The economic argument for the prevention of ill-health at population level.

For Working Group on Public Health Policy Framework

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Value for money is a key part of any strategy addressing the health and well-being of the population. This paper describes the different levels at which ill-health can be prevented, discusses the role of organised preventive programmes in cost-saving, and outlines the evidence base, and cost, of implementing preventive programmes to address specific key public health challenges and threats.

1. INTRODUCTION

Expenditure on health comprises the second largest component of public expenditure in Ireland, after social protection (Eurostat 2011). From 2000 to 2009 the Irish public health care spend has more than doubled in real terms to €19 billion euro p.a.

Health spending in Ireland is mainly directed towards diagnostic and treatment services for disease and injury. Chronic diseases are major drivers of health care costs, as well as associated economic losses. The rising burden of chronic disease is due mainly to behavioural factors; many chronic conditions such as cardiovascular disease, adult-onset diabetes and hypertension are amenable to prevention. Organised measures to protect health and well-being by prevention of ill-health and reduction of inequalities make economic sense (IPH and EuroHealth Net 2009), as demonstrated by economic modelling of prevention of chronic diseases (OECD 2011), and specifically obesity (Foresight 2007) and diabetes (Brown 2009). A shift from costly hospital based interventions towards primary care and population- based interventions can deliver a reduction in chronic diseases and an increase in the health of the population. Characteristics of a high-performing chronic care programme include a focus on preventive health; priority for support for self-management; priority for primary health care and an emphasis on population management (Ham 2010).

The contribution of leading determinants of health on mortality (population attributable fractions) are shown in Figure 1.

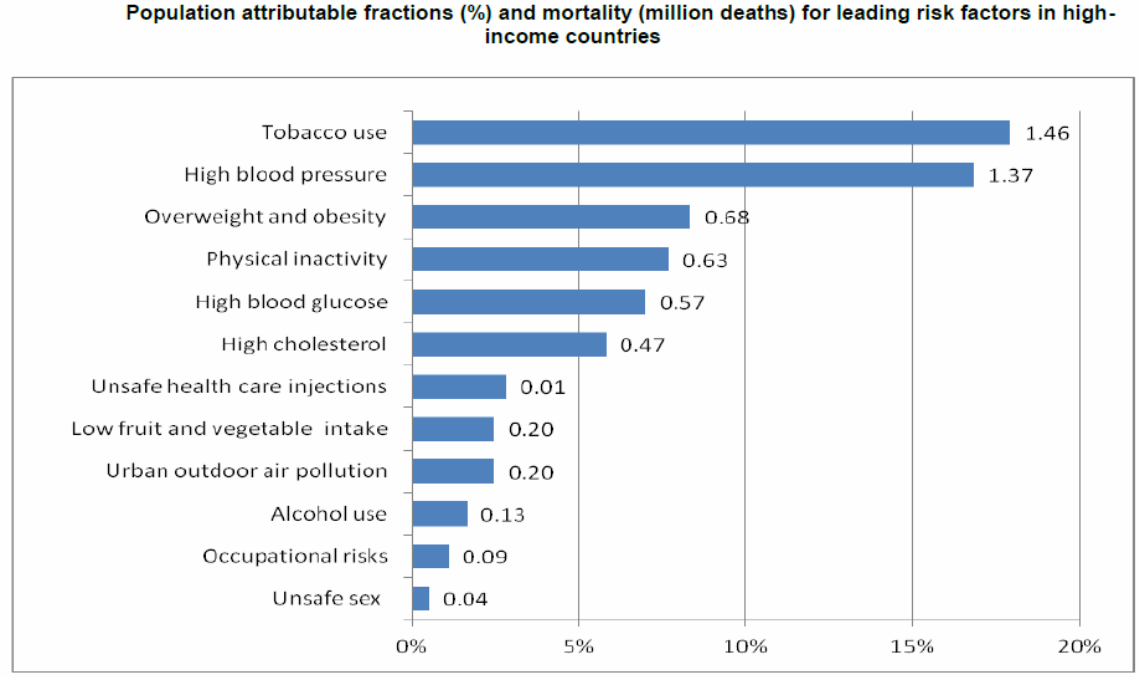

Figure 1. (Source OECD 2011)

Ill-health is expensive, for example, estimates from the UK applied to Ireland surmise that the annual economic cost of obesity in Ireland is about €2.7 billion, based on an estimated 2000 premature deaths annually attributable to obesity (Department of Health and Children, Report of the taskforce on obesity 2005). In 2006-07 poor-diet-related ill-health cost the NHS £5.8 billion. The cost of physical inactivity was £0.9 billion. Smoking cost was £3.3 billion, alcohol cost £3.3 billion, overweight and obesity cost £5.1 billion (Scarborough, Bhatnagar et al. 2011).

The financial and economic implications of any programme, intervention or policy form an important guide towards decision-making. Opportunity cost (eg the loss of another programme) should be considered. The key areas through which ill-health and chronic disease impact on the economy are through direct effects on health-care and social care consumption, and indirect costs such as lost function, lost productivity and reduced labour supply. Productivity losses can be variable, depending on the type of activity of the affected person/s, underlying labour market conditions (eg unemployment rate) and the skill-set of the person affected, and may lie between zero cost and the total cost of replacement. The ethics around elimination of health disparities and the social good of increased well-being are further arguments for investing in better health for all.

2. BACKGROUND

Preventive programmes

The three levels of prevention are shown below.

Levels of prevention

Primary prevention *blocks or delays the onset of disease, avoiding direct costs associated with diagnosis, treatment, rehabilitation and indirect costs associated with lost function, lost work productivity and other societal costs.*
Secondary prevention *includes early detection of disease e.g. through screening*
Tertiary prevention services *act when a disease or injury is already present, and seek to limit the effect of the condition and to improve quality of life, e.g. chronic disease management programmes*

Population-based prevention seeks to remove the underlying causes of disease, attempting to control the determinants of ill-health and disease (Rose 1985). Prevention and health promotion interventions occur across a risk reduction continuum from community- or employer- based strategies to clinician directed services to individualised interventions. The population can be supported to choose preventive approaches by the provision of education, a conducive environment and/ or regulation. Figure 2 shows the interactions between chronic diseases and a health system, showing where prevention can be directed.

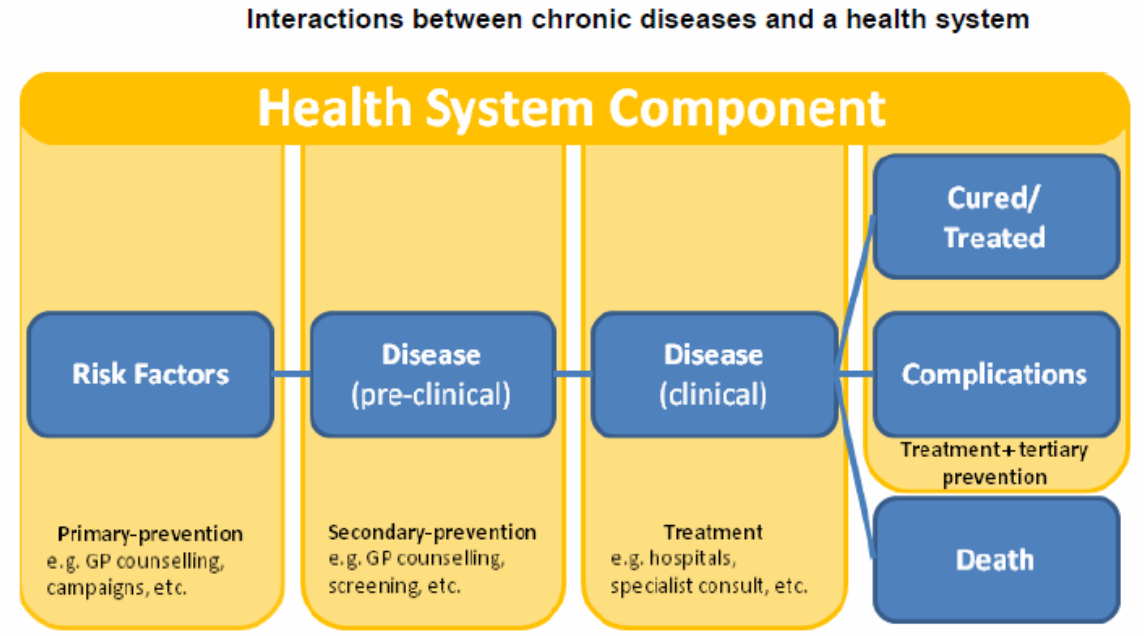

Figure 2. (Source OECD 2011)

Value for money and health production

Health has been extensively described as an economic good (Waitzkin 2003), with good health benefitting the economy in several areas: higher productivity, higher labour supply, improved skills and increased savings for investment in physical and intellectual capital (Suhrcke, McKee et al. 2006). Health is a pre-requisite for economic productivity and prosperity (Byrne 2004).

A large body of evidence from a wide variety of sources suggests that investments in prevention at the population level produce value, increased productivity and improved quality of life (Benson, Storey et al. 2008).

The health benefits and economic value of prevention are greatest when prevention is implemented at the earliest opportunity. Population-based prevention policies can be expected to generate substantial health gains while basically paying for themselves by reducing further health expenditure on treating morbidity. For example, four out of five deaths of people <75 years in the UK are estimated to be preventable, with a total annual cost of £187 billion (19% of total GDP) (National Social Marketing Centre, 2010). For every 1% improvement in health outcomes from preventive programmes, there would be a reduction in public expenditure by £190 million, a reduction in family/societal spending of £700m and a lowering of employer costs by £110m, not to mention the reduction in premature death and disability (National Social Marketing Centre, 2010).

A strategy of several concurrent interventions generates substantially larger health gains than individual interventions, often with a favourable cost-effectiveness profile (Cecchini, Sassi et al. 2010).

Health care spend is not synonymous with improved health. While the US per capita health spend is the highest in the world, US health outcomes lag behind most other industrialized countries (Benson, Storey et al. 2008). The desired outcome of health care spending should not be 'medical care' but healthy individuals and populations: that is, health production. Goals of interventions/ programmes/ procedures should include years of healthy life and quality of life and the elimination of health disparities.

Economic arguments for population interventions arise from three scenarios: from spending the same as previously, but achieving a better outcome; from spending less and achieving the same

outcome; and finally from spending more and getting a better outcome which is worth the extra spend.

Health gains from interventions targeting children occur in the long term. Early investment in disadvantaged children is more cost effective than later remediation (Carneiro and Heckman, 2003) (see figure 3 below). The benefits are enjoyed for longer and the return increases to investment. Early childhood intervention is discussed in detail later in this paper.

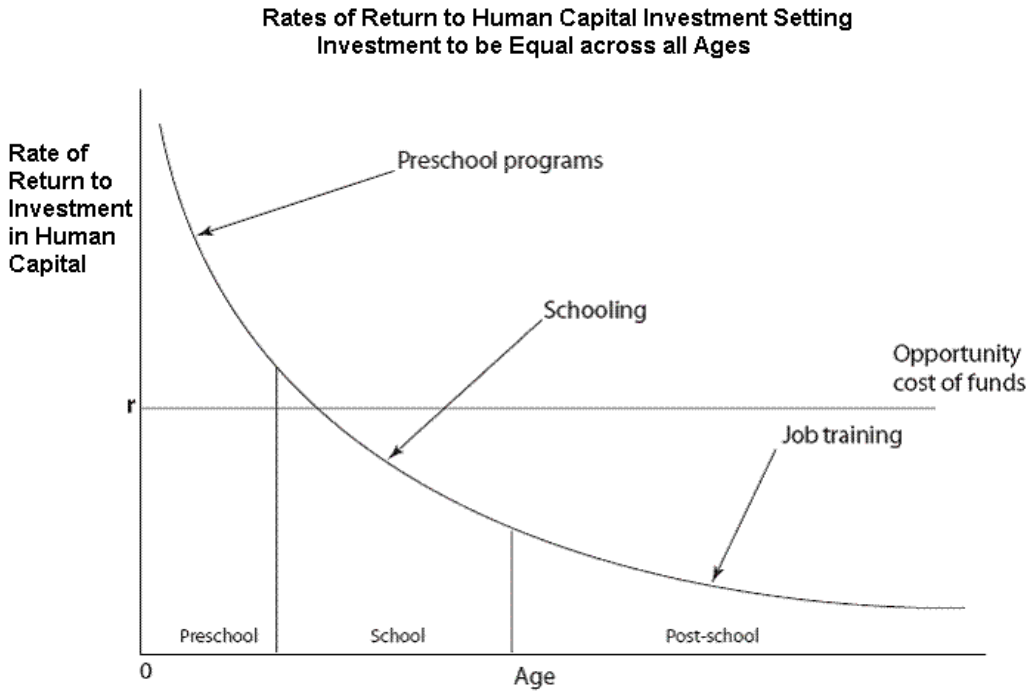

Figure 3. Source Carneiro and Heckman, 2003.

Evidence as part of public health policy

There are many population health interventions for which strong evidence of effectiveness exists. Failure to implement these evidenced-based interventions represents important missed opportunities for preventing disease and promoting health.

An OECD report comprehensively assessed investment in population health in five different OECD countries (Bennett 2003) and a sample of effective population health interventions is shown below (Box 1).

Box 1: A sample of effective population health interventions

The Centres for Disease Control and Prevention in the United States highlights the following practical interventions that exist for controlling and preventing many chronic diseases:

Proven clinical smoking cessation interventions would cost USD 2 321 for each year of life saved.

Each USD 1 spent on diabetes outpatient education saves USD 2-3 in hospitalisation costs.

The cost of preventing one cavity through fluoridation is USD 3, far below the average USD 55 cost of a dental restoration.

Mammography screening, when performed every 2 years for women aged 50-69 years, costs between USD 8 280-9 890 per year of life saved. This cost compares favourably with other widely used clinical preventive services.

Cervical cancer screening among low-income elderly women is estimated to save 3.7 years of life and USD 5 907 for every 100 Pap tests performed.

For every USD 1 spent on preconception care programs for women with pre-existing diabetes, USD 1.86 can be saved by preventing birth defects.

Participants in the arthritis self-help course experienced an 18% reduction in pain at a per-person saving of USD 267 in health care system costs over a four-year period.

The World Bank, in its 1993 World Development Report raises the idea of a minimum package of essential interventions which are both effective and cost effective to provide. Amongst the package are a variety of public health interventions such as immunisations, micronutrient supplementation, de-worming, and health education and promotion; as well as the control of tuberculosis, sexually-transmitted diseases and a cluster of childhood diseases, prenatal and delivery care, family planning and treatment for pain, other infections and minor traumas.

Teng *et al.* (1995) have assessed 500 life-saving interventions and their cost-effectiveness. Many population health interventions were found to be highly cost-effective (*e.g.* seat belts laws and use, reduced lead in petrol, pre-natal care, breast and cervical cancer screening, immunisation).

A study by the US Public Health Service in 1994 estimated that population–based strategies in six areas – heart disease, stroke, fatal and non-fatal occupational injuries, motor vehicle related injuries, low birth weight and gunshot wounds – would reduce medical spending by USD 69 billion by 2000, or 11% of medical spending on those conditions.

In Australia, Segal assessed the relative cost-effectiveness of six interventions to reduce the burden of diabetes (NIDDM) and found investment in workplace based programs for overweight men to be highly effective in terms of life years saved and net savings to the health system.

Examples of effective primary prevention interventions are shown in Box 2.

Box 2.: Effective primary prevention interventions (Benson, Storey et al. 2008)

Primary Prevention Interventions
Examples with Demonstrated Evidence of Effectiveness and Cost-Effectiveness

Intervention	Study population(s)	Health effects/benefits
Community water fluoridation	Children 4-17 years old	Prevents dental caries.
Early childhood development programs	Children 3 years old from low income families	Improved cognitive and social outcomes which often lead to improved long-term health.
Reducing environmental pollutants	Children	Reduction in lead poisoning, asthma, cancer, and developmental disabilities.
Maternal health and safe motherhood interventions; family planning	Adults and adolescents	Prenatal and delivery care, postpartum care, prevention of unintended pregnancies.
Multi-component workplace health promotion program	Employees	Reductions in health risk factors and absenteeism; increased work performance.
Workplace fitness facilities	Employees	Reduced disability and health care costs.
Ergonomic interventions	Employed	Reduced workplace accidents, injuries, illnesses.
Immunizations	Children, elderly	Infectious disease prevention.
Reducing alcohol-impaired driving through sobriety checkpoints and mass media campaigns	Alcohol-impaired drivers	Accidents/trauma reduction, medical cost savings, averted productivity losses, pain, and suffering.
Increasing excise taxes on tobacco products	Current and potential tobacco users, especially teens	Tobacco free lifestyles.
Health education about smoking	Adolescents	Tobacco free lifestyles.
Smoking bans and restrictions; environmental tobacco smoke restrictions	Current and potential tobacco users; general public	Medical cost savings, reduced morbidity and mortality, averted smoking-related fires, productivity gains.
Prenatal and infancy nurse home visitation	Pregnant, low-income women and their children	Improvement in a wide range of maternal and child health outcomes, including reduced smoking and improved diets during pregnancy, fewer preterm deliveries, higher mean birthweights, reduction in child abuse and neglect, fewer child emergency room visits.

Do we or should we use the evidence-base for effectiveness in policy formation? Evidence-based interventions and programmes for the most part will provide the greatest economic advantage in delivering health and social gains in the most equitable fashion (Macintyre 2003). Others suggest that public health policy need not or cannot be completely evidence based (Davey Smith, Ebrahim et al. 2001), but the potential for significant harm and opportunity cost arising out of ineffective public health interventions has been discussed (Macintyre 2010). There are issues with lack of evidence of effectiveness: it may reflect true ineffectiveness, it can also be due to inadequate or inappropriate evaluation, failure of implementation (Rychetnik et al., 2002), or simply lack of evaluation. Evaluations may not always be robust, for example recording satisfaction and usage during an initiative but failing to record health outcomes.

There is a recognised gap in the evidence base around the cost-effectiveness of some preventive measures (Wanless 2004), due to diverse, difficult-to-measure costs and benefits, long time-frames for benefits to accrue, and the difficulty of linking good outcomes to specific interventions. There is a lack of evidence on the effectiveness of cross-cutting themes and programmes, and even within evaluations of actions on specific topics there may be insufficient attention to comparing

effectiveness across socio-economic and other equality/diversity groups (Davey Smith, Ebrahim et al. 2001).

One consequence of the skewing of available evidence is that actions and types of action for which evidence is strongest are not necessarily the most important for achieving population health gain and reducing health inequalities. Economic evidence itself is not sufficient to establish priorities in health policy; other important concerns must be considered, particularly the fairness of distribution of available resources and health outcomes among different sectors of society.

It seems that in high-income settings, people who are less affluent may benefit over and above others from interventions to reduce at-risk behaviour (Sassi, Cecchini et al. 2010), provided that the interventions can generate the same changes in behaviour in individuals in different socio-economic groups.

The gap in the evidence base underlying recent national public health policy has been examined in the UK (Katikireddi, Higgins et al. 2011). This review examined 51 interventions from '*Healthy Lives, Healthy People'* (Department of Health UK 2010) and found that many of the evaluations did not assess effectiveness in a robust way, rarely reporting on health outcomes but on uptake and satisfaction. This assessment concluded that many recommended interventions are likely to be ineffective, or lack evidence to establish effectiveness. The authors suggest that large gaps in the research remain and that ineffective interventions should not be implemented, and novel interventions, such as sports competitions for children, should be rigorously evaluated.

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3. THE ECONOMICS OF PREVENTIVE APPROACHES IN SPECIFIC AREAS

The economics of prevention with respect to several key public health issues is discussed in this section. Clearly there is considerable overlap as risk factors for each issue may be similar. In each section the evidence is presented first, followed by examples of the cost-saving of interventions. Often there have been no economic evaluations specific to Ireland so international examples are given. Issues discussed here are: obesity and physical activity, immunisation, chronic diseases, early childhood interventions, screening, mental health, work setting programmes, alcohol and tobacco-related ill-health and health0care associated infections.

A review of other determinants of health such as education, transport, agriculture, safety (including injury prevention), climate change and energy efficiency are outside the scope of this paper and can be found elsewhere (Drummond et al 2007; I PH and EuroHealth Net 2009).

Prevention of obesity and physical inactivity

Evidence of effectiveness

Rising levels of overweight and obesity pose significant challenges for the health and social services in terms of increases in chronic disease. Findings from a WHO review of the effectiveness of interventions to improve diets, increase physical activity and tackle obesity showed that school-based interventions were most commonly assessed, and relatively few studies focused on other public health interventions (WHO 2009). A recent Cochrane review on the prevention of obesity has outlined promising interventions in school children (Waters, de Silva-Sanigorski et al. 2011).

Cost effective strategies include health information and communications strategies that improve population awareness about the benefits of healthy eating and physical activity; fiscal measures that increase the price of unhealthy food content or reduce the cost of healthy foods rich in fibre; and regulatory measures that improve nutritional information or restrict the marketing of unhealthy foods to children (Cecchini, Sassi et al. 2010). Price interventions and regulation can produce the largest health gains in the shortest time-frame (Cecchini, Sassi et al. 2010). Regulation of food advertising to children can be more effective and efficient than can school-based health promotion (Cecchini, Sassi et al. 2010). Physician counselling of individuals at risk in primary care is one of the most effective interventions, particularly where the population has regular access to primary care (Cecchini, Sassi et al. 2010).

Economic evaluation

The annual economic cost of obesity in Ireland is about €2.7 billion, based on an estimated 2000 premature deaths annually attributable to obesity (Report of the taskforce on obesity 2005).

A review of the evidence base around obesity prevention concluded that several population-based prevention policies in this area can be expected to generate substantial health gains while entirely or largely paying for themselves through future reductions of health-care expenditures (Cecchini, Sassi et al. 2010).

An Australian study estimated that if Australian people became more active for just 30 minutes per day, it could save €815 million per year in costs linked to cardiovascular heart disease, stroke, Type 2 diabetes, breast cancer, colon cancer, depression and falls. This equals 17% of the total health costs linked with the medical conditions included in the study (Medibank, 2007).

In Canada physical inactivity results in about 6% of total health care costs (WHO, 2003). In the USA, the cost linked with inactivity and obesity was 9.4% of the national health expenditure in 1995. Each dollar invested in physical activity (time and equipment) is estimated to produce medical cost savings of over three dollars.

Workplace physical activity programmes in the USA can reduce short-term sick leave by 6% - 32%, reduce health care costs by 20% -55% and increase productivity by 2% -52% (WHO 2003).

Immunisation

Evidence of effectiveness

Immunisation is one of the greatest achievements of medicine and has spared millions of people the effects of devastating diseases. Before vaccines became widely used, infectious diseases killed thousands of children and adults each year worldwide. Immunisation is undoubtedly one of the most cost-effective public health achievements of modern times. It costs very little, but offers huge benefits for the health and well-being of populations. Immunisation prevents death and disability at a fraction of the cost of treatment, to the benefit of both the individual and society as a whole. It protects against the long-term effects of a disease on physical and mental wellbeing and ability to complete education or training and to carry out work. In this way, the protection provided by immunisation offers immeasurable individual and societal benefits in terms of earning capacity, productivity and growth.

Immunisation saves more than 3 million lives worldwide each year, and it saves millions more from suffering illness and lifelong disability (WHO estimates, 2009b). Vaccine-preventable diseases kill 3 million people around the world every year (WHO estimates, 2009b). Effective and safe vaccines, which protect against more than 20 serious diseases, are available and many promising new vaccines are being developed.

WHO estimates that, since the beginning of the Global Polio Eradication Initiative in 1988, five million people are walking today who would have otherwise been paralysed by the poliovirus (WHO 2011). Failure to completely eradicate polio would result in at least 10.6 million new cases of polio worldwide in the next 40 years, representing in total the loss of 60 million human life years (including all consequences of the disease) (WHO 2011).

In recent years, countries of the European Region have had to fight large and sporadic outbreaks of infectious disease, especially due to measles. In 2007-2010, measles outbreaks were reported in many countries in the western part of Europe, including Ireland, due to pockets of unvaccinated people allowing wide and rapid spread when the virus was introduced. These outbreaks can be very costly to manage and can lead to disability and death.

Below are some statistics from the US which demonstrate the effectiveness of childhood vaccination (Atkinson, Wolfe et al. 2000):

- Before 1985, Haemophilus influenzae type b (Hib) caused serious infections in 20,000 children each year, including meningitis (12,000 cases) and pneumonia (7,500 cases) (Bisgard, Kao et al. 1998). In 2002, there were 34 cases of Hib disease
- In the 1964-1965 epidemic, there were 12.5 million cases of rubella (German measles) (Atkinson, Wolfe et al. 2000). Of the 20,000 infants born with congenital rubella syndrome, 11,600 were deaf, 3,580 were blind, and 1,800 were mentally retarded as a result of the infection. There were 9 cases of rubella in 2004 and only four cases of congenital rubella between 2001 and 2004.
- Before 1963, more than 3 million cases of measles and 500 deaths from measles were reported each year. More than 90% of children had measles by age 15. In 2002, there were 44 cases of measles.
- In 1952 polio paralysed more than 21,000 people. In 2002, there were no cases of polio in the United States.
- In the early 1940s, there was an average of 175,000 cases of pertussis (whooping cough) per year, resulting in the deaths of 8,000 children annually. In 2002, 9,771 cases were reported.
- In the 1920s, there were 100,000 to 200,000 cases of diphtheria each year and 13,000 people died from the disease. In 2002, there was only one case of diphtheria in the United States.

Economic evaluation

Economic evaluation of the childhood routine immunisation schedule (seven vaccines) in the US using a hypothetical childhood cohort in 2001 demonstrated substantial cost savings from direct and societal perspectives (Zhou, Santoli et al. 2005). Without routine vaccination, costs of diphtheria, tetanus, pertussis, H. influenza b, poliomyelitis, measles, mumps, rubella, congenital rubella syndrome, hepatitis B and varicella would be $12.3 billion (direct costs) plus $46.6 billion (societal

costs). Direct and societal costs for the vaccination programme were an estimated $2.3 billion and $2.8 billion respectively.

A study of 11 western European countries reported that the cost of measles treatment was €209-480 per case, while the cost of measles vaccination and control was €0.17-0.97 per person. Health-care provider costs during a measles outbreak of 614 cases in Germany were reported to be €102,804 for measles with complications, while total services were a total of €229,122 (WHO 2011).

Screening

Evidence of effectiveness

Secondary prevention refers to the early detection of a disease process and intervention to reverse or slow its progression. Screening is a public health service in which members of a defined population, who do not necessarily perceive that they are at risk of, or are already affected by, a disease or its complications, are asked a question or offered a test to identify those individuals who are more likely to be helped than harmed by further tests or treatment to reduce the risk of disease or its complications (Holland, Stewart et al. 2006).

With the raised perception by both policy-makers and the public that stringent criteria must be applied before screening procedures are introduced, economic facts have been increasingly demanded in order to try to quantify the costs and benefits in terms that are more readily understood. Evidence-based screening involves intervention and treatment earlier than otherwise would have been the case, and is demonstrably evidenced by better outcomes. A hazard of screening is the possibility of over-treatment, where tests with low specificity lead to more intervention than necessary and treatment or intervention in those who have no disease. The ensuing costs must be borne in mind.

Although most screening tests are simple, relatively cheap procedures in themselves, the actual costs of a national screening programme is considerable because of the organisation required and the large numbers involved. In any screening programme, as with any other service programme, adequate steps must be taken to ensure that the original objectives are being met and that the methodology meets appropriate standards. The ideal method for evaluating a screening programme is the randomised controlled trial in which individuals in a population are allocated, at random, either to a group that is screened or to a group that receives only its normal medical care.

Randomised controlled trials are expensive and difficult to manage and may also be ethically questionable in situations where the control group is denied treatment for the condition in question Holland, 2006). Despite this, the UK National Screening Committee will only recommend the introduction of any new screening programme after assessing the findings of a properly conducted randomised controlled trial. The Committee also keeps all screening programmes under regular review to ensure that they continue to perform in the way intended and continue to be effective. Health Technology Assessment to evaluate the evidence on the effectiveness of early detection through (for example) neonatal screening (Cornel et al, 2011) and treatment should be achievable in practice. For rare conditions, best level evidence should be used. Methods need to be developed to both optimise health benefit and careful evaluation.

Few countries have a single national body to review screening practice and policy, and population registers for recall and follow-up of patients are also comparatively rare. A recent WHO report on screening in Europe calls for the need for greater consideration to be paid to the effectiveness of screening and the need for more attention to be given to evaluating the processes of screening (Holland, 2006).

Effective population-based screening programmes in Ireland include prenatal screening (maternal HIV and syphilis, gestational diabetes, hepatitis B), newborn bloodspot screening, childhood, breast, cervical and colorectal cancer screening (Pignone et al, 2002), diabetic retinopathy screening in adulthood (Gillespie et al 2011).

Newborn screening is beneficial to patients and, in many cases, cost saving. Over the long term, newborn screening programs are likely to save money for society (Carroll & Downes, 2006). In Ireland there is a high comparative prevalence of many of the inborn errors of metabolism screened for by newborn bloodspot screening. Expansion of newborn screening programmes to test for many more diseases in the newborn has been considered elsewhere (Cipriano et al, 2007) with the suggestion that the cost-efficiencies gained by using spectometry to screen for bundles of diseases rather than just one disease are sufficient to warrant consideration of an expanded screening program. It is, however, not cost-effective to screen for all diseases that can be screened for using this technology.

Cancer screening has proven benefits for cervical and colo-rectal cancers. Cervical screening has had a substantial impact on the incidence and mortality of cervical cancer in many developed countries

(Sasieni 2009). One study of colo-rectal cancer screening modalities showed that most strategies prevented more than 60% of cases of cancer and 80% of colorectal cancer deaths (Khandker et al, 2000).

Recent reviews of breast cancer screening have debated its benefits (Duffy, 2010). Absolute numbers of lives saved and numbers overdiagnosed (whose cancers would not otherwise have been treated in their lifetime) have been reviewed. A substantial and significant reduction in breast cancer mortality was associated with screening in both the Two-County Trial and the screening programme in England. The absolute benefits were estimated as 8.8 and 5.7 breast cancer deaths prevented per 1000 women screened for 20 years starting at age 50 from the Two-County Trial and screening programme in England, respectively. The corresponding estimated numbers of cases overdiagnosed per 1000 women screened for 20 years were, respectively, 4.3 and 2.3 per 1000. One review concluded that the benefit of mammographic screening in terms of lives saved is greater in absolute terms than the harm in terms of overdiagnosis, with between 2 and 2.5 lives are saved for every overdiagnosed case (Duffy, 2010).

Over the past 11 years, Ireland' s breast screening service Breastcheck has detected 5,071 breast cancers by providing 826,210 free mammograms to 368,851 women. A detailed value-for- money review of the service is intended to be carried out in 2012.

Economic evaluation

The table below lists some examples of screening measures that have been proven to be effective in preventing or minimising disease and cost-effective (estimated cost of under $100,000 per life year/ quality adjusted life year gained, or less).

Box 3. Examples of secondary prevention with demonstrated evidence of effectiveness and cost-effectiveness (Benson, Storey et al. 2008)

Intervention	Target population	Health effects/benefits
Colorectal cancer screening	Adults age ≥50	Reduces mortality from colorectal cancer.
Hypertension (high blood pressure) screening	All adults	Detection of hypertension. Treatment of hypertension substantially decreases the incidence of cardiovascular events.
Problem drinking screening and brief counseling	All adults	Identify adults whose levels or patterns of alcohol consumption place them at risk for increased morbidity and mortality. Reductions in alcohol consumption that are sustained over 6- to 12-month periods or longer.
Cervical cancer screening	All women who have been sexually active and have a cervix	Reduces incidence of and mortality from cervical cancer.
Cholesterol screening	Men ≥35 and women ≥45	Identify asymptomatic persons at increased risk of coronary heart disease. Diet and lipid-lowering drug therapy substantially decreases incidence of coronary heart disease.
Breast cancer screening	Women age 40+	Reduces mortality from breast cancer.
Breast cancer screening (mammography)	Women age 65+	Reduces mortality from breast cancer.
Chlamydia screening	Sexually active women ≤25; older women at increased risk	Reduces incidence of pelvic inflammatory disease (PID).
Vision screening	Children aged < 5 years	Screening tests identify strabismus, amblyopia, and refractive error in children with these conditions and leads to improved visual acuity. Treatment of strabismus and amblyopia can improve visual acuity and reduce long-term amblyopia.
Visual Screening for Malignant Melanoma	Adults age 50+	Increases life expectancy and quality-adjusted life expectancy.
Testing for Primary HIV Infection	Outpatients with fever or other viral symptoms	Early detection of HIV and cases avoided in sexual partners.
Neonatal screening for Cystic Fibrosis	Neonates	Improved quality of life and life expectancy for persons with CF.

A review of colorectal cancer screening showed that, compared with no screening, cost-effectiveness ratios for screening with any of the commonly considered methods were generally between $10 000 and $25 000 per life-year saved (Pignone et al, 2002).

The estimated cost per life saved by breast cancer screening was £6,000–£130,000 (Morgan, 2011). In Australia, the policy of breast cancer screening in eligible women aged 40+ who participate, while specifically targeting women aged 50–69 years, yielded a cost-effectiveness estimate of $38,302 per life year gained and $23,713 per life year gained over a period of 20 and 40 years, respectively.

Health-care associated infection

Managing issues such as antimicrobial resistance and health-care associated infection through preventive programmes and awareness and changes in prescribing practice at primary care and secondary care level can bring substantial savings and avoid considerable morbidity and mortality for patients.

The clinical and economic impact of antimicrobial resistance, although imperfectly measured, is of longer hospital stays, higher cost of healthcare and increases in mortality and morbidity. Patients

with infections due to antimicrobial-resistant organisms have higher costs (US$6000-30,000) than do patients with infections due to antimicrobial-susceptible organisms; the difference in cost is even greater when patients infected with antimicrobial-resistant organisms are compared with patients without infection (Maragakis, Perencevich et al. 2008).

The ECDC reported that approximately 4, 131,000 patients are affected by about 4, 544,100 episodes of health-care associated infection every year in Europe, with a mean health-care associated infection prevalence of 7.1% (ECDC, 2012). European estimates indicate that HCAIs cause 16 million extra-days of hospital stay and 37 000 attributable deaths annually, but also contribute to an additional 110 000 deaths.76The burden of HCAI is also reflected in significant financial losses. According to a report from the ECDC, these infections account for approximately € 7 billion per year, including direct costs only (ECDC 2012).

It has been estimated that there are approximately 90,000 deaths in the US attributed to health-care associated infection annually, ranking it as the fifth leading cause of death in acute care hospitals. The total annual hospital-related financial burden of HAI in the United States was estimated to exceed $4.5 billion in 1992 (equals 6.5 billion in 2004 dollars). An audit of the attributable costs of HAI and interventions aimed at reducing this burden found a wide variation in the cost estimates (eg, $3500 to $40,000 per survivor of bloodstream infection in 2000 dollars) (Maragakis, Perencevich et al. 2008) and wide variation in the savings accruing in preventing all preventable cases (Graves, Barnett et al. 2011).

Robust evidence exists that HCAI can be prevented and the burden reduced by as much as 50% or more (WHO 2011b).

Early childhood intervention

Evidence of effectiveness

Inequalities in children's health and development appear early in life. Early childhood development (ECD) programmes are designed to mitigate the factors that place children at risk of poor outcomes. Early investment in preventative programmes is more cost effective than later remediation. Three features appear to be associated with more effective interventions: programmes with better-trained caregivers, smaller child-to-staff ratios and using proven programme models.

There is some evidence that more intensive programs are associated with better outcomes, but not enough to indicate the optimal number of program hours or how they might vary with child risk characteristics.

Negative early experiences can have a detrimental effect on brain development and subsequently compromise development, learning and regulation of emotion' (Shore 1997, cited in McLoughlin and Nagorcka 1999). A child lacking positive stimulation or exposed to chronic stress in the early years of life may find difficulty overcoming a bad early start (McCain and Mustard 1999).

Early intervention programs have been found to: provide psychological and social benefits to children, families and communities. These include: higher rates of employment and skill levels in mothers; decreased welfare expenditure; increased school performance; a lower rate of criminality within families; a reduction of child abuse and neglect notifications and some decrease in health service (emergency room) attendance rates (NIFTeY online 2002).
Example of effective ECD programmes include: Perry Preschool Project, Head Start**,** Elmira Prenatal/Early Infancy Project**.**
New policy initiatives recently launched in the UK and Ireland represent a significant move towards investment in the antenatal and early years period. The UK Government have launched a £7 million pilot study of the Nurse Family Partnership, recruiting 1,000 families in ten Primary Care Trusts in England (UK Cabinet Office Social Inclusion). Additionally, the first large-scale non-US based childhood intervention programme has recently been initiated in Ireland. The Irish Government are co-funding, with Atlantic Philanthropies, a series of childhood interventions, many of which will be evaluated by randomised control trial. The programme is characterised by a large number of interventions which vary in terms of treatments, duration, and intensity.

Economic evaluation
Investments in high-quality early childhood intervention programmes consistently generate benefit-cost ratios exceeding 3-to-1or more than a $3 return for every $1 invested well above the 1-to-1 ratio needed to justify such investments, apart from the improved academic performance (and subsequent benefits), decreased criminal conduct and improved earnings (with higher tax returns) (Barnett 2000; Karoly et al 1998).
A publicly financed, comprehensive ECD program for all children from low-income families would cost billions of dollars annually, but would create much larger budget savings over time. By about the 17-year mark, the net effect on budgets for all levels of government combined would turn

positive. Within 25 years, the budget benefits would exceed costs by $31 billion (in 2004 dollars). By 2050, the net budget savings would reach $61 billion (in 2004 dollars).

Investment in the health and development of young children while producing social benefits will also produce economic benefits, particularly associated with a decreased need for services (Barnett 2000; Karoly et al. 1998). By improving the skills of a large fraction of the U.S. workforce, programs for poor children would raise the gross domestic product (GDP), reduce poverty, and strengthen U.S. global competitiveness (Lynch 2004). Within 45 years the increase in earnings due to ECD investments would likely boost GDP by nearly one-half of 1%, or $107 billion (in 2004 dollars). Crime rates and the heavy economic costs of criminality to society are likely to be substantially reduced, as well, with savings of about $155 billion (in 2004 dollars) realized by 2050 (ibid).

Features associated with more successful programs tend to be costly and this suggests that more money may need to be spent to obtain greater benefits.

Many of the benefits from early childhood interventions can be translated into dollar figures and compared with program costs. For example, if school outcomes improve, fewer resources may be spent on grade repetition or special education classes. If improvements in school performance lead to higher educational attainment and subsequent economic success in adulthood, the government may benefit from higher tax revenues and reduced outlays for social welfare programs and the criminal justice system. As a result of improved economic outcomes, participants themselves benefit from higher lifetime incomes, and other members of society gain from reduced levels of delinquency and crime.

Benefit-cost analyses (carried out by Karoly, Lynn et al 2005), found that:

- For those programs that served more-disadvantaged children and families, the estimates of benefits per child served, net of program costs, range from about $1,400 per child to nearly $240,000 per child.
- Some of the largest estimates of net benefits were found for programs with the longest follow-up, because those studies measured the impact for outcomes that most readily translate into dollar benefits (e.g., employment benefits, crime reduction).
- Large economic returns were found for programs that required a large investment (over $40,000 per child), but returns were also positive for programs that cost considerably less (under $2,000 per child).

Because not all benefits can be translated into dollar values, some of the other potential include labour market performance for the parents of participating children, as well as stronger national economic competitiveness as a result of improvements in educational attainment of the future workforce.

Mental Health

While measures of GDP provide a picture of the economic health of a nation, measures of well-being provide an indication of how life in a country is experienced. Public discourse often presents mental health in a wholly negative light, focusing on mental health 'problems', rather than the concept of promoting mental well-being. Such thinking assumes that mental health promotion is only relevant for a minority of people. In reality people have different levels of resilience to common problems in life, such as stress and bereavement. It is more accurate to think of mental health, as something which fluctuates throughout a person's lifetime.

Evidence of effectiveness

Research indicates that resilience is best developed in the early years of a person's life. Skills children develop at a young age will help them cope better as adults. Many advocate that mental health promotion programmes should take place in schools.

Research shows that mental health promotion programmes can be effective in equipping people with the skills necessary to avoid or deal with mental distress. Studies indicate that the whole-school approach is the most effective approach to mental health promotion. This involves students, school staff, parents as well as key community groups.

School-based programmes can have positive effects for students in terms of behaviour and self-control, social and emotional skills, ability to learn and achieve academically and problem-solving in social settings.

UK research analysed the costs and economic payoffs of a range of interventions in 15 areas of mental health promotion, prevention and early intervention (Dept of Health UK, 2011).

Each of the modelled interventions was evidence based, i.e. effective in improving mental health. Over and above these gains in health and quality of life, the interventions also generated significant economic benefits including savings in public expenditure.

A number of interventions are self financing over time, even from the narrow perspective of the NHS alone. However, the scope for 'quick wins', in the sense of very short payback periods for the NHS, is relatively limited. Many interventions have a broad range of payoffs, both within the public sector

and more widely (such as through better educational performance, improved employment /earnings and reduced crime). In some cases the payoffs are spread over many years, particularly with childhood mental health problems, which in the absence of intervention have a strong tendency to persist throughout childhood and adolescence into adult life. However, the overall scale of economic payoffs from these interventions is generally such that their costs are fully recovered within a relatively short period of time. Many interventions are very low cost. A small shift in the balance of expenditure from treatment to prevention/promotion should generate efficiency gains. For some interventions the most cost effective action when refining a programme may be to increase take up among high risk groups or to improve completion rates, rather than to broaden coverage of the intervention.

Economic evaluation

The WHO estimates that up to 20% of children and adolescents worldwide experience a disabling mental health problem. The costs of mental ill health are considerable. The OECD (2008) reports that 21 million people in 28 European countries (4.5% of the total population) have depression, with an associated cost of more than € 118 billion (1% of the region's GDP). Direct costs were €42 billion, comprised of outpatient care (€ 22 bn), pharmaceuticals (€ 9 bn) and hospitalisation (€10 bn), but indirect costs due to work absenteeism and premature mortality accounted for two-thirds of the total (€76 bn).

The Mood Disorders Society of Canada (2009) report that costs for disability due to depression are the fastest growing disability costs for Canadian employers. In Ireland the costs of poor mental health was estimated to be 2% of GNP (€3bn) in 2006. In 2010, Ireland spent 5.2% of its overall health budget on mental health.

In a study carried out by Sobocki et al (2006) to estimate the total cost of depression in Europe based on published epidemiologic and economic evidence in 28 countries with a population of 466 million:

- at least 21 million were affected by depression.
- The total annual cost of depression in Europe was estimated at Euro 118 billion in 2004, which corresponds to a cost of Euro 253 per inhabitant.
- Direct costs alone totalled dollar 42 billion, comprised of outpatient care (Euro 22 billion), drug cost (Euro 9 billion) and hospitalization (Euro 10 billion). Indirect costs due to morbidity and mortality were estimated at Euro 76 billion.

The empirical results from this study confirm previous findings, that depression is a major concern to the economic welfare in Europe which has consequences to both healthcare providers and policy makers. One important way to stop this explosion in cost is through increased research efforts in the field. Moreover, better detection, prevention, treatment and patient management are imperative to reduce the burden of depression and its costs. Mental healthcare policies and better access to healthcare for mentally ill are other challenges to improve for Europe.

Prevention of life-style related chronic diseases

Evidence of the effect of lifestyle interventions

Chronic diseases are the leading cause of mortality in the world, representing 60% of all deaths (HSE, 2008). It has been well documented that lifestyle and other risk factors have a significant impact on health, leading to chronic illness and premature death. At least 80% of premature heart disease, stroke and Type 2 diabetes can be prevented through healthy diet, regular physical activity and avoidance of tobacco products (HSE, 2008).

Chronic diseases and the increased mortality associated with them are not distributed evenly across social groups, with those in the most disadvantaged socioeconomic conditions displaying the highest prevalence and mortality rates, and those in the most advantaged conditions the lowest rates, with a continuous gradient among groups positioned between the two extremes. In countries such as Finland, Norway, Denmark, Belgium, Austria and England researchers demonstrated a widening of inequalities in premature mortality from cardiovascular diseases and many cancers between socioeconomic groups (Mackenbach, 2006).

Lifestyles play an important role in determining chronic diseases and lifestyle changes are likely to be responsible for a significant proportion of their increase over time. Smoking alone is estimated to be responsible for 22% of cardiovascular diseases in industrialised countries, and for the vast majority of some cancers and chronic respiratory diseases (Sassi and Hurst, 2008). Alcohol abuse is deemed to be the source of 8%-18% of the total burden of disease in men and 2%-4% in women. Overweight and obesity account for an estimated 8%-15% of the burden of disease in industrialised countries, while high cholesterol accounts for 5%-12% (Sassi and Hurst, 2008).

Between 1985 and 2000, coronary heart disease mortality rates in Ireland fell by 47% in both men and women aged 25-84. This resulted in 3,760 fewer deaths in 2000. Some 44% of this mortality fall

was attributed to treatments (including 18% secondary prevention). Approximately 48% of the mortality fall was attributable to population risk factor reductions (principally cholesterol and smoking, but also blood pressure) (IMPACT study).

The OECD project on the Economics of Prevention (Sassi, Cecchini et al. 2009) aims to determine whether and to what extent efforts should be made to prevent non-communicable diseases rather than to accept the consequences of treating and managing them.

The strategic approaches that deliver best value for money to address unhealthy diets, physical inactivity and obesity closely match those for other key chronic disease risk factors (eg tobacco and harmful alcohol use, high blood pressure and cholesterol) (Gaziano, Galea et al. 2007).

improved awareness and information

appropriate fiscal measures

enhanced regulatory mechanisms

Selected preventive measures against chronic disease and their effects are assessed in an OECD review (Sassi, Cecchini et al. 2009) and presented below.

Summary of coverage and main effects of selected preventive interventions

	School-based Intervention	Worksite intervention	Mass media Campaign	Fiscal measures	Physician counselling	Physician/ dietician counselling	Food advertising regulation	Food advertising self-reg.	Food labelling
Target									
Age range	8-9	18-65	18+	0+	22-65		2-18		0+
Restrictions	only school-children	large employers	none	none	BMI≥25or high chol/blood pressure or diabetes		none		only label users
Target as % of the population	2.3%	5.8%	79.4%	100%	7.22%		19.7%		67.9%
% Pop. affected at steady-state	91.3%	7.2%	79.4%	100%	9.71%		97.9%		67.9%
Effectiveness									
Fruit/vegetables (g/day)	+ 37.6	+ 45.6	+ 18.4	+ 8.6	-	-	-	-	+ 9.87
Fat (% of total energy from fat)	- 1.64	- 2.2	-	- 0.77	- 1.6	-9.8	0.39	0.2	- 0.36
Physical activity (% of active)	-	+ 11.9	+ 2.4	-	-	-	-	-	-
BMI (kg/m^2)	-0.2	- 0.5	-	-	- 0.83	-2.32	- 0.12 to - 0.18	- 0.06 to - 0.9	- 0.02
Cholesterol (mmol/l)	-	-	-	-	-0.12	-0.55	-	-	-
Systolic blood press. (mmHg)	-	-	-	-	- 2.3	-12	-	-	-
Costs ($PPPs)									
Per target individual	$112.95	$77.13	$2.27	$0.28	$99.13	$210.82	$7.11	$0.51	$3.18
Per capita (whole population)	$2.59	$4.51	$1.80	$0.28	$7.16	$15.23	$1.40	$0.10	$2.16

The political costs of prevention, in the form of interference with individual choice, often follow an inverse pattern relative to the economic costs. Interventions that involve lower degrees of interference tend to have higher economic costs (Sassi, Cecchini et al. 2009).

A recent strategy on chronic disease in Europe discusses the evidence base around many chronic disease prevention programmes and interventions (Busse, Blumel et al. 2010).

Economic evaluation

The most successful strategies for prevention of chronic illness employ both individual-based approaches and population-wide approaches which address the determinants of health. (WHO, 2008). A strategy of several concurrent interventions for the prevention of chronic diseases would generate substantially larger health gains than individual interventions, often with a favourable cost-effectiveness profile (Cecchini, Sassi et al. 2010). Cost−effectiveness studies have found that individual and group approaches to chronic disease prevention may be highly cost-effective. However, the success of interventions is largely determined by regional differences in cost structures and in the burden of chronic diseases (Busse, 2010).

One study found that "self-management diabetes education", physical activity and diet were cost-effective for preventing diabetes (Venkat Narayan et al. 2006). Screening for greater risk of cardiovascular disease is cost-effective, according to the evidence. However, the number of proven screening procedures for chronic diseases is limited (Novotny 2008).

Results differ for primary prevention of cardiovascular disease. Controlling blood pressure with drugs or serum cholesterol is highly cost-effective for those with risk factors, and sometimes cost-effective for the general population. For high-risk adults over 45 years with high blood pressure (over 105 mmHg diastolic pressure), drug treatment may only cost a few hundred dollars per life year gained. On average across all age groups, however, drug treatment costs US$4600 to US$100 000 per life year gained. Differences in underlying risks, age and cost of medication explain the enormous difference in cost−effectiveness (Rodgers et al. 2006).

Cost−effectiveness ratios for cholesterol-lowering interventions are improving, but they vary significantly by age and risk level. Some evidence has suggested that dietary interventions for reducing cholesterol can also be cost-effective, costing about US$2000 per QALY (Prosser et al. 2000).

The original goal of DMPs (disease management programmes) when first introduced in the United States was to reduce costs. It was expected that using the programmes to change usage would lower hospitalisation and complication rates and be more efficient. However, few studies included measures of utilisation, such as emergency department visits or hospitalisations. Economic

evaluations of DMPs tend to focus only on costs, while benefits and cost-benefits are rarely considered and there is no evidence that DMPs are more cost-effective than standard care. (Busse, 2010). The long-term and medium-term impact of DMPs has not yet been studied satisfactorily. As a consequence, no conclusions can be drawn about the financial returns on investment (Nolte and McKee 2008).

Workplace Programmes

Systematic reviews of workplace programmes have established cost benefit ratios from such programmes in the region of 1:4 to 1:6, that is, the savings obtained from improvements in employee health are around four to six times the costs of the programmes (Aldana, 2001).

In Thameside Metropolitan Borough Council, the introduction of a wellbeing programme for employees, including a number of simple and low-cost interventions such as walking schemes and free fruit and water bottles, proved highly successful. The rate of absenteeism fell from 13.2 days per employee in 2001 to 8.9 days in 2007 (Callender, 2007). The value of this reduction has been calculated as £1.5m over three years. There have also been measurable improvements in employees' overall physical and mental health (Anon, 2006).

A stress reduction programme for staff implemented by London Underground was estimated to have saved £455,000; approximately eight times the cost of the scheme. Interventions for the prevention of anxiety and depression among employees have also shown promising results in the reduction of sickness absenteeism (Washington, 2008).

Preventing alcohol-related harm

Evidence

The burden of alcohol related harm represents a significant threat to public health in Ireland. Hope (2008) documented a large increase in alcohol-related accidents and illnesses, crime, domestic abuse, work absences, hospital discharges and sexually transmitted infections. Within a society, high levels of alcohol consumption lead to high levels of alcohol related harm and associated costs; costs to society and costs borne by the drinker.

The WHO (2009) outlined a number of cost effective policy measures to reduce the harm from alcohol, among these were; (1) enforced legislative measures to reduce drinking and driving, (2)

pricing and taxation, (3) availability, (4) marketing, (5) individually-directed interventions to already at-risk drinkers. A population approach using a combination of these interventions is required to reduce alcohol related harm (NICE Guidelines, 2010) while policy measures directed at high risk drinkers are important to reduce more specific alcohol related harm (Babor, 2002; Edwards, 2001; Allamani et al, 2001).

Enforcement of legislative measures to reduce drink driving: Drink driving measures are effective if strongly enforced and can be combined with server training for more impact. There is strong evidence for a low limit for blood alcohol concentration (0.02% to 0.05%) and intensive random breath testing coupled with selective breath testing to reduce alcohol related injuries and fatalities (WHO, 2009). This is the measure that has had the most policy emphasis in Ireland over the last 5 years with the reduced detection of driving while intoxicated and halving of road deaths over the past five years.

Pricing and taxation: Consistent evidence shows that levels of consumption are directly linked to an increase in final price and that raising the price of alcohol reduces alcohol related harm (Farrell *et al,* 2003; Trolldal & Ponicki, 2005). Meier et al (2008) undertook research to model the impact of specific policy measures for the UK and estimated that a 10% increase in the price of alcoholic beverages would reduce consumption by 4.4%, an average reduction of 5.5 g alcohol per week. They concluded that pricing policies can be effective in reducing health, crime and employment harms and these policies can be targeted so that those who drink within recommended limits are minimally affected and very heavy drinkers, who are responsible for the majority of alcohol-related harms, pay the most. Modelling shows that setting a minimum price per unit gram of alcohol reduces alcohol consumption and alcohol related harm (WHO, 2010). The most cost-effective measure across Europe is increased taxation (current + 50%) (WHO, 2009; Chisholm et al, 2004; Chisholm et al, 2006; Cnossen, 2006).

Availability: Policies that regulate the physical availability of alcohol are effective in reducing alcohol related harm. The most effective means of enforcement is on the sellers of alcohol (WHO, 2009). Suggested measures include; limiting the physical availability of alcohol through reduced days and hours of sale, regulating and limiting the number of outlets and outlet density and maintaining a minimum purchase age. However, availability measures are only effective if they are fully enforced and the importance of a legal framework to control the sale and serving of alcohol is highlighted

Marketing: Systematic reviews and meta-analyses show that policies regulating the environment in which alcohol is marketed (particularly its price and availability) are effective in reducing alcohol-related harm (Anderson et al, 2009). There is evidence to show that exposure to alcohol advertising is associated with the onset of drinking among young people and has a marginal effect on adults in the short-term (WHO, 2009). A comprehensive advertising ban is a cost-effective countermeasure.

Individually directed interventions: Brief intervention ranks highly in terms of effective and cost effective evidence based treatment methods. Despite this brief interventions are under utilised as a population approach and opportunities to identify those at risk of becoming hazardous or harmful drinkers are missed. A feasibility test for the implementation of screening and brief interventions in four Irish emergency departments (Barry & Armstrong, 2011) showed that there was good co-operation from the public with only 6% declining to be screened. The screening tool detected 36% requiring brief advice and 9% required referral to specialist services. In total 49% required no further intervention. Because brief interventions are the main effective measures that necessitate personnel, they are expensive relative to other measures.

However, brief interventions are one of the most cost effective of all health service interventions in leading to health gain (WHO, 2009).

A substantial body of literature exists which supports the use of brief interventions across a range of healthcare settings, including emergency departments, primary care and mental health (Roy-Byrne et al, 2009; Irish College of General Practitioners, 2007; Wilhelm et al, 2007; Sommers et al, 2006; Crawford et al, 2004; Lang, 2003; Scottish Intercollegiate Guidelines Network, 2003; Babor and Higgins-Biddle, 2001).The Department of Health (2009) in the UK commissioned a review of the effectiveness and cost-effectiveness of public health interventions with the potential to achieve eight objectives, one of which was preventing dangerous drinking. The report found reliable evidence for the cost-effectiveness of brief interventions for high risk drinkers in terms of public sector savings.

Community mobilisation: Community mobilisation has some effect. However, community mobilisation is very important in shaping public opinion. Communities can be supported and encouraged to play a role in media advocacy and addressing their local determinants of alcohol related harm (WHO, 2010). Media advocacy can also be used to support a shift in public opinion for policy changes (Wallack *et al.* 1993).

Information and Education: Though politically popular, the evidence shows that information and educational type programmes are ineffective in reducing alcohol related harm. It is acknowledged that providing knowledge and information is important. However, these campaigns by themselves do not lead to alcohol related behaviour change and are therefore deemed not effective or cost-effective. Given that the alcohol industry spends upwards of €70 million on marketing per annum, it is not unexpected that State-funded campaigns have minimal effect. One way to address this is to have a more regulatory environment for marketing. To be effective, education about alcohol needs to also promote the availability of effective interventions and mobilise public support for effective alcohol policies (Casswell & Gilmore, 1989). There is some evidence to show that education campaigns funded by the alcohol industry are considered to have negative effects and serve to benefit their sales and public relations interests (WHO, 2009).

Economic evaluation

The estimated overall cost to Irish society of problem alcohol use was €3.7 billion in 2007. Approximately a third of these costs relate to healthcare and about a third to alcohol related crime (Byrne, 2010).

A NICE Guideline costing report (2010) estimated that by introducing a minimum price of £0.40 per unit of alcohol in the UK, savings would be achieved by the NHS, criminal justice system and individual employers at a total of £100 million; healthcare – £80.3 million (full effect), criminal justice system – £6.8 million, individual employers – £13.2 million.

A trial conducted in UK primary care practices reported that providing brief interventions for alcohol misuse gave cost savings of five times the expenditure on health, social and criminal justice services. This has frequently been summarised as every £1 spent on evidence based alcohol treatment results in a net saving of £5 to the public sector (UKATT, 2005b).

<u>Economics of prevention in relation to tobacco</u>

Smoking places an enormous burden of illness and mortality on our society and health service. One in every two smokers in Ireland will die from a disease directly related to their smoking, and half of

those people will die prematurely. On average, smokers lose ten healthy quality years of life. Tobacco use is a major preventable cause of death, chronic disability and inequality, accounting for some 5,500 deaths in Ireland every year. The morbidity and mortality caused by smoking place a huge burden on individuals, their families and friends, the health and social services and on society. The evidence base is clear that quitting smoking brings many benefits, and that health services can provide a range of proven support to help people increase their chances of making a successful quit attempt. According to the WHO report 'Reducing risks, promoting healthy life', tobacco use remains the leading avoidable cause of death in industrialised nations (WHO 2002).

Evidence of effectiveness

Increasingly more European countries have been tackling tobacco consumption and its negative health consequences (Busse and Schlette 2007). Common elements are:

• **pricing policies**: taxes, minimum duties and minimum prices;

• **information and communication**: limits on advertising and promotion, product displays and marketing, and requirements for compulsory labelling;

• **packaging**: minimum size of packs of cigarettes;

• **distribution**: restriction on sales to minors, introduction of cigarette vending machines with youth protection technology;

• **consumption**: smoking bans in public places, bars and restaurants and in the workplace; and

• **smoking cessation**: behavioural assistance.

The Health Service Executive has developed a Tobacco Control Framework (HSE, 2010) in order to provide a coherent health service-wide response to tobacco use in Ireland. The framework is based on the World Health Organisation's MPOWER package (WHO 2008), recognised as the six most important, effective and evidence based tobacco control policies.

Cost−effectiveness for tobacco control is clear (Busse, 2010). The World Bank (Jha and Chaloupka 2000) have found evidence indicating cost−effectiveness; this is not surprising considering the health benefits (Busse, 2010). These strategies have been applied successfully and are cost-effective (Jha et al. 2006).

There are thousands of peer reviewed publications on the evidence base for tobacco cessation and what supports are effective and proven to help people quit. Three internationally recognised sources of information cite the most up to date evidence:

- National Institute for Health and Clinical Excellence (NICE) Public Health Guidance on Smoking Cessation Services
- Cochrane systematic reviews of published and peer reviewed papers on smoking cessation
- Treating Tobacco Use and Dependence 2008 Update (US Department of Health and Human Services)

Evidence from above sources shows that there are seven proven smoking cessation activities or inventions. These include brief interventions, individual behavioural counselling, group behaviour therapy, pharmacotherapies which reliably increase long term smoking abstinence rates**,** self help materials, telephone counselling via quitlines and mass media campaigns.

Two components of counselling are especially effective; practical counselling (problem solving/skills training) and social support delivered as part of treatment. Clinicians should use these when counselling patients making a quit attempt (Fiore et al., 2008).
Comprehensive programmes which have integrated components including; education, counter-marketing, community partnerships, enforcement, and evaluation as well as placing heavy emphasis on community-based efforts, have been proven to produced a decline in adult and youth smoking prevalence (US Centre for Disease Control 2001). The Matrix Knowledge Group and Bazian (UK Department of Health in 2008) carried out research on the evidence for the effectiveness and cost-effectiveness of interventions targeting populations and specific topic areas, describing four effective interventions: drug therapies for smoking cessation, mass media campaigns, school education to prevent uptake and encourage cessation and nurse led cessation clinics.

Economic evaluation

There are two broad classes of benefits that accrue to society from smoking cessation. First, direct and indirect medical expenses will go down as a result of the improved health and risk reduction that follows, including reductions in smoking attributable deaths. Second, there will be improvements in workplace productivity due to reduced absenteeism and increased productivity during working hours.
There are costs to society associated with smoking cessation (Rumberger et al 2010): lost tax revenue to the public sector since smokers will no longer purchase cigarettes, and lost revenues to retailers and distributors because of reduced cigarette sales. Estimating the annualised costs and benefits of smoking cessation requires an estimate of how many smokers will successfully quit using

the interventions, the resulting reduction in cigarette sales, the lost tax revenue and retail revenue, and the medical costs and productivity losses avoided.

Results from one study found that in the United States the annual direct costs to the economy attributable to smoking were in excess of $298 billion, including workplace productivity losses of approximately $67.5 billion, premature death losses of $117 billion, and direct medical expenditures of $116 billion. While the retail price of a pack of cigarettes in the US was on average $5.51, the combined medical costs and productivity losses attributable to each pack of cigarettes sold are approximately $18.05 per pack of cigarettes. The ratio of benefits to cost varies from $0.86 to $2.52 saved per dollar spent on smoking cessation programs, depending upon the type of intervention. All therapies had a positive break even to costs at the mid-point of the range of treatment effectiveness.

Externalities specific to smoking (Featherstone 2010) include litter management, costs of passive smoking, environmental costs and fire costs.

Health-care costs

In high income countries like Ireland, smoking-related health care costs account for between 6% and 15% of all annual healthcare costs, which translates to approximately €1-2 billion per annum. An Irish study in 2010 (Howell, F. 2010) quantified the number of discharges, bed days used and cost to the system from smoking-related diseases.

Of approximately one million hospital discharges in Ireland in 2008, smoking related diseases accounted for 36,255 (3.7%) discharges and 300,756 (8.7%) bed days which equates to €280 million. Of the 36,255 discharges attributable to smoking, 95% were accounted for by the combination of cardiovascular diseases, respiratory diseases and cancers.

The average cost for a smoking related admission is €7,723 for the hospital stay, excluding other costs.

An Australian study (Hurley & Matthews, 2007) developed a 'Quit Benefits Model' which assessed the consequences of quitting smoking in terms of the avoided cases of four smoking related diseases. The average saving per 1,000 random quitters is A$373,000. Overall 40 of these quitters will be spared a diagnosis of acute myocardial infarct, chronic obstructive pulmonary disease, lung cancer and stroke in the first ten years following quitting, with an estimated saving of 47 life-years and 75 QALYs. If a male aged between 50 and 54 quits smoking, in the following 10 years he will gain 0.1 life-years and 0.1 QALYs, and the health care cost saving associated with his reduced risk of the

above diseases would be $861, the difference between $2,477 (if he had continued to smoke) and $1,616 having become a quitter (5% per annum discounting). Cost savings in the 10 years after quitting increase with the age at quitting, as older ages are associated with higher risks of developing the diseases under study. A 5% reduction in Australian smoking rates would give predicted cost savings within 7 years of over $60 million for myocardial infarction and stroke hospitalizations (Hurley, 2005).

Pharmaceutical savings

Small reductions in prevalence of smoking can bring large savings. A 5% reduction in Australian smoking rates would reduce pharmaceutical benefits scheme spending on drugs for smoking-related cardiovascular disease by $4.5 billion over the following 40 years, a 17% reduction (Hurley et al, 2004). In a UK study (Department of Health, 2008) nicotine replacement therapy alone was associated with a gain of £820-£1,840 per person.

Mass-media campaigns and school education

Mass media campaigns for both young and adult populations cost between £0.26 and £1.78 per capita. The intervention cost of specific school education aimed at preventing smoking initiation among young adolescents when compared with an average nationwide educational practice, would cost £72 per person. The monetary value of the health related quality of life gains associated with school education for smoking cessation exceed its costs (ibid).

Brief interventions

There is evidence that brief interventions delivered by physicians during routine care and focused advice given by nurses have a moderate effect in increasing smoking cessation. When compared with usual care, a nurse managed smoking cessation intervention targeted at patients hospitalised after a myocardial infarction costs £83 per person (Department of Health, 2008). Limited evidence suggests that, when compared with usual care, a nurse managed smoking cessation intervention for patients hospitalised after a myocardial infarction increases the chances of quitting by 26.3% over a period of 12 months. Health gains associated with a nurse managed smoking cessation intervention for patients hospitalised after a myocardial infarction are equivalent to 0.455 life years gained (ibid).

The true cost of smoking

In Scotland during 2008/9 (Callum et al 2008) the proportion of tobacco duty attributable to spending was £940 million. On the other side of the equation, the costs included

- treating smoking attributable disease in the NHS costs £271 million
- productivity losses due to excess absenteeism, smoking breaks and lost output due to premature death cost £692 million
- premature deaths due to second-hand smoke exposure in the home cost £60 million in lost productivity
- clearing smoking-related litter from the streets costs £34 million
- fires caused by smoking in commercial properties cost £12 million.

Direct costs to the Scottish health services of smoking have been estimated at £2.7 billion

Volpp et al. (2010) identified favourable returns to employers who offered incentives to employees to stop smoking. Using data from the CDC MMWR from 2002 on the economic costs of smoking, they identified $3,400 per year per employee that results from increased productivity, decreased absenteeism, and the reduced incidence of illness.

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4. CONCLUSION

This review of the evidence presents cogent economic arguments for the investment of public money in an organised way to preserve good health from an early age. The benefits presented here are proven, and the costs to society show that the investment is worth it, with often huge savings to be made. In developing and maintaining initiatives and programmes to augment health and well-being from an early age, evidence-based interventions should be embraced as an investment for health. In Ireland we need to move towards inbuilt economic evaluations during the development and roll-out of programmes. Gaps in research evidence remain, and all too often costs and benefits are not identified, measured or valued. Finally, by itself, economic evidence is not sufficient to establish priorities in health; other important concerns must be considered, particularly the fairness of distribution of available resources and health outcomes among different sectors of society.

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