The Role of Costs in Benefit Design Decisions 4

Whether and how costs should enter into decisions about health insurance coverage for preventive services are contentious issues. The following chapter discusses ways that information on costs and cost-effectiveness might inform benefit design decisions and the strengths and weaknesses of various uses.

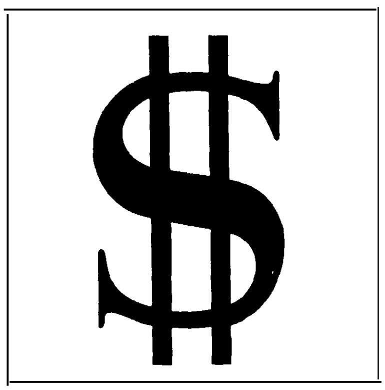
USE OF COST-EFFECTIVENESS ANALYSES IN BENEFIT DESIGN

Cost-effectiveness analysis provides information that allows various alternatives to be compared. Comparisons could include those between:

- several different types of interventions for different conditions;
- interventions aimed at the same condition;
- an intervention and the status quo; or
- different magnitudes of the same intervention.

If they are to allow for fair comparisons among interventions, cost-effectiveness analyses must be calculated using similar methods and assumptions. Sources of variation in methodology fall into five main areas:

- the perspective taken (e. g., society, patient, third-party payer);
- estimation of treatment effects (e.g., whether estimates derive from randomized trials or opinion; use of meta-analysis);
- valuations of outcomes (e.g., life years saved, quality-adjusted life years, deaths avoided, or other valuations of outcomes);



- estimation of costs (e.g., the inclusion of indirect costs);
- discounting.

Theoretically, cost-effectiveness analyses of interventions used to prevent different conditions (e.g., screening for breast cancer, smoking cessation programs, immunizations, etc.), could be used to rank all preventive services to make coverage decisions under a budget constraint (e.g. cost-effectiveness analysis was initially used in Oregon's Medicaid proposal [197]). This would involve comparing the cost-effectiveness of different interventions and eliminating those that were the least cost-effective until the budget constraint was met.

Attempting to rank different types of interventions is a demanding usage of cost-effectiveness and may be the least viable. A major obstacle is that few cost-effectiveness analyses have used similar enough assumptions to allow fair comparisons, Furthermore, even if most of the methods used to evaluate different interventions were similar-that is, the discount rate, the types of costs included, the method used to determine effectiveness, the perspective taken-it is likely to prove difficult to incorporate all the outcomes of interest.[1] If people rely too heavily on cost-effectiveness to rank interventions, political concerns and intangibles may be undervalued (183).

A more practical use of cost-effectiveness analysis may be in making comparisons of different types of preventive interventions for the same targeted condition, such as different drugs to treat hypertension (63,132) or for reducing cholesterol (175). For example, Littenberg and colleagues found that the cost-effectiveness of screening for hypertension and treating mild hypertension can be substantially reduced by using more expensive treatment regimens (132) (table 4-7). They found that the cost-effectiveness of screening and treatment, for a 40 year old man, would be $2,131 per quality-adjusted life-year saved when the treatment costs were ***$50*** per year, while the cost-effectiveness would be $27,599 per quality-adjusted life-year saved when the treatment cost $500 per year.[2] Based on their analysis, Littenberg and colleagues concluded that ''every effort should be made to manage hypertension with the low-cost interventions consonant with good pressure control, patient acceptability, and safety" (132).

Finally, cost-effectiveness analysis can provide information about the effects of altering the magnitude of a given intervention. This is likely to be the most practical use of cost-effectiveness analysis for benefit design decisions since the outcomes being compared are most similar. Medical interventions eventually have diminishing returns, and incremental benefits tend to fall as the intervention's scope and frequency rise (84). For example, Eddy found that the marginal cost of screening for cervical cancer, in average-risk asymptomatic women, from age 20 to age 75, every year as opposed to every two years was greater than $1,000,000 per year of life gained (63). Similarly, Fahs and colleagues found that, for low-income women 65 years of age and older, the incremental cost-effectiveness of increasing cervical cancer screening from triennially to

[1] Attempts have been made to improve comparisons of different interventions for different conditions by using a subset of cost-effectiveness analysis called cost-utility analysis (e.g., comparisons of morbidity from cancer and morbidity from hepatitis). The difference between cost-effectiveness analysis and cost-utility analysis is in the way outputs are measured (15). In cost-effectiveness measurement is in natural units (e.g., life years 'saved') (15). In cost-utility analysis outputs are measured in terms of both the quantitative aspects of health outcomes (i.e., lives lost, number of sick days) and in the form of quality-adjusted life years or healthy years equivalent (15). The strengths and weaknesses of cost utility analysis will be described in more detail in a forthcoming OTA study, *Prospects for Health Technology Assessment (in* progress).

[2] Variations in the cost of treatment were based on differences in the wholesale costs of various common medication regimens, the dosages of medication, the mark-up by retail pharmacists, the cost of repeat visits to monitor blood pressure and observe for adverse reactions, and the use of laboratory tests to monitor therapy (132).

annually was $39,693 per year-of-life-gained (66).[3]

Cost-effectiveness analyses may also be informative about the effects of expanding preventive services to populations with different levels of risk. In general, the lower the risk of disease, the less cost-effective the intervention. For example, Johannesson found that the lower Swedish cut-off point for treatment of hypertension (diastolic blood pressure of greater than 95 mm Hg) would lead to roughly 50 percent higher treatment costs than the British cutoff point (100 mm Hg) (107). Similarly, Taylor and colleagues found that programs to lower cholesterol have cost-effectiveness ratios that differ 4- to 12-fold when the results of a man at high risk are compared to those for a man at low risk (175) (see table 4-5). Finally, the Office of Technology Assessment (OTA) found that screening high-risk women, 65 years old and older, for cervical cancer every 3 years could actually be cost-saving; while screening low-risk women every 3 years would have a cost-effectiveness ratio of $120,520 (192). Based on this analysis, OTA concluded that programs to identify and screen women at high risk for cervical cancer could reduce the incremental cost-effectiveness of screening (192).

Sensitivity analyses can illustrate which factors have a large effect on the cost-effectiveness of an intervention. For example, Eddy and OTA examined how the cost of various aspects of breast cancer screening and treatment influence the overall cost-effectiveness of breast cancer screening (e.g., the cost of breast physical examination, mammography, workup, initial treatment, and terminal care) (63, 187). Eddy and OTA found the cost-effectiveness ratio to be most sensitive to the unit price of breast cancer screening (63,187). Similarly, sensitivity analyses indicated that the marginal cost-effectiveness of cervical cancer screening depends greatly on Pap smear charges, the false positive rate, and the cost of working up a false-positive test result (63). These sensitivity analyses may clarify the advantages of setting reimbursement limits or requiring that tests be evaluated by laboratories which meet certain standards. Potential ways to improve the cost-effectiveness of other preventive interventions could be illuminated through similar types of analyses.

NET COSTS AS A CRITERION FOR INSURANCE COVERAGE

Rather than limiting benefits based on the effectiveness and cost-effectiveness of specific services, one could limit services to those found to reduce society's health care costs. The problem with this criterion is that few preventive services would be able to meet it. While the evidence suggests that clinical preventive services can save lives and prevent suffering, many preventive services would not result in net savings of medical costs. This does not imply that clinical preventive services are not a worthwhile investment in terms of improving health status, but rather that a criterion which states that clinical preventive services must be able to reduce the Nation's health care costs may be too stringent (191,228).

OTA's review of the literature of the cost-effectiveness of several major types of clinical preventive interventions found that none of the potentially effective cancer screening interventions would reduce medical costs (i.e., breast cancer, colorectal cancer, cervical cancer) in

[3] The high incremental cost-effectiveness of increasing the frequency of cervical cancer screening relates primarily to the assumptions concerning duration of the preclinical stage of the disease. The longer it takes for atypical cells to progress to cancer, the smaller the benefits from more frequent screening.

populations at average risk for the disease (61,63,184,192,193)! In addition, physician counseling on smoking cessation, both with and without the use of nicotine gum, was not found to be cost-saving (52,155). Studies have found that preventive treatment of high cholesterol costs more than the savings from reduced coronary heart disease; thus, cholesterol screening is unlikely to be cost-saving (154,175). In addition, hypertension screening was not found to be cost-saving (132). Even adult immunizations have been found to be cost-saving only for subsets of the general population, or under certain circumstances. For example, influenza vaccines were cost-saving only for those over 65 years of age (185). Similarly, pneumococcal vaccines, for those over 65 years of age, were only cost-saving under optimistic assumptions (186).

The three preventive services reviewed that are cost-saving (under certain conditions) are: prenatal care for poor women (188), newborn screening for some congenital disorders (i.e., phenylketonuria and congenital hypothyroidism) (188), and most childhood immunizations (188). However, even childhood immunizations, prenatal care, and newborn screening may not be universally cost-saving. For example, a recent cost-effectiveness analysis indicated that hepatitis B virus vaccination will be cost-saving only in high-risk adults and not in newborns or adolescents (17). The cost-effectiveness analyses reviewed above are described in greater detail in tables 4-1 through 4-8.

Why is the intuition that ‘an ounce of prevention is worth a pound of cure” incorrect in most circumstances? A key reason is that most screening tests (e.g., Pap smears, mammography, cholesterol and blood pressure measurement), must be done on thousands of people, most of whom do not have, and never will have, the disease, and tests must be repeated at specified intervals (161,164). Further, once the disease, or precursor condition, is detected, treatment must be undertaken and often more expensive follow-up tests performed. Finally, not everyone will benefit from preventive interventions. For example, research shows that a relatively small number of individuals given smoking advice will quit smoking (see chapter 3).

While a zero net cost criterion may be too stringent a criterion for choosing preventive services for coverage, attempting to limit net costs may be appropriate and necessary, particularly in the face of budget constraints and considering that the net costs associated with clinical preventive services can be large. For example, if the guidelines of the National Cholesterol Education Program (NCEP) were fully implemented, serum cholesterol would be measured on over 150 million American adults every five years (215). Over 40 percent of these individuals would require more expensive lipoprotein analysis, after initial measurement of total cholesterol, on a more frequent basis (232). Over 60 million American adults would require medical advice and intervention, including intensive dietary counseling and extended use of lipid-lowering drugs (232). The annua1 screening costs alone for all adults ages 20 and older would be almost $870 million, assuming full compliance with NCEP protocols (77). If the cost of treatment is included, the total expenditures might range from approximately $6 billion to $67 billion, depending on assumptions about the age group treated, the effectiveness of diet in lowering cholesterol, and when diet fails, the medications used (77).

[4] The cost-effectiveness studies reviewed were limited to those which used the following assumptions, unless otherwise noted: (1) all costs and benefits were discounted at 5 percent, (2) the cost-effectiveness analyses took a societal perspective, (3) medical costs associated with additional years of life were excluded, (4) indirect costs were excluded (e.g., costs due to lost productivity or time costs). However, the results of these studies are only generalizable to the extent that the circumstances under which the interventions and treatments are applied (e.g., the population characteristics, price of services, effectiveness) are the same as those assumed in the analyses,

SUMMARY

Few clinical preventive services have been found to be cost-saving when applied to populations at average risk for the condition. Therefore, the use of most effective clinical preventive services will involve tradeoffs between improved health status and increased health care costs. Using explicit methods to evaluate costs in relation to benefits, such as cost-effectiveness analyses, may not make these decisions less political. However, in an environment of limited resources, cost-effectiveness analysis may be one of several useful tools for making better resource allocation decisions, such as those pertaining to insurance benefits. In particular, cost-effectiveness analyses may help shed Light on such questions as: who should receive preventive services, how often, and using what specific interventions

[5] A new panel, the Cost-Effectiveness Panel on Clinical Preventive Services (CEPCPS), has recently been established and will interact with the USPSTF and the agencies of the Public Health Service. The goal of the CEPCPS is to develop cost-effectiveness methodology and guidelines relevant to clinical preventive services; evaluate the adequacy of the literature on cost-effectiveness of selected clinical preventive services; and identify, and, when possible, direct studies of high priority areas where unresolved questions of cost-effectiveness remain (81).

Table 4-1—Selected Cost-Effectiveness Analyses of Adult Immunizations

Author[a]/ date	Target population	Treatment protocols compared	Data source(s) for effectiveness information	Other critical assumptions	Costs included	Cost-effectiveness per healthy life year gained,[b] case prevented or year of life saved (YOLS)
U.S. Congress, OTA (1981)	U.S. population, age 65+.	Influenza vaccination v. no vaccination.	Used the evidence from 3 clinical trials and 1 epidemiologic investigation; assumed a 60% efficacy rate.	5% discount rate; Vaccination costs $6 for vaccinees ≥ age 25 and $11 for vaccinees < age 25; 1 year duration of immunity.	Costs of vaccination, cost of treating side-effects, and the savings in reduced costs of treating pneumococcal pneumonia.	Cost saving.
U.S. Congress, OTA (1981)	U.S. population, aged 45 to 65.	Same as above.	Same as above.	Same as above.	Same as above.	$23 (1978 dollars).
U.S. Congress, OTA (1981)	U.S. population, age 25 to 44.	Same as above.	Same as above.	Same as above.	Same as above.	$64 (1978 dollars).
U.S. Congress, OTA (1981)	U.S. population, age 15 to 24.	Same as above.	Same as above.	Same as above.	Same as above.	$181 (1978 dollars).
U.S. Congress, OTA (1981)	U.S. population, age 3 to 14.	Same as above.	Same as above.	Same as above.	Same as above.	$196 (1978 dollars).
U.S. Congress, OTA (1981)	U.S. population, less than 3 years of age.	Same as above.	Same as above.	Same as above.	Same as above.	$258 (1978 dollars).
U.S. Congress, OTA (1984)	Persons age 65+.	23-valent pneumococcal pneumonia vaccination v. no vaccination.	80% efficacy rate.	5% discount rate. The lowest estimate assumed that 15% of all pneumonia is pneumococcal and an 8-year duration of immunity. The highest estimate assumed that 10% of all pneumonia is pneumococcal and a 3-year duration of immunity. Vaccination cost $11.	Costs of vaccination, cost of treating side-effects, and the savings in reduced costs of treating pneumococcal pneumonia.	Cost saving to $6,154 (1983 dollars) (depending on assumptions about duration of immunity and the percentage of pneumonia that is pneumococcal).

Table 4-I-Selected Cost-Effectiveness Analyses of Adult Immunizations-Continued

Author[a]/ date	Target population	Treatment protocols compared	Data source(s) for effectiveness information	Other critical assumptions	costs included	Cost-effectiveness per healthy life year gained,[b] case prevented or year of life saved (YOLS)
Mulley et al. (1982)	Homosexual men and surgical residents.	Hepatitis B vaccination, with or without prior screening v. no vaccination.	A randomized ciinical triai of 1083 homosexual men; 87.5% efficacy rate.	6% discount rate; 5-year duration of immunity; serious reactions to vaccination would occur at a rate of 1/100,000 and 10°/0 of these would be fatal. 60% prevalence of HBV markers and 15°/0 annual attack rate of hepatitis B in the homosexual population in the absence of screening or vaccination. Cost of vaccination was $100.	Cost of vaccination. Savings from treatment of HBV infection and chronic sequelae of HBV infection.	Vaccinations will save medical costs for populations with attack rates above 5°/0 (i.e., vaccination of homosexual men and vaccination of surgical residents) (1980 dollars).
Mulley, et al. (1982)	General population.	Same as above.	Save as above.	Same assumptions except 5% prevalence of HBV markers and O.1% annual attack rate.	Same as above.	Vaccination of the general population would cost $22,469 per case of hepatitis B prevented (1980 dollars).
Bloom, et al. (1993)	U.S. high-risk adult population and general adult population.	Compared universal hepatitis B vaccination, to screening and vaccinating high-risk populations, to no vaccination.	Review of the medical literature and expert panel. Estimates of efficacy were based on randomized and historical clinical trials.	Base case assumption was 10 years of immunity; no side-effects requiring medical care; efficacy depended on the population, doses, and boosters (i.e., 60°/0 to 90%); vaccine cost $225 for adults (this included in administration fee). 5% discounting of benefits and costs.	Direct medical care costs.	Vaccination without screening is cost- saving in high-risk adults; vaccination in the general adult population would cost $257,418/YOLS and $15,001 per case prevented (1989 dollars).

ABBREVIATIONS: YOLS = year of life saved; HBV - Hepatitis B.

[a]Full cites can be found in references at the end of this report.

[b]Healthy life years were calculated as a weighted average of death, disability days with confinement to bed, disability days without confinement to bed, and full functioning.

SOURCE: U.S. Congress, Office of Technology Assessment, 1993.

Table 4-2—Selected Cost-Effectiveness Analyses of Breast Cancer Screening

Author[a]/ date	Target population	Treatment protocols compared	Effectiveness data source(s)	Other critical assumptions	costs included	Cost effectiveness ratio per year of life saved (YOLS)
U.S. Congress, OTA (1 987)	Women age 65 to 74.	Annual Breast Physical Examination (BPE) and mammography v. no screening.	5 controlled trials and 1 uncontrolled study.	5%. discount rate. Screening mammogram and BPE cost $50. Annual screening will reduce mortality by about 50% after 5 years, 40% after 10 years and 30% after 20 years.	*Screenlng* rests, *workup* for false positives, cost of care for women with cancer, terminal care for cancer.	$34,600.
Eddy (1991a)	Women younger than 50 at average risk.	Annual BPE and mammography v. annual BPE alone.	Health Insurance Plan (HIP) and Breast Cancer Detection Demonstration Project (BCDDP) studies.	BPE costs $25, mammography costs $75, 5%. discount rate. Screening leads to a 24-60% reduction in mortality after 10 years and a 24-580/. reduction after 20 years.	*Screening* costs, *workup* for false positives, cost of care for women with cancer, terminal care for cancer.	$30,000 to $135,000 depending on whether use HIP or BCDDP.
Eddy (1991 a)	Women older than 50 at average risk.	Annual BPE and mammography v. annual BPE alone.	HIP and BCDDP studies.	Screening leads to a 30-59% reduction in mortality after 10 years and a 25-57% reduction in mortality after 20 years.	*Same as above.*	$20,000 to $90,000 depending on whether use HIP or BCDDP.

ABBREVIATIONS: BPE. Breast Physical Examination; HIP - Health Insurance Plan; BCDDP. Breast Cancer Detection Demonstration Project

[a] Full cites can be found in references at the end of this report.

SOURCE: U.S. Congress, Office of Technology Assessment, 1993.

Table 4-3—Selected Cost-Effectiveness Analyses of Cervical Cancer Screening

Author[a]/ date	Target population	Treatment protocols compared	Effectiveness data source(s)	Other critical assumptions	Costs included	Cost-effectiveness ratio per years of life saved (YOLS)
U.S. Congress, OTA (1981)	100,000 women age 30-39.	Physician-based services, screened annually for 10 yrs. beginning at age 30 v. no screening.	Estimated using various sources and a Markov model, no RCTs.	Population was screened twice before the program began, 5% discount rate.	Screening, diagnosis and treatment (e.g., Pap test, pap cytology, colposcopy, biopsy, cryosurgery, conization, hysterectomy, hospitalization).	$51,928.
U.S. Congress, OTA (1981)	Same as above.	Screened every 10 years v. no screening.	Same as above.	Same as above.	Same as above.	$10,190.
U.S. Congress, OTA (1981)	Same as above.	"Low cost program" where health vocational nurses do the screening. Screened annually v. no screening.	Same as above.	Same as above.	Same as above.	$27,300.
U.S. Congress, OTA (1990)	Women age 65 and older.	One-time screening v. no screening.	Estimated using a Markov model and indirect evidence (e.g., the natural history of the disease, the efficacy of screening, anc the efficacy of treatment).	5% discount rate; Pap smear costs $11 (in base case).	Costs of screening, costs of false-positives, cost of treatment, cost of follow-up. Costs based on Medicare average allowable charges.	$1,666 (1988 dollars).
U.S. Congress, OTA (1990)	Same as above.	Annual screening until age 110 v. no screening.	Same as above.	5% discount rate.	Same as above.	$39,693 (1988 dollars).
U.S. Congress, OTA (1990)	Same as above.	Screening every 3 years.	Same as above.	Same as above.	Same as above.	$5,956 (1988 dollars).
U.S. Congress, OTA (1990)	Women age 65 and older at high-risk.	Screening every 3 years.	Same as above.	Same as above.	Same as above.	Cost-saving.
Eddy (1991a)	Women age 29 to 75.	Screened every 4 years from age 20 to 75 v. no screening.	Based on analysis by the International Agency for Research on Cancer of several of the largest case-control and cohort screening programs.	5% discount rate; Pap smear costs $75; 0.5% false positive rate.	Charge for Pap smear, charge for working up a person with a false-positive pap smear, cost of treating a lesion, cost of initial therapy, cost of terminal care. Savings from avoided treatment costs.	$10,000.

ABBREVIATION: RCT = Randomized Clinical Trial.

[a]Full cites can be found in references at the end of this report.

SOURCE: U.S. Congress, Office of Technology Assessment, 1993.

Table 4-4—Selected Cost-Effectiveness Analyses for Childhood Immunizations

Author[a]/ date	Target population	Treatment protocols compared	Effectiveness data source(s)	Other critical assumptions	Costs included	Cost-effectiveness per healthy life year gained[a]
Cochi, et al. (1985)	1984 U.S. children birth cohor 1-2 years old.	Hib vaccination at 18 months v. no vaccination.	Clinical and epidemiologic data and data from the bacterial meningitis surveillance system maintained by the CDC. Finland field trial of vaccine efficacy.	Cost of vaccine = $3/ dose, no additional administrative costs, 80% coverage, 75% efficacy, no discounting of acute case costs saved, long-term costs discounted at 5%.	Direct medical and social service costs.	Cost saving, both in terms of net short-term medical costs and with long-term social service costs.
Cochi, et al., (1985)	Same as above.	Hib vaccination at 24 months v. no vaccination.	Same as above.	Cost includes $10 administration fee since visit is not in conjunction with scheduled DTP visits, 80% coverage, 90% efficacy.	Same as above.	Cost saving.
White, et al. (1985)	U.S. population (examined actual 1983 data).	MMR vaccination v. single antigen vaccination v. no vaccination.		Vaccine costs: office visit = $15; measles = $4.26, rubella = $4.76; mumps = $5.57; MMR = $11.30, discounted at 10%.	Direct and indirect costs.	sav g
Bloch, et al. (1985)	U.S. popu	Measles vaccination program 1963 to 1982 v. no vaccination program 1963 to 1982.	Comprehensive review of benefits due to measles vaccination from 1963 to 1982; based on previously published studies.	Unspecified.	Direct and indirect costs.	sav g
Hinman and Koplan (1984)	Hypothetical cohort of 1 million children. Followed from birth to age 6.	Pertussis vaccination in conjunction with DT vaccines (5 doses, 0-6 years) v. no vaccination (DT only).	Incidence rate reported in England and Wales from 1976 to 1981.	Vaccine cost = $0.03/ dose. No administrative costs because administered in conjunction with DT, 90% coverage, 80% efficacy, 5% discount rate.	Direct medical costs (physician visits, hospitalization, residential care).	Cost saving (1983 dollars).
Witte and Axnick (1975)	U.S. population.	Measles vaccination as implemented in 1963 to 1972 v. no measles vaccination.		Costs of production, distribution, administration, and promotion of the vaccine is $3.00/ dose, no discounting.	Direct and indirect costs.	Cost sav g

Table 4-4—Selected Cost-Effectiveness Analyses for Childhood Immunizations-Continued

Author[a]/ date	Target population	Treatment protocols compared	Effectiveness data source(s)	Other critical assumptions	costs included	Cost-effectiveness per healthy life year gained[a]
Massachusetts Department of Health (1980)	Massachusetts population.	MMR vaccination program run by State v. no program.		No discounting, calculated cumulative savings since program began in 1966.		Cost saving.
Koplan and Preblud (1982)	U.S. population.	Mumps vaccine in conjunction with measles and rubella v. measles and rubella vaccine only.	Reported 1978 age-specific mumps incidence rates were used to estimate the incidence of mumps where mumps vaccine was part of routine childhood immunization and more than 750/. of children were immunized. Used average annual incidence of mumps in prevaccine years to estimate effects without vaccine.	Cost of mumps vaccination = $1.00, discounted at 5%.	Direct and indirect costs.	Cost saving.
Schoenbaum et al. (1976)	U.S. population.	Rubella vaccination of 2-year-old children as part of measles and mumps vaccine v. vaccination of 6-year-old children with monovalent vaccine v. vaccination of 12-year-old females with monovalent vaccine.	Frequency of rubella infection based on two serologic surveys performed in 1968.	Compiiance for all ages is 80°/0, herd immunity not considered, 6% discount rate, rubella vaccination costs $3/dose when administration alone and $1/dose when administered with measles vaccine.	Direct costs of vaccination, direct and indirect costs of congenital rubella syndrome, where indirect costs include lifetime earnings lost.	Cost saving.

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Table 4-4-Selected Cost-Effectiveness Analyses for Childhood Immunizations-Continued

Author[a]/ date	Target population	Treatment protocols compared	Effectiveness data source(s)	Other critical assumptions	costs included	Cost-effectiveness per healthy life year gained[b]
Koplan et al. (1979)	U.S. infant population.	Pertussis vaccination in conjunction with diphtheria and tetanus (DTP) vaccines v. DT vaccine only.	Incidence rates in a population with and without a pertussis vaccination program were based on reports to the Massachusetts Department of Public Health. Vaccine complication rates were based on data from Sweden and the Netherlands. Vaccine efficacy was based on "intrafamilial secondary cases."	90% immunization coverage, 70% efficacy, serious vaccine complications 1 in 3,500, encephalitis, 1 in 50,000; case fatality from these complications same as for pertussis.	Direct medical costs.	Cost saving.
Bloom et al. (1993)	U.S. population of newborns and 10-year-old adolescents.	Universal Hepatitis B vaccination compared with screening and vaccinating and compared with no vaccination.	Review of the medical literature and expert panel. Estimate of efficacy was based on randomized and historical clinical trials.	Base case assumption was 10 years of immunity; no side-effects requiring medical care; efficacy depended on the population, doses, and boosters (i.e., 60% to 90%); vaccine cost $160 for newborns (this included an administration fee). 5% discounting of benefits and costs.	Direct medical care costs.	Universal vaccination would cost $36,632 for newborns and $97,256 for adolescents; screening and vaccination would cost $42,067 for newborns; screening and vaccination of high-risk newborns and all adolescents would cost $3,695.

ABBREVIATIONS: DT = Diphtheria-tetanus; DTP = Diphtheria-tetanus-pertussis; Hib = Haemophilus Influenzae Type b; MMR = Measles-mumps-rubella; CDC = Centers for Disease Control and Prevention.

[a] Full cites found in references at the end of this report.

[b] Healthy life years were calculated as a weighted average of death, disability days with confinement to bed, disability days without confinement to bed, and full functioning.

SOURCE: U.S. Congress, Office of Technology Assessment, 1993 (Adapted and updated from U.S. Congress, Office of Technology Assessment, *Healthy Children, Investing in the Future,* OTA-H-345 (Washington, DC: U.S. Government Printing Office, February 198S)).

Table 4-5—Selected Cost-Effectiveness Analyses of Cholesterol Reduction Interventions

Author[a]/ date	Target population	Treatment protocols compared	Effectiveness data source(s)	Other critical assumptions	costs included	Cost effectiveness ratio per year of life saved (YOLS)
Taylor, et al. (1990)	Men with given sets of risk factors for developing CHD (i.e., total serum cholesterol level, age, blood pressure, cigarette smoking, high-density lipoprotein level).	Dietary intervention. Intervention includes 10 visits to registered dietitian, 2 physician visits in the first year. After first year, 2 annual serum cholesterol measurements, 1 visit to physician, 3 visits to nutritionist. Intervention continues to age 65. Compared to no intervention.	Computed effectiveness of diet on lowering cholesterol based on the Multiple Risk Factor Intervention Trial (MRFIT), estimated the effect of lowering cholesterol on survival from the Framingham Heart study. Assumed no adverse consequences of cholesterol reduction.	Assumed that men with a given set of risk factors would be screened when visiting physician for some other reason. First-year dietary program costs $557 and each subsequent year costs $150. 5% discount rate.	Serum cholesterol tests ;visits with physician, nutritionist, lab test; Costs of initial cholesterol screen were not included. Savings from treating consequences of CHD (e.g., myocardial infarction).	Estimates ranged from $11,000 (40-year-old, high-risk[c] males with total serum cholesterol of 300 mg/dL) to $930,000 (20-year-old males at low risk with total serum cholesterol level of 180 mg/dL).
Taylor, et al. (1990)	Same as above.	Dietary intervention and drug therapy (cholestryamine) v. no intervention.	Effectiveness of dietary intervention plus cholestyramine in reducing cholesterol was based on the Lipid Research Clinics Coronary Primary Prevention Trial. Effect of lowering cholesterol on survival based on the Framingham Heart Study.	The first year of cholestyramine therapy cost $803; each subsequent year cost $755.	The costs of the dietary and medication programs. Medication program involved additional physician visits, liver chemistry determination and ocular examination (only for lovastatin).	Estimates varied from $24,000 (60-year-old man at high risk with total serum cholesterol of 240 mg/dL) to $1.4 million (20-year-old man at low risk with total serum cholesterol of 240 mg/dL).
Taylor, et al. (1990)	Same as above.	Dietary intervention and drug therapy (lovastatin) vs. no intervention.	Effectiveness of dietary intervention plus cholestyramine in reducing cholesterol was based on the work of Hoeg and colleagues.[b] Effect of lowering cholesterol on survival based on the Framingham Heart Study.	The first year of lovastatin therapy cost $1,291, each subsequent year cost $1,177.	The costs of the dietary and medication program. Medication program involves additional physician visits, liver chemistry determination and ocular examination (only for lovastatin).	Estimates varied from $20,000 (60-year-old man at high risk with total serum cholesterol of 240 mg/dL) to $1 million (20-year-old man at low risk with total serum cholesterol of 240 mg/dL).

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Table 4-5-Selected Cost-Effectiveness Analyses of Cholesterol Reduction Interventions-Continued

Author[a]/ date	Target population	Treatment protocols compared	Effectiveness data source(s)	Other critical assumptions	costs included	Cost effectiveness ratio per year of life saved (YOLS)
Oster and Epstein (1987)	Men in different age groups (35 to 74), without symptomatic coronary artery disease. Base case assumptions: cholesterol levels of 265-,290- and 315-mg/dL.	Cholestyramine, life-time treatment vs. no intervention.	Framingham Heart .	5% discount rate.	Costs of medication, routine office visits, cholesterol tests, visits for side-effects. The annual cost of a 16-g/d regimen of therapy is $707. Savings from treating consequences of coronary heart disease (e.g., myocardial infarction).	Cost/YOLS ranged from $56,100 (for 35 to 39-year-olds with 315 mg/dL to over $1,000,000 (for 65-69-year-olds with 265 mg/dL) (1985 dollars).

ABBREVIATIONS: CHD = coronary heart disease; dL -deciliter; mg = milligram.

[a]Full cites found in references at the end of this report.

[b]Hoeg, J. M., Maher, M. B., Bailey, K. R., et al., "Comparison of Six Pharmacologic Regimens for Hypercholesterolemia," *American Journal of Cardiology* 59:812-15, 1987 (97).

[c]High risk was defined as cigarette smoking, systolic blood pressure in 10th percentile of age- and sex-specific population distribution, high-density lipoprotein cholesterol at the 10th percentile of age- and sex-population distribution.

SOURCE: U.S. Congress, Office of Technology Assessment, 1993.

Table 4-6—Selected Cost-Effectiveness Analyses of Colorectal Cancer Scree^ing

Author[a]/ date	Target population	Treatment protocols compared	Effectiveness data source(s)	Other critical assumptions	Costs included	Cost-effectiveness ratio per year of life saved (YOLS)
U.S. Congress, OTA (1990)	1989 U.S. 65-year-old population.	Annual FOBT and flexible fiberoptic sigmoidoscopy every 3 years (FSIG) (using a 60 cm sigmoidoscope).	Effectiveness calculation was based on indirect evidence (i.e., accuracy of screening, natural history of disease, etc.).	5% discount rate.	Cost of screening, follow-up, polyp removal, surveillance, treatment of early and late cancers, cost of treating colonoscopy induced injuries, cost of treating surgery-related injuries.	$42,892 (1989 dollars).
U.S. Congress, OTA (1990)	Same as ab	Annual FOBT and FSIG every 5 years (using a 60 cm sigmoidoscope).	Same as bo	Same as	as above.	$42,509 (1989 dollars).
U.S. Congress, OTA (1990)	Same as above.	Annual FOBT and FSIG on entry to Medicare (using a 60 cm sigmoidoscope).	Same as above.	Same as above.	Same as above.	$47,308 (1989 dollars).
U.S. Congress, OTA (1990)	Same as above.	Annual FOBT.	am as above.	Same as	as bo	54 do

ABBREVIATIONS: FOBT = Fecal Occult Blood Test; FSIG = Flexible Fiber sco

[a]Full cites can be found in references at the end of this report.

SOURCE: U.S. Congress, Office of Technology Assessment, 1993.

Table 4-7—Selected Cost-Effectiveness Analyses of Hypertension Screening

Author[a]/ date	Target population	Treatment protocols compared	Effectiveness data source(s)	Other critical assumptions	Costs included	Cost-effectiveness ratio per QALY[b]
Littenberg, et al. (1991)	Women 20 years of age.	Sphygmomanometry for diastolic blood pressure in range of 90- to 105- mm Hg.	Effectiveness of therapy based on previous meta-analysis of 8 community-based trials of hypertension therapy.	5% discount rate. Costs of therapy based on average wholesale costs of various medication; annual drug costs vary from $2.92 to $220.10. Total treatment costs per year for mild hypertension vary from $50 to $500, with $300 base-line estimate. Cost of screening is $5 and varies from 0 to $50.	Direct medical costs of death, myocardial infarction, and cerebrovascular accident; drug therapy; repeat visits; lab tests to monitor therapy, blood pressure measurement.	$44,412/QALY (1988 dollars).
Littenberg, et al. (1991)	Women 40 years of age.	Same as above.	Same as above.	Same as abo	Same as above.	$23,536/QALY (1988 dollars).
Littenberg, et al. (1991)	Women 60 years of age.	Same as above.	Same as above.	Same as above.	Same as above.	$12,404/QALY (1988 dollars).
Littenberg, et al. (1991)	Men 20 years of age.	Same as above.	Same as above.	Same as above.	Same as above.	$29,291/QALY (1988 dollars).
Littenberg, et al. (1991)	Men 40 years of age.	Same as above.	Same as above.	Same as above.	Same as above.	$16,280/QALY (1988 dollars).
Littenberg, et al. (1991)	Men 60 years of age.	Same as above.	Same as above.	Same as above.	Same as above.	$8,374/QALY (1988 dollars).

ABBREVIATIONS: QALY = Quality-adjusted life year.

[a]Full cites can be found in references at the end of this report.

[b]The authors assumed that the morbidity, pain, inconvenience, and suffering associated with the average stroke is equivalent, in terms of patient utility or sense of well-being, to avoiding he stroke but suffering a loss of 1.5 years of healthy life expectancy. Likewise, they valued a heart attack at 0.5 life-year equivalents.

SOURCE: U.S. Congress, Office of Technology Assessment, 1993.

Table 4-8-Selected Cost-Effectiveness Analyses of Smoking Cessation

Author[a]/ date	Target or study population	Treatment protocols compared	Effectiveness data source(s)	Other critical assumptions	costs included	Cost effectiveness ratio per year of life saved (YOLS)
Oster, et al. (1986)	Male patients age 35 to 69 who smoke.	Nicotine chewing gum as an adjunct to physicians' advice and counseling against cigarette smoking.	Efficacy of physician's advice was based on trials which reported rate of smoking cessation after 12 months. Efficacy of nicotine gum was based on 7 placebo-controlled trials of nicotine gum. The two rates were multiplied to derive efficacy rate of nicotine gum in a primary care setting. Estimate that 6.1 % of patients seen in primary care practice who use nicotine gum will quit.	5% discount rate.	Cost of nicotine gum, cost of office visit medical costs avoided from quitting smoking.	$4,113 to $6,465 (depending on age).
Oster, et al. (1986)	Female patients age 35 to 69 who smoke.	Same as above.	Same as above.	Same as above.	Same as above.	$7,073 to $9,473 (depending on age).
Cummings, et al. (1989)	Men 35 to 69 years of age who smoke.	Brief advice to quit smoking during a routine office visit and a self-help booklet.	Four randomized trials that compared patients who were given advice by a physician to quit smoking and those who received no counseling. Found an average smoking cessation rate atone year Of 2.7°/0.	5% discount rate.	Cost of physician office visit and a self-help booklet. Medical costs avoided from quitting smoking.	$705 to $988 (depending on age).
Cummings, et al. (1989)	Women 35 to 69 years of age.	Same as above.	Same as above.	Same as above.	Same as above.	$1,411 to $2,058 (depending on age).

[a] Full cites can be found in references at the end of this report.

SOURCE: U.S. Congress, Office of Technology Assessment, 1993.