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Review

The current status of primary prevention in coronary heart disease

Cornel Pater

Hertford Medical International, Welwyn Garden City, Hertfordshire, UK

Correspondence: Cornel Pater, 5 Lodge Drive, Hatfield, AL9 5HL, UK. Tel: +44 (0)7796 238732; e-mail: cornel.pater@ntlworld.com

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Abstract

During the second part of the twentieth century, research advances caused a substantial decline in the rate of coronary heart disease. The decline lasted from the mid-1960s until the early 1990s and occurred primarily in Western countries. However, an unfavourable trend in coronary heart disease related mortality has gradually developed during the 1990s, with cardiovascular diseases anticipated to remain the main cause of overall mortality for the foreseeable future. The present paper aims at analyzing the current status of the main determinants of population-wide coronary heart disease prevention.

Keywords: cardiac, population, prevention, primary, risk

Introduction

Research has resulted in major improvements in healthcare in the past 50 years. Advances in the field of genomics/genetics are anticipated to lead to further acceleration in the progress of research development, with the promise of a new era for diagnosis, treatment and prevention of disease. But despite spectacular progress in medicine and general improvement of health across the world, cardiovascular diseases remain a global problem, and coronary heart disease (CHD) in particular is anticipated to be a problem over the next 30 years, both for the developed and developing world.

Retrospective analysis of health and social problems illustrates limited success in identifying and dealing with potentially preventable health problems. Recent conclusions from the European Action on Secondary Prevention through Intervention to Reduce Events (EUROASPIRE) II [1] drawn by Wood, who coordinated the study, are relevant here. Among the many disappointing results was the fact that 81% of the individuals surveyed in 1999/2000 were overweight, with a third of them obese. The proportion of obese people increased sharply from 25% in 1995/96, while the number of smokers was unchanged, despite anti-smoking campaigns. Further, 61% of those surveyed had hypertension and 59% had abnormally high cholesterol, despite increased use of antihypertensive and cholesterol lowering drug treatment. Wood argued that the findings revealed "inadequate standard of care" and "a collective failure of the medical practice." He claimed that cardiologists are too focused on acute management and are paying insufficient attention to prevention and long-term treatment.

The multifaceted clinical complexity of CHD, with a bias towards acute treatment, neglect of preventive care, and inappropriate long-term treatment of patients after acute coronary events, requires fundamental reform to improve patients` outcomes and quality of life, as well as the cost-effectiveness of treatment. Future preventive measures need to focus on establishing risk factor profiles in individual patients, accurately identifying those at risk, and actively intervening to maximize the ability to change that risk. Moreover, prevention strategies need to begin in childhood.

CHD = coronary heart disease; EUROASPIRE = European Action on Secondary Prevention through Intervention to Reduce Events; HDL = high-density lipoprotein; MRFIT = Multiple Risk Factor Intervention Trial.

Public health impact of CHD

Despite declining mortality rates from cardiovascular disease during the past three decades, cardiovascular disorders still account for the highest mortality rates both in developed and in developing countries. Coronary heart diseases are in turn the most prevalent of the cardiovascular disorders, accounting for 6.3 million deaths in 1990, at a time when a steady decline in heart disease mortality was stated to be ongoing [2].

CHD remains a massive public health problem in the developed world, both for survival and for work capacity. In the USA alone, more than 10 million individuals have symptomatic CHD, resulting each year in approximately 1.5 million myocardial infarctions, almost 1 million deaths, and an economic burden of $12 billion. "CHD is the single largest killer of American males and females" [3].

In European countries, cardiovascular mortality represents around 40% of all mortality before the age of 74. Despite decreasing age-specific cardiovascular disease mortality rates in Western European countries, there has been no decrease in the absolute number of people who die from cardiovascular diseases. The number of chronically ill cardiovascular patients may even be increasing in these countries due to the ageing of the population. Because of a fall in early mortality, currently available treatments for diseases such as acute myocardial infarction may lead to an increase in the number of patients who reinfarct and the number with congestive heart failure. For this reason, and because of the increasing trend in cardiovascular mortality in Central and Eastern European countries, the burden of cardiovascular diseases in European societies will not decrease and may even increase in the forthcoming decades [4].

Despite national and international guidance, evidence of clinical effectiveness, and widespread agreement on management of risk factors, primary prevention of CHD is inadequate and remains underdeveloped and underfunded [5,6].

The joint European Task Force set up in 1998 has emphasized the need for national guidelines to establish a "model for care" for preventive cardiology and for promotion of greater collaboration between hospitals and primary care. Representatives from the European Society of Cardiology, European Atherosclerosis Society, International Society of Behavioral Medicine, European Society of General Practice/Family Medicine, and from the European Heart Network underlined the concern that Europe is not capitalizing upon the extensive life-saving potential of preventive cardiology [7]. The task force proposals are focusing upon the need that each country should draw up its own model of care with the aim of implementing routine screening for cardiovascular disease, medical record keeping, systematic follow-up of patients, and coronary risk management.

This paper will attempt to draw attention to different factors encountered in daily practice that may potentially have a negative impact on the provision of long-term care to patients with CHD and, particularly, on the primary prevention of CHD in the general population.

The author proposes a paradigm shift in the approach to primary and secondary prevention of CHD, with their integration into a common management strategy for the different stages of the same pathological entity: the coronary heart disease.

Barriers in the implementation of preventive strategies

Surveys of CHD prevention-related services such as smoking cessations advice, measurement and treatment of lipid disorders, and physical activity assessment and counseling are disappointing [8–12]. Significant variation exists among the risk control therapies of patients with cardiovascular diseases. Major drugs in the cardiovascular therapy arsenal such as beta-blockers, angiotensin-converting enzyme inhibitors, aspirin, and lipid lowering drugs are currently underused [13–15]. A variety of factors at the levels of the patient, physician, health care setting and community/society, as well as the lack of a third party payment, may interfere with the provision of these services (see Table 1 [14]).

Low physician adherence

In spite of international consensus guidelines and tremendous amounts of health information surrounding CHD prevention, it seems that substantial confusion perpetuates among both physicians and their patients [16]. Unfortunately, conflicting messages in different guidelines [17–19] and inaccuracy in identifying high-risk patients are often contributing factors [20].

It is generally assumed that physicians are aware of the relative importance of the various risk factors for CHD. However, the busy schedules of both primary care and specialist clinicians, combined with defective training in the field of disease prevention, and the lack of financial incentives for prevention measures have combined to produce very poor systematic prevention of CHD in clinical practice [21,22].

Poor patient compliance

Nowadays we witness a rising interest in health, healthy living, and healthy environment. Successful campaigns in the field of 'prevention and health promotion' focusing on hot topics such as smoking, alcohol consumption, and high cholesterol have undoubtedly raised the level of awareness of health issues in the general population.

Table 1

Barriers to Implementation of Preventive Services

Patient
Lack of knowledge and motivation
Lack of access to care
Cultural factors
Social factors
Physician
Problem-based focus
Feedback on prevention is native or neutral
Time constraints
Lack of incentives, including reimbursement
Lack of training
Poor knowledge of benefits
Perceived ineffectiveness
Lack of skills
Lack of specialist–generalist communication
Lack of perceived legitimacy
Health care settings (hospitals, practices, etc)
Acute care priority
Lack of resources and facilities
Lack of systems for preventive services
Time and economic constraints
Poor communication between specialty and primary care providers
Lack of policies and standards
Community/society
Lack of policies and standards
Lack of reimbursement

Data from Pearson *et al* [94].

However, closer scrutiny uncovers a poor compliance of the general, still healthy population, with the need for lifestyle changes and risk factor modification strategies. This may simply be explained by the fact that people are generally attracted by the prospect of a benefit which is visible early, and which they can definitely gain from. Health benefits rarely meet these criteria; they may be real, but they are likely to be delayed and to come to only a few of those who seek them. This phenomenon has been called "prevention paradox" [23], meaning that preventive measures that bring large benefits to the community offer little to individual participants.

Lastly, there is a lack of structured and systematic information on different treatments and decisions, which physicians are supposed to give to their patients to help them come to informed decisions about their healthcare. Failure to provide patients with basic information such as the potential risks and benefits of a certain therapy, the inconvenience, the side effects, and the cost may result in the rejection of a proposed therapy, instead of long-term adherence to it. It should also be noted that individual patients expect quite a lot, but carry too little responsibility for their own actions or participation in decisions. Most probably, the rights of individuals will increase in the next decades, but so will the responsibility of individuals and the acceptance of risk associated with medical decisions agreed between physician and patient [24].

Lack of third party payment

Medical thinking has been largely concerned with responding to the need of the sick individual. This has shaped its ethics (responsibility for the sick), its research (why do individuals become sick?), and the planning of medical services. A disease-oriented model of healthcare has emerged, with highest priority given to the prevention of death and acute illness. This reflects the particular outlook common to both doctors and healthcare policy makers of viewing ill health through a dichotomous paradigm of yes/no decisions, such as to investigate or not to investigate, to admit or to send home, to treat or not to treat, with the ultimate aim of reducing the number of people requiring medical care in order to cut cost.

This type of reasoning struggles to achieve the defined purpose-triad of medicine: to prevent occurrence of disease, to prolong life, and to improve quality of life by minimizing unwanted symptoms.

In an era of cost consciousness, there are increasingly demands that health promotion and disease prevention programs be proven economically worthwhile by means of cost-effectiveness analysis. People generally agree that it is worth investing in health promotion activities; however, it is difficult to prove that the value of benefits obtained outweigh the cost of those investments or that they, at least, equal the clear benefits obtained from managing medical emergencies and waiting lists, both being focused by policy makers [25,26]. The continuous increase of the percentage of aging population demands allocation of greater amount of resources.

Demographic changes

The progressive ageing of the population in the twentieth century, caused by unprecedented gains in life expectancy, offers not only great opportunities but also formidable challenges for all societies. The global population of people over the age of 65 is increasing by 750,000 a month. Increases in the older population of up to 300% are expected in many developing countries within the next 30 years [27].

Another demographic feature that makes the process of ageing much more complicated is the fact that, in the next 25 years, while the population aged 65 years and above is likely to grow by 88%, the working-age population will increase by only 45%. The direct consequence of this fact is that a steadily declining number of people of productive age will have to provide for an expanding number of dependants, in the form of direct support to older relatives and through escalating taxation to cover the provision of health and social services [28–30].

Population ageing is beginning to transform health care and social systems, with new public policies in health and social care being widely adopted throughout the world [31]. Public interest and discussion of healthcare issues is at an all-time high. Because of the cost of healthcare, which is continually escalating both in developed and developing countries, there is a widespread trend toward structural reform of healthcare systems [32].

Nowadays, there is a growing discrepancy between what is possible in modern healthcare provision and what is affordable within limited budgets. Perverse incentives, which are inherent to all healthcare systems, result in ineffective and inefficient delivery of care. A competitive healthcare market with the separation of purchasers and providers has been introduced in several Western countries as a means of increasing the efficiency of healthcare provision. A common feature is that health authorities, hospital administrators, and providers are looking for additional means of financing through raised patient copayments and private insurance.

The impact of IT on healthcare

It is apparent that the development and diffusion of effective medical technology must not be limited, and that a well-organized assessment capability in close collaboration between physicians and health care insurers should be developed, if we want to maintain delivery and access to high quality care in the future [33].

This concrete strategy for change calls for joint investment by government and industry into healthcare infrastructure, applications for healthcare information systems, and the development of the pre-requisite technology for these applications.

New practice paradigms and administrative functions should be targeted for strategic investment in order to enhance the development of new medical practice paradigms that incorporate a trend towards patient-centered healthcare, including a focus on wellness, prevention programs, and evidence-based healthcare.

Implementing community-wide networks for healthcare information will lead to the development of information systems that allow clinical and administrative data to be readily accessed, regardless of location, with appropriate safeguards for protecting patient confidentiality, and in a manner convenient for practitioners and patients.

Integrated vision of primary and secondary prevention of CHD

Increasingly sensitive technologies that can identify pathophysiologic states, early lesions, or silent disease in persons who have never been symptomatic have permitted an expanded definition of health that extends far beyond 'absence of disease' and emphasizes the need for prevention of disease occurrence. Despite the large overlap of the primary and secondary prevention of CHD, the first can be defined as the prevention of the atherosclerotic process itself, with the latter being the treatment of the atherosclerotic disease process [35].

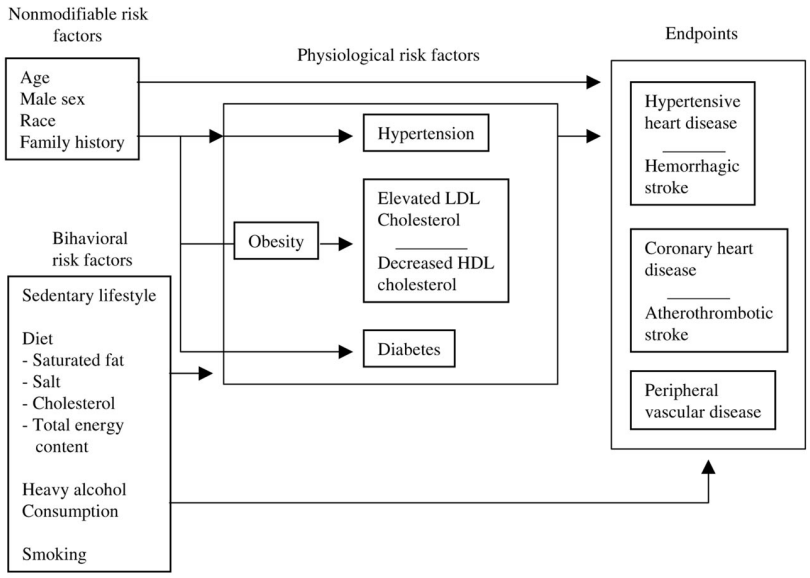
Since the risk factors concept was introduced in 1948 by the Framingham Study investigators, tens of risk factors have been suggested as determinants of CHD. Several modifiable, or behavioral, risk factors (cigarette smoking, poor diet, hypercholesterolemia, excessive alcohol intake, lack of exercise) have been shown to be causally related to CHD [36–38], and these may be approached either on a population-wide or an individual basis. Nonmodifiable factors, such as age, sex, race and family history of CHD, may be used to identify high-risk groups of individuals who would benefit from specific programs. Additional factors termed physiological, such as hypertension, diabetes, obesity and different types of dyslipidemias, interact with the nonmodifiable and behavioural risk factors, leading to the clinical manifestations of atheroclerosis: coronary heart disease, hypertensive heart disease, thrombotic or hemorrhagic stroke and peripheral vascular disease (Fig. 1) [39].

During the past 5 decades, and in particular during the past 10 years, we not only accumulated knowledge on risk factors and CHD pathophysiology, we also witnessed a continual metamorphosis of recommendations and guidelines for prevention and treatment of coronary heart disease. Nevertheless, during the first years of the last decade, individual risk factors such as raised blood pressure and high cholesterol were focused on by separate guidelines, which recommended treatment on the basis of specified cut-off points. Not only that, but professional societies both in the US and in Europe had separate guidelines on coronary prevention [40], hyperlipidemia [41,42], hypertension [43], and diabetes [44]. However, there is nowadays a universal consensus as to similar management of the modifiable risk factors in the context of both primary and secondary prevention of CHD (Table 2).

In 1989 Rose described two approaches for the practical management of risk factors [22]: the 'population approach' and the 'high risk approach'. The recommendation of combining both approaches in clinical practice is based on reasoning from epidemiological explanations of the risk factor distribution in populations.

The bell-shaped distribution of values (Fig. 2) of a particular risk factor, (eg cholesterol) suggests that most people are found in its middle part and have cholesterol levels around the average. However, one tail of the distribution contains individuals with higher values. A more concrete example is reflected by Fig. 3, which has been assembled

Figure 1



Relationship between cardiovascular risk factors and cardiovascular diseases. HDL, high-density lipoprotein; LDL, low-density lipoprotein.

from Multiple Risk Factor Intervention Trial (MRFIT) data [89]. The bar diagram presents the distribution of serum cholesterol levels, with the commonest values being around 5–5.5 mmol/l. The broken curve shows that the incidence of fatal heart attacks rises steeply with increasing levels of cholesterol. At the highest level (8 mmol/l) 20 deaths per 1000 individuals are registered, although the prevalence of such exposure is only 2%.

Persons with risk levels in the tail of a distribution are a deviant high-risk minority. They qualify for special attention and are the target of high-risk preventive strategy, which normally takes place when the physician is treating a patient for ailments such as hypertension or high cholesterol. With this approach, the remaining individuals in the population are classified as normal and can be left in peace. However, while the rate of cardiovascular disease is higher in the high-risk individuals, they only account for a small percentage of those who suffer from the disease. Most cases of CHD occur among those falling in the average risk group, classified as normal. The 'population approach' is concerned with this latter group and the reduction of the population burden of CHD that may result from shifting the entire population level of risk factors (the dashed bell-shaped curve, Fig. 2).

The population and high-risk approaches are not mutually exclusive. They should be used in combination and constitute one of the main pillars of any health policy. However, the two approaches are somewhat different, primarily from a logistic and organizational point of view.

The population approach proceeds from the basic axiom that CHDs are epiphenomenona in populations that adopt a Western lifestyle, characterized by high-fat and high-cholesterol diet, tobacco use, and lack of physical activity. It is therefore a matter of application of essential public services such as surveillance, education, organizational partnerships, assurance of personal health services, and legislation/policy [90] in a variety of community settings including work sites, healthcare facilities, religious organizations, schools, and whole communities [91], with the main goal of achieving reduced impact of risk factors and risk behaviors on the health of the general population. Epidemiological evidence and results from clinical trials have demonstrated that such goals are achievable in practice [92].

Fig. 4 illustrates the specific means applicable in specific community settings, with the aim of controlling risk factors and risk behaviors on a population basis.

Individual risk assessment

Gradually, previous guidelines based on relative risk have been replaced by joint American and European recommendations and guidelines based on absolute measures of risk [65]. The absolute risk of cardiovascular disease is strongly influenced by the combination of risk factors present, particularly a history of cardiovascular disease, age, gender, diabetes, smoking, blood pressure, and blood lipid concentrations [66]. The assessment of these factors through careful history taking, physical examination, and selected laboratory testing is absolutely neces-

Table 2

Evidence base for benefit of risk factor modification

Risk factor	Primary prevention of CHD	Secondary prevention of CHD
Smoking	Smoking cessation will reduce the risk of death by 50% [45]. Men who stop smoking have a reduced risk of myocardial infarction [46] and within 2–3 years the risk is similar to those who have never smoked [47].	Patients who continue to smoke after a myocardial infarction had a 22–47% increase in mortality risk [49]. In patients followed up for 15 years, 82% mortality was seen in those patients who continued to smoke after the first myocardial infarction or unstable angina. In patients who had stopped smoking, the figure was 37% [50].
Diet	Dietary changes (reduction in saturated fat, cholesterol and an increase in polyunsaturated fat) can result in decreased mortality from CHD [46,51]. The addition of stanol esters and plant sterols (which reduce cholesterol absorption) to food, for example margarine, has been shown to reduce plasma cholesterol concentrations by about 10%. The effect equates with a mortality risk reduction of about 23%; lack of control over intake results in variable effects [52].	There was a 29% reduction in 2-year all-cause mortality in post-myocardial infarction patients who received advice on an increase in fatty fish intake [53]. However the incidence of re-infarction and CHD mortality was not significantly changed. A Mediterranean-type diet (replacing red meat with poultry and increasing fish, vegetables, fruit, and use of olive oil) in myocardial infarction patients demonstrated a 76% reduction in the risk of CHD mortality.
Cholesterol	Total serum cholesterol of >6 mmol/l is associated with an increased incidence of CHD risk and risk of CHD mortality [54].	
Exercise	Lack of physical fitness or physical activity are associated with an increased risk of death from all causes and from cardiovascular disease both in middle-aged [55] and older men [56].	
Alcohol	Mortality from CHD is lowest in those who reported drinking 8 to 14 units of alcohol a week. Drinking above 21 units a week increases total mortality [57]. Differences between types and patterns of alcohol intake remain unclear [58].	
Diabetes mellitus	Mortality from CHD increases about 3-fold to 10-fold and 2-fold to 4-fold in patients with type 1 and type 2 diabetes, respectively [49]. The UKPDS study indicated that for each increment of 1% increase in HbA1c there was a 1.11-fold increase in the risk of CHD [59].	
Blood pressure	Chronic hypertension is closely related to the risk of developing CHD [60]. A decrease of 5 mmHg in diastolic blood pressure is associated with a 21% decrease in risk of developing CHD [61].	
Obesity	Although increased body mass index is related to increased risk of CHD [62,63], there are no clinical trials of the effect of weight reduction on CHD morbidity and mortality [64].	

CHD, coronary heart disease; UKPDS, UK Prospective Diabetes Study; HbA1c, glycated hemoglobin.

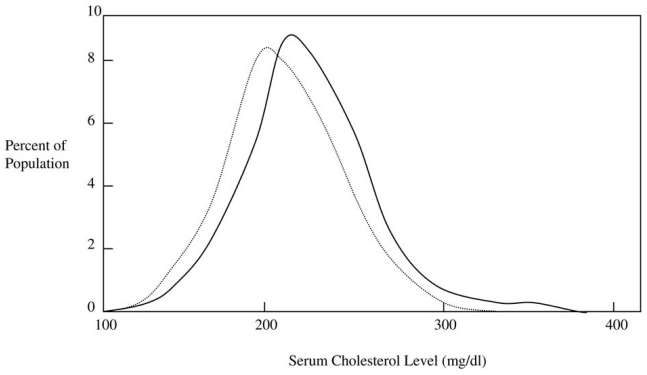
sary for quantification of global risk score. Specific target levels for particular risk factors are used to prioritize goals for behavioral and pharmacological intervention (Table 3) [93]. The new clinical guidelines recommend that priority for treatment should be given to patients at high absolute risk of coronary heart disease, defined as probability of developing coronary heart disease over a specified period, rather than emphasis being placed on an individual risk factor [67].

Fig. 5 attempts to present CHD in its whole spectrum, as a continuum in which the dichotomy of having or not having an acute coronary event is only one level of the same disease, which actually starts many years before the occurrence of that acute event.

The Primary Prevention section in Fig. 5 summarizes the distribution of high absolute risk (>20% probability of developing CHD in the next 10 years) in the high risk (H) group and part of the medium risk (M) group individuals. The high absolute risk individuals may sustain acute coronary events in their late thirties or early forties, depending upon a multitude of factors that are difficult to predict. Individuals with relative risk corresponding to the low-risk group and part of the medium risk group individuals in the general population, run the risk of coronary events at a later age, usually in their sixties or even later.

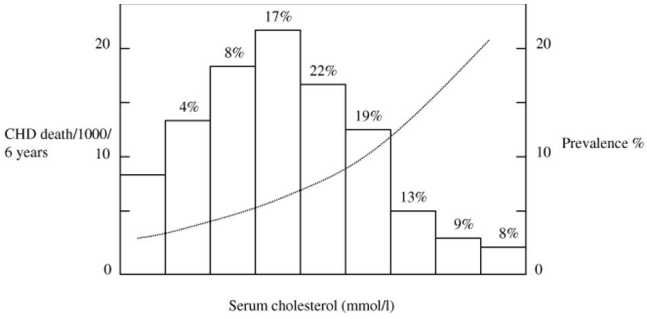
The risk of a coronary heart disease event (death, non-fatal myocardial infarction, and angina) in 10 years has been adopted as the standard measure in both Europe and the

Figure 2



Cholesterol distribution and its shift (dashed line) with application of population approach. Data from Carleton *et al* [95].

Figure 3



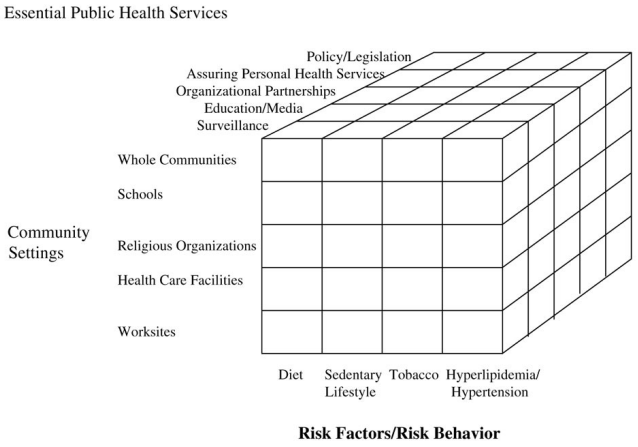
Prevalence distribution (bars) of serum cholesterol concentration related to age-adjusted mortality from coronary heart disease (CHD) (broken curve) in men aged 40–59 years. The number above each bar is the percentage of death "attributable" to the cholesterol effect and arising at that level. Data from Martin *et al* [96].

United States [68] and proposed as the common instrument to guide treatment for raised blood pressure as well as treatment with aspirin and statins [69,70].

The Framingham equations computed on the basis of prespecified categorical variables have been the mathematical background for calculation of absolute risk in the most popular charts, tables and computer programs so far [71,72]. However, it has been emphasized that the Framingham equations based on North American high-risk population may have limited applicability to other high-risk groups, such as South Asians, Polynesians, African Americans and South Europeans [73]. Evidence indicates that risk prediction is quite reliable in central and western populations [74,75], but is overestimated for southern populations [76,77].

Several methods are available at present for the assessment of a patient's risk of developing CHD. All of these

Figure 4



A conceptual framework for public health practice in cardiovascular disease prevention.

methods are based on estimates from the Framingham study and they only take into account the standard risk factors – gender, smoking, blood pressure, ratio of total cholesterol to high-density lipoprotein cholesterol (HDL), and presence of diabetes. Other factors such as family history of premature CHD, ethnicity, obesity, and lifestyle may need to be considered in clinical interpretation and decision making in individual patients. The most commonly used tools are the New Zealand Guidelines [78], the Sheffield Table [79], and the Joint British Societies coronary prediction chart [80].

The Sheffield table has been used to identify those patients where measurements of total cholesterol and HDL cholesterol are indicated. The modified Sheffield table requires only yes/no categorization of the patient as hypertensive, rather than a systolic blood pressure measurement [79]. The Joint British Societies chart requires more information and is not intended for use in treated hypertensive patients. In these patients, the use of current blood pressure measurements gives an underestimate of risk. None of the charts are used in patients who already have a diagnosis of CHD.

The Joint European societies have used the multiple-risk approach to develop figures that allow the visual calculation of previous absolute risk of developing CHD over the next 10 years, based on age, sex, smoking, systolic blood pressure, and total cholesterol level [81] (Figs 6 and 7).

Cardiovascular risk is defined as the CHD risk plus the risk of stroke, vascular disease and heart failure. Cardiovascular risk can be estimated from the CHD risk since the two are correlated; a CHD risk of 15% equates to a cardiovascular risk of 20% [81].

Table 3

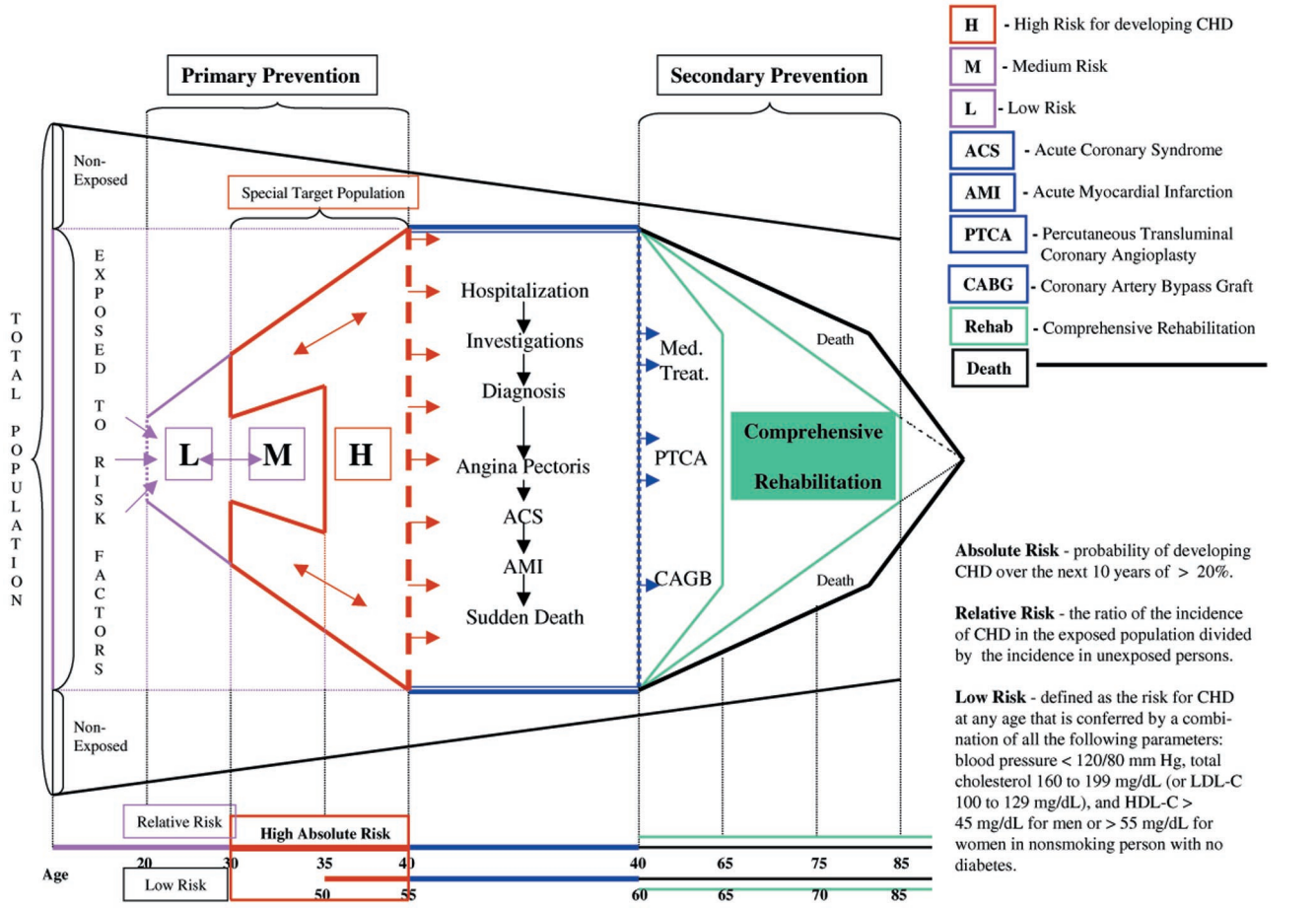
Guide to primary prevention of cardiovascular disease

Risk intervention	Recommendations
Smoking: Goal complete cessation	Ask about smoking status as part of routine evaluation. Reinforce smoking status. Strongly encourage patient and family to stop smoking. Provide counseling, nicotine replacement, and formal cessation programs as appropriate.
Blood presure control: Goal <140/90 mmHg	Measure blood pressure in all adults at least every 2.5 years. Promote lifestyle modification: weight control, physical activity, moderation in alcohol intake, and moderate sodium restriction. If blood pressure >140/90 mmHg after 3 months of life habit modigfication of if initial blood pressure >160/100 mmHg: add blood pressure medication, individualize therapy to patients`s other requirements and characteristics.
Cholesterol management: Primary goal LDL <160 mg/dl if 0–1 risk factors or LDL <130 mg/dl if ≥2 risk factors Secondary goals HDL >35 mg/dl; TG <200 mg/dl	Ask about dietary habits as part of routine evaluation. Measure total and HDL cholesterol in all adults >19 years and assess positive and negative risk factors every 5 years. For all persons: promote AHA Step I diet (≤30% fat, <10% saturated fat, <300 mg/day cholesterol), weight control, and physical activity. Measure LDL if total cholesterol ≥240 mg/dl or ≥200 mg/dl with ≥2 risk factors or if HDl <35 mg/dl. If LDL ≥160 mg/dl with 0–1 risk factors or ≥130 mg/dl on 2 occasions with ≥2 risk factors; then Start Step II Diet (≤30% fat, <7% saturated fat, <200 mg/dl cholesterol) and weight control. Rule out secondary causes of high LDL (LFTs, TFTs, UA). If LDL: ≥160 mg/dl plus two risk factors; or ≥190 mg/dl; or ≥220 mg/dl in men <35 years; or in premenopausal women; then consider adding drug therapy to diet therapy for LDL levels > those listed above that persist despite Step II Diet. Risk factors: age (men >45 years, women >55 years) or postmenopausal), hypertension, diabetes, smoking, HDL<35 mg/dl, family history of CHD in first-degree relatives <65 years) HDL ≥60 mg/dl: Substract 1 risk factor from the number of risk factors. Suggested drug therapy for high LDL levels (≥160 mg/dl) drug selection priority modified according to TG level) TG <200 mg/dl: Statin, Resin, Niacin TG mg/dl 200–400: Statin, Niacin TG >400 mg/dl: Consider combined drug (niacin, therapy, fibrates, statin) HDL <35 mg/dl: Emphasize weight management, physical activity, avoidance of cigarette smoking. Niacin raises HDL. Consider niacin if patient has ≥2 risk factors and high LDL (except patients with diabetes). If LDL goal not achieved, consider combination drug therapy
Physcial activity: Goal Increase amount of exercise regularly 3–4 times per week for 30 min	Ask about physical activity status and exercise habits as part of routine evaluation. Encourage 30 min of moderate-intensity dynamic exercise 3–4 times per week as well as increased physical activity in daily life habits for persons who are active. Encourage regular exercise to improve conditioning and optimize fitness level. Advise medically supervised programs for those with functional capacity and/or comorbidities. Promote environmental factors conducive to health (eg golf courses that permit walking).
Weight management: Goal Achieve and maintain desirable BMI (21–25 kg/m^2)	Measure patient`s weight and height, BMI, and waist-to-hip ratio at each visit as part of routine evaluation. Start weight management and physical activity as appropriate. Desirable BMI range 21–25 kg/m^2. BMI of 25 kg/m^2 corresponds to percentage desirable body weight of 110%; desirable waist-to-hip ratio for men, <0.9; for middle-aged and elderly women, <0.8).

BMI, body mass index; LDL = low-density lipoprotein; LFT, liver function test; TG, triglycerides; UA, uric acid; TFT, thyroid function test. Data from Grundy *et al* [93].

Identification of individuals at high absolute risk is straightforward and can be undertaken accurately by using one of the available modalities mentioned above [17,83–85]. Quantification of the absolute risk assists in deciding upon the need for lipid lowering treatment, considered at present to decrease the risk of heart attacks and strokes without increasing other causes of mortality or morbidity. However, the increased understanding and widespread

Figure 5



Preventive strategies in CHD. A holistic approach to quantitative assessment.

acceptance of the usefulness of lipid lowering treatment has brought into consideration the cost-effectiveness of such treatment. Current UK policy, for instance, recommends that lipid lowering treatment should be offered to anyone with an absolute annual risk of 3% or more [86], while others favor a 1.5–2% absolute risk threshold before beginning treatment [81,83]. Still others have argued that estimates of relative risk should form the basis for treatment guidelines [87]. Since age is the major determinant of absolute risk, treatment thresholds based on absolute risk will tend to postpone treatment to older age, whereas guidelines based on relative risk will tend to lead to treatment of younger people.

Using absolute risk for decision making on lipid lowering treatment raises the problem faced by practicing clinicians of what advice to give to younger people who are at substantially increased risk compared with their age group, but who nevertheless remain below the defined absolute risk threshold for treatment.

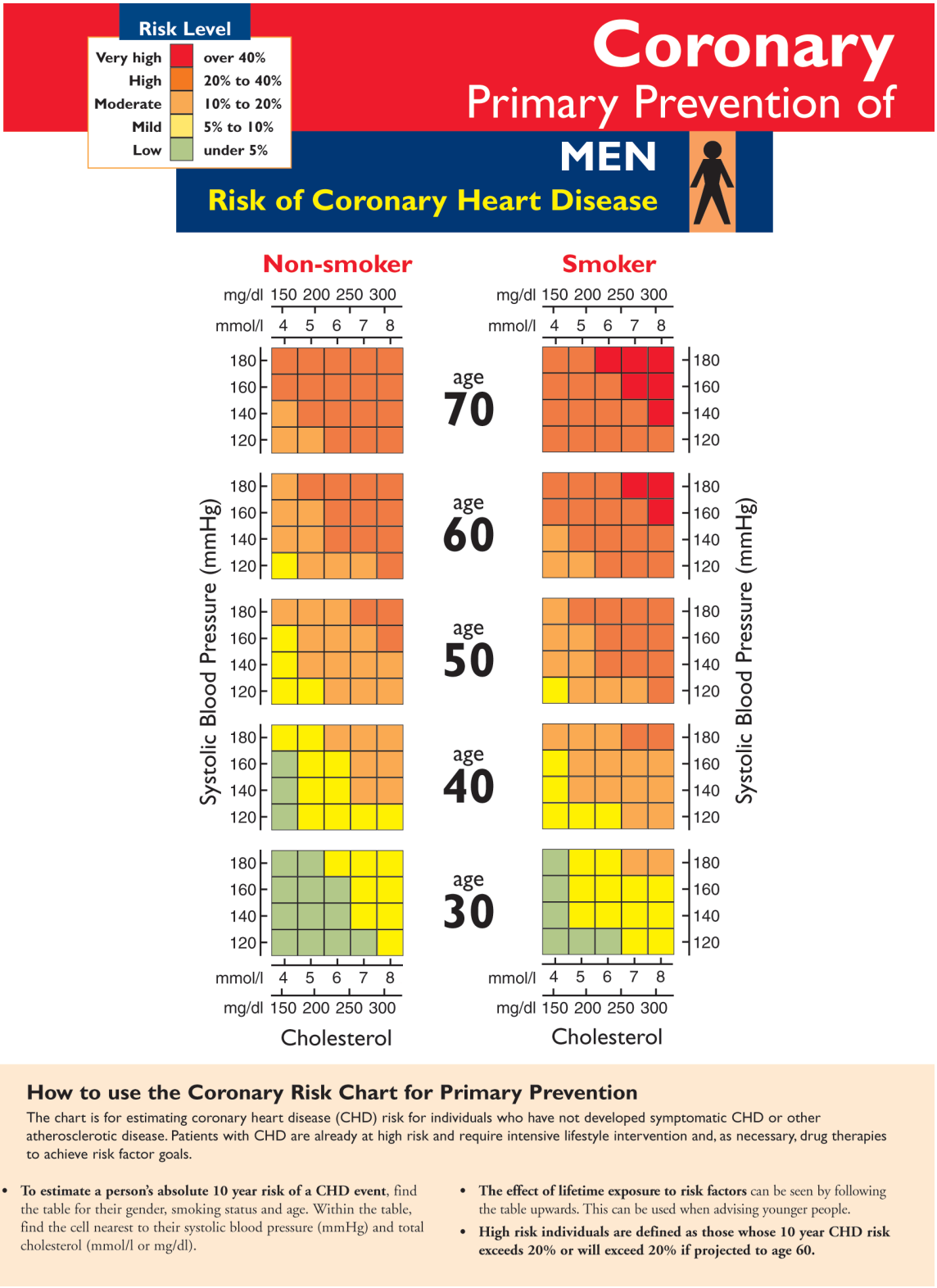
Common sense, of course, dictates that all such individuals should be offered appropriate advice on lifestyle modification at the earliest opportunity and that individualized decisions about treatment should be taken from case to case, based on the global risk profile of the particular individual.

Conclusion

Primary prevention programs aimed at reduction of risk behaviors on a population-wide basis and the identification, stratification, and selected treatment of high-risk individuals prior to their development of disease should be cornerstones of any approach to reduce the population's burden of CHD. Also, prevention strategies should begin in childhood. These two approaches should be complementary.

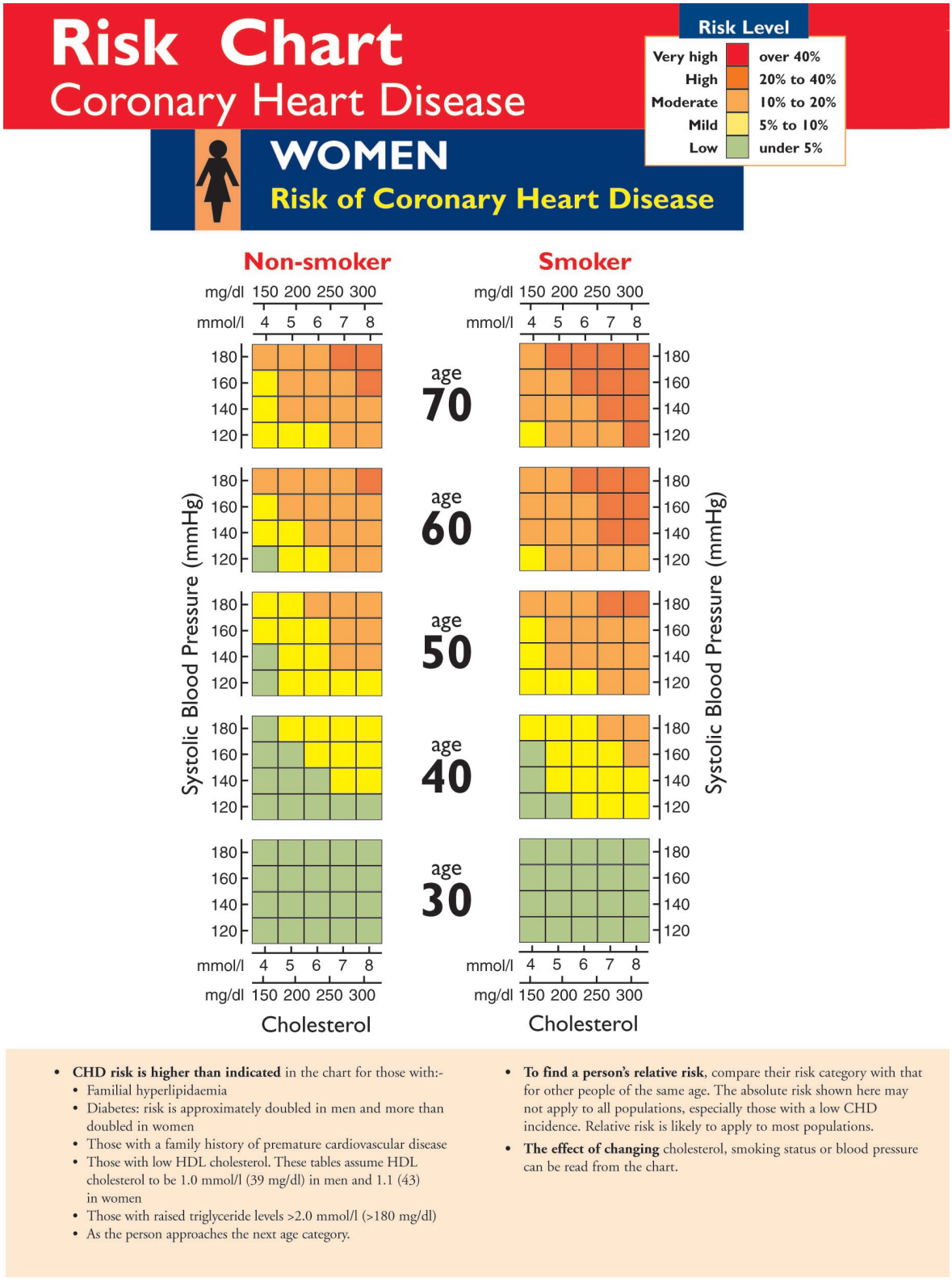
The healthcare system should benefit from population-wide efforts via health education, environmental intervention, or legislation to reduce the burden of deleterious health behaviors. This should facilitate risk-factor change in the clinical setting. Policy makers, employers, and com-

Figure 6



Coronary risk chart for primary CHD prevention in men.

Figure 7



Coronary risk chart for primary CHD prevention in women.

munity leaders look to healthcare providers to provide advice and leadership. Both the capacity to prevent CHD and the will to implement policies and programs will be necessary to reduce CHD and communities and physicians` offices [88].

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