardiology &amp; Exercise Section of the European Association of Preventive Cardiology (EAPC), the European Society of Cardiology (ESC) Working Group on Adult Congenital Heart Disease and the Sports Cardiology, Physical Activity and Prevention Working Group of the Association for European Paediatric and Congenital Cardiology (AEPC). <i>Eur Heart J.</i> 2020 Aug 26. DOI: 10.1093/eurheartj/ehaa501.</li> <li>• Heidbuchel H, Adami PE, Antz M, et al. Recommendations for participation in leisure-time physical activity and competitive sports in patients with arrhythmias and potentially arrhythmogenic conditions: Part 1: Supraventricular arrhythmias. A position statement of the Section of Sports Cardiology and Exercise from the European Association of Preventive Cardiology (EAPC) and the European Heart Rhythm Association (EHRA), both associations of the European Society of Cardiology. <i>Eur J Prev Cardiol.</i> 2020 Jun 29. DOI: 10.1177/2047487320925635.</li> <li>• Heidbuchel H, Arbelo E, D'Ascenzi F, et al. Recommendations for participation in leisure-time physical activity and competitive sports of patients with arrhythmias and potentially arrhythmogenic conditions. Part 2: ventricular arrhythmias, channelopathies, and implantable defibrillators. <i>Europace.</i> 2020 Jun 29. DOI: 10.1093/europace/euaa106.</li> <li>• Pelliccia A, Solberg EE, Papadakis M, et al. Recommendations for participation in competitive and leisure time sport in athletes with cardiomyopathies, myocarditis, and pericarditis: position statement of the Sport Cardiology Section of the European Association of Preventive Cardiology (EAPC). <i>Eur Heart J.</i> 2019;40:19-33.</li> <li>• Borjesson M, Dellborg M, Niebauer J, et al. Recommendations for participation in leisure time or competitive sports in athletes-patients with coronary artery disease: a position statement from the Sports Cardiology Section of the European Association of Preventive Cardiology (EAPC). <i>Eur Heart J.</i> 2019;40:13-18.</li> </ul>

- Niebauer J, Borjesson M, Carre F, et al. Recommendations for participation in competitive sports of athletes with arterial hypertension: a position statement from the sports cardiology section of the European Association of Preventive Cardiology (EAPC). *Eur Heart J.* 2018;39:3664-3671.
- Mont L, Pelliccia A, Sharma S, et al. Pre-participation cardiovascular evaluation for athletic participants to prevent sudden death: Position paper from the EHRA and the EACPR, branches of the ESC. Endorsed by APHRS, HRS, and SOLAECE. *Europace* 2017; 19: 139-163.

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## 4.2 Manage the work-up of an athlete with suspected or known cardiovascular disease

<b>Description</b>  <b>Scope and timeframe:</b> Leisure-time and competitive athletes, from the time the athlete with suspected or known CVD self-refers or is referred for a consultation until regular follow-up  <b>Setting:</b> Most commonly out-patient setting, but also in-patient setting and emergency department  <b>Including:</b> Assessment with history, physical examination, basic and advanced tools for investigation, differentiation of physiological adaptation to exercise from phenotypes of CVD, identification of risk factors for sudden cardiac death and high-risk conditions, recommendation of lifestyle and pharmacological treatment, exercise prescription and counselling on leisure-time and competitive sports  <b>Excluding:</b> Performing specialist investigations or interventional or surgical procedures, interpreting genetic test results
<b>CanMEDS-Roles</b> <ul style="list-style-type: none"><li>• Medical expert</li><li>• Communicator</li><li>• Collaborator</li><li>• Leader</li><li>• Health advocate</li><li>• Scholar</li><li>• Professional</li></ul>
<b>Knowledge</b> <ul style="list-style-type: none"><li>• Describe phenotypes of physiological adaptation to exercise</li><li>• Recognize the challenges of differentiating athlete's heart from heart disease</li><li>• Identify risk factors for sudden cardiac death and high-risk conditions</li><li>• Outline non-pharmacological and pharmacological treatment of athletes with common CV conditions</li><li>• Outline exercise recommendations in athletes with CVD</li><li>• Recognize the ethical and legal considerations of disqualification from competitive sports participation</li></ul>
<b>Skills</b> <ul style="list-style-type: none"><li>• Obtain a focused history and perform appropriate physical examination</li></ul>

<ul style="list-style-type: none"> <li>Propose and perform appropriate non-invasive, first-line clinical investigations (12-lead ECG, transthoracic echocardiogram, exercise testing/CPET, ECG monitor) to assess athletes with suspected or known cardiac disease</li> <li>Propose further appropriate advanced investigations, including genetic testing</li> <li>Integrate the results in an interdisciplinary setting</li> <li>Illustrate how risk stratification of athletes with CVD informs their management</li> <li>Prescribe tailored exercise recommendations based on CPET</li> <li>Implement recommendations for exercise prescription and eligibility for participation in competitive sport in athletes with cardiac disease</li> <li>Prescribe comprehensive CV prevention and rehabilitation for athletes with CVD, if indicated, and adopt programmes appropriately</li> </ul>
<p><b>Attitudes</b></p> <ul style="list-style-type: none"> <li>Integrate the results of investigations in an interdisciplinary setting</li> <li>Communicate effectively results and exercise recommendations to the athletes, team doctors, coaches, families</li> <li>Promote a shared-decision making model, particularly in conditions with limited evidence relating to the risk of exercise</li> <li>Adopt a holistic approach to the impact of exercise restriction and disqualification from competitive sports on an athlete, in terms of psychological, physical and financial wellbeing</li> </ul>
<p><b>Assessment tools</b></p> <ul style="list-style-type: none"> <li>MCQs</li> <li>Direct observation, workplace-based assessments ( e.g. DOPS, mini-CEX, fieldnotes)</li> <li>Case-based discussions, entrustment-based discussions</li> <li>Multiple consultant reports</li> <li>Multi-source feedback</li> </ul>
<p><b>Level of Independence</b></p> <ul style="list-style-type: none"> <li>Level 4 (perform the activity under distant supervision . In this context this means to work in a network with dedicated sports cardiology referral centres in complicated cases.)</li> </ul>
<p><b>Related ESC Guidelines and EAPC Position Papers</b></p> <ul style="list-style-type: none"> <li>Pelliccia A, Sharma S, Gati S, et al. 2020 ESC Guidelines on sports cardiology and exercise in patients with cardiovascular disease. Eur Heart J. 2020 Aug 29. DOI: 10.1093/eurheartj/ehaa605.</li> <li>Budts W, Pieles GE, Roos-Hesselink JW, et al. Recommendations for participation in competitive sport in adolescent and adult athletes with Congenital Heart Disease (CHD): position statement of the Sports Cardiology &amp; Exercise Section of the European Association of Preventive Cardiology (EAPC), the European Society of Cardiology (ESC) Working Group on Adult Congenital Heart Disease and the Sports Cardiology, Physical Activity and Prevention Working Group of the Association for European Paediatric and Congenital Cardiology (AEPC). Eur Heart J. 2020 Aug 26. DOI: 10.1093/eurheartj/ehaa501.</li> <li>Heidbuchel H, Adami PE, Antz M, et al. Recommendations for participation in leisure-time physical activity and competitive sports in patients with arrhythmias and potentially arrhythmogenic conditions:</li> </ul>

Part 1: Supraventricular arrhythmias. A position statement of the Section of Sports Cardiology and Exercise from the European Association of Preventive Cardiology (EAPC) and the European Heart Rhythm Association (EHRA), both associations of the European Society of Cardiology. Eur J Prev Cardiol. 2020 Jun 29. DOI: 10.1177/2047487320925635.

- Heidbuchel H, Arbelo E, D'Ascenzi F, et al. Recommendations for participation in leisure-time physical activity and competitive sports of patients with arrhythmias and potentially arrhythmogenic conditions. Part 2: ventricular arrhythmias, channelopathies, and implantable defibrillators. Europace. 2020 Jun 29. DOI: 10.1093/europace/euaa106.
- Pelliccia A, Solberg EE, Papadakis M, et al. Recommendations for participation in competitive and leisure time sport in athletes with cardiomyopathies, myocarditis, and pericarditis: position statement of the Sport Cardiology Section of the European Association of Preventive Cardiology (EAPC). Eur Heart J. 2019;40:19-33.
- Borjesson M, Dellborg M, Niebauer J, et al. Recommendations for participation in leisure time or competitive sports in athletes-patients with coronary artery disease: a position statement from the Sports Cardiology Section of the European Association of Preventive Cardiology (EAPC). Eur Heart J. 2019;40:13-18.
- Niebauer J, Borjesson M, Carre F, et al. Recommendations for participation in competitive sports of athletes with arterial hypertension: a position statement from the sports cardiology section of the European Association of Preventive Cardiology (EAPC). Eur Heart J. 2018;39:3664-3671.

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420 **Chapter 5: Cardiopulmonary exercise testing**

421 **5.1 Use cardiopulmonary exercise testing for diagnosis, risk stratification and**  
 422 **exercise prescription**

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Description
<p><b>Scope and timeframe:</b>            Healthy individuals, athletes, individuals with CVD risk factors, and CVD patients. From indication for using CPET until communicating the results</p> <p><b>Setting:</b>            In-patient, out-patient, exercise physiology laboratory, on field</p> <p><b>Including:</b>            Performing a comprehensive CPET on a bicycle or treadmill, or other types of ergometers, or using mobile devices under real-life conditions (i.e. patient's workplace, athlete on the field), with and without invasive measurements, interpreting and reporting the results</p> <p><b>Excluding:</b>            Complex cases with a predominant pulmonary problem which should be managed in cooperation with a pulmonary specialist</p>
CanMEDS-Roles
<ul style="list-style-type: none"> <li>• Medical expert</li> </ul>

<ul style="list-style-type: none"> <li>• Communicator</li> <li>• Collaborator</li> <li>• Scholar</li> <li>• Professional</li> </ul>
<p><b>Knowledge</b></p> <ul style="list-style-type: none"> <li>• Understand CV exercise physiology and cardiorespiratory fitness</li> <li>• List the indications and contraindications for CPET in healthy individuals, patients with CVD, and athletes</li> <li>• Know the risk of CPET in infertile patients and preventive measures for the personal</li> <li>• Know the potential complications of CPET</li> <li>• Define the key variables of CPET</li> <li>• Discuss the interpretation of the nine-panel plot</li> <li>• Discuss the indications for and value of additional blood gas analysis</li> <li>• Describe patterns of pulmonary, cardiac, and muscular conditions</li> <li>• List and detect pitfalls and artefacts of CPET</li> <li>• Describe the role of combining CPET with other (hemodynamic) evaluations (e.g. echocardiography, right heart catheterization)</li> <li>• Describe the overlapping and discriminating concepts of CPET and lactate testing</li> </ul>
<p><b>Skills</b></p> <ul style="list-style-type: none"> <li>• Apply appropriate indications and avoid contraindication to CPET</li> <li>• Perform CPET calibration and quality control</li> <li>• Prepare the patient or athlete</li> <li>• Choose the appropriate exercise protocol and device</li> <li>• Interpret the nine-panel plot</li> <li>• Formulate a function-based diagnosis and prognostic stratification</li> <li>• Formulate exercise training recommendations based on ventilatory thresholds</li> <li>• Communicate the results appropriately</li> </ul>
<p><b>Attitudes</b></p> <ul style="list-style-type: none"> <li>• Integrate CPET in the evaluation of healthy individuals, CV patients and athletes</li> <li>• Recognise the strengths and weaknesses of CPET in a clinical situation and in relation to other diagnostic modalities</li> <li>• Interact cooperatively with sports physicians, sports scientists, and paramedical staff involved in the execution of the test</li> </ul>
<p><b>Assessment tools</b></p> <ul style="list-style-type: none"> <li>• MCQs</li> <li>• Direct observation, workplace-based assessments ( e.g. DOPS, mini-CEX, fieldnotes)</li> <li>• Case-based discussions, entrustment-based discussions</li> <li>• Multiple consultant reports</li> </ul>
<p><b>Level of Independence</b></p> <ul style="list-style-type: none"> <li>• Level 5 (perform the activity without supervision, teach and supervise others)</li> </ul>

### Related ESC Guidelines and EAPC Position Papers

- Guazzi M, Adams V, Conraads V, et al. EACPR/AHA Joint Scientific Statement. Clinical recommendations for cardiopulmonary exercise testing data assessment in specific patient populations. *Eur Heart J* 2012; 33: 2917-2927.
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### 426 **Figure Legends**

427 **Figure 1** Preventive cardiology – domains, necessary competencies, and cooperation partners  
428 CPET, cardiopulmonary exercise testing; CV, cardiovascular

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430 **Figure 2** Lifelong CVD prevention from the cradle to the grave and beyond<sup>31</sup>

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