2.11 Preventive medicine 127

2.11 Preventive medicine 127

ESSENTIALS Causes of death Most deaths before age 80 years are preventable but preventive medicine cannot offer immortality. Childhood and early adult life Deaths from infectious diseases and trauma usually reflect poverty and political instability. Prevention requires political action to reduce the risk of war and improve the supply of food, clean water, sanitation, and shelter. Preventive medicine can help by controlling spread of infection through vaccination, health education, control of insect vectors, and treatment of disease carriers to prevent onward transmission. Middle age The commonest cause of premature death globally is vascular disease—mainly heart attacks and stroke. The main causes are poor diet, obesity, and tobacco smoking. Political action is important to make it easy for people to take exercise and eat healthily, and to make it difficult to buy and smoke tobacco. Preventive medicine Preventive medicine can identify and treat people at increased risk of death from vascular disease (particularly those with diabetes, high blood pressure, and high blood lipids) and will save many lives by doing this effectively, but the need for medicines to treat vascular disease in individuals is a measure of public health failure. The co- existence of obesity and starvation as major causes of preventable mortality in many countries is a growing public health challenge. Many effective preventive interventions such as legislation to make seatbelts compulsory or tax tobacco should be targeted at the whole population, whereas preventive medicine provided by clinicians must target individuals. This often requires screening to detect early signs of disease (e.g. HIV infection, cancer) or markers of risk of disease (e.g. high blood pressure, intrauterine growth delay), but clinicians must be clear that something effective can be done to ameliorate the condition detected before any screening is undertaken. Failure of evidence-based preventive interventions The usual reason for failure is lack of effective implementation, with the three most important issues being: (1) poor population coverage, meaning that only a small proportion of the at-risk population re- ceive the intervention; (2) inadequate staff training; and (3) inad- equate quality control. Preventive medicine and curative medicine Preventive medicine is an important and integral part of good curative medicine. All doctors have a responsibility to think about why someone is ill. Whatever disease is diagnosed, the question of whether it could have been prevented, and whether the risk of pro- gression can be reduced, must be addressed. For example, every clinician

who diagnoses a stroke must ask themselves whether a pre- vious clinical opportunity to measure and control blood pressure has been missed, and reflect on this in regard to their future practice re- lating to other patients. Introduction In his millennium address, Nelson Mandela reminded the world that ‘we close the century with most people still languishing in poverty, subjected to hunger, preventable disease, illiteracy, and insufficient shelter’. The health gap between rich and poor nations remains shameful. For example, overall life expectancy in Sierra Leone is currently estimated as 46 years compared to 81 years in the United Kingdom. But even in the economically developed world, many people still die prematurely. In 2013, approximately 23% (114 740 out of 506 790) of all deaths registered in England and Wales were from causes considered avoidable through good- quality healthcare or wider public health interventions. Again, there is a marked gap between rich and poor. Men in the most advantaged areas of England lived on average 9 years longer, and experienced 19 more years of good health, than men living in the least advantaged areas. It is naive to think that medicine will remedy this situation. The fundamental step in achieving good health remains the elimination of poverty, with consequent access to food, sanitation, education, and shelter. The power of medicine lies in the scientific understanding it provides of the disease pro- cess. Preventive medicine uses this understanding both to try to reduce the risk of disease and to detect and treat appropriately emergent disease before it does damage. 2.11 Preventive medicine David Mant

 What is the scope for prevention? Fig. 2.11.1 shows the number expected to die at different ages if 10 000 men were subject to the age-specific death rates in the United Kingdom in 2010 compared to 1870. The dramatic fall in deaths during childhood and early adult- hood demonstrates unequivocally that such deaths are preventable. Moreover, most deaths before age 80 in high-income countries are from diseases which are amenable to preventive intervention. Migrant studies show that genetic advantage does not explain the high average life expectancy in Japan (81 years in men and 87 years in women). It therefore seems reasonable to expect that effective pre- ventive medicine can make death before age 80 years uncommon. However, the proportion of men or women who can expect to live over 100 years remains very low (1.1% in England in 2011/12). The achievable objective therefore seems to be better quality of life before death, and avoidance of premature death, rather than extension of life beyond 100 years. Preventive medicine cannot offer immortality.

Preventive strategies Identifying and reducing risk The main difference between preventive and curative medicine is the focus on risk. The leading global risk factors for preventable mor- tality in 2013, estimated by the Global Burden of Disease study, are shown in Table 2.11.1. The most disturbing fact remains the occur- rence of both starvation and obesity on the same list. Although there has been progress in some areas since 1990 (e.g. the number of at- tributable deaths due to child starvation, unclean water, and unsafe sex have more than halved), other issues such as deaths due to air pollution, substance abuse (including alcohol and tobacco), and oc- cupational hazards have increased. Although there has been a shift from environmental towards individually mediated risks, individual behaviour is always constrained by sociocultural and economic fac- tors largely outside individual control. On a global scale, the dietary and behavioural risk factors leading to chronic disease now predominate, whether risk is measured in terms of deaths or disability. The geographical differences in risk factors for ill health mainly reflect national wealth. The individual behaviours which promote hypertension and cardiovascular disease (eating an unhealthy diet, smoking tobacco, taking too little exer- cise) are now the most important risk factors in middle-income as well as high-income countries. However, Table 2.11.2 shows that lack of food, unsafe

water, and unsafe sexual practices still remain the top three causes of years of healthy life lost in the low-income countries of sub-Saharan Africa. The prevention paradox Preventive medicine aims to reduce the risk of disease (or the risk of further morbidity and mortality in those who develop disease) so its benefit is the absence of disease in the future rather than the present. Absence of something is a difficult benefit to champion, particularly to the individual. As Geoffrey Rose pointed out many years ago, not only is the benefit intangible but many people must take precautions in order to prevent illness in only a few. Even in a country where diphtheria is common, several hundred children must be immunized to prevent one death. Rose called this the 'pre- vention paradox'—a preventive measure, which brings large benefits to the community may offer little to each participating individual. 0 50 100 150 200 250 300 Number of deaths Age at death Age at death of 10 000 people born in the UK experiencing the age- specific death rates of 1870 and 2010 0–5 6–10 11–15 16–20 21–24 25–30 31–35 36–40 41–45 46–50 51–55 56–60 61–65 65–70 71–75 76–80 81–85 86–90 91–95 96–100 100–105 105–110 1870 2010 Fig. 2.11.1 Numbers dying at different ages if 10 000 men were subject from birth to the UK mortality rates in 1870 and 2010. Source of data: Office of National Statistics Life Tables, United Kingdom; the figure is based on one originally drawn by Doll R in British Medical Journal 1982; 286: 445–53.

2.11 Preventive medicine 129 The risk paradox The importance of the risk paradox is best illustrated by an example. One of the leading global risk factors for vascular disease is a high level of cholesterol in the blood. Fig. 2.11.2 shows historical data from the United Kingdom on the prevalence of high blood chol- esterol, the death rate associated with each cholesterol level, and the proportion of all deaths attributable to cholesterol occurring at each level. The risk paradox is that although those with a blood cholesterol greater than 7.5 mmol/litre are at highest individual risk of disease, they account for only 8% of total deaths. The group of people in whom most deaths occur (22%) is that with only a mod- estly increased cholesterol level of 5.5–6.0 mmol/litre. This is simply because of the number of people involved. There are far fewer in the high-risk group than in the moderate risk group. Targeting Table 2.11.1 Leading risk factors for global mortality in 2013 Risk factor Attributable deaths each year (millions) Comment Environmental Ambient air pollution 3.1 Particulates 2.9 m; ozone pollution 0.2 m; overall 33% increase in attributable deaths since 1990 Indoor smoke from solid fuels 2.9 No reduction since 1990 Unsafe water, sanitation, and handwashing 1.3 The most important of these issues remains unsafe water (1.2 m attributable deaths) but the number of attributable deaths from this cause has almost halved since 1990 Occupational risks 0.7 Top three issues: 1. air quality (gases/fumes/dust); 2. asbestos; 3. industrial injuries. Overall 27% increase in attributable deaths since 1990 Dietary Unhealthy diet 11.3 Top three issues: 1. High sodium; 2. Lack of fruit; 3. Lack of whole grain cereals Child and maternal malnutrition 1.7 Top three issues: 1. undernutrition (starvation); 2. suboptimal breastfeeding; 3. iron deficiency Obesity (high BMI) 4.4 Overeating is compounded by low physical activity (attributable deaths 2.2 m) Other behavioural Tobacco smoke 6.1 Smoking 5.8 m, passive smoking 0.3 m; overall 18% increase in attributable deaths from tobacco use since 1990 Alcohol and drug use 3.2 Alcohol 2.8 m, other drugs 0.4 m; overall 51% increase in attributable deaths since 1990 Unsafe sex and sexual abuse 1.8 Unsafe sex 1.5 m, abuse of partner or child 0.3 m; deaths from unsafe sex more than halved since 1990 Metabolic High systolic blood pressure 10.3 Main modifiable risk factors for high blood pressure are dietary (especially salt intake) High blood cholesterol 4.4 Mean cholesterol levels vary between WHO Regions, but not more than 2.0 mmol/litre in any age group High fasting blood glucose 4.0 The main risk factor for diabetes is obesity Data from: Global Burden of Disease Study 2013. Published in The Lancet online 11

September 2015 (http://dx.doi.org/10.1016/50140-6736(15)00128-2). Table 2.11.2 Top 10 risk factors for ill health (disability-adjusted life years attributable to level 2 risk factors) in 2013 in sub-Saharan Africa and globally Rank Sub-Saharan Africa Global 1 Child and maternal nutrition Dietary risks 2 Unsafe sex High systolic blood pressure 3 Unsafe water sanitation and hand washing Child and maternal nutrition 4 Air pollution Tobacco smoke 5 Alcohol and drug use Air pollution 6 High systolic blood pressure High body mass index 7 Dietary risks Alcohol and drug use 8 High body mass index High fasting blood glucose 9 High fasting blood glucose Unsafe water, sanitation, and hand washing 10 Tobacco smoke Unsafe sex Data from: Global Burden of Disease Study 2013. Published in The Lancet online 11 September 2015 (http://dx.doi.org/10.1016/50140-6736(15)00128-2). CHD deaths/1000/6 year Prevalence 20 10 0 4 5 6 7 8 4% 8% 17% 22% 19% 13% 9% 8% 0 10 20 Serum cholesterol (mmol) Fig. 2.11.2 Proportion of coronary heart disease deaths attributable to raised serum cholesterol (percentages above columns). Columns and right axis show population distribution of cholesterol levels. The broken line and left axis show the attributable mortality. Reproduced from Rose G. Rose's Strategy of Preventive Medicine, 2008. With permission from Oxford University Press, Oxford.

130 section 2 Background to medicine preventive medicine at just the high-risk group will often have rela- tively little impact on the total number of deaths in the population. Primary and secondary prevention Use of these two terms is sometimes inconsistent (e.g. antenatal care is usually characterized as secondary prevention although preg- nancy is not a disease) but usually they can be interpreted as follows: • Primary prevention—interventions to reduce the risk of disease in healthy people (e.g. use of seat belts to prevent injury in car accidents; tobacco control to prevent the occurrence of smoking- related disease; immunization against infectious disease). • Secondary prevention—interventions to prevent avoidable mor- bidity in people with disease (e.g. treatment of vascular disease with aspirin; screening for early cancer). Primary prevention could be perceived as always better than sec- ondary prevention in the same way that prevention is better than cure. However, this is oversimplistic for three reasons: (1) many ap- parently healthy people will have undetected disease; (2) some inter- ventions fall into both categories (e.g. stopping smoking reduces the progression as well as onset of many smoking-related diseases); (3) primary prevention may be less effective than secondary preven- tion, particularly when the intervention is aimed at the individual. Strategic choices In choosing priority strategies for risk prevention, the World Health Organization (WHO) has recommended that in general it is more effective: • to focus on population-based rather than individual interventions • to prioritize primary rather than secondary prevention • to control distal before proximal risks to health This advice makes good sense from a public health perspective—it is self-evidently better to prioritize provision of clean water before fo- cusing on early recognition and treatment of dehydration from diar- rhoea caused by dirty water. However, making strategic choices about preventive medicine aimed at individual patients is less straightfor- ward. It is much easier to persuade individuals to change their behav- iour when they perceive themselves at high risk (e.g. to convince them to stop them smoking after they develop a smoking-related illness). Primary prevention is seldom delivered cost-effectively to healthy people by doctors or nurses in routine clinical practice. The one ob- vious exception is vaccination, where involvement of clinicians is often important in delivering vaccines and ensuring high coverage of the population at risk. Clinicians are also in an ideal position to re- inforce some key public health messages, such as stopping smoking and hand washing, with brief opportunistic advice during routine consultations (see next). However, several large-scale clinical trials have shown that it is not cost-effective for doctors and nurses to ex- pend scarce resources trying to

convince otherwise healthy individ- uals to change eating or exercise habits determined primarily by the cultural and socioeconomic context in which they live. Defining and identifying the at-risk population Public and individual intervention Some public health interventions do not require anything other than a broad geographical definition of risk. Interventions are targeted at whole populations and do not require identification of individuals within that population—for example, road accidents can be reduced by seatbelt legislation and tobacco consumption by taxation without identifying the individual driver or smoker. However, some primary preventive strategies (e.g. vaccination) and most examples of secondary prevention (e.g. screening) have to be delivered to specific individuals at risk. You not only need to know that people with high blood pressure are at risk of stroke, you need to know who has high blood pressure. These individuals can be defined in one of three ways: by demographic, phenotypic, or familial characteristics. Within each group of at-risk people so defined, further subpopulations may be identifiable as at particu- larly high risk. Demographic risk This is the most common way to define the target group for pre- ventive medicine services. For example, the United States Preventive Task Force defines the target group for most of the preventive services it recommends in terms of age. The other demographic risk characteristic commonly used by the Task Force to define the target population is gender. It is obvious why it recommends that breast and cervical cancer screening should only be targeted at women, but gender-specific recommendations are also made for aortic an- eurysm (based on differential risk) and gonorrhoea (based on the differential likelihood of asymptomatic infection). Some preventive programmes may also target specific ethnic or racial groups—for example, in Australia, interventions to reduce the risk of rheumatic fever associated with group A streptococcal infection of the throat have been restricted to the indigenous Aboriginal population who are at exceptionally high risk. Phenotypic risk A phenotype is a set of observable characteristics of an individual or group. Many epidemiological risk factors for disease are phys- ical characteristics (e.g. obesity, hyperlipidaemia); other phenotypic categories often used to define at-risk target populations are behav- iour (e.g. smoking, driving) and disease states (diabetes mellitus, an- gina). As some phenotypic risks interact (e.g. smoking and exposure to asbestos interactively increase risk of mesothelioma), multiple risk assessment is an increasingly common practice. Several clin-ical tools have been developed to help estimate multifactorial risk in everyday practice, such as the New Zealand risk charts for cardio- vascular disease. Familial risk Recent advances in genetic technology have increased our ability to characterize familial risk accurately, and further advance is likely. At present, most preventive medicine programmes in this area use genetic assessment to refine assessment of individual risk in pheno- typically identified high-risk individuals or families (e.g. cystic fibrosis, neurofibromatosis) or demographically defined popula- tions (e.g. pregnant women at risk of giving birth to a child with Down’s syndrome). However, the characterization of risk based on population-based genetic screening is already technically feasible in the economically developed world, increasing the potential power of preventive medicine but also raising important ethical issues about how society deals with accurate predictions of high disease risk, par- ticularly when evident at or before birth.

 Registration, screening, and case-finding It is much easier to identify specific individuals at risk when uni- versal health registration is in place and its accuracy is systematically maintained. It not only allows efficient provision of primary preven- tion strategies, such as vaccination, but screening for disease risk is also much more efficient when based on an accurate population register. In the absence of a population health register, it is neces- sary to rely on case-finding. This requires identification of at-risk individuals during routine clinical work

(normally in clinical con- sultations, but sometimes through contact or family tracing). It is less efficient than systematic population screening, but sometimes provides better access to socially disadvantaged groups who may re- spond poorly to screening invitations or have no registered address. It also allows some interventions to be given at a particularly appro- priate moment (e.g. smoking cessation advice at a consultation for cough or contraceptive advice after termination of pregnancy). Interventions to modify risk The importance of public health The marked improvements in health which have been achieved in economically developed countries over the past 150 years are not attributable to medicine. Life expectancy has doubled mainly be- cause of environmental control of infectious pathogens (through sanitation and control of insect vectors) and a lifestyle that reduces individual susceptibility to infectious disease (better food, shelter, and education). So although medical science can play an important role in guiding public health policy by improving understanding of the mechanisms of disease, and specific medical interventions allow us to treat disease when it occurs, the role of preventive medicine should not be overestimated. In particular, the medical profession should not take upon itself responsibilities for public health which are more appropriately assumed by governments and other social and environmental agencies. The preventive responsibilities of all doctors Preventive medicine is an important and integral part of good cura- tive medicine. All doctors have a responsibility to think about why someone is ill. Whatever cause is identified (physiological, social, or psychological), the question about whether the cause can be pre- vented (and the risk of future disease reduced) should be addressed. Clinicians should be held professionally accountable if they can be shown to have missed a previous clinical opportunity to measure blood pressure in an individual who subsequently develops a stroke. Doctors who work in a primary care role (particularly those with a registered population) have the added responsibility to ask them- selves whether the risk should be addressed at a population rather than just an individual patient level. Changing behaviour Most of the leading risk factors for preventable mortality cited earlier can be influenced by individual behaviour: smoking, diet, exercise, alcohol consumption, hand washing, and unsafe sex. The most effective way to influence such behaviour is usually through public health policy, but individual practitioners can play an im- portant complementary role. People do listen to their doctors, and several clinical trials have shown brief advice on behaviour modi- fication to be cost-effective, even though the impact may be small (e.g. in most studies only about 1 in 30 smokers given brief advice to stop smoking actually quit). Brief advice is most effective if prac- tical in nature (giving guidance on how change can be achieved) and if backed up by written advice to take home (see Chapters 26.6.1, 26.6.2, and 26.6.3 for further discussion). More intensive inter- ventions may sometimes be more effective but tend to be less cost- effective. In each case, it is important to take account of the scientific evidence about effectiveness and the local socioeconomic context. Immunization Vaccination is a very effective preventive strategy. Vaccination against smallpox has led to global eradication of the disease; eradi- cation of polio is a feasible global objective. Vaccination against many diseases, particularly diseases of childhood such as measles, diphtheria, and polio, has led to rapid and dramatic falls in disease incidence. Fig. 2.11.3 shows the impact of introduction of the Hib vaccine in 1992 on the incidence of Haemophilus influenzae infec- tion in England and Wales. Table 2.11.3 shows the current routine vaccine schedule in the United Kingdom. Every individual in the population is routinely vaccinated against 14 different organisms. At-risk groups may be re- quired to have specific vaccines to protect themselves (e.g. health workers against hepatitis B), and the general population and trav- ellers to other countries can choose and pay for a range of vaccines for other diseases including hepatitis A, typhoid, and rabies. It is not uncommon for a United Kingdom resident to have received vaccin- ation against 15–20 microorganisms during their

lifetime. Several new and important vaccines are on the horizon (e.g. against malaria), but the existence of an effective vaccine does not guarantee the success of an immunization programme. This depends on the ef- fective delivery of the vaccine to the at-risk population. Programmes are often limited in their effect by affordability (some vaccines are unaffordable without external funding in many low-income coun- tries), acceptance (parental anxiety about the adverse effects often limits uptake), and delivery (vaccines may lose potency if stored outside a refrigerator). There are also potential problems with the Number of reports 250 200 150 100 50 0 Years Hib vaccine introduced 1995 1994 1993 1992 1991 1990 1989 up to 1 year of age all other ages
Fig. 2.11.3 Effect of introduction of Haemophilus influenzae type b (Hib) vaccination in the United Kingdom on laboratory reports of Hib infection. Reproduced by permission of the Controller, Her Majesty's Stationery Office.

 antigenic variability of organisms over time (e.g. influenza) and the difficulty of immunizing at an age young enough to prevent mor- bidity but old enough to stimulate an immune response (e.g. mea- sles). Nevertheless, immunization is probably the most important medical contribution to primary disease prevention. Screening The issue of screening is dealt with in Chapter 2.12. Two-thirds of the preventive services for adults recommended for implementation by the United States Preventive Services Task Force involve screening. The purpose of screening is to identify disease at an early and curable stage. The most important criterion that has to be met for screening to be ethical is that the condition identified can be treated. Good intention is not enough. Screening will do harm if it identifies con- ditions that we can do nothing about, either because of lack of ef- fective interventions or lack of resources. It is particularly important to assess the effectiveness of screening interventions in randomized trials, as people whose disease was detected by screening will appear to clinicians to do well even if the screening is ineffective. This is because early diagnosis will lead to longer survival irrespective of treatment, and illness detected by screening will always tend to be more benign in its natural history than illness detected clinically. Prophylactic treatment Although most people think of medicines as cures for current illness, many medicines are prescribed with a view to preventing future illness. Antibiotics are given before surgery to prevent postoperative infection, antimalarials to prevent malaria in travel- lers, anticoagulants to prevent stroke in people with atrial fibrilla- tion, and lipid-lowering agents to prevent heart attacks in people at high risk of cardiovascular disease. The duration of treatment may also be extended beyond the initial treatment phase to achieve a pre- ventive effect. Antidepressants are continued after cure to prevent relapse, angiotensin converting enzyme (ACE) inhibitors to prevent worsening of ventricular dysfunction, and uricosuric agents to pre- vent further episodes of gout. It must be clear from these examples that many drugs have the po- tential to be used for prevention as well as cure. In some cases (e.g. treatment of diabetes) the distinction between prevention and cure is unhelpful: treatment aims to prevent morbidity in both the short and long terms. However, in all the examples given, prescribing is limited to a defined high-risk group. Prophylactic treatment with drugs is less helpful when a high-risk population cannot be easily defined. It is usually inappropriate to use prophylactic treatment to reduce population risk for three reasons: the strategy is seldom cost- effective, increasing the reliance of the population on medicine is an adverse social outcome, and uncommon adverse effects can easily outweigh any benefit. However, a case can be made for treating high- risk populations defined only by age and gender with a 'polypill' combining certain drugs with a low side-effect profile that have been shown to be effective in preventing cardiovascular disease. Environmental change Most environmental causes of disease are best modified on a public health

rather than an individual basis. Such factors include the safety of the workplace, environmental pollution, transport safety, food hygiene, and provision of clean water. However, some diseases have environmental causes, which need to be recognized and avoided by the individual patient. On a global scale, avoidance of insect and other disease vectors (e.g. by netting) and attention to nutritional hygiene (e.g. by hand washing and filtering water) are probably the most important. In economically developed countries, the most common diseases amenable to individual environmental interven- tion are those associated with atopy, such as asthma and eczema. Not all patients have an identifiable allergenic cause for their symp- toms and, even if one is identified, avoidance (e.g. of house dust mite in asthma) may not be easy. But dramatic improvement can occur, and treating contact dermatitis without giving advice on contact Table 2.11.3 Routine immunization programme in the United Kingdom according to age 2 months 3 months 4 months 1 year 2 years, then annually until 16 years 3 ½ years Girls 12–14 years 14 years 65 years 65 years then annually 70 years Diphtheria ✔ ✔ ✔ ✔ ✔ Tetanus ✔ ✔ ✔ ✔ ✔ Polio ✔ ✔ ✔ ✔ ✔ Pertussis ✔ ✔ ✔ H. influenzae B ✔ ✔ ✔ ✔ Rotavirus ✔ ✔ Pneumococcus ✔ ✔ ✔ ✔ Meningococcus C ✔ ✔ Measles ✔ ✔ Mumps ✔ ✔ Rubella ✔ ✔ Influenza ✔ ✔ Human Papillomavirus ✔ Shingles ✔ Data from: Department of Health/Public Health England. Immunisation against infectious disease (The Green Book) Chapter 11. HMSO, London (updated February 2015). https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/400554/2902222_Green_Book_Chapter_11_v2_4.pdf

2.11 Preventive medicine 133 avoidance, or treating louse bites without giving advice on how to rid clothes of lice, is bad medical practice. What interventions work? Public health interventions It is impossible to list here all the public health initiatives that are known to be effective. There is no doubt that provision of clean water and sanitation; avoidance of war; progressive taxation; pro- vision of education; fiscal policy to reduce tobacco and alcohol use; food policies to reduce community intake of salt, saturated fat, and excess calories; and education to promote safe sex, are all ef- fective public health interventions. Their effective implementation depends on political will at a national and international level. In general, the effectiveness of public health interventions will reflect government attitude to regulation (e.g. whether the presumption of market-led development and free trade dominates individual and societal health concerns) and the understanding of health risk by the general public, politicians, and health practitioners. At an inter- national level, the World Health Organization cites the Framework Convention for Tobacco Control as an exemplar of a very effective government-led international public health initiative. This covers advertising, regulation, taxation, and smoke-free zones, as well as the individual treatment of addiction. Interventions aimed at the individual As with public health interventions, it is impossible to list here all the preventive interventions targeted at individuals which have been shown to be effective. Many are in any case better seen as part of good routine clinical care (and are included in the relevant chapters on specific diseases). Nevertheless, one accessible source of regularly updated evidence on individual interventions is the United States Preventive Services Task Force and Table 2.11.4 lists Table 2.11.4 Preventive interventions recommended for adults by the United States Preventive Services Task Force as providing important health benefit on the basis of research evidence rated as A (high certainty of substantial net benefit) or B (high certainty of moderate net benefit or moderate certainty of moderate to substantial net benefit) Men Women Timing and target groups Screening interventions Alcohol misuse screening and counselling ✔ ✔ Counselling about safe-drinking for all; specific help for heavy drinkers identified by screening Aortic aneurysm ✔ Ultrasound at age 65–75 in ever smokers BRCA-related cancer ✔ Women with

family history suggestive of BRCA1 or BRCA2 gene mutations Breast cancer ✔ Biennial mammography from ages 50 to 74 years Cervical cancer ✔ Cytology every 3 years age 21–65 years or combined cytology/HPV testing every 5 years Chlamydia infection ✔ All sexually active women age <25 years (after age 25 only high-risk groups) Colorectal cancer ✔ ✔ Age 50–75 years using faecal occult blood (FOB) testing, sigmoidoscopy, or colonoscopy Depression ✔ ✔ Recommendation states that screening is appropriate only when accurate diagnosis, treatment, and follow-up possible Diabetes mellitus ✔ ✔ Adults with sustained hypertension (BP >135/80) Risk of falling in older adults ✔ ✔ Community-dwelling adults 65+ years; physical therapy and/or vitamin D supplements recommended for high-risk groups Gonorrhoea infection ✔ At-risk groups Hepatitis C infection ✔ ✔ At-risk groups and those born between 1945 and 1965 High blood pressure ✔ ✔ All adults age 18+ years HIV infection ✔ ✔ At-risk groups Intimate partner violence ✔ Women of childbearing age (guideline also includes advice on identifying risk of abuse of elderly) Lipid disorders ✔ ✔ All men aged 35+; women and younger men 20+ if high cardiovascular disease (CVD) risk Lung cancer ✔ ✔ Heavy smokers (current or within 15 years of cessation) Obesity ✔ ✔ Assuming availability of intensive multifactorial behavioural intervention when BMI 30+ Osteoporosis ✔ Women aged 65+ (plus women at equivalent risk for reasons other than age) Syphilis infection ✔ ✔ At-risk groups Other interventions Aspirin ✔ ✔ Adults at increased CVD risk Breast cancer chemoprevention ✔ Women age 35+ years at high risk of breast cancer Dietary counselling ✔ ✔ Adults at high risk of CVD Tobacco use counselling ✔ ✔ All who use tobacco (assuming all patients are asked about tobacco use opportunistically at clinical consultations) Data from: Recommendations of the U.S. Preventive Services Task Force. US Department of Health and Human Services, Washington, DC; October 2015 (http://www.uspreventiveservicestaskforce.org/Page/Name/uspstf-a-and-b-recommendations/Individual interventions).

134 section 2 Background to medicine the conditions for which evidence of effectiveness is rated by them as A (high certainty of substantial net benefit) or B (high certainty of moderate net benefit or moderate certainty of moderate to sub- stantial net benefit). In interpreting this evidence, it is important to recognize that the recommendations reflect the specific context of the United States; differences in the prevalence of the target condition and the availability and effectiveness of interventions to ameliorate risk identified impact on their relevance to other countries. The recommended preventive interventions (other than vac- cination) for two important at-risk groups—pregnant women and children—are listed separately in Table 2.11.5. Again, in interpreting this evidence it is important to consider its local ap- plicability. For example, the appropriateness of treating individual children with fluoride to prevent dental caries depends both on whether the local diet promotes caries and whether fluoride is added to drinking water as a public health measure. Similarly, screening for sickle cell disease and counselling about skin cancer prevention is only appropriate in at-risk ethnic groups, and screening for depression in adolescents is only appropriate if re- sources are available to make an accurate diagnosis and manage the problem effectively. Implementation issues Cultural constraints Most behaviour aimed at preventing disease has a strong sociocul- tural component and reflects prevalent attitudes and norms in so- ciety. Preventive interventions are severely constrained by this social context. Convincing people to stop smoking, eat less salt, drink less beer, or drive more slowly is difficult if everyone else is doing the op- posite. For example, the data in Fig. 2.11.4 (showing that the mean blood cholesterol level in Finland in the 1990s was almost twice that in Japan), supported by migrant studies showing that this dif- ference was dietary rather than genetic in origin, led some enthu- siastic policy makers to assume

that medical advice to individuals to modify their diet could cut cholesterol levels by half. However, even in clinical trials, dietary advice from health professionals in a community setting has seldom achieved a reduction in blood chol- esterol of more than 3–5%. Studies of salt restriction (to lower blood pressure) show a similar result. Intensive intervention and support are needed for an individual patient to achieve a physiologically significant reduction in intake and many find such a diet unpal- atable. Countercultural change is difficult to achieve. The adverse Table 2.11.5 Preventive interventions for pregnant women and children (other than vaccination) recommended by the US Preventive Services Task Force as providing important health benefit on the basis of research evidence rated as A (high certainty of substantial net benefit) or B (high certainty of moderate net benefit or moderate certainty of moderate to substantial net benefit) Children Pregnant women Timing and target groups Alcohol misuse screening and counselling ✔ First antenatal visit Asymptomatic bacteriuria screening ✔ 12–16 weeks' gestation Breastfeeding promotion ✔ During pregnancy and after delivery Congenital hypothyroidism screening ✔ Newborn Deafness ✔ Newborn Dental caries prevention (fluoride) ✔ From first tooth eruption to 5 years Depression (major depressive disorders) screening ✔ Children aged 12+ if diagnostic and treatment provision in place Folic acid supplementation ✔ All women planning or capable of pregnancy Gestational diabetes screening ✔ After 24 weeks' gestation Gonococcal ophthalmia neonatorum prophylaxis (antibiotic drops) ✔ Newborn Infection screening (chlamydia, gonorrhoea, Hep B,
Hep C, HIV, syphilis) ✔ ✔ All at-risk of specific infections (all pregnant women for HIV and syphilis); Iron deficiency anaemia screening and dietary iron supplementation ✔ ✔ Screen all pregnant women; supplement at-risk children 6–12 months Obesity ✔ Children age 6+ years Pre-eclampsia prevention (aspirin) ✔ After 12 weeks' gestation in women at high risk PKU (phenylketonuria) screening ✔ Newborn Rhesus (D) incompatibility screening ✔ First antenatal visit and repeat at 24–28 weeks if Rh (D) negative Sexually transmitted infection, behavioural counselling ✔ Sexually active adolescents Sickle cell disease screening ✔ Newborn Skin cancer avoidance counselling ✔ Children and young adults age 10–24 years with fair skin Tobacco use counselling ✔ ✔ School age children and pregnant women who smoke Visual-impairment screening ✔ Ages 3–5 years Data from: Recommendations of the U.S. Preventive Services Task Force. US Department of Health and Human Services, Washington, DC; October 2015 (http://www.
uspreventiveservicestaskforce.org/Page/Name/uspstf-a-and-b-recommendations/Individual interventions).

2.11 Preventive medicine 135 consequence is the common use of medication (in this case statins) to treat what is effectively a sociocultural problem. Time constraints One lesson we often forget is that things change over time. The North Karelia project is of more than historical interest. It was a large-scale, long-term programme to reduce mortality from cardiovascular disease in northern Finland, started in 1972, which involved both public health and individual intervention. Fig. 2.11.5 compares mortality from cardiovascular disease in North Karelia with that in 10 other provinces in Finland before and during the intervention by plotting two regression lines. The difference in slopes of these two lines shows that the intervention was to some extent effective. However, far more impressive in magnitude is the absolute fall in mortality over time both in North Karelia and in the other prov- inces. The lessons for preventive medicine are twofold: the effect of medical intervention may be small compared to the effect of other economic and social influences; and the change in baseline risk and social context over time may be so rapid that it will substantially in- fluence the absolute benefit of any preventive intervention. Programme effectiveness Many of the

interventions cited earlier are known to work because they have been tested in clinical trials. However, clinical trials are often done in settings far removed from everyday life. Participants are compliant, those delivering the intervention are highly trained, the technology is of high specification, and quality control is rigorous. These conditions will not hold under ordinary working conditions. When recommended preventive interven- tions fail, the most common reason is lack of effective implemen- tation of the programme, rather than lack of effectiveness of the intervention itself. The three most important implementation issues that determine programme effectiveness are: • Coverage—the population at risk needs to receive the intervention. • Delivery—the way the intervention is delivered (e.g. maintenance of equipment, the training of staff, and the storage of biological materials) must be high quality. • Quality assurance—performance indicators (e.g. the maximum number of cases missed by screening) need to be predefined and monitored. Failure to implement any one of these issues can stop a poten- tially effective intervention delivering any benefit. Two well- documented examples from the United Kingdom are the resur- gence in whooping cough when vaccine population coverage fell (after media publicity about potential adverse effects of the pertussis vaccine) and the missed cases of uterine cervix which occurred before adequate quality standards were defined and monitored for cervical sampling and cytological assessment in the national screening programme. Conclusion Preventive medicine is an integral part of clinical practice for all doctors. It is our responsibility as clinicians not only to cure the presenting illness but also to take action where possible to prevent future morbidity. However, we must display both humility and as- sertiveness in our approach. We need to be humble in our approach to patients and to recognize that medicine is not the main deter- minant of health. At the same time, we must display assertiveness in our advocacy of prevention. In the United Kingdom, the Royal College of Physicians' reports, the campaigning of medical charities, and the decision by virtually all doctors to stop smoking have all played an important part in influencing both public and political opinion against tobacco use. As a profession, we can make a unique and powerful contribution to the prevention of premature death by identifying and publicizing the existence and causes of ill health. We also have a unique and powerful responsibility to act as advocates for our patients in ensuring that these causes are addressed and the risk to their health is ameliorated. Good clinical practice entails pre- ventive medicine, but good preventive medicine is more than just good clinical practice. Total serum cholesterol (mg/100 ml) 80 60 40 20 0 100 200 300 400 500 South Japan East Finland Relative frequency (%) Fig. 2.11.4 Distribution of serum cholesterol in southern Japan and eastern Finland. Reproduced from Rose G. Rose's Strategy of Preventive Medicine, 2008. With permission from Oxford University Press, Oxford. 1969 Year 1000 Mortality/1000 900 800 700 600 500 400 82 81 80 79 78 77 76 75 74 73 72 71 70 North Karelia Ten other provinces Fig. 2.11.5 The North Karelia project. Age-standardized annual mortality from cardiovascular disease in men aged 35–64 years in Finland, 1969–1982. Redrawn from original data published by Tuomilehto J et al., British Medical Journal 1986: 293: 1068–71.

FURTHER READING Department of Health/Public Health England (2015). Immunisation Against Infectious Disease (The Green Book). HMSO, London (https://www.gov.uk/government/collections/ immunisation-against-infectious-disease-the-green-book) Rose G (1992). The strategy of preventive medicine. Oxford University Press, Oxford. US Preventive Services Task Force (2014). Guide to Clinical Preventive Services—Recommendations of the US Preventive Services Task Force. (http://www.uspreventiveservicestaskforce. org/) World Health Organization (2003). World Health Report 2002. Reducing risks, promoting healthy life. World Health Organization, Geneva. http://www.who.int/whr/2002 World Health Organization

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