World Health Organization

THE CASE FOR INVESTING IN PUBLIC HEALTH

A public health summary report for EPHO 8

Assuring sustainable organizational structures and financing

FACULTY OF PUBLIC HEALTH

THE CASE FOR INVESTING IN PUBLIC HEALTH

The strengthening public health services and capacity

A key pillar of the European regional health policy framework Health 2020

A public health summary report for EPHO 8

ABSTRACT

The economic crisis has led to increased demand and reduced resources for health sectors. The trend for increasing healthcare costs to individuals, the health sector and wider society is significant. Public health can be part of the solution to this challenge. The evidence shows that prevention can be cost-effective, provide value for money and give returns on investment in both the short and longer terms. This public health summary outlines quick returns on investment for health and other sectors for interventions that promote physical activity and healthy employment; address housing and mental health; and reduce road traffic injuries and violence. Vaccinations and screening programmes are largely cost-effective. Population-level approaches are estimated to cost on average five times less than individual interventions. This report gives examples of interventions with early returns on investment and approaches with longer-term gains. Investing in cost-effective interventions to reduce costs to the health sector and other sectors can help create sustainable health systems and economies for the future.

Keywords

Cover photos:
Top: ©Shutterstock
Middle: ©iStock.com
Bottom: ©Shutterstock

Design, layout and production by Phoenix Design Aid, Denmark

CONTENTS

Acknowledgements

About this report

The target audience for this report is public health planners and managers, as well as wider decision-makers and policy-makers both in national and local governmental and professional roles in health and social care settings and in broader roles influencing health and well-being.

Scope

Public health is defined as "the art and science of preventing disease, prolonging life and promoting health through the organized efforts of society" (Acheson, 1988). It consists of three main domains: health protection, disease prevention and health promotion. These are strengthened by robust public health intelligence and supported by enablers, including sustainable funding and organization, governance, workforce development, advocacy and research.

This summary report supports Health 2020, the new policy framework from the WHO Regional Office for Europe, which seeks to support a wide range of actions that can improve health (WHO, 2012a), and the European Action Plan for Strengthening Public Health Capacities and Services (WHO, 2012b), which sets out 10 essential public health operations (EPHOs). The report specifically supports the strengthening and delivery of EPHO 8: assuring sustainable organizational structures and financing.

Objectives

The report's objectives are:
- to describe the economic and health benefits to individuals and governments of a public health approach;
- to set out the costs of failing to address current public health challenges;
- to summarize evidence for the cost–effectiveness of public health and prevention approaches, including the wider determinants of health, resilience, health behaviours, vaccination and screening;
- to summarize the recommendations from WHO's study of the costs of scaling up action to prevent and reduce the impact of non-communicable diseases (NCDs) (WHO, 2011a);
- to summarize which preventive interventions show evidence for early returns on investment, and which provide longer-term gains.

Key messages

1. The current costs of ill health are significant for governments in Europe: trends suggest unsustainable increases in costs unless cost-effective policies are put in place.

- Ageing populations with higher rates of NCDs have increased demand, while health care costs have generally increased.
- The costs of health inequalities – the total welfare loss across 25 European countries – are estimated at 9.4% of gross domestic product (GDP) or €980 billion.
- Cardiovascular disease (CVD) and cancer cost the countries of the European Union (EU) €169 billion and €124 billion respectively each year.

- Tobacco use reduces overall national incomes by up to 3.6%.
- Air pollution from road traffic costs the countries of the EU €25 billion, while road traffic injuries cost €153 billion each year.
- Obesity accounts for 1–3% of total health expenditure in most countries; physical inactivity costs up to €300 per European inhabitant per year.
- Mental illness costs the economy £110 billion per year in the United Kingdom and represents 10.8% of the health service budget.

The economic crisis has increased demand and reduced resources. Cost-effective preventive approaches can

contribute to improvements in health outcomes at lower and more sustainable costs, while supporting universal health coverage. The Organisation for Economic Co-operation and Development (OECD) predicts that, according to current trends, if nothing is done the cost of health care will double by 2050. This will place strain on health systems – which for some countries may not be sustainable – and may compromise quality of care and risk widening health inequalities.

2. The evidence shows that a wide range of preventive approaches are cost-effective, including interventions that address the environmental and social determinants of health, build resilience and promote healthy behaviours, as well as vaccination and screening. The evidence in this report shows that prevention is cost-effective in both the short and longer term. In addition, investing in public health generates cost-effective health outcomes and can contribute to wider sustainability, with economic, social and environmental benefits.

- The WHO "best buy" interventions for NCDs (WHO, 2011a) include several that are highly cost-effective, including tobacco and alcohol legislation, reducing salt and increasing physical activity.
- Interventions that affect health behaviours and enhance resilience – including improving mental health and reducing violence – can give early and longer-term returns on investment, with improved and social benefits.
- Interventions that focus on addressing social and environmental determinants (such as promoting walking and cycling, green spaces, safer transport and housing interventions) are shown to have early returns on investment, with additional social and environmental benefits. Healthy employment programmes show returns on investment within 1–2 years.
- Disease prevention interventions such as vaccinations generally achieve a good return on investment, while some screening programmes are shown to be cost-effective.

3. Even small investments promise large gains to health, the economy and other sectors, with sustainable outcomes.

- Investing in health in general has been shown to give economic returns to the health sector, other sectors and the wider economy, with an estimated fourfold return on every dollar invested.

- Evidence shows that preventive approaches contribute between approximately 50% and 75% to the reduction of CVD mortality in high-income countries, and 78% globally.
- The WHO report on reducing the economic impact of NCDs in low- and middle-income countries (WHO, 2011a) estimates that a further investment of 1–4% of current health spending is needed to reduce escalating health care costs.
- It is estimated that only of 3% of national health sector budgets in Europe (range: 0.6–8.2%) is currently spent on public health and prevention, indicating scope for increases in public health investment in order to enhance cost-effective health and wider outcomes.

Prevention can give returns on investment within 1–2 years. Examples include:

- mental health promotion
- violence prevention
- healthy employment
- road traffic injury prevention
- promoting physical activity
- housing insulation
- some vaccinations.

A short video presenting the key messages, featuring international public health experts and ministers of health, can be found at the Oslo conference on health systems and the economic crisis section of the WHO Regional Office for Europe website (WHO, 2013a).

Fig. 1 shows the range of interventions proven to be cost-effective.

Fig. 1. Cost-effective public health interventions
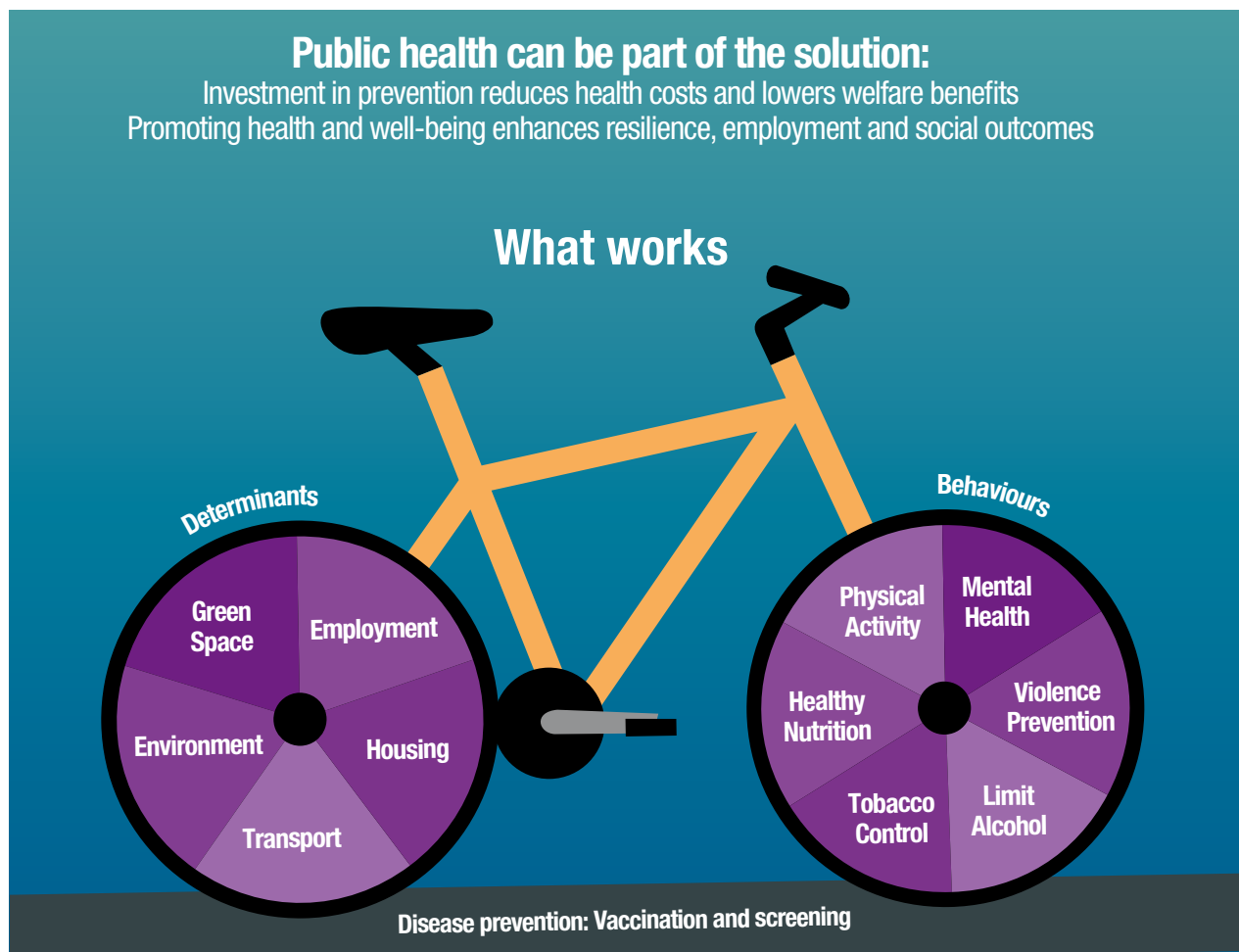
Source: WHO (2013a).

Table 1 summarizes cost-effective interventions that provide returns on investment and/or cost savings in the short term ("quick wins") and longer term. It should be noted that the table only reflects evidence of examples where timescales on returns and cost saving have been reported (in green and orange font).

Table 1. Summary of interventions found to be cost-effective

Intervention focus	Quick wins (0–5 years)	Longer-term gains (over 5 years)
Environmental determinants	• Road traffic injury prevention[a] • Active transport[a] • Safe green spaces[a] • Heat wave plan[a]	• Removal of lead and mercury • Chemical regulation
Social determinants	• Healthy employment programmes • Insulating homes[a] • Housing ventilation for asthma • Community falls prevention	–
Resilience	• Violence prevention legislation • Prevention of postnatal depression • Family support projects • Social emotional learning • Bullying prevention • Mental health in the workplace • Psychosocial groups for older people • Parenting programmes • Depression prevention	• Preschool programmes • Prevention of conduct disorder • Multisystemic therapy for juvenile offenders • Detection of and care for the victims of intimate partner violence
Behaviour	• Lifestyle diabetes prevention programme[a] • Restricting alcohol availability • Community-based youth tobacco control intervention • Workplace obesity intervention • Tobacco legislation, taxation and control (WHO very cost-effective) • Alcohol legislation, taxation and control (WHO very cost-effective) • Nutrition – reducing salt; replacing trans fatty acids; raising public awareness of healthy diets[a] (WHO very cost-effective) • Physical activity mass media awareness (WHO very cost-effective)	• Alcohol minimum price • Counselling to smokers (WHO quite cost-effective) • Alcohol brief interventions and alcohol driving breath tests (WHO quite cost-effective)
Vaccination	• For children: norovirus, pneumococcus, rotavirus, influenza	• Influenza, pneumococcus • Measles, mumps and rubella; diphtheria, pertussis and tetanus • Human papillomavirus; hepatitis B; meningitis C
Screening	• Screening for abdominal aortic aneurysm • Screening for depression in diabetes • Cervical cancer screening (WHO very cost-effective)	• Screening for diabetes and impaired glucose tolerance • Vascular disease health checks • Breast and colon cancer screening (WHO quite cost-effective)
Treatment	• Treatment of depression in diabetes patients • Treatment ofCVD (WHO very cost-effective)	• Treatment of diabetes (WHO quite cost-effective) • Treatment of asthma (WHO quite cost-effective)

Key: Green: offers a return on investment
Orange: cost-effective
Black: WHO "best buy" interventions – timescales and costs not included; please note that these calculations were performed for low- and middle-income countries
[a] "win win win" approaches with multiple health, social and environmental benefits: these have been shown to be cost-effective, with potential returns on investment within five years; they also contribute to wider aspects of sustainability, including economic, social and environmental benefits (Bone and Nurse, 2010).

The WHO "best buy" interventions for NCDs (WHO, 2011a) are positioned according to whether they were assessed as very cost-effective (quick wins) or quite cost-effective (longer-term gains). The table aims to provide an overview so that planners can consider interventions appropriate to their own settings, recognizing the limitations of a lack of evidence and comparability of many economics studies. In addition, many studies did not record the timescales of returns or may have only examined certain outcomes. In general, investing in early life interventions is estimated to be more cost-effective – see the example of the first 1000 days (Box 1).

Box 1. The importance of the first 1000 days

Maternal and child malnutrition in terms of both under- and overnutrition are areas for continuing and increasing attention. The 1000 days between a woman's pregnancy and her child's second birthday offer a unique window of opportunity to shape healthier and more prosperous futures. Child undernutrition accounts annually for an estimated 45% of all child deaths, which are more prevalent in low- and middle-income countries. Providing optimal maternal nutrition, breastfeeding and mineral and vitamin supplementation, however, requires an estimated US$ 9.6 billion investment to tackle global undernutrition and save approximately 900 000 lives. Costs per life-year saved include US$ 125 for the management of acute malnutrition, US$ 159 for micronutrient supplementation for children at risk, US$ 175 for infant and young child feeding (including breastfeeding) and US$ 571 for optimum maternal nutrition during pregnancy. Increases in maternal and child overnutrition occurring as part of the global nutritional transition are key stages to intervene to reduce and prevent longer-term NCDs.

For further information see Black et al. (2013) and the 1,000 Days (2014) website.

Background

Many governments have responded to the global economic crisis by reducing budgets. Health is the second largest area of public expenditure for most countries; as a consequence, it is in the financial spotlight. At the same time, there is upward pressure from the rising costs of technologies and pharmaceuticals and – to a lesser extent – from ageing populations. Additional upward pressure comes from ill health associated with rising unemployment and, for those in employment, job insecurity and wages that fail to keep up with inflation. Some of these health costs can be avoided by shifting investment to prevent harm and increase activity in health promotion, disease prevention and health protection. Funding for prevention remains a small proportion of overall health spending, but can represent excellent value for money, with gains in both the short and the long term, as well as savings for sectors other than health.

The economic impact of NCDs – many of which are avoidable – amounts to billions of euros per year.

Nevertheless, European governments currently spend an average of only 2.8% of their health sector budgets on prevention. Across the WHO European Region, the balance of expenditure on preventive versus curative care varies widely from an estimated less than 1% to over 8% of total health budgets (WHO, 2014a). In the context of the financial crisis, already vulnerable public health budgets have been further cut in several cases (Mladovsky et al., 2012). Many countries have also seen an increase in unemployment, accompanied by an increase in mental ill health and suicides, with outbreaks of infectious diseases in some countries linked to the breakdown of surveillance and control systems. In Iceland, however, which was hit very hard by the crisis, there was no worsening of health outcomes. This has been attributed to the country's maintenance of social support and high level of social cohesion (Karanikolos et al., 2013).

Set against this picture of weak public health responses is the growth in demand for health care, associated with

a rising burden of NCDs, increasing inequalities and demographic changes – in particular, population ageing. More recent trends such as rising unemployment, combined with more profound threats such as climate change, are likely to add further challenges to the system. Some of the greatest advances in health in Europe of the last century resulted from addressing the causes of disease – such as poor housing and nutrition – rather than just treating the consequences. One example is tuberculosis, which fell from 13% of total mortality in the United Kingdom in 1855 to 0.1% by 1990. Much of this decline took place through improvements in housing before medical interventions such as the Bacillus Calmette–Guérin (BCG) vaccination became available (Donaldson & Donaldson, 2003). More recently, the results of the Finnish North Karelia Project show that preventive approaches can have a major impact on risk factors: the decline in heart disease mortality in Finland was one of the most rapid in the world (Puska et al., 2009). Mortality from coronary heart disease fell by 85% over a 35-year period, from around 650 to 150 per 100 000 (Fig. 2).

Evidence from several studies suggests that the observed decline in many countries in coronary heart disease mortality (one of the most important NCDs in terms of burden of disease) has resulted from tackling risk factors such as blood pressure, tobacco, cholesterol and salt: through preventing rather than treating the consequences of disease. This includes both population-

Fig. 2. Age-adjusted coronary heart disease mortality rates in North Karelia and the whole of Finland among males aged 35–64 years, 1969–2005

Source: Puska et al. (2009).

based measures and individual-based approaches. A reduction in risk factors (such as reducing cholesterol, blood pressure and smoking and increasing physical activity) has been shown to account for an estimated 50–70% of the decline in global coronary heart disease mortality, with treatment contributing approximately 25–50% (Fig. 3).

Fig. 3. Contribution of treatment and risk factor reduction to global heart disease morbidity

Study	Treatments	Risk factors	Unexplained
Goldman USA, 1968-76	40	54	6
Beaglehole New Zealand, 1974-81	40	60	0
Nunink USA, 1980-90	43	50	7
IMPACT Scotland, 1975-94	35	55	10
IMPACT New Zealand, 1982-93	35	60	5
IMPACT England and Wales, 1981-2000	38	53	11
IMPACT USA, 1980-2000	47	44	9
IMPACT Poland, 1991-2005	43	49	8
IMPACT Czech, 1985-2007	39	60	1
IMPACT Sweden, 1986-2002	36	55	9
BMJ Finland, 1982-97	24	76	0
IMPACT Finland, 1982-97	25	72	5
IMPACT Iceland, 1981-2006	24	74	2

Source: Ford et al. (2007).

The pale blue bars in the figure represent the contributions of changing risk factors, rather than those of specific preventive interventions. Nevertheless, these data demonstrate the significant opportunity for prevention interventions focused on modifying these risk factors.

The economic justification is clear. There is good evidence to support an expanded role for health promotion and disease prevention to increase value for money and, for some approaches, create a return on investment for health and other sectors, as well as potentially promoting an increase in economic productivity. Additional benefits will also occur, with improved educational and employment outcomes, reduced crime and antisocial behaviour and environmental benefits. Many cost-effective interventions also help to reduce inequalities – for example, those addressing mental health and violence prevention, issues disproportionately affecting population groups already suffering from adverse effects of health inequality. Investing in upstream population-based prevention is more effective at reducing health inequalities than funding more downstream prevention (Orton et al., 2011) (Fig. 4).

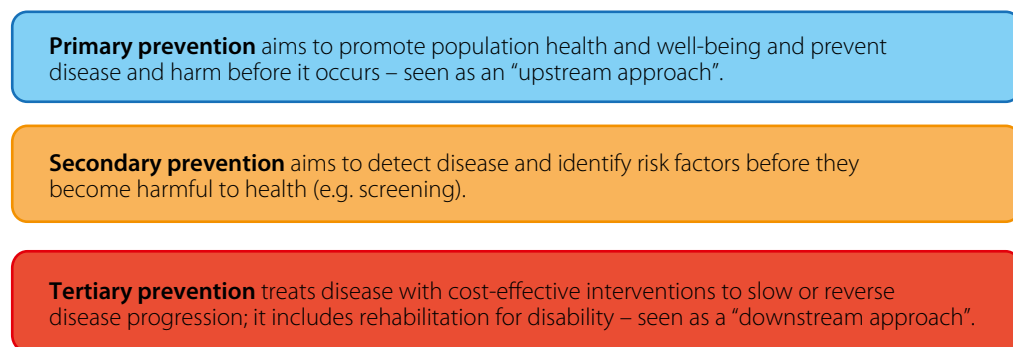The following sections provide economic evidence for interventions in different areas relating to health. They illustrate the cost of inaction ("business as usual") and outline the cost–effectiveness of interventions. They review economic evaluations, highlighting which interventions are cost-effective or make a positive return on investment and the duration over which this return is realized. The trend for steadily rising health and social care costs, as well as the costs of inaction, is an unsustainable problem. The evidence presented in this report demonstrates the potential benefits of cost-effective prevention, using whole-system approaches and intersectoral partnership working. It also shows that public health can be part of the solution.

Fig.4. Levels of prevention

Primary prevention aims to promote population health and well-being and prevent disease and harm before it occurs – seen as an "upstream approach".

Secondary prevention aims to detect disease and identify risk factors before they become harmful to health (e.g. screening).

Tertiary prevention treats disease with cost-effective interventions to slow or reverse disease progression; it includes rehabilitation for disability – seen as a "downstream approach".

Source: adapted from Donaldson &Donaldson(2003).

The economic case for prevention

Prevention can be the most cost-effective way to maintain the health of the population in a sustainable manner, and creating healthy populations benefits everyone. Concerns about upfront costs and the intangibility of outcomes, however, too frequently lead to a lack of action and continued investment in increasingly expensive curative approaches.

Health economic evaluations are complex, as they take into account both direct health costs and indirect social costs. A growing body of evidence, however, supports the economics of prevention (Merkur et al., 2013), for which this report summarizes where possible the length of time to receive a return on investments. The report sets out the case that prevention is – on the whole –
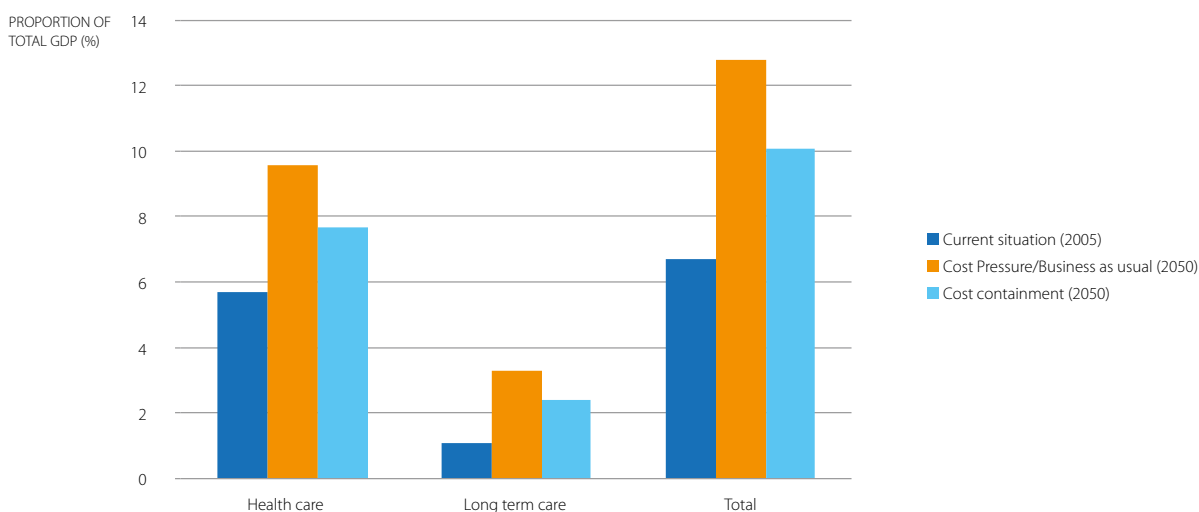
cost-effective, with a number of interventions providing quick returns that can be balanced by investments for longer-term benefits. The alternative of treating the consequences is likely to be unnecessarily costly and unsustainable over time, which risks reducing both quality of and access to care and increasing health inequalities, with a knock-on effect on the overall economy.

Sustainability of current and future costs

Health spending has risen steadily over the past three decades, and has accelerated since the turn of the century to reach an average of approximately 7% of GDP for countries that were OECD members in 2005,

with private spending adding another 2% (OECD, 2006). If no specific policies are employed to move away from past trends, health sector spending is projected to almost double, reaching nearly 13% of GDP by 2050 (Fig. 5) and leading to what OECD calls the "cost pressure" scenario. OECD has identified a number of policies, mainly involving efficiencies in core services that could curb health expenditure, described as the "cost containment" scenario. Average spending is still predicted to increase, however, to around 10% of GDP by 2050. For many countries the current and projected costs of health care are not sustainable, and many budgets have been reduced with the economic crisis.

Fig. 5. OECD projections for public spending on health care 2005–2050

PROPORTION OF TOTAL GDP (%)

Legend:
- Current situation (2005)
- Cost Pressure/Business as usual (2050)
- Cost containment (2050)

Categories: Health care, Long term care, Total

Source: OECD (2006).

The cost of health inequalities

Evidence from a review of the economic cost of health inequalities in 25 European countries (Mackenbach et al., 2011) identified that over 700 000 deaths and 33 million cases of ill health were caused by health inequality. These accounted for 20% of total health care costs. The loss of labour productivity caused by health inequalities was estimated to cost 1.4% of GDP, resulting in an absolute cost of €141 billion. When reviewing health inequalities as a capital good, the total welfare loss across the 25 European countries assessed was estimated at 9.4% of GDP or €980 billion.

Tables 2a and 2b summarize examples of some of the typical costs of the major health threats within Europe. They show recent estimated costs of health outcomes

and risk factors, alongside the burden of disease for the disease or risk area. In particular, they highlight the fact that the collective costs of inequalities are substantial.

Some calculations use disability-adjusted life-years (DALYs) lost – a time-based measure that combines years of life lost due to premature mortality and years of life lost due to time lived in states of less-than-ideal health, which was developed to assess the global burden of disease (GBD) (OECD, 2006). Others use quality-adjusted life-years (QALYs) – a unit of measurement of utility that combines life-years gained as a result of health interventions/health care programmes with a judgement about the quality of those life-years (NICHSR, 2014). Although there are differences in study methodologies, making direct comparisons difficult, the tables provide a

range of examples of where costs will be experienced and, where evidence is available, give illustrations of costs to the individual, the health sector and wider society. The examples are drawn from a wide range of sources, both within Europe and further afield.

Table 2a. Costs of not acting: health outcomes

Health topic	DALYs lost in Europe (millions)[a]	Costs at the individual level	Costs to health sectors	Costs to governments/ wider society
CVD	36.4	–	–	€169 billion per year in the EU (Leal et al., 2006)
Mental health	28.9	Annual cost to society of mental illness in childhood: £11–59 000 per child *(United Kingdom)* (Suhrcke et al., 2007) Costs for children with severe and complex mental health problems: over £1000 per week *(United Kingdom)* (Clarke et al., 2005)	10.48% of 2008/9 National Health Service (NHS) budget spent on mental health services *(United Kingdom)* (Department of Health, 2012) Cost of depression: £1.7 billion in 2007 *(United Kingdom)* (McCrone et al., 2008) Cost of anxiety disorders: £1.2 billion in 2007 *(United Kingdom)* (McCrone et al., 2008)	£110 billion per year in the United Kingdom (McCrone et al., 2008; Friedli& Parsonage, 2007)
Cancer	17.0	–	6.5% of health care expenditure in the EU (Stark, 2006)	€117 billion per year in the EU (Luengo-Fernandez et al., 2012)
Communicable disease	15.9	–	Each unplanned influenza admission costs the NHS £347–774 *(United Kingdom)* (Department of Health, 2010) The measles epidemic cost the NHS £433 000–995 000 over the two-year period 2008/9 *(United Kingdom)* (Department of Health, 2010)	Influenza cost the economy £6.75 billion in 1999 *(United Kingdom)* (Voelker, 1999)
Road traffic injuries	3.6	–	–	Up to 2% of GDP in middle- and high-income countries in the EU (Racioppi et al., 2004) Road traffic collisions cost €153 billion per yearin the EU (Racioppi et al., 2004)
Diabetes	2.6	–	Cost to the NHS: £1.3 billion per year *(United Kingdom)* (Wanless, 2002)	–
Violence	1.9	Around DKr 65 000 per female victim of violence *(Denmark)* (Helweg-Larsen et al., 2010)	In 2007, violence cost the NHS an estimated £2 billion *(United Kingdom)* (Home Office, 2009) Annual costs for the immediate treatment of injuries resulting from violent assaults: nearly DKr 11 million *(Denmark)* (Helweg-Larsen et al., 2010)	Violence costs the economy in England and Wales over £40.1 billion per year *(United Kingdom)* (Home Office, 2009) Violence against women costs Danish society approximately DKr 500 million (about €70 million) per year *(Denmark)* (Helweg-Larsen et al., 2010)

[a] DALYs include 3% discounting and age weights.

Table 2b. Costs of not acting: risk factors

Health topic	DALYs lost in Europe (millions)a	Costs at the individual level	Costs to health sectors	Costs to governments/ wider society
Tobacco	17.7	The average smoker spends two months' wages per year on cigarettes *(Albania)* (Viscusi&Hersch, 2008) Private mortality costs per packet: US$ 222 (men) and US$ 94 (women) *(United States)* (Viscusi&Hersch, 2008)	Smoking-related conditions cost the NHS more than £5 billion per year *(United Kingdom)* (University of Oxford, 2009)	US$ 500 billion per year to the global economy(Shafey et al., 2009) Tobacco use reduces overall national incomes by up to 3.6% (Shafey et al., 2009)
Harmful alcohol use	17.3	Heavy drinking increases the risk of unemployment, absenteeism, and presenteeism (attending work while sick) (Anderson et al., 2012)	Alcohol-use disorders cost the NHS £2.9 billion per year *(United Kingdom)*(NICE, 2010)	Effects on health, well-being and productivity reach US$ 300–400 purchasing power parity per capita per year (Rehm et al., 2009) Alcohol-related harm costs £20–55 billion per year *(United Kingdom)*(PMS Unit, 2004) Alcohol cost the EU €125 billion in 2003 (1.3% of GDP) (Anderson &Baumberg, 2006)
Unhealthy diet	15.3	Obese individuals incur health expenditure more than 30% higher than those of normal weight(Withrow& Alter, 2011)	Obesity accounts for 0.7–2.8% of total health expenditure in most countries (Withrow& Alter, 2011)	Obesity accounts for 1–3% of GDP in most countries, but is as high as 5–10% of GDP in the United States (Sassi, 2010)
Physical inactivity	8.2	Inactive Danish men lose three days of work compared to moderately active men (Juel et al., 2008) Lack of physical activity could account for 8% of all social disability pensions in Denmark (Juel et al., 2008)	Globally physical inactivity accounts for 1.5–3% of national health care budgets (Oldridge, 2008) Physical inactivity accounted for 2.9% of total health expenditure in 2000 *(Denmark)* (Juel et al., 2008) Direct medical costs to the NHS: £1.06 billion *(United Kingdom)* (Allender et al., 2007)	Physical inactivity is estimated to cost €150–300 per inhabitant per year in Europe(Cavill et al., 2006)
Environ-mental risks	2.5 (includes occupational risks, urban outdoor air pollution, unsafe water, sanitation, hygiene, indoor smoke from solid fuels, lead exposure and global climate change)	An estimated total of 1087 potential years of life lost in 2005 *(Switzerland)*(FOEN, 2009)	Lead paint in homes in the United States estimated at US$ 11–53 billion of annual health care costs in children under 6years (Gould, 2009) Calculated lost lifetime earnings over US$ 165 billion among children estimated to have raised lead levels (Gould, 2009)	Air pollution caused by road traffic costs the EU €25 billion per year (TU Dresden, 2012) Air pollution from industrial facilities costs the European Environment Agency €102–169 billion per year (EEA, 2011) Noise pollution from road traffic costs the EU €7 billion per year (TU Dresden, 2012) The cost of road traffic noise pollution in England is estimated to be £7–10 billion per year *(United Kingdom)*(DEFRA, 2013) Mercury emissions from coal burning in the United States reduce IQ, with a resultant US$ 1.3 billion loss in economic productivity(Trasande et al., 2005) Global costs from loss of productivity due to mercury pollution are expected to rise to US$ 29.4 billion by 2020 (Pacyna et al., 2008)

a DALYs include 3% discounting and age weights.

These tables demonstrate the importance of preventing disease and maintaining well-being for the wider economy. Simply reducing health sector spending is likely to reduce its effectiveness, thereby shifting these costs onto the wider society. Reducing public health budgets also poses a risk to population health and increases the risk of disease outbreaks such as HIV and malaria and the spread of multidrug resistant infections, as seen in some countries since the economic crisis. Not only does this fail to solve the current problem, it may lead to widening inequalities that could become increasingly difficult and expensive to address. What matters is not just the amount of money spent but how it is spent. A relatively small shift in spending from treatment to prevention and health promotion over a few years, with a focus on cost-effective solutions, will help to reduce health care costs in a sustainable way, as well as contributing to the overall economy.
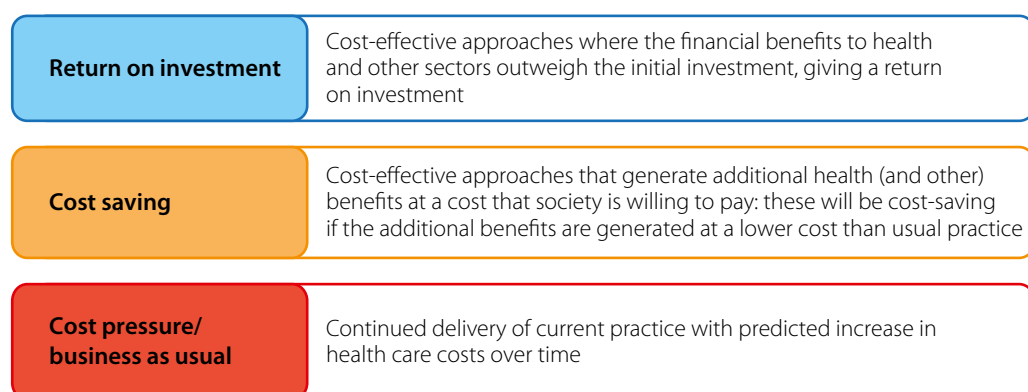
The benefits of action

Containing or reducing the costs of health care without negative effects on health outcomes requires cost-effective prevention interventions to play a much more substantial role. If health spending is to be reduced or even stabilized without compromising quality and outcomes, further measures are needed. One approach is to consider the relative cost–effectiveness of different interventions, looking first at those that are both cost-effective and achieve a positive return on investment, followed by those that are cost-effective and produce savings, with better health benefits at lower cost and finally considering "business as usual" options (Fig. 6).

It needs to be recognized that all approaches require initial investment and that cost-effective approaches that are cost-saving but do not produce a return on investment can increase overall costs. Nevertheless, they frequently achieve better outcomes and can therefore be considered better value for money for improving health outcomes than "business as usual". Many high-income countries judge health care interventions to be cost-effective if they cost less than US$ 50 000 per DALY gained. The preventive interventions listed in the "cost saving" columns in Tables 4a–4d can be considered to be as good as or better than this. Those listed in the "return on investment" columns are examples of interventions that have the potential to provide a return on investment, while also achieving health and wider benefits.

Fig. 6. A suggested hierarchy of prevention interventions

Return on investment	Cost-effective approaches where the financial benefits to health and other sectors outweigh the initial investment, giving a return on investment
Cost saving	Cost-effective approaches that generate additional health (and other) benefits at a cost that society is willing to pay: these will be cost-saving if the additional benefits are generated at a lower cost than usual practice
Cost pressure/ business as usual	Continued delivery of current practice with predicted increase in health care costs over time

A summary of the evidence

This report provides a number of summary tables to illustrate the concepts outlined above (Fig. 7). Tables 3a and 3b set out known "best buy" interventions, according to the WHO report on reducing the economic impact of NCDs in low- and middle-income countries (WHO, 2011a). These are considered "not only highly cost-effective but also feasible and appropriate to implement within the constraints of low- and middle-income countries' health systems". Owing to the scope of the study, however, costs and timescales for the areas covered by the NCD "best buys" report were not included.

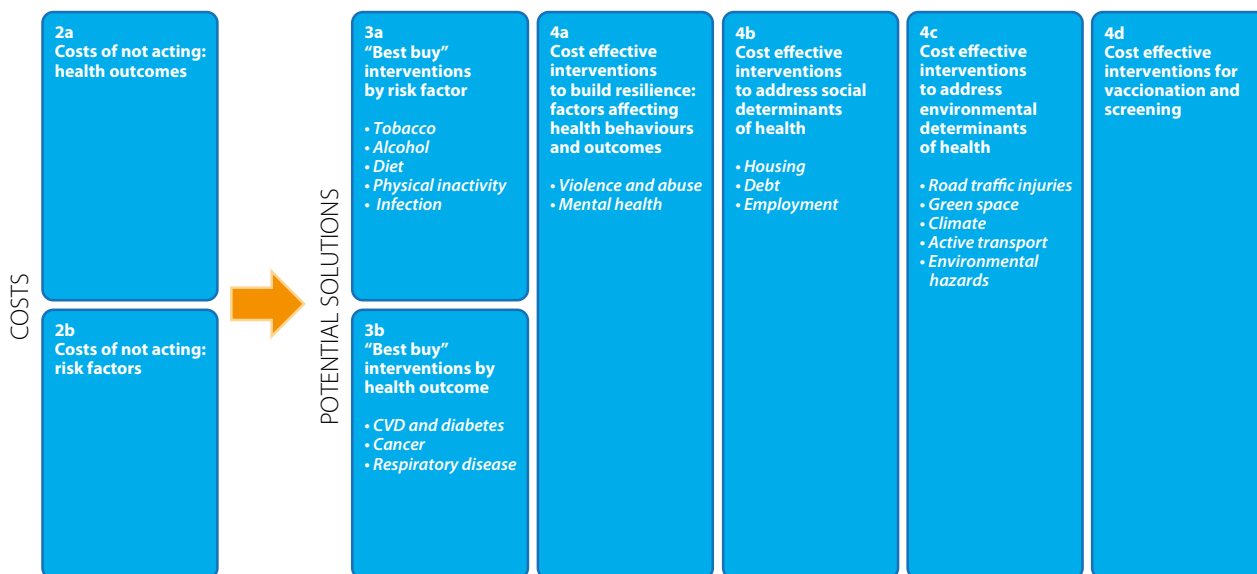### Fig. 7. Conceptual diagram of the summary tables

COSTS

2a
Costs of not acting: health outcomes

2b
Costs of not acting: risk factors

POTENTIAL SOLUTIONS

3a
"Best buy" interventions by risk factor

• *Tobacco*
• *Alcohol*
• *Diet*
• *Physical inactivity*
• *Infection*

3b
"Best buy" interventions by health outcome

• *CVD and diabetes*
• *Cancer*
• *Respiratory disease*

4a
Cost effective interventions to build resilience: factors affecting health behaviours and outcomes

• *Violence and abuse*
• *Mental health*

4b
Cost effective interventions to address social determinants of health

• *Housing*
• *Debt*
• *Employment*

4c
Cost effective interventions to address environmental determinants of health

• *Road traffic injuries*
• *Green space*
• *Climate*
• *Active transport*
• *Environmental hazards*

4d
Cost effective interventions for vaccination and screening

Table 3a. "Best buy" interventions by risk factor

Risk factor (DALYs lost, millions; % GBD)	Intervention/action (core set of "best buys")	Avoidable burden (DALYs averted)	Cost–effectiveness (Very: <GDP per person; Quite: <3 × GDP per person; Less: >3 × GDP per person)	Implementation cost (Very low: <US$ 0.50; Quite low: <US$ 1; Higher: >US$ 1)	Feasibility (health system constraints)
Tobacco use *(>50; 3.7)*	Protect people from tobacco smoke Warn about the dangers of tobacco Enforce bans on tobacco advertising Raise taxes on tobacco	Combined effect: 25–30 million DALYs averted (>50% tobacco burden)	Very cost-effective	Very low	Highly feasible: strong framework (WHO Framework Convention on Tobacco Control (WHO, 2003))
	Offer counselling to smokers		Quite cost-effective	Quite low	Feasible (primary care)
Harmful use of alcohol *(>50; 4.5)*	Restrict access to retailed alcohol Enforce bans on alcohol advertising Raise taxes on alcohol	Combined effect: 5–10 million DALYs averted (10–20% alcohol burden)	Very cost-effective	Very low	Highly feasible
	Enforce drink–driving laws (breath-testing) Offer brief advice for hazardous drinking		Quite cost-effective	Quite low	Intersectoral action; feasible (primary care)
Unhealthy diet *(15–30; 1–2)*	Reduce salt intake Replace trans fat with polyunsaturated fat Promote public awareness about diet	Effect of salt reduction: 5 million DALYs averted Other interventions: not yet assessed globally	Very cost-effective	Very low	Highly feasible
	Restrict marketing of food and beverages to children Replace saturated fat with unsaturated fat Manage food taxes and subsidies Offer counselling in primary care Provide health education in worksites Promote healthy eating in schools		Very cost-effective? (more studies needed) Quite cost-effective Less cost-effective	Very low Higher	Highly feasible Feasible (primary care) Highly feasible
Physical inactivity *(>30; 2.1)*	Promote physical activity (mass media)	Not yet assessed globally	Very cost-effective	Very low	Highly feasible
	Promote physical activity (communities)		Not assessed globally	Not assessed globally	Intersectoral action
	Support active transport strategies		Quite cost-effective	Higher	Feasible (primary care)
	Offer counselling in primary care Promote physical activity in worksites Promote physical activity in schools		Less cost-effective		Highly feasible
Infection	Prevent liver cancer via hepatitis B vaccination	Not yet assessed	Very cost-effective	Very low	Feasible (primary care)

Source: WHO (2011b).

Table 3b. "Best buy" interventions by health outcome

Disease *(DALYs lost, millions; % global burden)*	Intervention/action *(core set of "best buys")*	Avoidable burden *(DALYs averted)*	Cost–effectiveness *(Very: <GDP per person; Quite: <3 × GDP per person; Less: >3 × GDP per person)*	Implementation cost *(Very low: <US$ 0.50; Quite low: <US$ 1; Higher: >US$ 1)*	Feasibility *(health system constraints)*
CVD and diabetes *(170; 11.3)*	Counselling and multidrug therapy (including glycemic control for diabetes mellitus) for people (≥30 years) with 10-year risk of fatal or nonfatal cardiovascular events ≥30% Aspirin therapy for acute myocardial infarction	60 million DALYs averted *(35% CVD burden)*	Very cost-effective	Quite low	Feasible (primary care)
		4 million DALYs averted *(2% CVD burden)*	Very cost-effective	Quite low	
	Counselling & multidrug therapy (including glycemic control for diabetes mellitus) for people (≥ 30 years) with a 10-year risk of fatal and nonfatal cardiovascular events ≥ 20%	70 million DALYs averted *(40% CVD burden)*	Quite cost-effective	Higher	
Cancer *(78; 5.1)*	Cervical cancer – screening through visual inspection with acetic acid and treatment of pre-cancerous lesions to prevent cervical cancer	5 million DALYs averted *(6% cancer burden)*	Very cost-effective	Very low	Feasible (primary care)
	Breast cancer – treatment of stage I	3 million DALYs averted *(4% cancer burden)*	Quite cost-effective	Higher	Not feasible in primary care (diagnosis and treatment requires secondary or tertiary care)
	Breast cancer – early case-finding through mammographic screening (50–70 years) and treatment of all stages	15 million DALYs averted *(19% cancer burden)*	Quite cost-effective	Higher	
	Colorectal cancer – screening at age 50 and treatment	7 million DALYs averted *(9% cancer burden)*	Quite cost-effective	Quite low	
	Oral cancer – early detection and treatment	Not assessed globally	Not assessed globally	Not assessed	
Respiratory disease *(60; 3.9)*	Treatment of persistent asthma with inhaled corticosteroids & beta-2 agonists	Not assessed globally *(expected to be small)*	Quite cost-effective	Very low	Feasible (primary care)

Source: WHO (2011b).

An evidence review was conducted to cover a wide range of public health approaches, including environmental and social determinants of health, mental health and violence prevention, which are framed as interventions promoting resilience. An overview of cost-effective vaccinations was also included. The evidence review looked at peer-reviewed literature from Cochrane Evidence Reviews and PubMed. The search terms used were "cost saving" or "cost-effective", together with the 12 different individual categories presented in Tables 4a–4d. In total, 545 papers were screened by title and abstract for inclusion, of which 53 met the eligibility criteria for the review. These criteria included randomized control trials, reviews and modelling studies that contained cost–effectiveness or cost savings/return on investment calculations. The information was collected, reviewed and categorized into a series of tables.

The review adds to the evidence of the WHO "best buy" interventions report, with a wider range of preventive approaches to provide an overview of cost-effective interventions. Its aim is to provide planners and managers with an overview of examples to assist in planning and decision-making, showcasing the benefits of prevention and highlighting what can be achieved with early prevention in the short and long term, including a focus on the wider determinants of health and factors affecting behaviour. It should be noted that the studies are from a range of different countries with varied funding and organizational systems – differences that need to be considered before piloting in other countries or settings. Factors such as uptake of interventions will also affect cost–effectiveness.

The final four tables (4a–4d) provide examples of interventions that generate a return on investment or are cost-effective. Table 4a shows key factors affecting health behaviours. Violence (Brown et al., 2009; CDC, 2013) and poor mental health (Walsh et al., 2013) are known to be associated with other more proximal health behaviours and are recognized as complex issues, manifesting as both determinants and outcomes of poor health and well-being. Tables 4b and 4c look at social and environmental determinants of health behaviour and, in turn, outcomes. Table 4d outlines measures within what can be seen as the traditional remit of the health sector, which can save money by directly preventing disease and include vaccination and screening interventions not covered in the "best buys" tables (3a and 3b).

Although these tables present the cost–effectiveness of specific interventions, greater potential efficiencies can be gained by strengthening the overall functioning of public health services within the context of a health-systems approach. A recent global survey of health experts reported that 63% considered strengthening health systems over the coming years to be the most critical investment in global health (PSI, 2014).

Note: the greatest quantity of evidence was found for vaccinations. For that category, a further selection was made and a range of evidence on different types of infections from a variety of countries considered most relevant to the widest audience in terms of disease prevalence and target groups was selected.

Table 4a. Cost-effective interventions to build resilience: factors affecting health behaviours and outcomes

Focus	Return on investment	Cost saving
Violence and abuse	**Violence Against Women Act of 1994** *(United States)* (Clark et al., 2002) • Empirical evaluation • Timescale: 1 year At the government level • Cost: US$ 1.6 billion for programmes over 5 years • Saving: US$ 14.8 billion in net averted social costs At the individual level • Cost: US$ 15.50 per woman • Saving: US$ 159 per woman in averted costs of criminal victimization **School-based interventions to reduce bullying** *(United Kingdom)* (Knapp et al., 2011) • Modelling study • Timescale: no finite timescale • Cost: £15.50 per pupil per year • Saving: £1080 per pupil **Perry preschool program in Ypsilanti, Michigan** *(United States)* (Anderson et al., 2003) • Modelling study • Timescale: lifetime estimate • Net savings: US$ 108 516 for males and US$ 110 333 for females **Cost–benefit analysis of multisystemic therapy (MST) with serious and violent juvenile offenders** *(United States)* (Klietz et al., 2010) • Timescale: 13.7 years • Cost: US$ 10 882 per MST participant • Return on investment: US$ 9.51–23.59 for every dollar spent on MST (savings to taxpayer and crime victims) **Identification and Referral to Improve Safety (IRIS), a domestic violence training and support programme for primary care** *(United Kingdom)* (Devine et al., 2012) • Modelling study • Timescale: within 1 year • Cost: £136 per woman registered in the primary care practice • Savings: £37 per woman registered in the primary care practice (£178 saved to a cost of £136) (societal perspective)	**Cost–effectiveness of a programme to detect and provide better care for female victims of intimate partner violence** *(United Kingdom)* (Norman et al., 2010) • Modelling study • Timescale: 10 years • Cost: £5210 per year • Incremental cost–effectiveness ratio (ICER): £742 per quality-adjusted life-year (QALY) (societal perspective)

Table 4a. Cost-effective interventions to build resilience: factors affecting health behaviours and outcomes contd.

Focus	Return on investment	Cost saving
Mental health	**Early identification of postnatal depression with intervention (health visitor)** *(United Kingdom)* (Petrou et al., 2006) • Empirical study • Timescale: 18 months • Cost: preventive intervention group cost £119 more than standard treatment • Net savings: £383 per mother–infant pair per month (societal) **Antisocial behaviour family support projects** *(United Kingdom)* (Nixon et al., 2006) • Empirical study • Timescale: 2 years • Cost: £8000–15000 per family per year • Savings: £17–44 for every £1 spent **Reducing conduct problems through school-based social and emotional learning** *(United Kingdom)* (Knapp et al., 2011) • Cost: £132 per pupil per year • Savings of £39 to health sector in first year, rising to £751 by fifth year • Net societal savings of £6369 for whole of society by fifth year (mostly through reduced crime) **Intervention for prevention of childhood conduct disorder for a one-year cohort** *(United Kingdom)* (Friedli& Parsonage, 2007) • Empirical study • Timescale: based on projected lifetime savings • Cost: £210 million or £6000 per individual programme • Savings: £5.2 billion or £150 000 per case **Psychosocial group therapy for older people identified as lonely** *(Finland)* (Pitkala et al., 2009) • Empirical study • Timescale: 2 years • Cost: €881 per person • Savings: Mean net reduction in health care costs: €943 per person per year **One-day training programme for police officers that improves interactions with mentally ill individuals** *(Canada)* (Krameddine et al., 2013) • Experimental study • Timescale: 6 months • Cost: US$ 120 per officer • Savings: more than US$ 80 000 in the following 6 months	**Cost–effectiveness analysis of parenting programmes for parents of children at risk of developing conduct disorder** *(United Kingdom)* (Bywater et al., 2009) • Costs for children with conduct problems reduced from £5350 to £1034 after 18 months following parent training intervention **Population cost–effectiveness of interventions designed to prevent childhood depression (ages 11–17)** *(Australia)* (Mihalopoulos et al., 2012) • Modelling study • ICER: US$ 5400 per DALY (health sector perspective) **Cost–effectiveness of a stepped care intervention to prevent depression and anxiety in late life** *(Netherlands)* (Van't Veer-Tazelaar et al., 2010) • Experimental study • Timescale: 1 year • Cost: €563 per recipient • € 4367 per disorder-free year gained **Mental health promotion and the prevention of depression in older age: regular participation in exercise classes by older people in England** *(United Kingdom)* (Munro et al., 2004) • Timescale: within 2 years • Cost-effective in England: €17 172 per QALY (2004 prices) (health system perspective) **Befriending of older adults** *(United Kingdom)* (Knapp et al., 2011) • Timescale: in the first year for the NHS • Cost £85 per older person • Approximate savings of £40 per £85 invested

Table 4b. Cost-effective interventions to address social determinants of health

Determinant	Return on investment	Cost saving
Housing	**Affordable warm housing: insulation and heating** *(United Kingdom)* (CIEH, 2008) • Investment of £251 million to reduce domestic impacts of excess cold • Savings of £859 million (assuming full coverage) will result in a £608 million return of savings to NHS (England) • Return on investment within 0.3 years **Supported housing for families with complex emotional needs and chaotic lives** *(United Kingdom)* (Department of Health, 2009) • Empirical study(pilot project in 1999) • Timescale: unavailable • Savings: £12 000 per client for local authorities **Preventing bath water scalds: a cost–effectiveness analysis of introducing bath thermostatic mixer valves in social housing** *(United Kingdom)* (Phillips et al., 2011) • Costs: treating bath water scald £25 226–71 902 • Net saving: £1887–75 520 • Return on investment: £1.41 saved for every £1 spent	**Enhancing ventilation in homes of children with asthma** *(United Kingdom)* (Edwards et al., 2011) • Cost–effectiveness study alongside randomized control trial • Timescale: 12 months • Cost: £1718 per child given tailored package of housing interventions (ventilation and heating) • ICER: £234 per point improvement on asthma scale (£165 for children with severe asthma) **Falls prevention leaflets** *(United Kingdom)* (Irvine et al., 2010) • Timescale: 12 months • Cost: £349 per person • ICER: £3320 per fall averted
Debt	**Debt advice services** *(United Kingdom)* (Knapp et al., 2011) • Modelling study • Timescale: 2–5 years • Pay-off: £2.92 per £1 expenditure	–
Employment	**Individual active treatment combined with group exercise for acute and subacute low back pain** *(United Kingdom)* (Wright et al., 2005) • Savings: £250–578 per patient • Timescale: 1–2 weeks **Coordinated and tailored work rehabilitation undertaken with workers on sick leave due to musculoskeletal disorders** *(Denmark)* (Bultmann et al., 2009) • Economic evaluation based on a randomized controlled trial • Timescale: 6–12 months • Cost: US$ 2200 per person • Savings: US$ 1366 per person at 6 months; US$ 10 666 per person at 12 months **Workplace screening for depression and anxiety disorder** *(United Kingdom)* (Knapp et al., 2011) • Modelling study • Timescale: 1–2 years • Cost: £20 600 in first year (per 500 employees) • Savings: £19 700 (500 employees) in first year and £63 500 by second year **Mental health promotion and prevention of depression in the workplace: early diagnosis and intervention for employees with depressive symptoms** *(United States)* (Wang et al., 2007) • Empirical study • Timescale: 1 year • Cost: US$ 100–400 per person per year • Savings: US$ 1800 per employee per year **Promoting well-being in the workplace** *(United Kingdom)* (Knapp et al., 2011) • Modelling study • Timescale: 1 year • Cost: £40 000 • Savings: £340 000 within 1 year	**Seasonal influenza vaccination of healthy working-age adults** *(United States)* (Gatwood et al, 2012) • Review of economic evaluations • Costs: US$ 85.92 per person • Net savings: US$ 68.96 per person • Cost–effectiveness ratio (2 studies): US$ 26 565–50 512 per QALY (societal perspective)

Table 4c. Cost-effective interventions to address environmental determinants of health

Determinant	Return on investment	Cost saving
Road traffic injuries	**Nationwide speed limit reduction** *(United States)* (Shafi et al., 2008) • Cost–benefit analysis • Timescale: 1 year • Savings: US$ 13 billion annually (including a US$ 2 billion reduction in trauma care costs) **Seat-belt use** *(United States)* (Shafi et al., 2008) • Timescale: 1 year • Savings: US$ 50 billion annually **Airbag use** *(United States)* (Shafi et al., 2008) • Timescale: 1 year • Savings: US$ 1.94 billion annually **Photo radar speed enforcement programme on an inner city motorway** *(Spain)* (Perez et al., 2007) • Empirical study • Timescale: 2 years • Cost: €14.5 million • Net savings: €6.8 million over 2 years **Economic cost savings associated with state motorcycle helmet laws** *(United Sates)* (CDC, 2012) • Timescale: 2 years • Savings: US$ 725 per registered motorcycle (societal perspective) **Alcohol-impaired driving: "The Australian Campaign"** *(Australia)* (Elder et al., 2004) • Modelling study • Timescale: 23 months • Costs: AU$ 403 174 per month • Savings: AU$ 8 324 532 per month, including AU$ 3 214 096 in averted medical costs **Safety camera enforced speed limits** *(United Kingdom)* (Gains et al., 2005) • Empirical study • Timescale: 4 years • Costs: £96 million per year • Savings: £258 million per year	**Injury awareness education programme on outcomes of juvenile justice offenders in western Australia** *(Australia)* (Ho et al., 2012) • Economic analysis • Timescale: 5 years • Cost of programme: US$ 33 735 • Annual savings: US$ 3765 (from serious injury) • Cost–effectiveness: • cost per offence prevented: US$ 3124; • cost per serious injury avoided: US$ 42 169; cost per discounted life-year gained: US$ 17 910
Green space	**The US study for Philadelphia city parks** *(United States)* (Trust for Public Land, 2008) • Empirical study • Timescale: within 5 years • Savings: US$ 69.4 million per year through avoided health care costs **Conservation volunteering projects** *(United Kingdom)* (Greenspace Scotland, 2009) • Empirical study • Timescale: over 5 years • Return on investment: £7.35 for every £1 invested	–
Climate	**Heat warning systems** *(Europe)* (Toloo et al., 2013) • Systematic review • Timescale: 4 years • Cost: US$ 210 000 • Savings: US$ 468 million	–

Table 4c. Cost-effective interventions to address environmental determinants of health contd.

Determinant	Return on investment	Cost saving
Active transport	**Switching from car to active transport** *(United Kingdom)* (Davis, 2011) • Modelling study • Timescale: 1 year • Benefits of moving from car to walking: £1220 per year • Benefits of moving from car to cycling: £1121 per year **Introducing pedestrian crossings and other pedestrian facilities for 579 schemes** *(United Kingdom)* (Gorell&Tootill, 2001) • Timescale: 1 year • Net first year rate of return – 246% **Effect of increasing active travel in urban England and Wales on costs to the NHS** *(United Kingdom)* (Jarrett et al., 2012) • Timescale: 20 years • Savings: £17 billion for the NHS (reduction in the prevalence of type 2 diabetes, dementia, ischaemic heart disease, cerebrovascular disease and cancer)	**Counselling programmes to promote physical activity and a community-based walking scheme** *(United Kingdom)* (Windle et al., 2008) • Timescale 6 months • Cost: £9.50–220 per participant (community-based) • QALY gains: from 3.0 per 1000 individuals over 6 months (physical activity counselling intervention) to 28.3 per 1000 individuals over 6 months (community-based walking programme)
Environmental hazards	**Reducing childhood exposure to mercury through mercury and air toxics standards (MATS)** *(United States)* (EPA, 2011) • Empirical study • Timescale: 10 years • Savings: > US$ 37 billion per year in health benefits **Window replacement and residential lead paint hazard control** *(United States)* (Dixon et al., 2012) • Timescale: 12 years • Net savings: US$ 1700–2000 per housing unit **Removal of lead from domestic paint and plumbing in at-risk neighbourhoods** *(France)* (Pichery et al., 2011) • Modelling study • Timescale: projected life-year • Cost: €3600–9200 per home • Savings: €8800–51 400 reduction in cost of illness per de-leaded home	–

Table 4d. Cost-effective interventions for vaccination and screening

Intervention	Return on investment	Cost saving
Vaccination	**Pneumococcal vaccination in Spain (children under 2)** *(Spain)* (Morano et al., 2011) • Timescale: 1 year • Cost: €38.36 per dose + €4.88 administration per person • Savings: €22 million **Human norovirus vaccine** *(United States)* (Bartsch et al., 2012) • Timescale: 2 years • Cost of vaccine: US$ 400 million–1 billion • Savings: US$ 2.1 billion **Rotavirus vaccine and health care utilization for diarrhoea in children** *(United States)* (Cortes et al., 2011) • Timescale: 2 years • Savings: US$ 278 million in reduced treatment costs **Measles, mumps and rubella (MMR) vaccination** *(United Kingdom)* (WHO, 2013b) • Modelling study • Timescale: 10 years • Costs: £0.17–0.97 per person • Savings: £240 730–544 490 over 10 years in reduced treatment costs **Flu vaccine** *(United Kingdom)* (Scuffham& West, 2002; Burls et al., 2006) • Modelling study • Timescale: projected lifetime • Return on investment: £1.35 for every £1 spent on targeted flu vaccination • Savings rise to £12 per vaccination when health care workers are vaccinated	**Hepatitis B vaccination** *(United States)* (Margolis et al., 1995) • Modelling study • Timescale: projected lifetime • US$ 164 per life-year saved for perinatal immunization (societal perspective) **Rotavirus vaccination** *(Armenia)* (Jit et al., 2011) • Timescale: 1 year • Cost: US$ 220 000 in 2012; US$ 830 000 in 2016; US$ 260 000 in 2025 • Cost effectiveness: US$ 650 per DALY (health sector perspective); US$ 820 per DALY (societal perspective) **Implementation of bivalent Human papillomavirus vaccination in young women in addition to cervical cancer screening for women over 40 years** *(Netherlands)* (Coupe et al., 2009) • Timescale: 10 years • Cost–effectiveness: €19 500 per QALY **Human papillomavirusvaccination programmes** *(Austria)* (Zechmeister et al., 2009) • ICER for girls: €64,000 per life-year gained and €50,000 per life-year gained (payer's and societal perspectives, respectively) **Human papillomavirus vaccination** *(Iceland)* (Oddsson et al., 2009) • Modelling study • ICER: €18 500 per QALY saved
Screening (Note: cancer screening not included here as covered in Table 3b)	–	**Standard vascular disease health check** *(France)* (Schuetz et al., 2013) • Timescale: 30 years • Cost–effectiveness: offering health checks to all: €14 903 per QALY; offering health checks only to higher-risk(obese) individuals: €10 200 or less per QALY **Screening for diabetes and impaired glucose tolerance** *(United Kingdom)* (Gillies et al., 2008) • Modelling study • Timescale: 50 years • Cost–effectiveness: £6242 per QALY

Other considerations: risk and preparedness

High-impact high-risk events – including pandemics such as avian flu and natural disasters such as flooding or heat-waves – are particularly difficult to plan for but can be extremely costly. For example, flooding in 2007 gave rise to £3 billion of damages in the United Kingdom (Pitt, 2008). There may be long gaps between such events, making their timing impossible to predict. Setting such large sums of money aside when there is no guarantee when they will be used can be seen as politically unappealing. Health and environmental impact assessments, including estimation of future trends and costs, are helpful methods to quantify the likelihood and impact of risks. In response to anticipated risks, policy-makers can build capacity andensure preparedness of systems and development and testing of emergency plans.

Climate change vastly complicates suchissues by increasing the probability and severity of extreme events while reducing their predictability. It is therefore essential to invest in and modernize health protection services – including control of communicable diseases, environmental health and emergency preparedness – in order to address current and future public health challenges.

Conclusions

The evidence presented in this report shows that interventions targeting the environmental and social determinants of health; those that build resilience, affecting factors such as mental health and violence; those that promote healthy behaviours; and those for screening and vaccination can be cost-effective and give returns on investment in the short and longer term. In particular, theresearchers found a number of interventions with quick returns on investment within one or two years in a number of areas, including for mental health promotion, healthy employment, reducing road traffic injuries and promoting safe active transport.

Public health services have been shown to be at risk in several areas, however. Many structures for delivering public health services in the WHO European Region are already facing substantial cutbacks, and public health programmes and interventions in several countries have been reorganized or scaled down. These short-term measures risk escalating demand and costs in the future – costs that evidence shows can be prevented with cost-effective measures. Funding for public health and prevention approaches can come from a range of mechanisms, such as through a combination of taxes, health insurance funds and private sources (Savedoff et al., 2012).

Protected budgets for public health services and preventive measures have been established in some countries, and some have dedicated cross-sector funds from the ministry of finance. Benefits to investing in public health can be seen across the health sector and contribute to the sustainability of health care funding. Providing public health services is part of the universal health coverage approach advocated by WHO and contributes to reducing health inequalities (Frenk & de Ferranti, 2012). Strengthening public health approaches also has the potential to contribute to improving health outcomes in sustainable ways, even in lower-resource settings (Sachs, 2012).

WHO has developed a financial planning tool to assist low- and middle-income countries in scaling up a core set of interventions to tackle NCDs(WHO, 2011a). This provides a valuable indication of the likely costs of such actions. The per capita cost is low, representing an annual investment of under US$ 1 in low-income countries, US$ 1.50 in lower middle-income countries and US$ 3 in upper middle-income countries. These figures represent just 1–4% of current health spending. Interventions examined were categorized as being either population-based or individual-level approaches.

It is recognized that a comprehensive strategy needs to include a combination of population and targeted individual preventive approaches, but it should be noted that, on average, individual-level approaches were found to cost five times more than interventions at the population level (WHO, 2011a). In general, evidence also shows that investing in upstream population-based prevention is more effective at reducing health inequalities than more downstream prevention (Orton et al., 2011). Meanwhile, the National Institute for Health and Care Excellence in the United Kingdom found that many public health interventions were a lot more cost-effective than clinical interventions (using cost per QALY), and many were even cost-saving (Kelly, 2012).

Aside from the pressures to reduce health sector costs resultingfrom the economic crisis, the general trend has been for costs and demand on health care services to increase over time owing to increasing lifeexpectancy, NCDs and the costs of health technologies. By applying a strategic approach to investing wisely in public health services, especially for health promotion and primary preventive interventions that provide greater returns on investment, funding can be freed up in health and other sectors. This can contribute to achieving greater sustainability of budgets with better health and wider outcomes.

Investing in health in general has been shown to give economic returns to the health sector, other sectors and the wider economy, with an estimated fourfold return on every dollar invested (described as the "fiscal multiplier" (Reeves et al., 2013)). For example, interventions that promote mental health within childhood contribute to better educational outcomes and employment opportunities, while those that promote health within the workplace can increase productivity and economic returns. As a result, some countries have agreed cross-sector funding to public health approaches in order to reflect these wider benefits.

In addition, efficiencies can be further increased by clustering a variety of cost-effective approaches in the design and delivery of programmes to enhance the effectiveness and efficiency of overall services. For example, working to a common vision of safe urban design, a cluster of cost-saving interventions and approaches – such as safe green spaces, safer driving and encouragement of walking and cycling – can be identified, potentially resulting in multiple health, social and environmental benefits. Moreover, focusing on upstream prevention earlier in the life-course has the potential to bring economic, social and health gains, and in some cases environmental benefits, as part of a more sustainable approach to achieving well-being (Nurse et al., 2010). Strengthening integrated public health services within a health systems approach will provide the infrastructure required to deliver cost-effective interventions in an efficient manner, thereby maximizing health and wider outcomes, including well-being, in a sustainable way.

This report summarizes a wide range of cost-effective health promotion and preventive interventions that can be delivered by public health services, the wider health system and other sectors in a health-in-all-policies approach. Much of the existing research collated for the report, however, is from higher-income countries; further research is needed for low- and middle-income settings. In particular, greater understanding is required of the optimum investment for public health services to make a more substantial contribution to the sustainability of health systems and universal health coverage. In particular, more knowledge is needed about the cost–effectiveness of public health services, including the operations of health intelligence, health protection, promotion and prevention and enabling functions within a range of settings, especially for lower-resource situations.

⚖ Glossary

Cost

The economic definition of cost (also known as opportunity cost) is the value of opportunity forgone (strictly the best opportunity forgone) as a result of engaging resources in an activity. Note that there can be a cost without the exchange of money. In addition, economists' notion of cost extends beyond the cost falling on the health service alone: it includes, for example, costs falling on other services and on patients themselves (NICHSR, 2014).

Cost–effectiveness analysis

This is an economic evaluation in which the costs and consequences of alternative interventions are expressed as cost per unit of health outcome. Cost–effectiveness analysis is used to determine technical efficiency: comparison of costs and consequences of competing interventions for a given patient group within a given budget (NICHSR, 2014).

Disability-adjusted Life Year (DALY)

One DALY can be thought of as one lost year of "healthy" life. The sum of these DALYs across the population, or the burden of disease, can be thought of as a measurement of the gap between current health status and an ideal health situation where the entire population lives to an advanced age, free of disease and disability (WHO, 2014b).

Health inequality and inequity

Health inequalities can be defined as differences in health status or in the distribution of health determinants between different population groups – for example, differences in mobility between elderly people and younger populations or differences in mortality rates between people from different social classes. It is important to distinguish between inequality and inequity in health. Some health inequalities are attributable to biological variations or free choice; others are attributable to the external environment and conditions mainly outside the control of the individuals concerned. In the first case it may be impossible or ethically or ideologically unacceptable to change the health determinants, so the health inequalities are unavoidable. In the second, the uneven distribution may be unnecessary and avoidable, as well as unjust and unfair, so that the resulting health inequalities also lead to inequity in health (WHO, 2013c).

Public health

WHO uses the following definition of public health: "the art and science of preventing disease, prolonging life and promoting health through the organized efforts of society" (Acheson, 1988).

Quality-adjusted life-year (QALY)

QALYs are units of measurement of utility that combine life-years gained as a result of health interventions/health care programmes with a judgement about the quality of those life-years. A common measure of health improvement used in cost–effectiveness analysis, it measures life expectancy adjusted for quality of life (NICHSR, 2014).

References

1,000 Days (2014). Resources [website].Washington, DC: 1,000 Days (www.thousanddays.org/resources/essential-documents/, accessed 2 September 2014).

Acheson, D (1988). Public health in England: the report of the Committee of Inquiry into the Future Development of the Public Health Function. London: HMSO.

Allender S, Foster C, Scarborough P, Rayner M (2007). The burden of physical activity-related ill health in the UK.J Epidemiol Community Health. 61(4):344–348.

Anderson LM, Shinn C, Fullilove MT, Scrimshaw SC, Fielding JE, Normand J et al. (2003). The effectiveness of early childhood development programs: a systematic review. Am J Prev Med. 24(3S):32–46.

Anderson P, Baumberg B (2006). Alcohol in Europe: a public health perspective: a report for the European Commission. London: Institute of Alcohol Studies (http://ec.europa.eu/health/ph_determinants/life_style/alcohol/documents/alcohol_europe.pdf, accessed 5 September 2014).

Anderson P, Møller L, Galea G (2012). Alcohol in the European Union: consumption, harm and policy approaches. Copenhagen: WHO Regional Office for Europe (http://www.euro.who.int/en/health-topics/disease-prevention/alcohol-use/publications/2012/alcohol-in-the-european-union.-consumption,-harm-and-policy-approaches, accessed 5 September 2014).

Bartsch SM, Lopman BA, Hall AJ, Parashar UD, Lee BY(2012). The potential economic value of a human norovirus vaccine for the United States. Vaccine. 30(49):7097–7104.

Black R, Victora C, Walker S, Bhutta Z, Christian P, de Onis M, et al. (2013). Maternal and child undernutrition and overweight in low-income and middle-income countries. Lancet. 382(9890):427–451.

Bone A, Nurse J (2010). Health co-benefits of climate change action: how tackling climate change is a "win win win".CHaP Report.16:51–55.

Brown D W, Riley L, Butchart A, Meddings DR, Kann L, Harvey AP (2009). Exposure to physical and sexual violence and adverse health behaviours in African children: results from the Global School-based Student Health Survey. Bull World Health Organ. 87:447–455 (http://www.who.int/bulletin/volumes/87/6/07-047423/en/index.html, accessed 5 September 2014).

Bultmann U, Sherson D, Olsen J, Hansen CL, Lund T, Kilsgaard J (2009). Coordinated and tailored work rehabilitation: a randomized controlled trial with economic evaluation undertaken with workers on sick leave due to musculoskeletal disorders. J OccupRehabil. 19(1):81–93.

Burls A, JordanR, BartonP, OlowokureB, WakeB, AlbonE et al. (2006). Vaccinating healthcare workers against influenza to protect the vulnerable – is it a good use of healthcare resources? A systematic review of the evidence and an economic evaluation. Vaccine. 24(19):4212–4221.

Bywater T, Hutchings J, Daley D, Whitaker C, Yeo ST, Jones K et al.(2009). Long-term effectiveness of a parenting intervention for children at risk of developing conduct disorder.Br J Psychiatry. 195(4):318–24.

Cavill N, Kahlmeier S, Racioppi F (2006). Physical activity and health in Europe: evidence for action. Copenhagen, WHO Regional Office for Europe (http://www.euro.who.int/en/health-topics/disease-prevention/physical-activity/publications/2006/physical-activity-and-health-in-europe-evidence-for-action, accessed 5 September 2014).

CDC (2012). Helmet use among motorcyclists who died in crashes and economic cost savings associated with state motorcycle helmet laws – United States 2008–2010. MMWR Weekly. 61(23):425–430.

CDC (2013). Intimate partner violence: consequences [web site]. Atlanta, GA: Centers for Disease Control and Prevention (http://www.cdc.gov/violenceprevention/intimatepartnerviolence/consequences.html#, accessed 5 September 2014).

CIEH (2008).Good housing leads to good health: a toolkit for environmental health practitioners. London: Chartered Institute of Environmental Health (http://www.cieh.org/uploadedFiles/Core/Policy/Housing/Good_Housing_Leads_to_Good_Health_2008.pdf, accessed 12 September 2014).

Clark KA, Biddle AK, Martin SL (2002).A cost–benefit analysis of the Violence Against Women Act of 1994. Violence Against Women. 8(4):417–428.

Clarke AF, O'Malley A, Woodham A, Barrett B, Byford S (2005). Children with complex mental health problems: needs, costs and predictors over one year. J Child Adolescent Health. 10(4):170–178.

Cortes JE, CurnsAT, Tate JE, Cortese MM, Patel MM, Zhou F et al.(2011). Rotavirus vaccine and health care utilization for diarrhea in U.S. children. N Engl J Med. 365(12):1108–1117.

Coupe VM, van GinkelJ, de MelkerHE, SnijdersPJ, Meijer CJ,BerkhofJ (2009). HPV16/18 vaccination to prevent cervical cancer in the Netherlands: model-based cost–effectiveness. Int J Cancer. 124(4):970–978.

Davis A (2011). Essential evidence on a page: No. 76 – benefits of switch from car to active travel. Bristol: Bristol City Council.

DEFRA (2013). Protecting and enhancing our urban and natural environment to improve public health and wellbeing [website]. London: Department for Environment, Food and Rural Affairs (https://www.gov.uk/government/policies/protecting-and-enhancing-our-urban-and-natural-environment-to-improve-public-health-and-wellbeing/supporting-pages/managing-noise-and-other-nuisances-in-the-local-environment, accessed 5 September 2014).

Department of Health (2009). Support related housing: incorporating support related housing into your efficiency programme. London: Department of Health.

Department of Health (2010).NHS reference costs 2008–2009 [website]. London: Department of Health (http://www.dh.gov.uk/en/Publicationsandstatistics/Publications/PublicationsPolicyAndGuidance/DH_111591, accessed 5 September 2014).

Department of Health (2012). 2003–04 to 2010–11 programme budgeting data [website]. London: Department of Health (https://www.gov.uk/government/publications/2003-04-to-2010-11-programme-budgeting-data, accessed 5 September 2014).

Devine A, Spencer A, Eldridge S, Norman R, Feder G (2012). Cost-effectiveness of Identification and Referral to Improve Safety (IRIS), a domestic violence training and support programme for primary care: a modelling study based on a randomised controlled trial. BMJ Open. 2:e001008.doi:10.1136/bmjopen-2012-001008.

Dixon SL, JacobsDE, WilsonJW, AkotoJY, NevinR, Scott Clark C(2012).Window replacement and residential lead paint hazard control 12 years later. Environ Res. 113: 14–20.

Donaldson LJ, Donaldson RJ (2003). Essential public health, second edition. Abingdon: Radcliffe Publishing.

EEA (2011).Revealing the costs of air pollution from industrial facilities in Europe. Copenhagen: European Environment Agency (EEA Technical Report, No.15; http://www.eea.europa.eu/publications/cost-of-air-pollution, accessed 5 September 2014).

Edwards RT, Neal RD, Linck P, Bruce N, Mullock L, Nelhans N et al.(2011). Enhancing ventilation in homes of children with asthma: cost–effectiveness study alongside randomised controlled trial. Br J Gen Pract. 61(592):e733–741.

Elder RW, Shults RA, Sleet DA, Nichols JL, Thompson RS, Rajab W et al. (2004). Effectiveness of mass media campaigns for reducing drinking and driving and alcohol-involved crashes: a systematic review. Am J Prev Med 27(1):57–65.

EPA (2011).Regulatory impact analysis for the final mercury and air toxics standards.Research Triangle Park, NC: U.S. Environmental Protection Agency (http://www.epa.gov/mats/pdfs/20111221MATSfinalRIA.pdf, accessed 5 September 2014).

FOEN (2009). Noise pollution in Switzerland: results of the SonBase national noise monitoring programme. Bern: Federal Office for the Environment. (State of the Environment Series, No. 0907; http://www.bafu.admin.ch/publikationen/publikation/01036/index.html?lang=en, accessed 5 September 2014).

Ford E, Ajani U, Croft J, Critchley J, Labarthe DR, Kottke TE et al. (2007). Explaining the Decrease in US Deaths from Coronary Disease, 1980–2000. N Engl J Med. 356(23):2388–2398.

Frenk J, de Ferranti D(2012). Universal health coverage: good health, good economics. Lancet. 380(9845):862–864.

Friedli L, Parsonage M (2007). Mental health promotion: building an economic case. Belfast: Northern Ireland Association for Mental Health (http://www.chex.org.uk/what-we-do/mental-health-and-well-being/documents-of-interest/, accessed 5 September 2014).

Gains A, Nordstrom M, Heydecker B, Shrewsbury J, Mountain L, Maher M (2005). The national safety camera programme four year evaluation report. London: PA Consulting Group (http://www.eltis.org/docs/studies/thenationalsafetycameraprogr4598.pdf, accessed 12 September 2014).

GatwoodJ, Meltzer MI, Messonnier M, Ortega-Sanchez IR, Balkrishnan R, Prosser LA (2012). Seasonal influenza vaccination of healthy working-age adults: a review of economic evaluations. Drugs. 72(1):35–48.

Gillies CL, Lambert PC, Abrams KR, Sutton AJ, Cooper NJ, Hsu RT et al.(2008). Different strategies for screening and prevention of type 2 diabetes in adults: cost effectiveness analysis. BMJ. 336(7654):1180–1185.

Gorell RSJ,TootillW(2001). Monitoring local authority road safety schemes using MOLASSES. Wokingham: Transport Research Laboratory.

Gould E (2009). Childhood lead poisoning: conservative estimates of the social and economic benefits of lead hazard control. Environ Health Perspect. 117(7):1162–1167.

Greenspace Scotland (2009).Social return on investment (SROI) analysis of the Greenlink, a partnership project managed by the Central Scotland Forest Trust (CSFT). Stirling: Greenspace Scotland.

Helweg-Larsen K, Kruse M, Sørensen J, Brønnum-Hansen H (2010).The costs of violence-economic and personal dimensions of violence against women in Denmark.Copenhagen: National Institute of Public Health, University of Southern Denmark (http://www.si-folkesundhed.dk/upload/summary_the_cost_of_violence-samlet.pdf, accessed 5 September 2014).

Ho KM, Geelhoed E, Gope M, Burrell M, Rao S (2012). An injury awareness education program on outcomes of juvenile justice offenders in Western Australia: an economic analysis. BMC Health Serv Res. 12: 279.

Home Office (2009).Saving lives. Reducing harm. Protecting the public: an action plan for tackling violence 2008–11 – one year on. London: Home Office (http://webarchive.nationalarchives.gov.uk/20100413151441/http://www.crimereduction.homeoffice.gov.uk/violence/violence028.htm, accessed 5 September 2014).

Irvine L, Conroy SP, Sach T, Gladman JR, Harwood RH, Kendrick D et al. (2010). Cost–effectiveness of a day hospital falls prevention programme for screened community-dwelling older people at high risk of falls. Age Ageing. 39(6):710–716.

Jarrett J, WoodcockJ, Griffiths UK, ChalabiZ, EdwardsP, Roberts I et al.(2012).Effect of increasing active travel in urban England and Wales on costs to the National Health Service. Lancet. 379(9832):2198–2205.

Jit M, YuzbashyanR, SahakyanG, AvagyanT,MosinaL (2011). The cost–effectiveness of rotavirus vaccination in Armenia. Vaccine. 29(48):9104–9111.

Juel K, Sørensen J, Brønnum-Hansen H (2008). Risk factors and public health in Denmark. Scand J Public Health. 36(Suppl 1):11–227.

Karanikolos M, Mladovsky P,Cylus J, Thomson S, Basu S, Stuckler D et al. (2013). Financial crisis, austerity, and health in Europe. Lancet. 381(9874):1323–1331.

Kelly MP (2012). Public health at National Institute for Health and Clinical Excellence (NICE) from 2012. Perspect Public Health. 132(3):111–113.

Klietz S, BorduinC, Schaeffer C (2010). Cost–benefit analysis of multisystemic therapy with serious and violent juvenile offenders. J Fam Psychol. 24(5):657–666.

Knapp M, McDaid D, Parsonage M (2011). Mental health promotion and prevention: the economic case. London: Department of Health (http://www2.lse.ac.uk/businessAndConsultancy/LSEEnterprise/pdf/PSSRUfeb2011.pdf, accessed 12 September 2014).

Krameddine YI, Demarco D, Hassel R, Silverstone PH (2013). A novel training program for police officers that improves interactions with mentally ill individuals and is cost-effective.Front Psychiatry.4:9.

Leal J, Luengo-Fernandez R, Gray A, Petersen S, Rayner M (2006). Economic burden of cardiovascular disease in the enlarged European Union.Eur Heart J. 27:1610–1619.

Luengo-Fernandez R, Leal J, Sullivan R (2012).The economic burden of malignant neoplasms in the European Union. Congress of the European Society for Medical Oncology, Vienna, Austria, 22 May.

Mackenbach JP, Meerding WJ, Kunst AE (2011). Economic costs of health inequalities in the European Union. J Epidemiol Community Health. 65(5):412–419.

Margolis HS, Coleman PJ, Brown RE, Mast EE, Sheingold SH, Arevalo JA (1995). Prevention of hepatitis B virus transmission by immunization: an economic analysis of current recommendations. JAMA 274(15):1201–1208.

McCrone P, Dhanasiri S, Patel A, Knapp M, Lawton-Smith S (2008). Paying the price: the cost of mental health care in England to 2026. London: The King's Fund.

Merkur S, Sassi F, McDaid D (2013). Promoting health, preventing disease: is there an economic case? Copenhagen: WHO Regional Office for Europe (http://www.euro.who.int/en/about-us/partners/observatory/policy-briefs-and-summaries/promoting-health,-preventing-disease-is-there-an-economic-case, accessed 4 September 2014).

Mihalopoulos C, Vos T, Pirkis J, Carter R (2012). The population cost–effectiveness of interventions designed to prevent childhood depression. Pediatrics. 129(3):e723–730.

Mladovsky P, Srivastava D, Cylus J, Karanikolos M, Evetovits T, Thomson S et al. (2012). Health policy responses to the financial crisis in Europe. Copenhagen: WHO Regional Office for Europe (http://www.euro.who.int/en/data-and-evidence/evidence-informed-policy-making/publications/2012/health-policy-responses-to-the-financial-crisis-in-europe, accessed 4 September 2014).

Morano R, Pérez F, Brosa M, Pérez Escolano I (2011). Análisis de coste-efectividad de la vacunación antineumocócica en España [Cost–effectiness analysis of pneumococcal vaccination in Spain].Gac Sanit. 25(4):267–273.

Munro JF, Nicholl JP, Brazier JE, Davey R, Cochrane T (2004). Cost effectiveness of a community based exercise programme in over 65 year olds: cluster randomised trial. J Epidemiol Community Health.58: 1004–1010.

NICE (2010). Alcohol-use disorders: preventing harmful drinking. London: National Institute for Health and Care Excellence. (NICE public health guidance 24; http://www.nice.org.uk/guidance/PH24, accessed 5 September 2014).

NICHSR (2014).Glossary of frequently encountered terms in health economics [website].Bethesda, MD: National Information Center on Health Services Research and Health Care Technology (http://www.nlm.nih.gov/nichsr/edu/healthecon/glossary.html, accessed 14 September 2014).

Nixon J, Parr S, Sanderson D (2006). Anti-social behaviour intensive family support projects: an evaluation of six pioneering projects. London: Department for Communities and Local Government.

Norman R, Spencer A, Eldridge S,FederG (2010). Cost–effectiveness of a programme to detect and provide better care for female victims of intimate partner violence. J Health Serv Res Policy. 15(3):143–149.

Nurse J, BasherD, Bone A, Bird W(2010). An ecological approach to promoting population mental health and well-being–a response to the challenge of climate change. Perspect Public Health. 130(1):27–33.

Oddsson K, JohannssonJ., AsgeirsdottirTL,GudnasonT(2009).Cost–effectiveness of human papilloma virus vaccination in Iceland. ActaObstetGynecol Scand. 88(12):1411–1416.

OECD (2006). Future budget pressures arising from spending on health and long-term care. OECD Economic Outlook 79:145–156 (http://www.oecd.org/eco/outlook/oecdeconomicoutlookspecialchapters.htm, accessed 4 September 2014).

Oldridge NB (2008). Economic burden of physical inactivity: healthcare costs associated with cardiovascular disease. Eur J CardiovascPrevRehabil. 15(2):130–139.

Orton LC, Lloyd-Williams F, Taylor-Robinson DC, Moonan M, O'Flaherty M, Capewell S (2011). Prioritising public health: a qualitative study of decision making to reduce health inequalities. BMC Public Health.11:821.

Pacyna JM, Sundseth K, Pacyna EG, Munthe J, Åström S, Panasiuk D (2008). Socio-economic costs of continuing the status-quo of mercury pollution. Copenhagen: Nordic Council of Ministers, 2008 (http://www.norden.org/en/publications/publikationer/2008-580, accessed 5 September 2014).

Perez K, Mari-Dell'Olmo M, Tobias A,BorrellC (2007). Reducing road traffic injuries: effectiveness of speed cameras in an urban setting.Am J Public Health. 97(9):1632–1637.

Petrou S, Cooper P, Murray L, Davidson LL (2006). Cost–effectiveness of a preventive counseling and support package for postnatal depression. Int J Technol Assess Health Care. 22(4):443–453.

Phillips C J, Humphreys I, Kendrick D, Stewart J, Hayes M, Nish L et al.(2011). Preventing bath water scalds: a cost–effectiveness analysis of introducing bath thermostatic mixer valves in social housing. InjPrev 17(4):238–243.

Pichery C, Bellanger M, Zmirou-Navier D, Glorennec P, Hartemann P, Grandjean P (2011). Childhood lead exposure in France: benefit estimation and partial cost–benefit analysis of lead hazard control. Environ Health. 10:44.

Pitkala KH, Routasalo P, Kautianinen H, Tilvis RS (2009). Effects of psychosocial group rehabilitation on health, use of health care services, and mortality of older persons suffering from loneliness: a randomized, controlled trial. J Gerontol A BiolSci Med Sci. 64A(7):792–800.

Pitt M (2008). The Pitt Review – learning lessons from the 2007 summer flood. London: The Cabinet Office (http://webarchive.nationalarchives.gov.uk/20100807034701/http://archive.cabinetoffice.gov.uk/pittreview/thepittreview/final_report.html, accessed 12 Sepcember 2014).

PMS Unit (2004). Alcohol harm reduction strategy for England. London: Prime Minister's Strategy Unit (http://webarchive.nationalarchives.gov.uk/20130128101412/http://www.cabinetoffice.gov.uk/strategy/work_areas/alcohol_misuse.aspx, accessed 5 September 2014).

PSI (2014). The best buys survey: where to invest in global health in 2014. Washington, DC: PSI (http://psiimpact.com/the-best-buys-survey/, accessed 5 September 2014).

Puska P, Vartiainen E, Laatikainen T, Jousilahti P, Paavola M, editors (2009). The North Karelia Project: from North Karelia to national action. Helsinki: National Institute for Health and Welfare (http://www.thl.fi/thl-client/pdfs/731beafd-b544-42b2-b853-baa87db6a046, accessed 4 September 2014).

Racioppi F, Eriksson L, Tingvall C, Villaveces A (2004). Preventing road traffic injury: a public health perspective for Europe. Copenhagen: WHO Regional Office for Europe (http://www.euro.who.int/en/publications/abstracts/preventing-road-traffic-injury-a-public-health-perspective-for-europe, accessed 4 September 2014).

Reeves A, BasuS, McKeeM, MeissnerC,StucklerD(2013). Does investment in the health sector promote or inhibit economic growth? Global Health. 9: 43.

Rehm J, Mathers C, Popova S, Thavorncharoensap M, Teerawattananon Y, Patra J (2009). Global burden of disease and injury and economic cost attributable to alcohol use and alcohol-use disorders. Lancet. 373:2223–2233.

Sachs JD (2012). Achieving universal health coverage in low-income settings. Lancet 380(9845):944–947.

Sassi F. (2010). Fighting down obesity. OECD Observer. 281, October(http://www.oecdobserver.org/news/fullstory.php/aid/3339/Fighting_down_obesity_.html, accessed 5 September 2014).

Savedoff WD, de FerrantiD, Smith AL, Fan V (2012). Political and economic aspects of the transition to universal health coverage. Lancet. 380(9845):924–932.

Schuetz CA, AlperinP, GudaS, van HerickA, CariouB, EddyD et al. (2013). A standardized vascular disease health check in Europe: a cost–effectiveness analysis. PLoS One. 8(7):e66454.

Scuffham PA, West PA (2002). Economic evaluation of strategies for the control and management of influenza in Europe. Vaccine. 20(19–20):2562–2578.

Shafey O, Eriksen M, Ross H, MacKay J (2009). The Tobacco Atlas, 3rd edition. Atlanta, GA: American Cancer Society, 2009, p. 42.

Shafi S, Parks J,GentilelloL (2008). Cost benefits of reduction in motor vehicle injuries with a nationwide speed limit of 65 miles per hour (mph). J Trauma. 65(5):1122–1125.

Stark CG (2006).The economic burden of cancer in Europe.Eur J Hosp Pharm SciPract. 12:53–56.

Suhrcke M, Pillas D, Selai C (2007). Economic aspects of mental health in children and adolescents. Copenhagen: WHO Regional Office for Europe (http://www.euro.who.int/en/health-topics/Life-stages/child-and-adolescent-health/publications/2007/economic-aspects-of-mental-health-in-children-and-adolescents, accessed 5 September 2014).

Toloo GS, Fitzgerald G, Aitken P, VerrallK, Tong S (2013). Are heat warning systems effective? Environ Health. 12: 27.

Trasande L, Landrigan P J, Schechter C (2005). Public health and economic consequences of methyl mercury toxicity to the developing brain. Environ Health Perspect. 113(5):590–596.

Trust for Public Land (2008). How much value does the city of Philadelphia receive from its park and recreation system? Philadelphia: Trust for Public Land and Philadelphia Parks Alliance (http://cloud.tpl.org/pubs/ccpe_PhilaParkValueReport.pdf, accessed 12 September 2014).

TU Dresden (2012). The true costs of automobility: external costs of cars: overview on existing estimates in EU-27. Dresden: Technische Universität Dresden (http://www.greens-efa.eu/fileadmin/dam/Documents/Studies/Costs_of_cars/The_true_costs_of_cars_EN.pdf, accessed 12 March 2013).

University of Oxford (2009).Smoking costs NHS over £5 billion a year [website].Oxford: University of Oxford (http://www.ox.ac.uk/media/news_stories/2009/090609_1.html, accessed 5 September 2014).

Van't Veer-Tazelaar P, Smit F, van Hout H, van Oppen P, van der Horst H, Beekman A et al.(2010). Cost–effectiveness of a stepped care intervention to prevent depression and anxiety in late life: randomized trial. Br J Psychiatry. 196(4):319–325.

Viscusi WK, Hersch J (2008). The mortality cost to smokers. J Health Econ. 27(4):943–958.

Voelker R (1999). Fighting the flu. JAMA. 281(2):123.

Walsh JL, Senn TE, Carey MP (2013). Longitudinal associations between health behaviors and mental health in low-income adults. TranslBehav Med. 3(1):104–113.

Wang PS, Simon GE, Avorn J, Azocar F, Ludman EJ, McCulloch J et al. (2007). Telephone screening, outreach, and care management for depressed workers and impact on clinical and work productivity outcomes. JAMA. 298(12):1401–1411.

Wanless D (2002). Securing our future health: taking a long-term view. London: The Public Enquiry Unit, HM Treasury (http://www.yearofcare.co.uk/sites/default/files/images/Wanless.pdf, accessed 5 September 2014).

WHO (2003).WHO Framework Convention on Tobacco Control. Geneva: World Health Organization (http://www.who.int/fctc/text_download/en/, accessed 12 September 2014).

WHO (2011a).From burden to "best buys": reducing the economic impact of non-communicable diseases in low- and middle-income countries. Geneva: World Economic Forum (http://apps.who.int/medicinedocs/en/d/Js18804en/, accessed 2 September 2014).

WHO (2011b).First Global Ministerial Conference on Healthy Lifestyles and Noncommunicable Disease Control (Moscow, 28–29 April 2011): discussion paper: prevention and control of NCDs: priorities for investment. Geneva: World Health Organization (http://www.who.int/nmh/publications/who_bestbuys_to_prevent_ncds.pdf, accessed 29September 2014).

WHO (2012a).Health 2020: the European policy for health and well-being [website]. Copenhagen: WHO Regional Office for Europe (http://www.euro.who.int/en/health-topics/health-policy/health-2020-the-european-policy-for-health-and-well-being, accessed 4 September 2014).

WHO (2012b).European Action Plan for Strengthening Public Health Capacities and Services.Copenhagen: WHO Regional Office for Europe (http://www.euro.who.int/en/health-topics/Health-systems/public-health-services/publications2/2012/european-action-plan-for-strengthening-public-health-capacities-and-services, accessed 4 September 2014).

WHO (2013a).Oslo conference on health systems and the economic crisis [website]. Copenhagen: WHO Regional Office for Europe (http://www.euro.who.int/en/media-centre/events/events/2013/04/oslo-conference-on-health-systems-and-the-economic-crisis, accessed 2 September 2014).

WHO (2013b).Seven key reasons why immunization must remain a priority.Copenhagen: WHO Regional Office for Europe (http://www.euro.who.int/en/health-topics/disease-prevention/vaccines-and-immunization/publications/2010/7-key-reasons-to-immunize, accessed 12 September 2014).

WHO (2013c).Health impact assessment: glossary of terms used [website]. Geneva: World Health Organization(http://www.who.int/hia/about/glos/en/index1.html, accessed 14 September 2014).

WHO (2014a).Global health expenditure database [online database]. Geneva: World Health Organization (http://apps.who.int/nha/expenditure_database/en/, accessed 4 September 2014).

WHO (2014b).Health statistics and information systems [website].Geneva: World Health Organization (http://www.who.int/healthinfo/global_burden_disease/metrics_daly/en/, accessed 29 September 2014).

Windle G, Hughes D, Linck P, Russell I, MorganR,Woods R et al. (2008). Public health interventions to promote mental well-being in people aged 65 and over: a systematic review of effectiveness and cost–effectiveness. London: National Institute for Health and Care Excellence (http://www.nice.org.uk/guidance/ph16/resources/mental-wellbeing-of-older-people-effectiveness-and-cost-effectiveness-review-final2, accessed 12 September 2014).

Withrow D, Alter DA (2011). The economic burden of obesity worldwide: a systematic review of the direct costs of obesity. Obes Rev. 12(2):131–141.

Wright A, Lloyd-Davies A, Williams S, Ellis R, Strike P (2005). Individual active treatment combined with group exercise for acute and subacute low back pain. Spine. 20(11):1235–41.

Zechmeister I, Blasio BF, Garnett G, Neilson AR, Siebert U (2009).Cost–effectiveness analysis of human papillomavirus-vaccination programs to prevent cervical cancer in Austria. Vaccine. 27(37):5133–5141.

Assuring sustainable organizational structures and financing

The 10 Essential Public Health Operations (EPHOs) 2012

1. Surveillance of population health and well-being
2. Monitoring and response to health hazards and emergencies
3. Health protection, including environmental, occupational, food safety and others
4. Health promotion, including action to address social determinants and health inequity
5. Disease prevention, including early detection of illness
6. Assuring governance for health and well-being
7. Assuring a sufficient and competent public health workforce
8. Assuring sustainable organizational structures and financing
9. Advocacy, communication and social mobilization for health
10. Advancing public health research to inform policy and practice