International Task Force for Prevention
Of Coronary Heart Disease

Clinical management of risk factors
of coronary heart disease and stroke

Economic analyses of primary prevention of
coronary heart disease (CHD) and stroke

Economic analyses of primary prevention of CHD and Stroke at a population level

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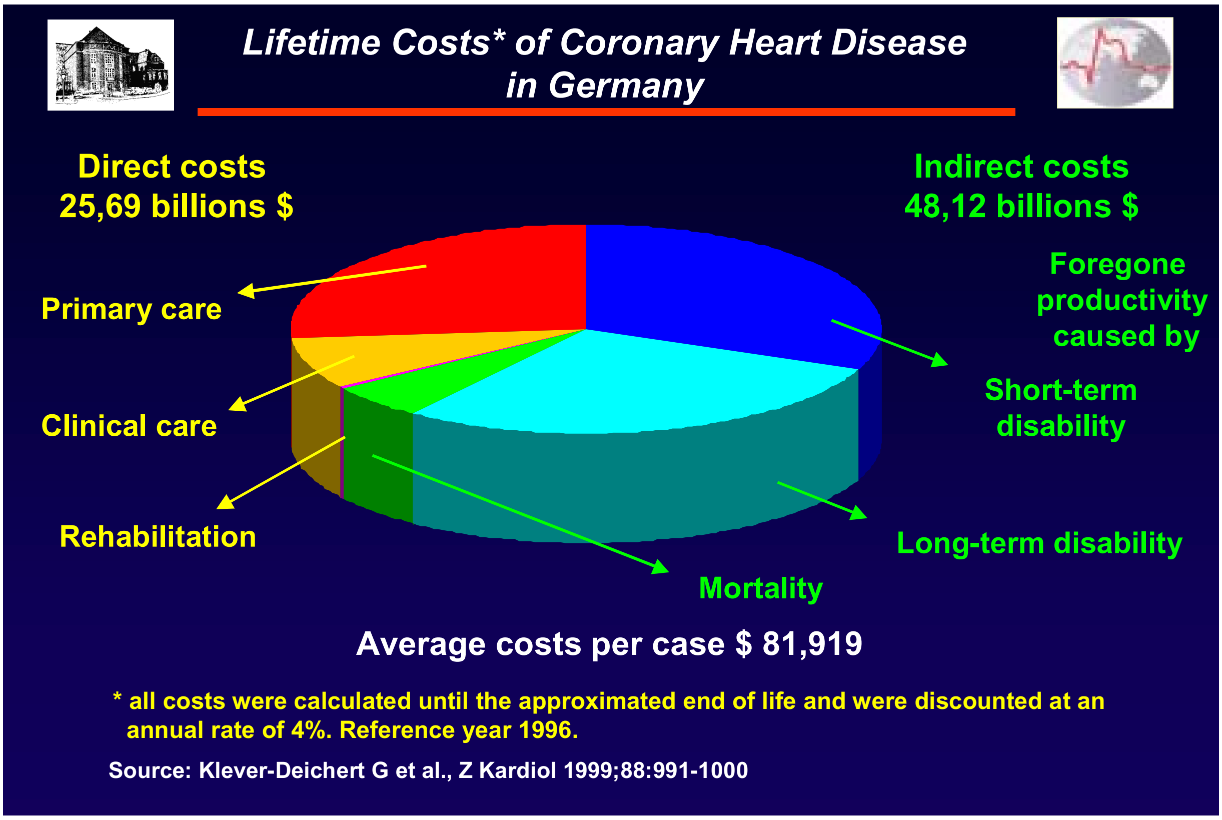
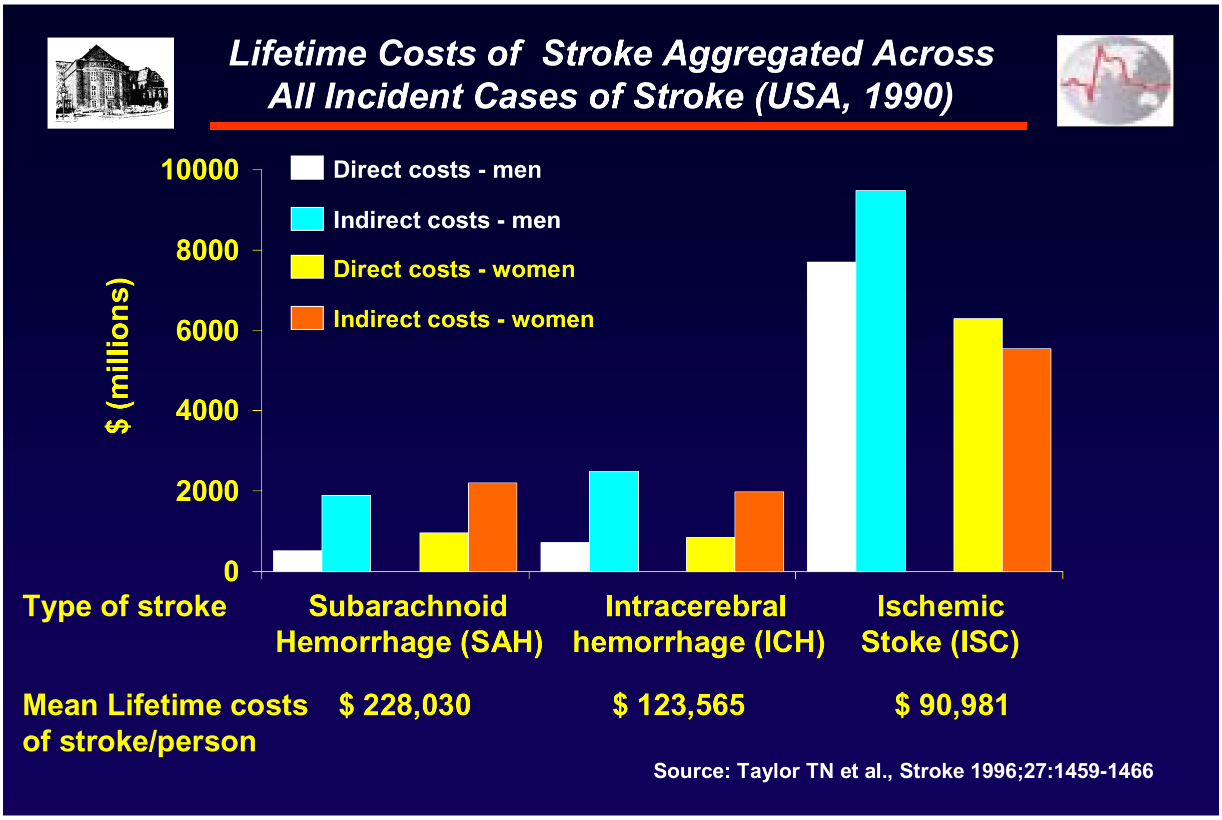


Lifetime costs of coronary heart disease in Germany

This slide shows the estimated costs of coronary heart disease (CHD) for the German population from the perspective of the society. Considered as cases were all patients hospitalised in the reference year (1996). The costs of this cohort were estimated from the reference year 1996 and up to their projected end of life. Indirect costs such as foregone productivity were calculated using the human capital approach. The model considers age- and gender-specific unemployment rates and a reduced life expectancy due to CHD. Costs were discounted at an annual rate of 4 %. And converted to $US (1 DM = 0.65535 $). The cost analysis shows that indirect costs are higher than direct costs.

Slide 2:

Lifetime costs of stroke aggregated across all incident cases of stroke (USA, 1990)

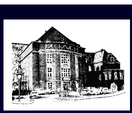


Lifetime costs of stroke aggregated across all incident cases of stroke (USA, 1990)

This study estimated the lifetime direct and indirect costs associated with the three major types of stroke: subarachnoid hemorrhage (SAH), intracerebral hemorrhage (ICH), and ischemic stroke (ISC). Taylor et al. developed a model of the lifetime cost of incident strokes occurring in 1990. An epidemiological model of stroke incidence, survival, and recurrence was developed based on a review of the literature. Data on direct cost of stroke treatment were obtained from Medicare claims data, the 1987 National Medical Expenditure Survey (NMES), and insurance claims data representing a group of large, self-insured employers. Indirect cost (the value of foregone market and nonmarket production) associated with premature morbidity and mortality were measured according to the human capital approach and were estimated based on data from the US Bureau of Economic Analysis and the 1987 NMES.
This graph shows lifetime costs of stroke aggregated across all incident cases of stroke and mean lifetime cost of stroke per person below. Acute-care costs incurred in the 2 years following a first stroke accounted for 45.0%, long-term ambulatory care accounted for 35.0%, and nursing home costs accounted for 17.5% of aggregate lifetime cost of stroke. The lifetime cost of stroke varies considerably by type of stroke and entails considerable costs beyond the first 2 years after a stroke.

Slide 3:

Economic impact of cardio- and cerebrovascular diseases attributable to diabetes (USA, 1997)



Economic Impact of Cardio- and Cerebrovascular Diseases Attributable to Diabetes (USA, 1997)

Health Care expenditures attributable to Diabetes due to Cardiovascular Disease ($ millions)	**7,608**
Mortality costs attributable to diabetes due to Cardiovascular conditions	
Deaths (n)	92,557
Life lost (years)	1.178,371
Foregone productivity ($ millions)	9,388
Cerebrovascular conditions	
Deaths (n)	12,955
Life lost (years)	125,482
Foregone productivity ($ millions)	432

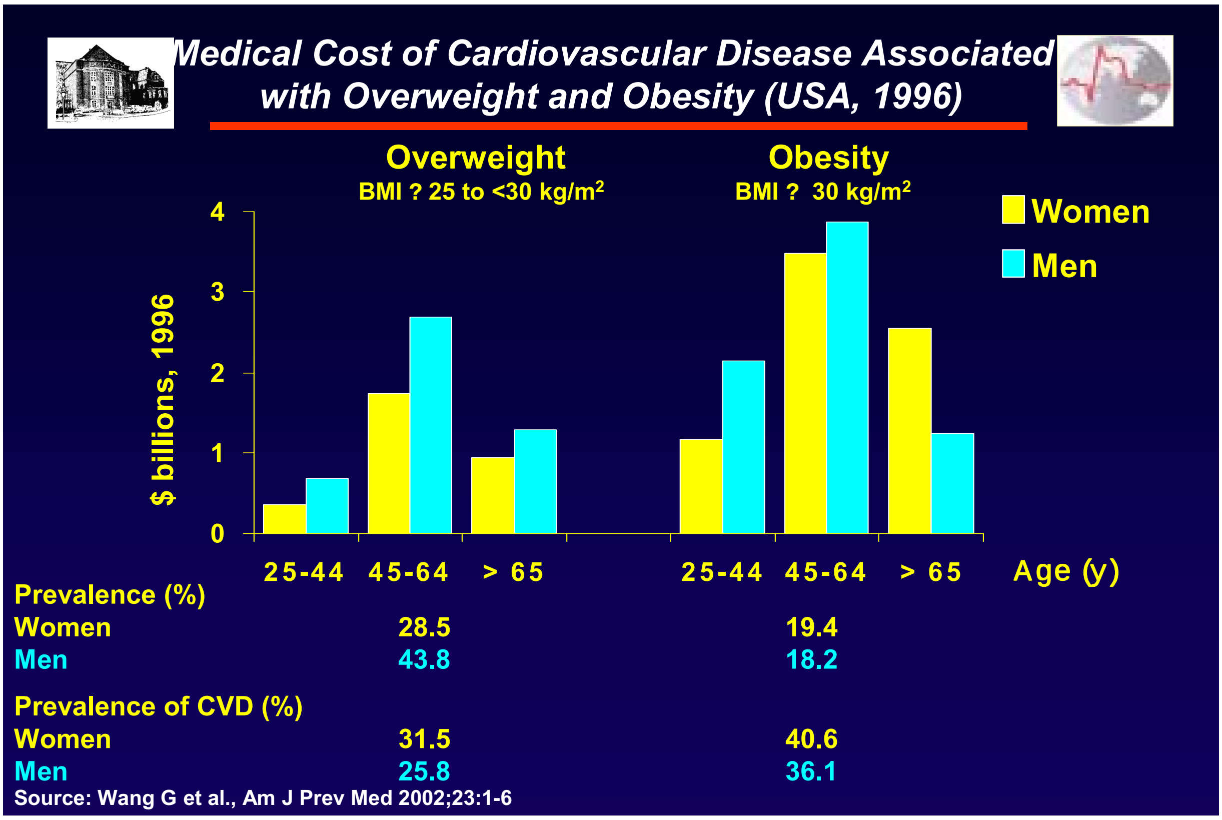
Source: American Diabetes Association Diabetes Care, 1998;21:296-309

Economic impact of cardio- and cerebrovascular diseases attributable to diabetes (USA, 1997)

Diabetes is an important risk factor of coronary heart disease and a major source of morbidity, mortality and economic expense. Direct medical and indirect expenditures attributable to diabetes (type 1 and 2) in 1997 in the United States were estimated at $98 billion. In 1997, according to the Centers for Disease Control and Prevention, 10.3 million people in the U.S. reported they had diabetes, and it was estimated that 5.4 million people had undiagnosed diabetes.
This table shows the medical expenditures for the treatment of diabetes estimated for individuals with cardiovascular disease and mortality costs of diabetes attributable to cardiovascular and cerebrovascular conditions.

Slide 4:

Medical cost of cardiovascular disease associated with overweight and obesity (USA,1996)

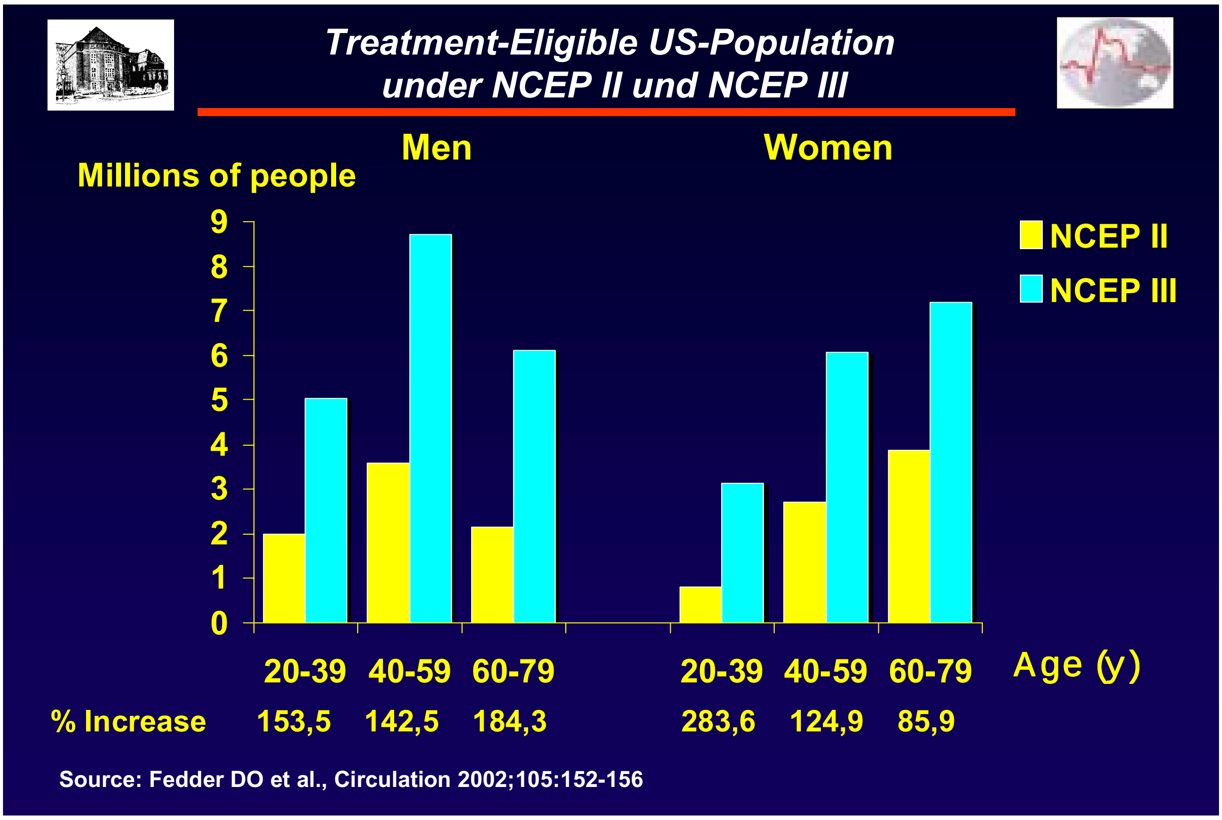


Medical cost of cardiovascular disease associated with overweight and obesity (USA,1996)

This slide shows the economic impact of cardiovascular disease (CVD) associated with overweight and obesity. Wang et al. conducted a population-based analysis of direct medical costs by linking the 1995 national Health Interview Survey and the 1996 Medical Expenditure Panel Survey. The study subjects are adults aged 25 years (excluding pregnant women) in the non-institutionalised, civilian population in 1996. There were 12.95 million CVD cases among overweight people, more than 25% of which were associated with overweight. There were 9.3 million CVD cases among obese people, of which more than 45% were associated with obesity. This extra disease burden led to $22.17 billion in direct medical costs in 1996. The strong positive association between excess body weight (EBW) and CVD, and the significant economic impact of EBW-associated CVD demonstrate the need to prevent EBW among U.S. adults.

Slide 5:

Treatment-eligible US-population under NCEP II and NCEP III

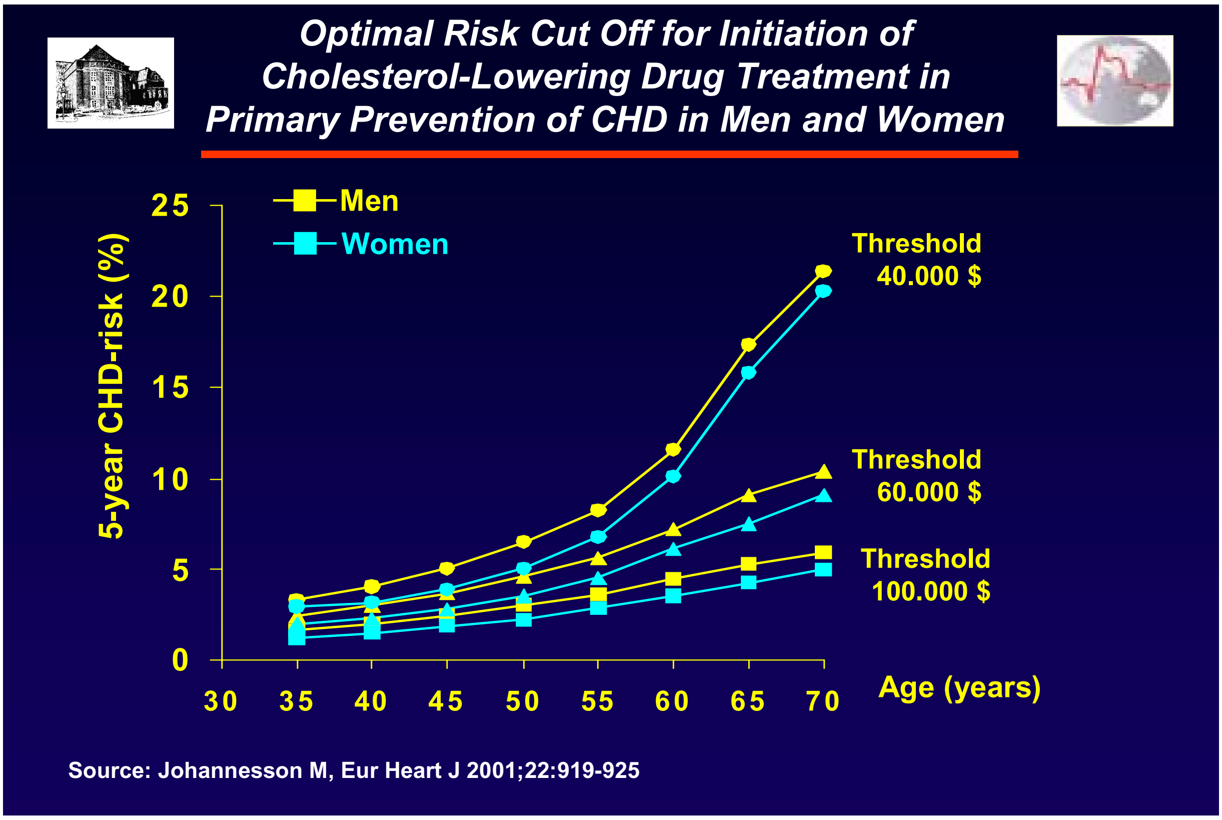


Treatment-eligible US-population under NCEP II and NCEP III

The guidelines in the Third Report of the National Cholesterol Education Program (NCEP III) include absolute risk estimates and lower LDL cholesterol levels (e.g. LDL-C 130 mg/dl and 10-year "hard" (fatal or non-fatal myocardial infarction) CHD risk 20%) to assess eligibility for lipid-lowering drug therapy. Fedder et al. studied the impact of these changes on the size, sex, and age distribution of the target US population using data from the Third Annual National Health and Nutrition Survey (NHANDES III) (1988 to 1994). This slide shows the number of treatment-eligible patients (according to sex and age) for aggressive lowering using NCEP II and NCEP III criteria.

Slide 6:

Optimal risk cut off for initiation of cholesterol-lowering drug treatment in primary prevention of CHD in men and women

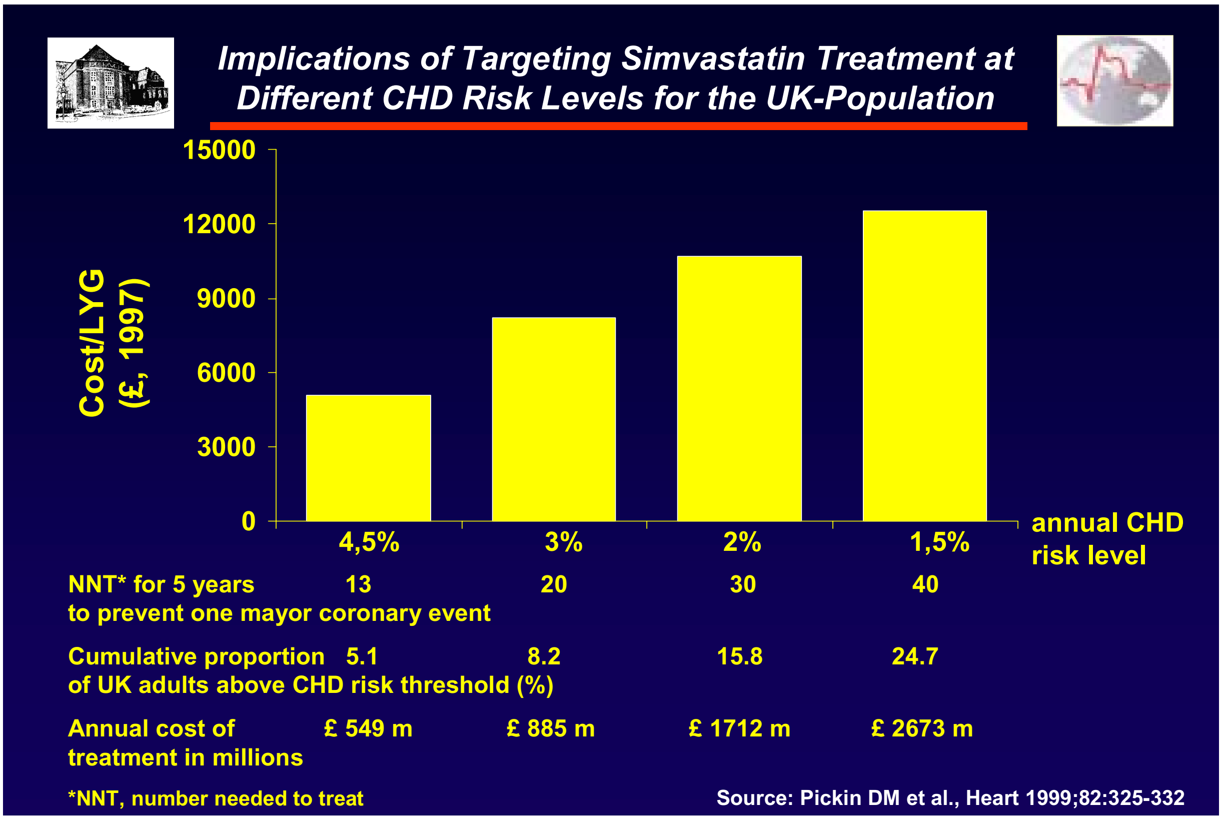


Optimal risk cut off for initiation of cholesterol-lowering drug treatment in primary prevention of CHD in men and women

Since treatment of coronary heart disease (CHD) should be based on the absolute risk of the individual, Johannesson estimated at what level of coronary risk it is cost-effective to initiate cholesterol lowering drug treatment in primary prevention for men and women of different ages in Sweden. From a societal perspective both direct and indirect costs of intervention and morbidity and the full future costs of decreased mortality were included. Both costs and quality-adjusted life-years (QALY) were discounted at an annual rate of 3 %. Data were taken from the National Board of Health and Welfare in Sweden and other Swedish statistics.
Cost-effectiveness was estimated as the incremental cost per quality-adjusted life-year (QALY) gained of cholesterol lowering drug treatment. Treatment was assumed to lower the risk of coronary heart disease by 31 %. The coronary risk, in a Markov model of coronary heart disease, was raised until the cost per QALY gained corresponded to a specific threshold value per QALY gained. Three different cost-effectiveness threshold values were used: $40 000, $60 000 and $100 000 per QALY gained.
This graph shows at what 5-year-risk of coronary heart disease it is cost-effective to initiate cholesterol lowering drug treatment for men and women at different ages. If society is willing to pay $60.000 to gain a QALY, it was cost-effective to initiate treatment if the 5-year-risk of coronary heart disease exceeded 2.4% for 35-year-old men, 4.6% for 50-year-old men and 10.4% for 70-year-old-men. The higher the cost-effectiveness threshold, the lower the optimal risk cut-off and the higher the fraction of the population eligible for lipid lowering treatment. The cut-off increases with age and is higher for men than for women.

Slide 7:

Implications of targeting simvastatin treatment at different CHD risk levels for the UK population

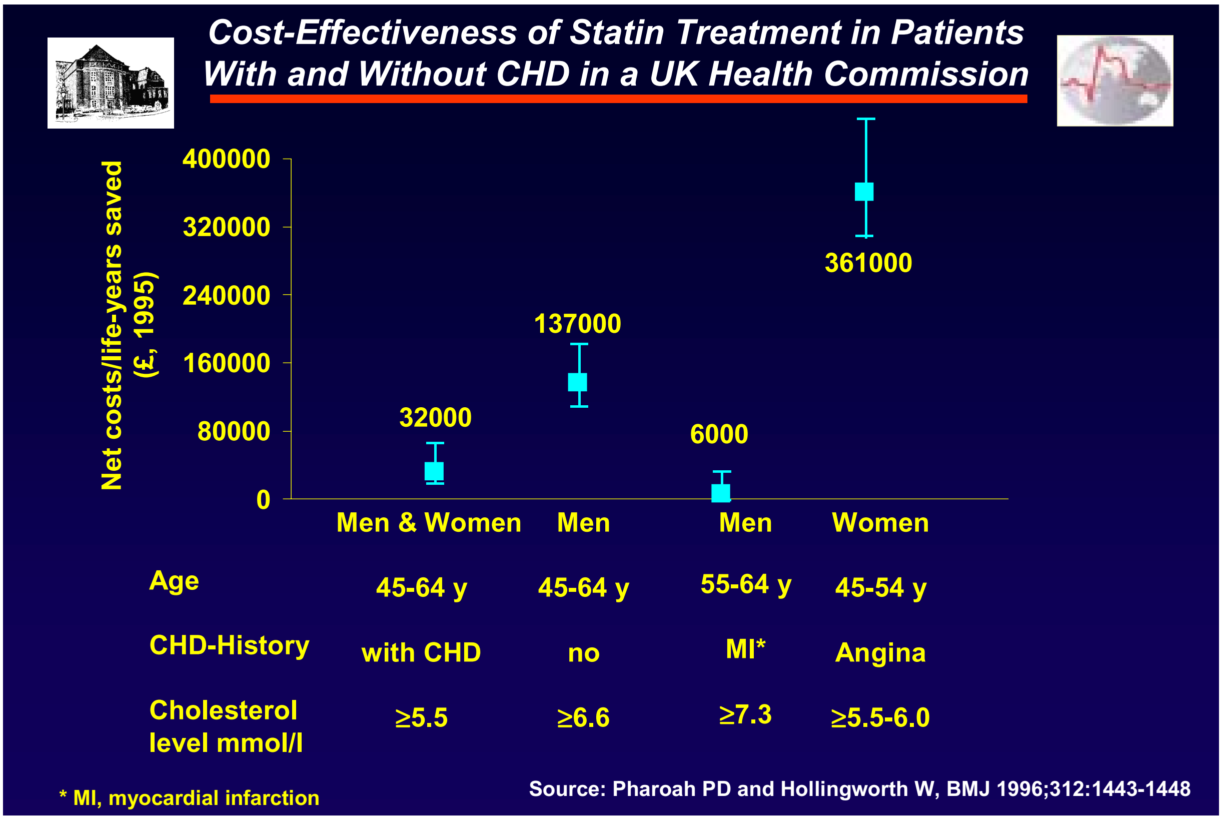


Implications of targeting simvastatin treatment at different CHD risk levels for the UK population

Pickin et al. applied the cohort life table method to estimate the cost per life-years gained (LYG) of statin treatment in cohorts of male patients of the same average ages as those in the 4S (average age 58 years for secondary prevention) and WOSCOPS trial (average age 55 years for primary prevention). Cost-effectiveness was estimated for four different levels of annual CHD-risk (4.5 % (high-risk primary and secondary prevention) and 3.0 %, 2.0 % and 1.5 % (primary prevention). Treatment with simvastatin was assumed to be at the average dose used in the 4S trial (27,4 mg/day) at 1997 British National Formulary costs. Costs and benefits were discounted at an annual rate of 6 %. Compliance was assumed to be 100 %. Since trial evidence was only available for 5 years of treatment, data were extrapolated under the assumption of life-long treatment. Estimates for the annual CHD risk of 4,5% are directly based on 4S data, estimates for 3.0% and 2.0% are based on interpolated data from 4S and WOSCOPS and estimates for 1.5% are directly based on WOSCOPS data.
This slide shows gross discounted cost per life-year gained for lifelong treatment with simvastatin at different levels of CHD risk and the cost implications for expanding treatment to lower CHD risk levels for the population of the United Kingdom. The authors conclude that at current prices statin treatment for secondary prevention and for primary prevention at a CHD event risk of 3.0 % per year is as cost effective as many treatments in wide use. Primary prevention at lower CHD event risks (< 3.0 % per year) is less cost effective and unlikely to be affordable at current prices and levels of health service funding. As the cost of statins falls, primary prevention at lower risk levels will become more cost effective. However, the large volume of treatment needed will remain a major problem.

Slide 8:

Cost-effectiveness of statin treatment in patients with and without CHD in a UK health commission



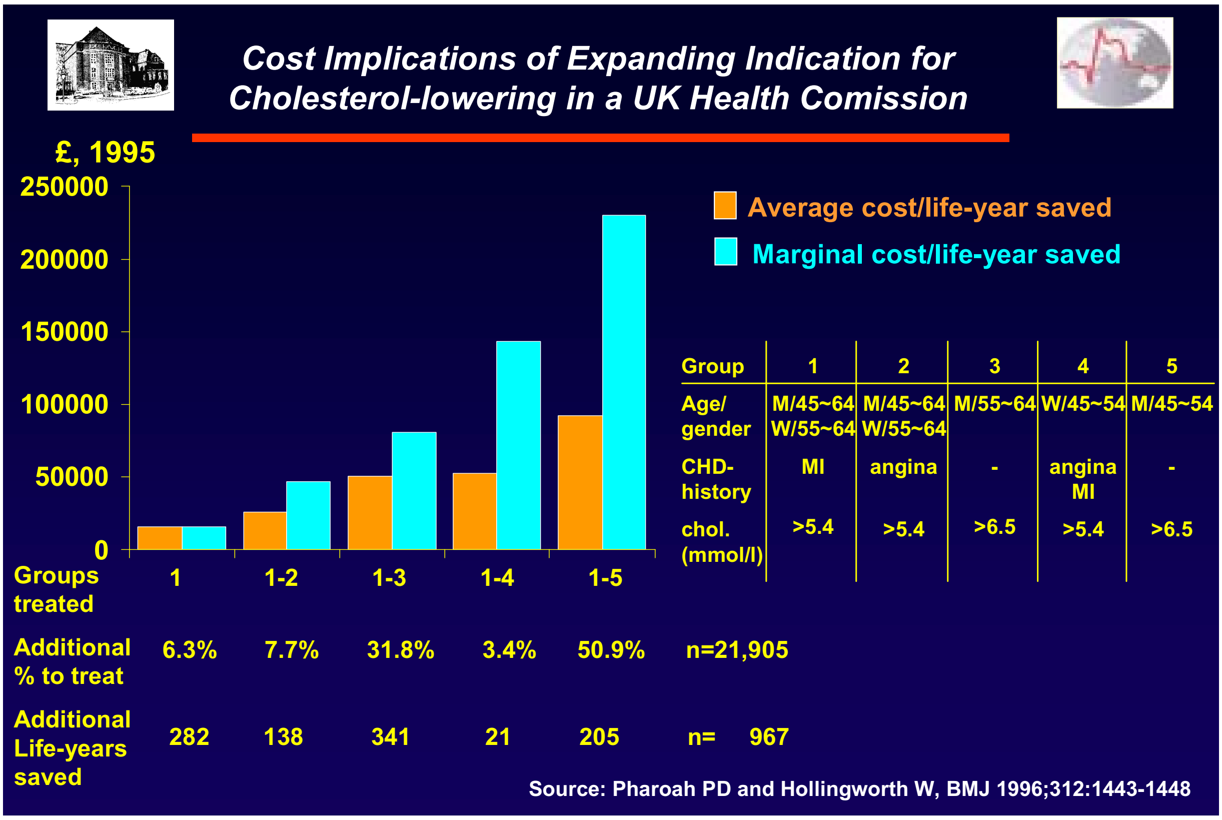
Cost-effectiveness of statin treatment in patients with and without CHD in a UK health commission

Pharoah and Hollingworth estimated costs and cost-effectiveness for the Cambridge and Huntingdon Health Commission in order to evaluate whether expansion of treatment with a statin to primary prevention is effective and sustainable within given NHS resources. Cost of treatment have been limited to drug costs (1995). Savings associated with a reduction in coronary angiography, non-fatal MI and revascularization procedures were included. Savings and future costs were discounted at an annual rate of 5 %. The life table method was applied to estimate life years gained associated with lowering serum cholesterol concentrations in a time horizon of ten years for the population of the respective health commission.

The cost-effectiveness ratios hide enormous differences between groups at different risk, ranging from £6 000 per life year to £361 000 per life year saved. Statin treatment should be reserved for patients who will get the most benefit – that is, those in whom intervention is most cost effective. This graph shows cost-effectiveness ratios for four different groups.

Slide 9:

Cost implications of expanding indication for lowering cholesterol concentration in a UK health commission

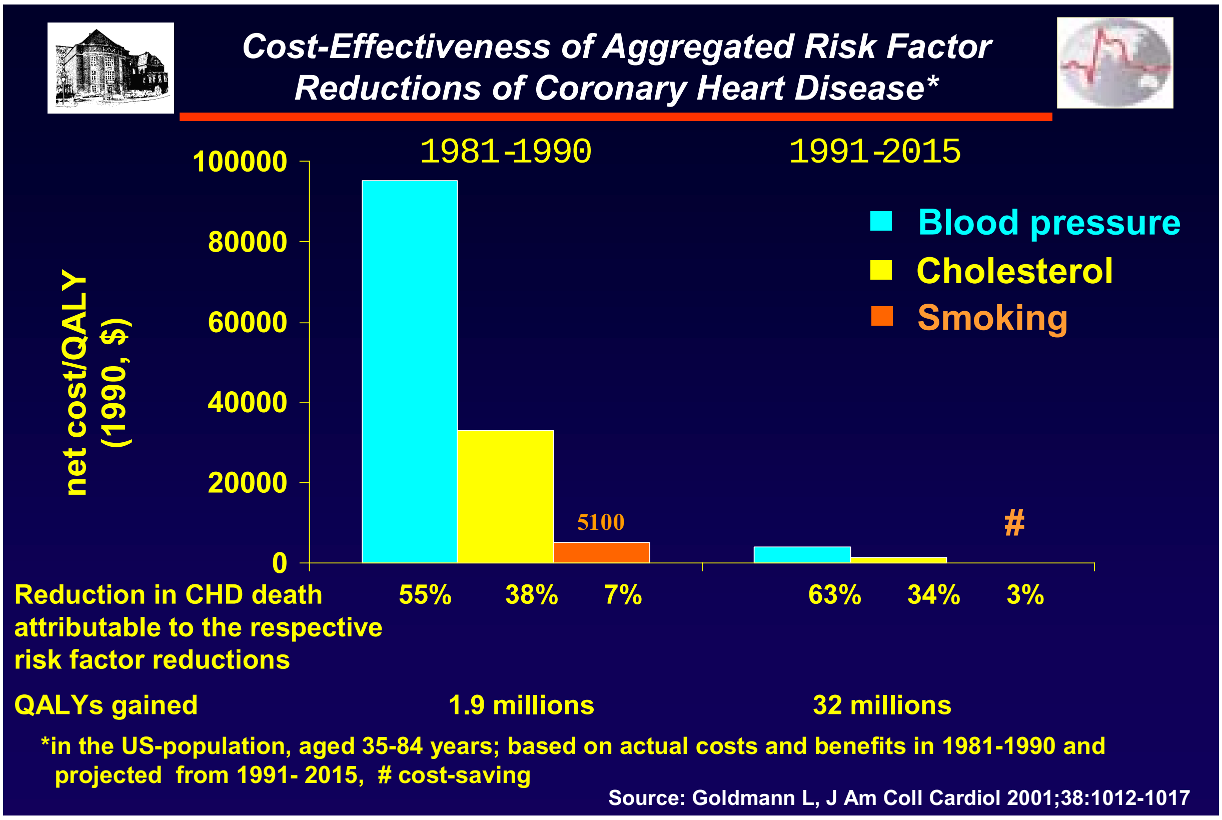


Cost implications of expanding indication for lowering cholesterol concentration in a UK health commission

This graph illustrates the cost implications of expanding indication for lowering cholesterol concentrations in Cambridge and Huntingdon Health Commission (n=21905) from those of high risk to those with low risk of coronary heart disease. This graph shows that marginal cost effectiveness of treatment increases substantially as lower risk groups are included, while average cost effectiveness is lower. For example if only those patients with the highest risk (group 1) are treated, 1,371 patients (6.3%) would require treatment. This would result in a benefit of 282 life years saved at £16,000 per life year saved. If the next successive risk group (group 2, additional 7.7%) is also treated an additional 1,688 patients would require treatment at an additional benefit of 138 life years saved at a marginal cost of £47,000 per life year gained. The average cost effectiveness of treating both groups (1-2) is £26,000 per life year saved. These differences in average and marginal cost are even more pronounced when successive lower risk groups are included in treatment. Including patients with the lowest risk (group 5, 50.9%) in treatment marginal cost per life years saved is £230,000 compared with an average cost of £92,000 and 205 additional life years saved, if all five groups are treated.
If data on cost effectiveness are to be used in determining who should be eligible for treatment, the results emphasise the importance of considering the marginal cost effectiveness rather than the average cost effectiveness when assessing the impact of moving from one health care strategy to another.

Slide 10:

Cost-effectiveness of aggregated risk factor reductions of coronary heart disease

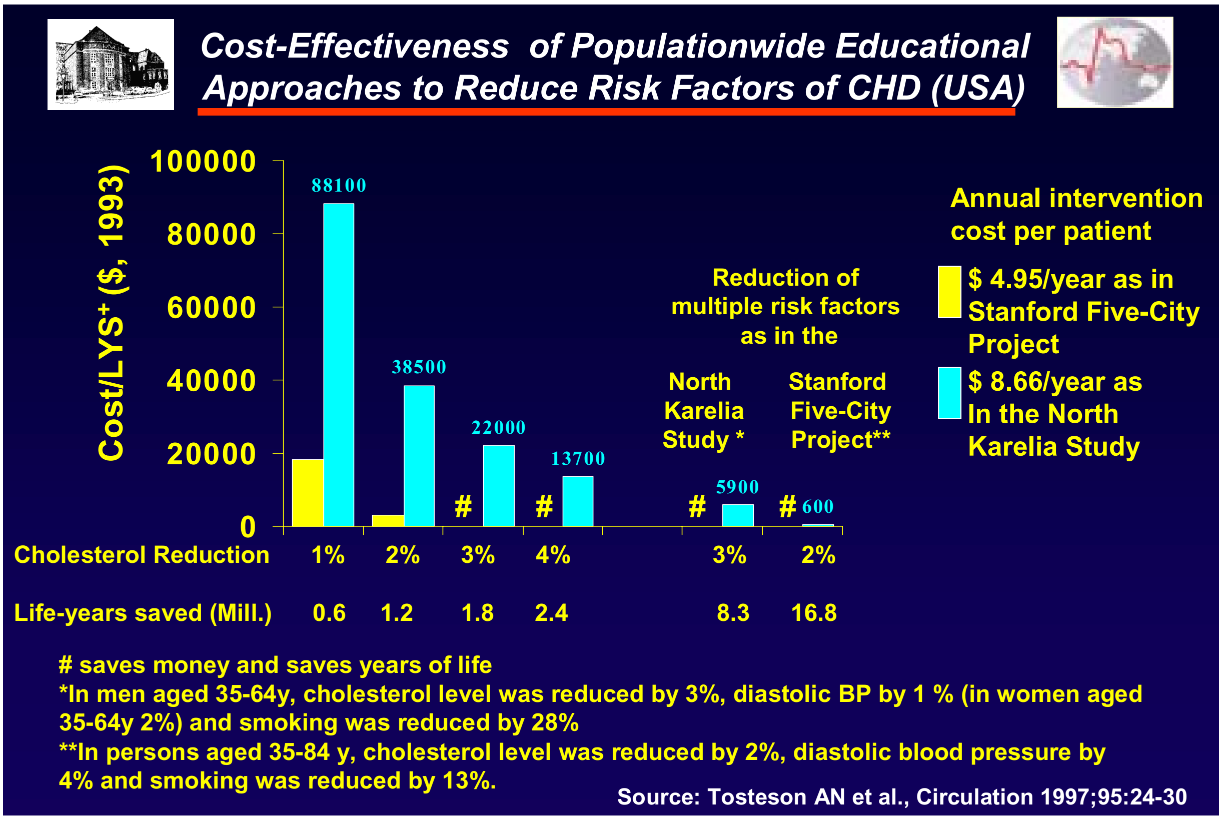


Cost-effectiveness of aggregated risk factor reductions of coronary heart disease

Coronary heart disease (CHD) mortality rates have declined dramatically, partly as a result of reductions in CHD risk factors. By using a validated computer-simulation CHD policy model Goldman et al. estimated the effects of actual investments made to change coronary risk factors such as blood pressure, serum cholesterol and smoking between 1981 and 1990, as well as the impact of these changes on the incidence, prevalence, mortality and costs of CHD in the U.S. population (aged 35 to 84 years) during this period and projected from 1991 to 2015. Data were obtained from a review of published reports, the U. S. Vital Statistics, hospital discharge data, nationwide health surveys, the Framingham Heart Study, the National Health and Nutrition Examination Survey (NHANES) and clinical trials. Cost for screening, treatment and population-wide intervention costs were estimated from national data, as available. Goldman et al. assumed that the inflation-adjusted costs (reported in 1990 U.S. dollars) of specific interventions did not change over time. However, the dramatic shifts in the types of cholesterol-lowering drugs were modelled.
This graph shows cost-effectiveness ratios of risk factor reductions of coronary heart disease, quality adjusted life years gained and the impact of these risk factor reductions on CHD mortality for the period of 1981 to 1990 and from 1991 to 2015.

Slide 11:

Cost-effectiveness of populationwide educational approaches to reduce risk factors of coronary heart disease (USA)



Cost-effectiveness of populationwide educational approaches to reduce risk factors of coronary heart disease (USA)

The aim of this study was to estimate the cost-effectiveness of populationwide approaches to reduce serum cholesterol levels in the US adult population (aged 35 to 84 years) within a 25-year period (1995-2020). Data were obtained from literature and the Coronary Heart Disease Policy Model (a comprehensive computer simulation of coronary heart disease (CHD)). Costs were updated to 1993 using the general medical care component of the Consumer Price Index. Costs and person-years were discounted at 5 % per year. Only the direct medical costs related to CHD were included in this analysis. Study interventions were populationwide programs to reduce serum cholesterol levels with costs and cholesterol-lowering effects similar to those reported from the Stanford Three-Community Study, the Stanford Five-City Project, and in North Karelia, Finland. These interventions consisted of education through media campaigns, including television, radio, newspaper, and other printed material, and direct education through community activities and face-to-face instruction.
The graph shows cost-effectiveness projections for the baseline assumptions (1-4% reduction of serum cholesterol) and for the scenario of multiple risk factors altered. Cost effectiveness ratios are more favourable, when multiple risk factors are modelled. For example, the Stanford Five-City Project, which costs $4.95 per person per year, reported a 4 % decrease in diastolic blood pressure and a 13 % decrease in smoking in addition to the 2 % decrease in serum cholesterol. The savings from averting CHD events would more than offset the costs of this program, so there would be an estimated discounted savings of $16.6 billion in addition o a savings of 16.8 million life-years.
Under a wide variety of assumptions, a populationwide program would achieve health benefits at a cost equivalent to that of many currently accepted medical interventions. Such programs would also lengthen life and save resources under many scenarios, The authors conclude that populationwide programs should be part of any national health strategy to reduce coronary heart disease.