Challenges in secondary prevention after acute myocardial infarction: A call for action

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Abstract

Worldwide, each year more than 7 million people experience myocardial infarction, in which one-year mortality rates are now in the range of 10%, but vary with patient characteristics. The consequences are even more dramatic: among patients who survive, 20% suffer a second cardiovascular event in the first year and approximately 50% of major coronary events occur in those with a previous hospital discharge diagnosis of ischaemic heart disease. The people behind these numbers spur this call for action. Prevention after myocardial infarction is crucial to reduce risk and suffering. Evidence-based interventions include optimal medical treatment with anti-platelets and statins, achievement of blood pressure, lipid and blood glucose targets, and appropriate lifestyle changes.

The European Society of Cardiology and its constituent bodies are determined to embrace this challenge by developing a consensus document in which the existing gaps for secondary prevention strategies are reviewed. Effective interventions in relation to the patients, healthcare providers and healthcare systems are proposed and discussed. Finally, innovative strategies in hospital as well as in outpatient and long-term settings are endorsed.

Keywords

Cardiovascular prevention, myocardial infarction, cardiac rehabilitation, risk factors, pharmacological therapy, exercise training, healthcare systems

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Disease burden

Worldwide, each year more than 7 million people experience acute myocardial infarction (AMI), and although substantial reductions in mortality have been experienced in recent decades, one-year mortality rates are still in the range of 10%, varying with patient characteristics. In the Swedish SCAAR registry one-year mortality rates were approximately 10% among patients aged 70–79 years and 24% among patients aged 80–90 years. The consequences of AMI are more dramatic: among patients who survive an AMI, 20% suffer a second cardiovascular event in the first year and approximately 50% of major coronary events occur in those with a previous hospital discharge diagnosis of AMI.

While early events are related to ruptured coronary plaques and associated thrombosis, the majority of later events may be the result of coronary and systemic atherosclerosis progression. Thus it is being increasingly appreciated that evidence-based long-term management of ischaemic heart disease (IHD) is critical to achieve optimal reduction in mortality and morbidity. Prevention after AMI is a crucial part of this, and is associated with improved prognosis with evidence-based interventions, such as optimal medical treatment, appropriate lifestyle changes and cardiovascular risk factor control. Importantly, the impact of lifestyle change after AMI has a rapid onset: patients who adhere to exercise and diet recommendations have a 54% lower risk and smokers who quit smoking a 43% lower risk of recurrent events six months after AMI.

Despite this compelling evidence, preventive care post AMI remains sub-optimal. Cross-sectional data from the serially conducted EUROASPIRE surveys across Europe in both patients with established IHD and people at high cardiovascular risk have demonstrated a high prevalence of unhealthy lifestyles, modifiable risk factors and inadequate use of drug therapies to achieve blood pressure and lipid goals. Most recently, in the fourth survey of coronary patients, after a median time of 1.35 years after their acute event, 48.6% of patients who were smoking at the time of their event persisted in smoking, little or no physical activity was reported in nearly two thirds of interviewees, over a third (37.6%) were obese, 42.7% had blood pressure ≥140/90 mmHg (≥140/80 in people with diabetes), 80.5% had low-density lipoprotein (LDL) cholesterol ≥1.8 mmol/L and in those with diabetes, glucose control was relatively poor, with less than half reaching the guideline target of haemoglobin A1c (HbA1c) of <7.0%.

Similarly, an Italian multicentre registry study performed in 2010–2012 showed in 11,706 patients from 163 large-volume coronary care units, that at six months drug adherence was 90%, but the recommended targets of blood pressure (<140/90 mmHg) were reached in only 74%, LDL (<1.8 mmol/l) in 76%, HbA1c (<7% in treated people with diabetes) in 45% and smoking cessation only in 73% of the participant patients.

Secondary prevention

Secondary prevention programmes, defined as the level of preventive care focusing on early risk stratification, use of referral services and initiation of treatment to stop the progress of an established disease process, are highly recommended in all IHD patients, to restore quality of life, maintain or improve functional capacity and prevent recurrence. Cardiac rehabilitation, operationally defined here as a structured multidisciplinary intervention for cardiovascular risk assessment and management, advice on physical activity, psychosocial support and the appropriate prescription and adherence to cardioprotective drugs, is the most investigated modality of secondary prevention interventions. Its core components in post-AMI patients well identified (Table 1).

Although traditionally divided into three phases (e.g. inpatient, outpatient, long-term intervention), in reality secondary prevention is a continuous lifelong process, a care pathway that follows the patient journey, made up of key stages that need to occur to enable patients to achieve the return to a normal life. Settings vary in different countries, according to local and national regulations and experiences, involving residential, ambulatory community, or home-based programmes. While the objectives are identical to those for outpatients, residential inpatient programmes are specifically structured to provide more intensive and/or complex interventions, reserved for high-risk patients.

Preventive services in the community offer the opportunity to maintain the benefits in the long term, with potential for overcoming existing barriers to healthcare such as distance, unfamiliarity and fear/distrust of hospitals, allowing the delivery of a programme that is best placed (i.e. ‘tailored’) to meet individual needs. EUROACTION and GOSPEL interventions provided scientific evidence for a beneficial long-term effect of community-based programmes. The EUROACTION study tested a comprehensive, nurse-led, family centred and multidisciplinary model of preventive and rehabilitative care in eight countries in Europe, and was subsequently set up as an integrated community centred service in the UK (MyAction) providing care for both vascular patients and those at high cardiovascular risk, while the GOSPEL study is an Italian long-term multifactorial educational and behavioral intervention (coordinated by a cardiologist) after a standard rehabilitation programme following AMI.
The existing health-economic literature supports comprehensive secondary prevention as a relatively more cost-effective intervention in IHD patients, in comparison to invasive therapies or cardiac surgery.\textsuperscript{22} Given the current economic challenges in healthcare it is noteworthy that in low and middle-income countries, cardiac prevention has been demonstrated to be both effective and cost-effective.\textsuperscript{23}

### Identification of gaps and potential solutions in implementation

Despite the availability of suitable secondary prevention programmes, only one third to one half of eligible patients are referred\textsuperscript{24} or finally take up a preventive programme.\textsuperscript{25} A plethora of research indicates that patient, healthcare provider and/or health system-based barriers all hold responsibility for this (Table 2).\textsuperscript{26}

#### Patient-related gaps

**Education and empowerment.** Patients with IHD understand poorly their disease and perceive themselves as having little control over its course, many lack interest in prevention and/or feel embarrassed about participating in preventive group sessions. Most of them report not receiving robust information and/or encouragement from physicians and other health professionals regarding how to prevent recurrent events.\textsuperscript{27}

Other factors, which hinder attendance, include lack of social support, poor psychological wellbeing, inconvenient location with transport difficulties, competing work commitments and financial cost.\textsuperscript{16}

Inadequacies and time constraints related to education and counselling of patients before they leave hospital lead to deficiencies in implementation of preventive care later on. Patients who have a clear understanding of their after-hospital care instructions are 30\% less likely to be readmitted or to visit the emergency department than patients who lack this information.\textsuperscript{28} Patients discharged from the hospital with a clear guideline-oriented treatment recommendation, a checklist of measures to ensure risk modification and lifestyle change provided in the discharge letter, educated to care for themselves and to know how or when to seek follow-up care, can better understand the importance of this information and its potential impact.\textsuperscript{29}

A wide variety of techniques and combinations of techniques has also been evaluated, but only self-monitoring of physical activity and action planning or coping strategies targeting barriers seem to be helpful (Table 3).\textsuperscript{30}

#### Adherence to healthy lifestyle interventions

A systematic review and meta-analysis of adherence to

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**Table 1. Components of secondary prevention in post-AMI patients.**

<table>
<thead>
<tr>
<th>Interventions</th>
<th>Components</th>
</tr>
</thead>
</table>
| Risk factor modification/lifestyle interventions | • Healthy diet  
• Physical activity  
• Weight control  
• Smoking cessation  
• Stop alcohol abuse |
| Preventive medications         | • Antithrombotic therapies  
• Beta-blockers  
• ACE inhibitors/ARBs/aldosterone antagonists (if depressed left ventricular function)  
• Statins |
| Management of comorbidities    | • Obesity  
• Dyslipidaemia  
• Arterial hypertension  
• Diabetes  
• Heart failure  
• Arrhythmia/arrhythmia risk |
| Psychosocial factors           | • Social isolation  
• Depression, stress, and anxiety  
• Sexual activity |
| Multidisciplinary team follow-up | • Cardiologist  
• Primary care  
• Advanced practice nurse/physician assistant  
• Other relevant medical specialists  
• Other non-medical specialists (e.g. physiotherapist, psychologist, pharmacist, dietician, vocational specialist) |
| Patient/family education       | • Plan of care  
• Education  
• Recognition of symptoms, signs and symptoms for urgent vs. emergency evaluations  
• Risk factor control  
• Activating EMS  
• CPR training for family members  
• Advanced directives |
| Socioeconomic and healthcare factors | • Access to health insurance coverage  
• Access to healthcare providers  
• Disability  
• Social services  
• Social networks  
• Community services  
• Electronic personal health records |

ACI: acute myocardial infarction; ACE: angiotensin-converting enzyme; ARB: angiotensin receptor inhibitors; CPR: cardiopulmonary resuscitation; EMS: emergency medical system.
cardioprotective medicines in more than 350,000 patients found low adherence in both individuals at high cardiovascular risk (66%) and in patients with cardiovascular disease (CVD) (50%) a median of two years after initiation of a prescription. This results in worse outcomes and higher healthcare costs. The reasons for non-adherence are complex and influenced by factors including demography, socioeconomic factors, health systems factors, intensity of follow-up, time since last provider visit, adverse effects of therapy, complex medication regimens and health literacy (Table 2). For these reasons, the healthcare provider should assess not only adherence to medication, but also identify reasons, and promote adherence according to established principles (Table 4). In this aspect, the active role of the pharmacist should be encouraged: in the UK, the new pharmacist-led medicines optimisation clinic is a model of implementation of the contribution of the pharmacist to support patients post-myocardial infarction (MI).

A Cochrane review of interventions to improve medication adherence advised drawing on the support of allied professionals such as nurses and pharmacists to deliver complex interventions, which may include telephone follow-up, interim appointments and monitoring of repeat prescriptions. Drawing on the support of non-professional people within the social context of the patient, such as spouses, other family members, carers or other key figures, and lay groups in the community, may prove to be a cost-effective way to improve adherence. However, the review acknowledged

Table 2. Factors leading to therapeutic inertia in cardiovascular prevention, attributed to patient level, clinician/healthcare provider level and healthcare system level.

<table>
<thead>
<tr>
<th>Patient</th>
<th>Clinician/healthcare provider</th>
<th>Healthcare system</th>
</tr>
</thead>
<tbody>
<tr>
<td>Medication side-effects</td>
<td>Failure to initiate treatment</td>
<td>Lack of clinical guideline</td>
</tr>
<tr>
<td>Too many medications</td>
<td>Failure to titrate to goal</td>
<td>Lack of care coordination</td>
</tr>
<tr>
<td>Cost of medications</td>
<td>Failure to set clear goals</td>
<td>No visit planning</td>
</tr>
<tr>
<td>Denial of disease</td>
<td>Underestimation of patient need</td>
<td>Lack of decision support</td>
</tr>
<tr>
<td>Denial of disease severity</td>
<td>Failure to identify and manage comorbid conditions</td>
<td>Poor communication between physician and others involved in a patient’s healthcare provision</td>
</tr>
<tr>
<td>Forgetfulness</td>
<td>Insufficient time</td>
<td>No disease registry</td>
</tr>
<tr>
<td>Perception of low susceptibility</td>
<td>Insufficient focus of emphasis on goal attainment</td>
<td>No active outreach</td>
</tr>
<tr>
<td>Absence of disease symptoms</td>
<td>Reactive rather than proactive</td>
<td>Perverse incentives</td>
</tr>
<tr>
<td>Poor communication with physician</td>
<td>Poor communication skills</td>
<td>Pressure to shorten length of hospital stay</td>
</tr>
<tr>
<td>Mistrust of physician</td>
<td>Shortage of time</td>
<td>Healthcare systems focused on acute care (hospital-based health systems)</td>
</tr>
<tr>
<td>Depression, mental disease, substance abuse</td>
<td>Poor awareness on value of preventive measure</td>
<td>Lack of preventive structure</td>
</tr>
<tr>
<td>Low health literacy/poor awareness on value of preventive measure</td>
<td></td>
<td>Poorly designed preventive programmes/lack of quality control</td>
</tr>
</tbody>
</table>

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that such interventions may be difficult to replicate in everyday clinical care due to cost and availability of personnel.

**Table 4. Adherence factors.**

- ‘Agree’ rather than ‘dictate’ a drug regimen and tailor it to personal lifestyle and needs
- Provide advice regarding benefits and possible adverse effects of medications, and duration and timing of doses
- Consider patients’ habits and preferences, encourage self-monitoring, use of cues and technologies to act as reminders
- Reduce dosage demands to the lowest feasible level and simplify the dosing regimen when possible
- Ask patients in a non-judgemental way how the medication works
- Back up verbal instructions with clear written instructions
- Implement repetitive monitoring and feedback and regular review of medicines to minimise polypharmacy
- Introduce trained nurses or physician assistants if needed and feasible
- Promoting the active role of the pharmacist in assessing drug adherence and in encouraging patients to discuss their medicines and any concerns they may have about them
- Involve the partner, other family member or carer in the patient’s treatment
- In case of persistent non-adherence, offer multisession or combined behavioural intervention

**Healthcare provider gaps**

**Healthcare providers’ knowledge and motivation.** In the description of the core curriculum for the cardiologist, the European Society of Cardiology (ESC) defines in detail the knowledge needed in regard to secondary prevention, including evaluation and management of cardiovascular risk, as well as the provision of appropriate prevention to CVD patients. However, it is questionable whether such requirements are part of the curriculum of most cardiologists or specialist allied health professionals trained in Europe. This gap in knowledge and motivation also apply to general practitioners (GPs) and non-cardiology healthcare professionals and need to be closed, by specific educational training.

Furthermore, for decades, much attention and many resources have been directed at encouraging physicians and providers to shift care as much as possible away from costly inpatient hospital stays towards less expensive outpatient treatment. Among the most important metrics for gauging the success of this endeavour is the shortening of the hospital length of stay, early discharge even directly from intensive care units, although real savings have not been proved. This leaves a limited amount of time for information and education. In addition, it does not allow for optimisation of risk stratification and secondary prevention therapy, particularly medication dose titration prior to hospital discharge.

**Risk stratification.** Risk stratification is the prerequisite for improving care management. Because the risk of events decreases with time, early assessment (e.g. infarct size and resting left ventricular function) is crucial before discharge. Current guidelines recommend evaluation of metabolic risk markers during the index admission, such as fitness level, body mass index, LDL cholesterol, fasting glucose level.

**Post-discharge plan.** Strategies effective to increase uptake include not only patient education and empowerment (see section on Education and empowerment above) but also, at post-hospital discharge, the development of gender-tailored sessions, structured follow-up via either telephone call or visit by a healthcare professional or both, a specific programme for older patients and planned early appointments to programmes.
challenge, as only about half of the GPs use guidelines in everyday practice and knowledge of treatment goals is often insufficient. Delayed communication or inaccuracies in information transfer among healthcare professionals has substantial implications for continuity of care, patient safety, patient and clinician satisfaction and resource use.6

Educational meetings, audit and feedback, with local opinion leaders and access to computer decision support devices can lead to improved continuity of care.47 Regular review and feedback of patient education in primary care leads to improved adherence to lifestyle advice (more physical activity, better diet), reduced symptoms, improved quality of life and reduced mortality.48 In the UK, the clinical indicators of GPs’ performance in chronic disease monitoring include checklists relating to medication and risk factor control, and engagement in this process is incentivised by financial reward.49

Healthcare systems gaps

Patients consistently cite physicians and other healthcare providers as the main sources of encouragement for subsequent participation in preventive programmes.30 Unfortunately, several factors negatively influence current referral rates.

Availability of structured secondary prevention programme. The lack of prevention centres constitutes an obstacle to the implementation of rehabilitation programmes in many European areas but particularly in less advantaged regions.50

Referral to structured secondary prevention intervention. Lack of referral is an important impediment to participation in preventive programmes. The presence of inter-hospital variability in referral rates suggests that several healthcare system factors might have a strong influence, including insurance coverage, hospital characteristics (dimension, geographical location) and other unidentified factors.50 Limited financial incentives for the physician to implement preventive measures and the pressures of competing workload priorities may negatively influence current referral rates.51

Various strategies can address the lack of referral and improve enrolment (Figure 1).52 Systematic processes such as automatic referral and liaison systems to connect cardiac patients with the preventive programme have been developed and can increase referral rates by more than 50%.53 Evidence is emerging to suggest that mechanisms to support automatic patient referral via electronic health records or discharge protocols are effective in increasing referral. Strength of physician endorsement for referring cardiac patients is a pivotal step to improve participation and its associated improved outcomes after AMI.53

Performance indicators. The lack of benefit from some interventions (e.g. RAMIT trial)54 highlights the need for quality and minimum standards in the delivery of preventive programmes. Audit and control of the programmes should include information about the core components and their implementation, results with clinical outcomes and patient satisfaction. Benchmarking against local, regional and national standards provides measures of performance and quality for commissioners and services providers.15 Accountability measures, including referral performance/quality indicators (e.g. percentage of cardiac patients referred to programmes) and financial incentives for centres performing well on the quality indicators should increase physicians’ willingness to refer and improve the delivery of prevention. Furthermore, the appropriate prescription of evidence-based medications (e.g. lipid-lowering drugs, antiplatelets) the titration of vasodilators, such as angiotensin-converting enzyme inhibitors or angiotensin receptor blockers and beta-blockers are well recognised performance indicators.15

Table 5 enumerates some examples of interventions on a patient, provider and system level.

The way ahead: embracing current challenges

In-hospital or acute intervention

This represents the earliest intervention, beginning immediately after the acute event during the hospital stay, and it should be given as high a priority as initial acute care. Acknowledging the formally shared responsibilities of all professionals involved in the cardiac patient’s care (i.e. nurses, GPs, intensivists, acute invasive cardiologists and cardiovascular surgeons) provides the first avenue. However, convincing all acute care clinicians remains challenging and is related to both the individual professional and the healthcare organisation.55 Poor knowledge regarding the benefits of the early initiation of secondary prevention could be a possible explanation. This underscores the need to increase awareness and to provide information regarding the available evidence. As a collaborative initiative, the European Association for Cardiovascular Prevention and Rehabilitation (EACPR), Acute Cardiovascular Care Association (ACCA) and Council on Cardiovascular Nursing and Allied Professions (CCNAP) elaborated videos on the benefits and challenges of secondary prevention after AMI (http://escardio.org/The-ESC/Communities/European-Association-for-Cardiovascular-Prevention-Rehabilitation)28...
Figure 1. Strategies to address the lack of referral and improve enrolment in cardiovascular secondary prevention programme.
### Table 5. Examples of cardiovascular preventive intervention at patient, provider and system level (adapted from Nieuwlaat et al.47).

<table>
<thead>
<tr>
<th>Example of intervention</th>
<th>Description</th>
<th>Effect</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Patient-level interventions</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Patient decision aids</td>
<td>Tools that help people become involved in decision-making by providing information about the options and outcomes of a treatment, and clarifying personal values</td>
<td>60% increase in accuracy of patient’s risk perception</td>
</tr>
<tr>
<td></td>
<td></td>
<td>30% reduction in post-menopausal hormone use</td>
</tr>
<tr>
<td></td>
<td></td>
<td>20% reduction in discretionary surgery</td>
</tr>
<tr>
<td>Self-management</td>
<td>Patients monitoring themselves, and making medication dosing decisions, with healthcare provider back-up</td>
<td>49% reduction in thrombotic events in self-management of vitamin K antagonist</td>
</tr>
<tr>
<td></td>
<td></td>
<td>56% reduction in heart failure hospitalisations in self-management of heart failure</td>
</tr>
<tr>
<td><strong>Provider-level interventions</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Continuing education meetings</td>
<td>Conferences, lectures, workshops, seminars, symposia, and courses for health professionals</td>
<td>6–10% increase in uptake of recommended care</td>
</tr>
<tr>
<td>Audit and feedback</td>
<td>Any summary of clinical performance over a specified period of time, given in a written, electronic or verbal format</td>
<td>5–16% increase in the uptake of recommended diagnostic and therapeutic strategies</td>
</tr>
<tr>
<td>Educational outreach visits</td>
<td>Visits by a trained person to health professionals. ‘Face-to-face’ visits, also referred to as academic detailing</td>
<td>5.6–21% increase in uptake of recommended care</td>
</tr>
<tr>
<td>Local opinion leaders</td>
<td>Healthcare professionals considered by colleagues as ‘educationally influential’</td>
<td>12% increase in uptake of recommended care</td>
</tr>
<tr>
<td>Computer-assisted clinical decision support</td>
<td>Automated clinical decision advice, based on individual patient data</td>
<td>Modest effects on process of care for a range of management issues</td>
</tr>
<tr>
<td><strong>Organizational/system-level interventions</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Clinical pathways</td>
<td>Structured multidisciplinary care plans used by health services to detail essential steps in the care of patients with a specific clinical problem</td>
<td>42% reduction of in-hospital complications for patients undergoing an intervention, primarily surgery</td>
</tr>
<tr>
<td></td>
<td></td>
<td>12% improvement of documentation in medical records</td>
</tr>
<tr>
<td>Financial incentives</td>
<td>Financial reward for professionals for affecting behaviour, including for a specified time period of work; for each service, episode or visit; for a patient or specific population; for providing a prespecified level or providing a change in activity or quality of care</td>
<td>Potential improvement in practice, but effects on patient outcomes are unknown</td>
</tr>
<tr>
<td>Legislation-based smoking bans</td>
<td>Legislative smoking bans and restrictions affecting populations</td>
<td>Reduction in admissions for acute coronary syndromes, related to improvements in first-hand and second-hand smoking exposure</td>
</tr>
</tbody>
</table>
programmes. Professionals in primary care are essential alternatives to traditional inpatient and/or outpatient nurse-coordinated and family-based care, can be valuable. Adapted preventive cardiology programmes, such as Adapted preventive programmes and community services. Telecommunication technologies. Recent developments in telecommunications have enabled the advent of new preventive delivery strategies, supplementing conventional centre-based services to expand their capabilities and to address the broad and extensive range of barriers preventing cardiac patients from participating. As such, cardiac telemedicine was introduced, that is, a comprehensive mHealth mode of care delivery, as a personalised prevention tool for cardiac patients to manage their own recovery and to prevent recurrent events remotely. The optimal programme consists of several modules devoted to monitoring, coaching, e-learning, social interaction and two-way communication with the caregiver. Adapted preventive programmes and community services. Adapted preventive cardiology programmes, such as nurse-coordinated and family-based care, can be valuable alternatives to traditional inpatient and/or outpatient programmes. Professionals in primary care are essential for this task as they often have detailed knowledge of an individual’s social, medical and/or cultural background. This applies especially for the disadvantaged groups (poor, less educated and older people), who are most likely to drop out. New models of individualised interventions. Efforts are waged to individualise programmes based on patient stratification to maximise clinical benefit and optimise safety. This can be achieved by prescribing patient-specific and tailored programmes, based on differing combinations of cardiovascular risk factors, underlying cardiac disease processes and/or exercise modifiers. Currently, the EXPERT (EXercise Prescription in Everyday practice & Rehabilitative Training) flowchart project, combining the collaborative work and knowledge of more than 35 experts (out of 11 European countries) in the rehabilitation of chronic internal diseases is being elaborated. It aims to aid future physicians in defining such individualised training programmes, based on the existing guidelines and position papers for different patient populations.

Focus on the identification of frailty syndrome post-AMI and high-risk patients. Patients with frailty syndrome, that is, older than 65 years, characterised by vulnerability to stress-related factors and a decrease in physiological reserves, suffer more often from AMI (15.4% vs. 7.4%), with increased mortality and hospitalisation risk after the index cardiac event. Future efforts need to focus on improved frailty identification, and to adapt/intensify prevention programmes, by adjusting medical therapies, modifying dosages and rehabilitative protocols. Several prognostic scores were developed specifically to identify the post-AMI patients being at highest risk for future adverse events (the Global Registry of Acute Coronary Events (GRACE) score and ACHTUNG-Rule). Long-term prevention Long-term adherence to healthy lifestyles and medications. It constitutes a joint lifelong effort of patient, primary care physician, nurse, therapist and cardiologist. In this era of an ever increasing CVD epidemic, most current cardiac centres do not have the capacity to deliver long-term supervised and centre-based prevention to all eligible patients. One model might be to transfer resources from short-duration residential services to longer-duration outpatient services of lesser intensity, designed for lower-risk patients, but of larger number. A successful example already implemented in routine clinical practice for low-risk patients is the EUROACTION model: all aspects of a healthy lifestyle, comprehensive risk factor management and appropriate use of cardioprotective drugs are addressed, without the use of specialised hospital or community facilities. In other countries, such as Italy, sport-medicine specialists, operating in selected community-based sport medicine centres, in collaboration with specially trained physiotherapists, have developed dedicated programmes for exercise-based rehabilitation, follow-up and care in low-risk patients. Home-based programmes can be equally effective as centre based and tele-interventions can be efficacious in both the medium and long term, encouraging large-scale deployment of innovative models of care delivery.

Finally, a fixed dose combination tablet (also called polypill) was shown to improve adherence compared to separate medications. However, potential adverse effects of a single drug component cannot be specifically corrected and therefore may also affect the treatment adherence to the other components.
Pharmacological strategies to strengthen long-term secondary prevention. Recent progress in drug strategies have widened the possibility in CVD prevention. Three issues in particular are considered here: (a) enhanced lipid-lowering therapy in addition to statins, according to the evidence of the efficacy of monoclonal antibodies targeted to proprotein convertase subtilisin/kexin type 9 (PCSK9)\(^6\), and of the ezetimibe added therapy;\(^6\) (b) enhanced antithrombotic therapy in which new options have been demonstrated to be particularly effective in further reducing coronary events, such as prolonged up to 30 months (in contrast to recommended 12 months) after acute coronary events dual antiplatelet therapy (DAPT);\(^6,7\) and in particular the combination of aspirin and ticagrelor,\(^6,8\) and the addition of new anticoagulants, such as rivaroxaban, to DAPT;\(^6,9\) (c) enhanced blood pressure control to improve outcome, as shown by new strategies involving spironolactone add-on therapy in resistant hypertension,\(^70\) amiloride plus hydrochlorothiazide in patients requiring a diuretic,\(^7\) and finally by a research protocol in which a lower blood pressure target of 120 mmHg in patients at high cardiovascular risk was associated with higher survival.\(^7,2\)

These advances open new possibilities in long-term secondary prevention after AMI. However, the cost is high, from both a clinical perspective (potential serious side-effects) and from an economic perspective, to make it unlikely that these pharmacological strategies will be widely indicated for reducing residual risk in the near future. For this reason, identification of the highest-risk patients is pertinent, that is, those who are most likely to benefit from very intense preventive therapy.

Moving forward and improving care delivery

The role of the government. National legislation regarding preventive programmes is absent in 54% of the participating countries to the European Cardiac Rehabilitation Inventory Survey (ECRIS).\(^1\) Legislation provides an imperative to make available and to optimise services, and needs to be extended to all countries if citizens of Europe are to be treated equitably. The national societies of cardiology are therefore encouraged to lobby their respective governments to promote this. The role of the ESC in relation to advocacy at a European level is crucial for setting standards and for promoting good practice among its members.

The role of the health insurance industry. As noted by ECRIS, in 46% of European countries, patients covered the total cost for the long-term intervention, while in 18% of countries, patients received a small financial support from patient clubs and private health insurance companies. Given the well established clinical benefits of the long-term persistence of a healthy lifestyle in secondary prevention, efforts to convince the health insurance industry to support long-term prevention programmes are justified. Higher reimbursement to systems that provide high-value evidence-based care and incentives for individuals with persistent adherence to healthy lifestyle changes should be encouraged.

The role of professional organisations. Numerous professional and European-wide organisations such as the ESC, EACPR, ACCA and CCNAP are committed to the different facets of secondary prevention after AMI. They have an important cross-fertilising role in sharing expertise and in supporting colleagues to develop better services. By collaborative efforts in establishing professional guidelines, cutting-edge scientific research and implementing initiatives that encourage good clinical practice; they play a pivotal role in assuring the flourishing of secondary prevention. As an example, the EACPR, the ESC and the Heart Failure Association of the ESC support the preventive cardiology, sports cardiology and exercise based rehabilitation – from set-up to new frontiers course (https://www.escardio.org/static_file/Escardio/Subspecialty/HFA/Education/EACPR_HFA_Exercise%20Training%20Programme%202015.pdf). This course enabled secondary prevention experts to accelerate their knowledge sharing with colleagues in the field.

Need for further research

Future research should focus on cost-effectiveness evaluations of novel care delivery strategies, to inform policy makers how limited healthcare resources should be allocated. Each nation and European partners should look to audit their own services against clinical minimum standards in delivery and outcomes. The development of action plans by the different individual stakeholders to move forward and improve care delivery is urgently needed.

Author contribution

MFP and UC contributed to the conception and design of the work and drafted the manuscript. All authors critically revised the manuscript and gave final approval and agree to be accountable for all aspects of work ensuring integrity and accuracy.

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