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The cost savings and cost-effectiveness of clinical preventive care

See companion Policy Brief available at *www.policysynthesis.org*

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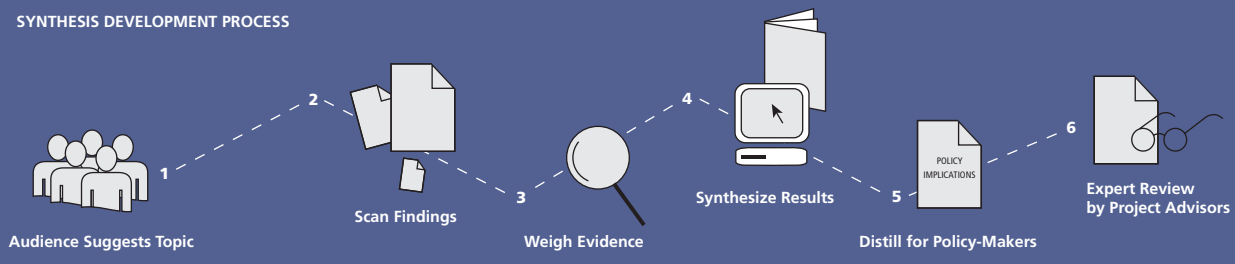


Introduction

A number of factors have contributed to interest in preventive health care measures. First, although advances in treatments to help people after they become sick have improved overall health over the last century (10, 13), the historical success of preventive measures against diseases has left a strong impression in the public consciousness. For example, typhoid, diphtheria, gastroenteritis, and smallpox have been virtually eliminated in developed countries as a result of preventive measures, including vaccination and improved public sanitation.

Second, important contemporary contributors to mortality have substantial behavioral risk factors that are, by their nature, preventable. Because the prevalence of many acute illnesses has been reduced, and because life expectancy grew from less than 50 years in 1900 to nearly 80 years in 2000 (44), chronic disease has become the dominant source of mortality in the United States. Heart disease and cancer, respectively, accounted for 31.4 percent and 23.3 percent of all U.S. deaths in 2000, compared with 6.2 percent and 3.7 percent in 1900 (44). Risk factors for these diseases include diet, exercise and smoking.

Finally, interest in prevention is driven by the need to reduce health care costs. A source of savings in health care is needed now more than ever. Between 1960 and 2000, present value lifetime medical expenditures increased from $14,000 to $83,000 per person in 2002 dollars (10). The increase was particularly steep for individuals after the age of 65, for whom lifetime medical costs (in the remaining years of life) increased from less than $12,000 to almost $160,000. The proportion of gross domestic product (GDP) devoted to health care spending has increased from 5.2 percent in 1960 to 16 percent in 2006, and is projected to reach more than 19 percent by 2017 (14).

The potential for cost savings from prevention has particular policy relevance at this time. For the elderly, growing costs could threaten the long-term viability of Medicare. Spending on Medicare and Medicaid, which now represents 4.6 percent of GDP, is projected to increase to 5.9 percent by 2017, and to 20 percent by 2050 if present trends continue (35). For workers, employment-based insurance premiums increased 78 percent between 2001 and 2007, compared with a 17 percent increase in inflation and a 19 percent increase in worker wages over the same time period (7). During this period, the number of people who are either uninsured (21) or underinsured (42) has increased. The looming crisis in health care costs makes understanding the economic consequences of investments in prevention particularly important.

The interest in promoting preventive services has given rise to – and been inspired by – an increasing number of reports and academic papers that have evaluated the economics of prevention. This synthesis provides policy-makers with a framework for evaluating the cost-effectiveness literature and investigates the economic evidence for investing in preventive care.

This synthesis addresses the following questions:

1. What concepts are important to consider in evaluating cost-effectiveness studies?
2. What information is available on the cost of preventive care?
3. What are the strengths and limitations of the information?
4. Which preventive measures save money or deliver good value?
5. How could cost-effectiveness reviews be improved?

Introduction

This review is limited to clinical preventive services, which are services primarily administered in a doctor's office, a hospital, or other similar clinical setting. By contrast, community-based preventive services refer to all other preventive interventions (see Zaza (47) for an extensive review). Examples include mass media campaigns and cigarette taxes to discourage smoking, school-based promotion of physical activity to combat obesity, and child safety seat laws to reduce motor vehicle injuries and fatalities. This synthesis limits attention to clinical prevention because information on the economic efficiency of community-based interventions is limited (5, 38).[1]

Prevention can be divided into three categories – primary prevention, secondary prevention and tertiary prevention (34). Primary prevention aims to avoid the onset of disease. Examples include childhood vaccines, smoking cessation counseling and weight loss programs. Secondary prevention aims to prevent disease from developing beyond its early stages and often depends on screening. For example, mammogram screening aims to detect breast cancer when it is more likely to be amenable to treatment. Tertiary measures minimize progression and symptoms associated with established disease. Examples include control of blood sugar levels in people with diabetes to prevent damage to blood vessels and organs. This synthesis focuses on primary and secondary prevention.

Before proceeding, we note that questions about cost-effectiveness and cost savings could – and equally should – be asked in the context of treatment and diagnostic services. It is not our intent to imply that preventive services should be held to a more stringent standard for efficiency. Nor is it our intent to imply that only those services that save money are worthwhile. The promise of savings, however, seems to have been made more in the context of preventive services. This report reviews the evidence for that claim.

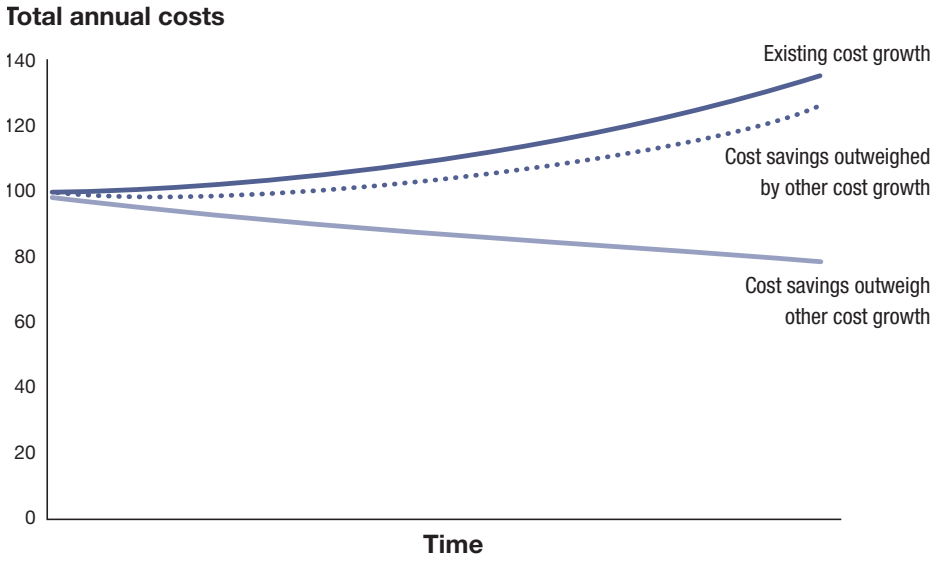
1 Some sources identify worksite measures as a third category (32). This category includes measures such as worksite fitness centers, worksite smoking bans, and worksite influenza immunization clinics. Rather than treating worksite interventions as a separate category, this review treats them as clinical interventions if they would typically be offered in a medical setting (e.g., immunizations) and otherwise as community interventions (e.g., a fitness center or smoking ban).

Findings

What concepts are important to consider in evaluating cost-effectiveness studies?

"Cost-saving" and "cost-effective" are distinct terms that are often mistakenly used interchangeably. Preventive care that decreases costs is cost-saving (e.g., many childhood immunizations). If the benefits are sufficiently large compared to the costs, the intervention is "cost-effective" even if it does not save money. Cost-saving measures may slow health care cost growth, but not be large enough to outweigh other cost increases (Figure 1). Alternatively, the savings may be large enough to reverse health care cost growth.

Figure 1: Possible impact of cost-saving intervention on health care costs over time



Cost-effective preventive care measures that do not save money may confer important health benefits and hence still be worthwhile. The adoption of such measures increases overall health care costs, but their health benefits are sufficiently large to justify the added expense. Cost-effectiveness analysis is a way to determine if an intervention that does not save money satisfies this criterion. It differs from comparative effectiveness analysis, which compares interventions only in terms of their impact on health without regard to cost.

An intervention's cost and how much health it delivers can be summarized in a single number called the "cost-effectiveness ratio," which is equal to the intervention's incremental costs divided by its incremental health benefits.

$$\text{CE ratio} = \frac{\text{Incremental Costs (\$)}}{\text{Incremental Health Benefits}}$$

Health benefits can be expressed as the number of deaths or cancer cases prevented, or the number of life years saved, for example.

Findings

Health economists often express health benefits in terms of the number of quality adjusted life years (QALYs) saved. The QALY takes into account both length of life and quality of life (e.g., freedom from pain, ability to participate in activities). A year in perfect health is defined to be worth 1 QALY. A year with any adverse condition is generally worth between 0 and 1 QALY. For example, a year of life following a minor stroke has been estimated to be worth 0.87 QALY, whereas a year of life after a major stroke has been estimated to be worth 0.52 QALY (23). Although estimated QALY weights are uncertain, the exact value used tends not to strongly influence the resulting cost-effectiveness ratio estimate (6).

A cost-effectiveness ratio is said to be "unfavorable" when the intervention's incremental costs are large relative to its incremental health benefits. That is, the health improvements it achieves are expensive. A small cost-effectiveness ratio would favor intervention. Typically, cost-effectiveness ratios less than $50,000 to $100,000 for each QALY gained are regarded favorably, although some health economists have argued that cost-effectiveness decision rules should use higher (i.e., less stringent) thresholds (3) (see *How much is one quality adjusted life year worth?).* In any case, computation of cost-effectiveness ratios makes it possible to evaluate and compare economic impacts for a wide range of health interventions whose costs exceed their savings.

How much is one quality adjusted life year worth?

Although values of $50,000 and $100,000 per QALY have often been used as thresholds for decision rules in cost-effectiveness analysis, economists complain that these benchmarks lack a sound foundation (19). Critics have suggested that these traditional benchmarks are too low and that a higher value should be placed on the QALY. Placing a higher value on the QALY would suggest that society is willing to spend more on improving health and would therefore increase the number of health interventions that are categorized as worthwhile.

Hirth et al. (19) evaluated the traditional benchmarks by looking at market data on extra pay people receive to take more dangerous jobs. They also looked at the prices people pay for safety features (e.g., smoke detectors). The job data indicated people demand $430,000 for each additional QALY, whereas the personal safety price data indicated they are willing to pay $93,000 for each additional QALY.

Braithwaite et al. (3) estimated the value of a life year by comparing the amount society has spent on health improvements between 1950 and 2003 with the improvement in health. They reasoned that this estimate, amounting to $183,000 per life year, is a lower bound because most people believe even more resources should be spent on health care. Braithwaite et al. developed an upper bound value of $264,000 per life year based on the cost of unsubsidized health insurance and its attendant health benefits. The fact that most people are unwilling to make this purchase implies that it confers benefits at a cost people find unacceptably high. After taking into account various sources of uncertainty and accounting for morbidity, Braithwaite et al. estimated the value of a QALY to range from $109,000 to $297,000.

Estimating the value of one QALY is difficult and estimates are uncertain because there is no market where QALYs are explicitly traded. Ultimately, decision-makers have to make a judgment as to what they think it is worth.

The cost-effectiveness of a preventive measure is typically improved by targeting a high-risk population (Table 1). Targeting high-risk populations increases the proportion of individuals who benefit and hence the health benefits accrued per dollar invested (40). Targeting high-risk patients also makes it more likely that the measure's therapeutic benefits will outweigh any side effects.

Findings

Table 1: Influence of population characteristics on cost-effectiveness

Intervention and study	Population	Cost-effectiveness ratio[a]
Diet treatment to reduce coronary heart disease (37)	35–44-year-old non-smoking men with normal cholesterol[b]	$160,000/QALY
	65–74-year-old non-smoking men with normal cholesterol[b]	$68,000/QALY
	65–74-year-old non-smoking men with elevated cholesterol[b]	$38,000/QALY
Screening for diabetes (20)	All 35-year-olds	$130,000/QALY
	35-year-olds with hypertension	$87,000/QALY
	75-year-olds with hypertension	$32,000/QALY
Routine childhood hepatitis A immunization (22)	Children living in regions of the U.S. with high hepatitis A prevalence rates[c]	Cost-saving
	Children living in regions of the U.S. with moderate hepatitis A prevalence rates[c]	$14,000/QALY
	Children living in regions of the U.S. with low hepatitis A prevalence rates[c]	$63,000/QALY

Notes:

[a] Cost-effectiveness ratios reported in this table are for the currency year reported by the original author. Values have been rounded to two significant digits.

[b] Assumes diastolic blood pressure < 95 mm Hg, HDL > 49 mg/dL, and no other risk factors. Cholesterol is "normal" if LDL is between 160 and 189 mg/dL, and "high" if it is 190 mg/dL or greater.

[c] Hepatitis prevalence rates are "high" if they exceed the national average, "moderate" if they are between 50% and 99% of the national average, and "low" if they are less than 50% of the national average.

The details of an intervention can strongly influence both clinical outcomes and cost savings (40). For example, the cost-effectiveness of colorectal cancer screening depends on the technology used (e.g., colonoscopy, fecal occult blood testing, or sigmoidoscopy) and how frequently the screenings are administered. Increasing screening frequency increases effectiveness (proportion of cancer cases detected early and number of QALYs saved), but generally at the cost of diminishing marginal returns and less favorable cost-effectiveness (Table 2).

Table 2: Cost-effectiveness of alternative colorectal cancer screening interventions[a]

Technology	Screening frequency	Range of cost-effectiveness estimates (2004 U.S. dollars)[b]
Colonoscopy	Every 3 years	$22,000/QALY
	Every 5 years	$17,000 to $37,000/QALY
	Every 10 years	$11,000 to $27,000/QALY
Fecal occult blood testing	Annually	$4,600 to $26,000/QALY
	Every 2 years	$2,900 to $11,000/QALY
Sigmoidoscopy	Every 3 years	$16,000 to $21,000/QALY
	Every 5 years	Cost-saving to $42,000/QALY
	Every 10 years	$9,300 to $24,000/QALY
	One-time screening	$1,400/QALY

Notes:

[a] Based on Table 10-1 in MedPAC *Increasing the Value of Medicare* (30)

[b] Comparator in all cases is no screening for colorectal cancer. Cost-effectiveness values have been rounded to two significant figures. Multiple values are reported where estimates are available from more than one study. Some studies used life years rather than QALYs.

Findings

How much money prevention saves, or how cost-effective it is, depends on what it is compared with. A preventive measure may save money when compared with no prevention, but may cost money when compared with another preventive measure that is just as effective but less expensive. How much money prevention saves or how cost-effective it is also depends on assumptions about how people who develop the targeted disease will be treated. The availability of an inexpensive, effective treatment for the targeted disease will make the cost-effectiveness of prevention less favorable.

How much money prevention saves may depend on whether the question is asked from the perspective of the health care system, individuals or employers. Changes in health care costs affect health care system entities, like private insurance companies and public programs such as Medicare. They also affect employers that subsidize employee health insurance policies, and employees who pay for health benefits through lower wages. Factors affecting out-of-pocket expenses and the time individuals must devote to their own care (e.g., to go to doctor appointments when they are sick) are relevant to individuals. Whether health care costs affect Medicare or private health care payers (typically funded by employers and individuals) can depend on the age when disease typically strikes. Private payers typically cover health care costs for individuals prior to retirement, whereas Medicare covers costs for older individuals. For example, one study found that smoking increases costs for private insurance plans, but saves money for Medicare (43). As a result, smoking prevention and cessation programs might produce savings for private insurance plans but increase Medicare costs. Finally, employers benefit directly from improvements in productivity.

Lifetime health care costs may rise if people live longer as a result of preventive interventions. Prevention can reduce health care expenditures by reducing the incidence of a targeted disease, and can in turn help people live longer. Living longer, however, means people can develop other ailments that increase lifetime health care costs. Whether the additional costs associated with these "competing risks" outweigh the savings from avoiding the targeted disease depends on how healthy people are during their added life years. If the added life years are relatively free of disability, which contributes substantially to care costs, then the economic impact of prevention is likely to be more favorable. Otherwise, there is a greater potential for competing risk costs to outweigh savings and potentially make the cost-effectiveness of a preventive measure unfavorable (see *Competing risks*).

Findings

Competing risks

The potential importance of health care costs associated with competing risks stems from the tendency of some preventive measures to add life years. Moreover, these life years are added at older ages when health care is typically more costly. In a brief review of the literature, Alemayehu et al. (1) noted that health care costs rise exponentially after age 50, and that per capita annual costs in individuals age 85 or older are twice as much as the annual per capita costs for 75–84-year-olds, and three times as much as they are for 65–74-year-olds.

One indicator of how likely it is that prevention will reduce costs is the extent to which it tends to add "healthy" life years (i.e., years relatively free of costly disabilities) as opposed to unhealthy life years. Diehr et al. (11) developed a Markov model to predict how long people live, and how much time they spend in various qualitative health states as a function of their self-reported health condition. For example, Diehr et al. (11) showed that women in fair health at age 65 live 3.8 years longer than women who are in poor health at age 65. Moreover, individuals in fair health at age 65 have 3.6 more healthy life years remaining, indicating that most of the 3.8 years of added life are healthy life years. Therefore, the increase in life expectancy adds little to the time spent in a disabled state. If lifetime health care costs depend strongly on time spent in a disabled state, then these results imply that preventing the development of poor health at age 65 (replacing it instead with "fair" health at age 65) will not substantially influence lifetime health care costs. Results are similar for men.

Another assessment of this phenomenon suggested that hypothetical prevention of near-term disabilities reduces short-term costs but increases long-term costs, almost eliminating net lifetime savings (26). The assessment classified Medicare recipients age 70 and over by level of disability (five levels ranging from no limitation to institutionalized) and developed a Markov model to estimate time spent in each state and time until death. By combining this information with estimates of cost associated with each level of disability, the investigators estimated lifetime health care costs. Life expectancy depended on level of disability at age 70. For example, individuals with no limitations at age 70 had a life expectancy of 14.3 years, whereas life expectancy for those with limitations in at least one activity of daily living (ADL) was nearly 20 percent less. On the other hand, remaining lifetime health care costs were similar ($145,000 for individuals with limitations in at least one ADL and $136,000 for individuals with no limitations).

The point is that even in this hypothetical scenario in which near-term disability was eliminated, the resulting additional life years made lifetime cost savings minimal. It is possible that other interventions that do not strongly influence near-term disability, or that make long-term disability more likely by extending life, could decrease savings even more, or even increase net costs (e.g., see van Baal et al. (45)).

Discounting scales down costs and benefits that occur in the future to reflect preferences for near-term consequences (12). Whether the added long-term costs associated with living longer exceed near-term cost reductions may depend on how an analysis treats the issue of discounting. An analysis that uses a sufficiently large discount rate will diminish the effective long-term costs associated with competing risks to the point that they have negligible importance (See *The discount rate and competing risks*). It is therefore important to understand what discounting assumptions an analysis makes if it affects long-term health care costs.

The discount rate and competing risks

An important consideration in estimating competing risk costs is the "discount rate," or rate of time preference. A discount rate of 3 percent is typically used in economic analyses because it represents the inflation-adjusted long-term risk-free return on capital (25). An annual discount rate of 3 percent implies that a cost of $100 next year has a "present value" of $97 because $\$97 = \$100 \times \frac{1}{1.03}$; a cost of $100 in two years has a present value of $\$94 = \$100 \times \frac{1}{1.03^2}$.

Although discounting has a minimal impact on cost calculations in the short term, it can have an important impact over the long term. The discount rate used can be especially important when there are competing risks because they can occur decades after a preventive measure is implemented. Suppose, hypothetically, that a preventive measure at age 45 eliminates short-term health care costs related to a targeted condition amounting to $5,000 but that it extends life expectancy by three years, from age 79 to 82. For the average 80–82-year-old, assume that typical health care costs are $10,000 per year. Table 3 details the year-by-year impact on health care costs.

Table 3: Impact of preventing health condition on health care spending

	Change in costs with preventive measure				
Age	**Target condition costs**	**Typical care costs**	**Total care costs: No discounting**	**Total: discounted at 3%**	**Total: discounted at 7%**
45	↓ $5,000	$ 0	↓ $ 5,000	↓ $5,000	↓ $5,000
46	0	0	0		
…					
79	0	0	0	0	0
80	0	↑ 10,000	↑ 10,000	↑ 3,554	↑ 937
81	0	↑ 10,000	↑ 10,000	↑ 3,450	↑ 875
82	0	↑ 10,000	↑ 10,000	↑ 3,350	↑ 818
Total			↑$25,000	↑ **$5,354**	↓ **$2,370**

Because the targeted condition imposes a short-term cost, prevention of that condition decreases short-term-care costs (age 45) by $5,000. Those savings end after age 45 because even if the condition had not been prevented, its costs would not persist beyond that age. The long-term impact of preventing the condition is to extend life by three years, from age 79 to 82. Prevention therefore extends typical care costs ($10,000 per year) for three years.

Whether the near-term decrease in cost of $5,000 is worth more or less than the long-term additional costs associated with longer life depends on the discount rate. If costs are discounted at 3 percent, the "present value" of the additional future costs exceeds the $5,000 short-term savings (second column from right in Table 3). If costs are discounted at 7 percent, the short-term savings are worth more than the present value of the added costs associated with longer life (furthest column to right in Table 3). This impact can be seen in published studies. One study of smoking prevention (45) concluded it saves money if a high discount rate is used (at least 5.7 percent). The more common discount rate of 3 percent, however, made competing risks sufficiently large to eliminate any cost savings.

Findings

To avoid the limitations of empirical studies, health economists use decision analysis models to study cost-effectiveness (36, 46). Many questions related to clinical medicine are addressed by empirically studying a patient population. For example, randomized clinical trials compare outcomes for patients randomly assigned to different treatments. Although often well-suited to answering focused questions about a treatment, empirical studies have several limitations (2). In addition, important outcomes – like death – may occur over an extended time period, making empirical study impractical. Finally, some study designs may raise ethical objections (e.g., a randomized trial that assigns some children to ride in cars without using car seats).

Decision models, by contrast, pull together information from different sources, but in doing so, they can introduce uncertainty. For example, to estimate the long-term health benefits of a drug to treat hypertension, a decision model can combine information from one study on how the drug influences blood pressure and information from another study on how blood pressure affects mortality. Decision analysis model results can vary widely depending on their underlying assumptions (see Appendix II). It is important to critically evaluate how well studies have accounted for this uncertainty and hence how definitive the results are.

What information is available on the cost of preventive care?

The literature evaluating the health and economic benefits of prevention is extensive. For example, the Tufts Medical Center Cost-Effectiveness Analysis Registry lists 541 articles published through 2006 that focus on either primary or secondary prevention measures (9). Many other studies of preventive measures do not appear in the Tufts Registry because they do not quantify health benefits in terms of quality adjusted life years (e.g., see studies on smoking prevention reviewed by Sloan et al. (43)).

Because the literature is so extensive, a number of organizations have conducted reviews to highlight useful findings for decision makers. The prominence and potential influence of these reviews makes them a useful subject for this synthesis. One of our goals is to describe where prominent reviews have reached similar or different conclusions regarding particular services, and to identify factors that potentially limit some of the findings.

Reviews included in this synthesis meet the following criteria:

1. Evaluate intervention costs and health benefits. For example, this synthesis does not include reviews of disease burden, or reviews that do not account for intervention costs and instead only estimate savings if disease prevalence could somehow be reduced.
2. Quantify benefits in terms of a general measure, like life years gained or quality adjusted life years gained.
3. Are not limited to a particular intervention or to interventions for a particular subpopulation (e.g., patients at risk for coronary heart disease).

Based on these criteria, the synthesis identified three reviews: National Commission on Prevention Priorities (NCPP) (28), National Business Group on Health (NBGH) (32), and Russell (41).

Although all three reviews meet these criteria, the Russell review differs from the other two in an important respect. The NCPP and NBGH reviews limited attention to clinically recommended preventive measures. Because they reviewed measures whose clinical effectiveness had been established, the NCPP and NBGH reviews ask what can be accomplished by investing in the "best" preventive interventions. Russell, on the other hand, reviewed a range of interventions described in the health economics literature without restricting attention to those focusing on recommended measures. That review therefore investigates the economics of prevention in general.

Findings

What are the strengths and limitations of this information?

Strengths and weaknesses of this literature fall into two categories: those related to the original studies of costs and health benefits for various preventive measures, and those related to the interpretation of these findings by the reviews.

There are numerous limitations in original studies of costs and benefits. Among the most important are the following:

1. *Unrecognized uncertainty:* As described in Appendix II, cost and benefit estimates often depend on models that make many assumptions about factors such as the natural history of a disease (how quickly it progresses and how severe its symptoms are), how accurate a screening test is, the effectiveness of treatment, and treatment costs. A well-conducted study will describe how those assumptions influence cost and benefit estimates. Failure to do so conveys an unrealistic sense of how reliable the estimates are.
2. *Omission of competing risks:* As described earlier, competing risks can offset savings from prevention. Economic analyses often omit these costs, however, apparently in part because they are difficult to estimate, and in part because the U.S. Public Health Service-appointed Panel on Cost-Effectiveness in Health and Medicine (hereafter referred to as the "Panel on Cost-Effectiveness") made their inclusion optional (27). This issue can be important for interventions that have a substantial impact on life expectancy (as opposed to morbidity).
3. *Omission of relevant outcomes:* Economic analyses tend to focus on costs to the health care system. Almost all omit productivity impacts[2] and thus have less relevance to employers. Many omit health care costs not borne by the health care system (e.g., the value of time spent by patients to get treatment). More than half of the recent analyses catalogued in the Tufts Cost-Effectiveness Analysis Registry (2000 through 2005) omit these costs.

Strengths and limitations of the reviews are related to their design and purpose, as described below (see also *Catalog of economic analysis limitations*).

National Commission on Prevention Priorities (NCPP)

NCPP aims to help clinicians and organizational decision-makers prioritize resources among recommended clinical preventive services (29). NCPP limited its review to primary and secondary prevention measures recommended by the U.S. Preventive Services Task Force (USPSTF) through December 2004 for the asymptomatic population and for patients with coronary heart disease (CHD), and to immunizations recommended by the Advisory Committee on Immunization Practices through December 2004.

NCPP emphasized the importance of relying on evaluations that used comparable methods. In addition to requiring compliance with recommendations by the Panel on Cost-Effectiveness (16), NCPP required comparison of each preventive measure with no provision of preventive services. Costs and benefits had to include lifetime impacts for all Americans born over the period of one year (including patient impacts, such as lost time). When an analysis meeting these requirements was not available in the primary literature, NCPP developed their own analysis. Assumptions were based on well-conducted literature reviews. NCPP's review had the following limitations:

2 The Panel on Cost-Effectiveness recommends against inclusion of productivity impacts in the numerator of the cost-effectiveness ratio (the change in costs), arguing that productivity considerations are already accounted for by the assigned QALY value and hence inclusion of productivity impacts in the numerator would constitute double counting of this factor (27). Others contend that productivity impacts should be explicitly included in the CE ratio numerator (4, 31, 39).

1. *Estimates apply to the hypothetical "average" individual:* Because detailed simulation modeling for all the reviewed interventions would have been impractical, NCPP used a simplified approach to calculate costs and health benefits. In effect, NCPP calculated costs and benefits for a hypothetical "average" individual for the population. Because the costs and benefits of a preventive measure averaged over all members of a population are not the same as the costs and benefits for the hypothetical "average" member of that population, this approach can introduce some inaccuracy. For example, in a population consisting of 30-year-olds and 70-year-olds in equal parts, it would be inaccurate to assume that the average value of screening for Alzheimer's disease can be estimated by calculating the value of screening 50-year-olds.
2. *Costs and benefits may not apply to new patients:* Decision-makers considering investments to increase the use of prevention need to know what the costs and benefits will be for new patients receiving the intervention. NCPP computed costs and benefits for all individuals, including those who already receive it. The average cost and average benefits over all individuals may not be the same as the marginal cost and marginal benefits for new treatment recipients. For example, some individuals may not receive a service already because the benefits to them would be less than they are for those who already receive the service. Similarly, the cost of delivering a service to those not already receiving it may be greater than the cost for those already receiving it. In short, if there is a "diminishing marginal return" associated with a service, the NCPP-estimated cost-effectiveness may be more favorable than is realistic for the purpose of evaluating future investments to expand the service's use.
3. *Analysis not yet available:* Because the NCPP effort is a work in progress, the group has not yet released supporting documentation for all of its estimates.

National Business Group on Health (NBGH)

NBGH reviewed data on the health and economic impacts of preventive interventions found to be effective by the USPSTF, the Centers for Disease Control and Prevention (CDC), and other "authoritative" organizations (32). They described their review as "an information source for employers on clinical preventive service benefit design."

Based on their review of the published health economics literature, NBGH provides estimates of cost-effectiveness (or evidence of cost savings) for many of the interventions included in their report. Because these estimates are based on studies conducted by others, the estimates are not always directly comparable. For example, one estimate may reflect informal care costs (e.g., family caregiver time for an Alzheimer's disease patient), while another may omit these costs. In addition to limitations described above, the NBGH estimates also had the following limitations in some cases:

1. *Analyzed and recommended interventions do not match:* In some cases, the intervention analyzed was not consistent with the described intervention. For example, the populations recommended to receive the intervention might differ from those analyzed. In other cases, the analysis evaluated the impact of a change in behavior (e.g., a successful reduction in smoking), rather than the impact of an intervention designed to achieve that behavior change (e.g., an anti-smoking education program).
2. *No systematic literature review:* NBGH did not specify a methodology for identifying relevant literature for the interventions they reviewed. Although some of the conclusions are based on comprehensive literature reviews, most do not appear to be.

Russell

Russell (41) reviewed selected studies that evaluated the costs and health benefits for screening measures, immunizations and medications. Because the Russell evaluation reported estimates from published cost-effectiveness analyses, it is subject to the limitations inherent in those studies. Moreover, because Russell did not set out to comprehensively review the literature, there is no assurance that the findings represent the results described in the literature as a whole. Limitations relevant to the Russell review are included among those that have been enumerated above.

Which preventive measures save money or deliver good value?

This section summarizes the findings of the reviews conducted by NCPP, NBGH, and Russell. We divide the interventions into three major categories: medications and immunizations (Table 4), screening (Table 5), and lifestyle modifications (Table 6). The tables illustrate a spectrum of cost-saving or cost-effective outcomes, as well as both concurrence and differences among the three reviews. For each intervention, the tables summarize the findings reported by each review[3] (in 2007 dollars) and identify key limitations. The tables identify these limitations by numeric code (see *Catalog of economic analysis limitations*).

3 Note that the interventions evaluated by NCPP, NBGH, and Russell are not precisely equivalent. Appendix III provides additional information on the interventions addressed by each review.

Catalog of economic analysis limitations

Tables 4–6 list limitations by code number in parentheses along with each estimate. The code numbers correspond to the list that appears above. For example, "(6)" indicates that the analysis supporting a reported estimate is not yet available. If needed, further detail appears in the far right column of these tables. Conditions for listing limitations include the following:

1. **Unrecognized uncertainty:** This factor is likely to be a limitation for many of the listed cost-effectiveness estimates because the underlying analyses failed to identify and address important sources of uncertainty. We flag this limitation, however, only if we identify a specific assumption that is not adequately treated and for which the resulting uncertainty introduced could be important.
2. **Omission of competing risks:** Although none of the analyses explicitly address competing risks, this limitation is listed only if it appears that it could be an important consideration. For example, it is not listed if the preventive measure does not substantially influence mortality.
3. **Omission of relevant outcomes:** Unless otherwise noted, this limitation indicates that productivity impacts were not explicitly accounted for. This limitation is listed only if this outcome is expected to be important (e.g., it is not listed for measures whose impact largely affects retired populations). Nor is the omission of productivity improvements listed if the analysis already reports the intervention is cost-saving.
4. **Estimates apply to the mythical "average" individual:** Listed for many estimates based on NCPP-conducted analyses. This limitation is not listed if the NCPP methods have not yet been released (see limitation (6)).
5. **Costs and benefits may not apply to new patients:** NCPP explicitly estimates cost-effectiveness of the preventive measure for all members of the population – not just those who do not already receive this service. The resulting cost-effectiveness estimate may not be applicable to those not yet receiving it if most eligible individuals already receive the service. We list this limitation if more than half the eligible population already receives the intervention.
6. **Analysis not yet available:** The tables list this limitation for NCPP estimates not supported by published analyses as of October 6, 2008.
7. **Analyzed and recommended interventions do not match:** We list this limitation if it appears that the analysis supporting the cost-effectiveness or cost-savings estimate does not correspond to the intervention of interest (e.g., due to important differences related to the details of the intervention, the assumed eligible population, or the alternative with which the intervention is compared).
8. **No systematic literature review:** We list this limitation only if the estimated cost-effectiveness or cost savings is based on a very limited subset of the literature.

Table 4: Cost-effectiveness: medications and immunizations

Intervention	NCPP	NBGH	Russell	Comments / Limitations
Medications				
Counsel adults about low dose aspirin use to prevent CHD	Cost-saving (2)	Cost-saving (2)	Cost-saving (2,8)	
Counsel women on contraception use	Not reported	Cost-saving (7)	Not reported	NBGH (7): The analysis evaluates the impact of contraceptive methods on costs but does not evaluate the impact of counseling.
Counsel women on folic acid supplementation	$17K–$42K (6)	$7K (3,7,8)	Not reported	NBGH (7): Estimate addresses folic acid use, not counseling to encourage use. The cost-effectiveness estimate was calculated prior to widespread folic acid fortification in the U.S.
Counsel women to use calcium supplements	$17K–$42K (6)	Not reported	Not reported	
Immunizations				
Childhood immunizations	Cost-saving (5,6)	Cost-saving (5)	Cost-saving (5,7,8)	Russell (7): Varicella immunization only.
Adult immunizations — pneumococcus	Cost-saving (2,5)	Not reported	Not reported	NCPP (5): 62% of eligible population already receive this immunization.
Adult immunizations — influenza	$1K–$34K (2,4,5)	Cost-saving (2,7)	Not reported	NCPP (5): 70% of age 65+ and 41% of ages 50–64 already receive influenza vaccination. NCPP range is for ages 50–64 ($34K/QALY) and ages ≥ 65 ($1K/QALY). NBGH (7): Estimate is for vaccination of adults ages 65+. Policy is for adults (age not specified).
Adult tetanus-diphtheria booster every 10 years	$200K–$540K (6)	Not reported	Not reported	

Note: Cost savings or cost-effectiveness ratio is in $/QALY unless otherwise indicated. All figures are in 2007 dollars. See text box for an explanation of the limitations, identified here by number.

Table 5: Cost-effectiveness: screening

Intervention	NCPP	NBGH	Russell	Comments / Limitations
Coronary heart disease				
Hypertension screening for all adults	$38K (2,4,5)	Cost-saving (2,7,8)	$29K (2,8)	NCPP (5): 58% of eligible population already receives intervention. Russell estimate is for beta blockers; other medications had less favorable ratios. Cited evidence is for treatment, not screening and counseling.
Cholesterol screening; medications for adults with elevated lipid levels	$46K (2,4,5)	Cost-effectiveness discussed but not quantified	$85K–$210K (2,8)	NCPP (5): 71% of eligible population already receives intervention. Russell range corresponds to screening of high-risk males ($85K/QALY) and females ($210K/QALY).
Diabetes screening	$200K–$540K (6)	$44K (2,7)	$51K	NBGH (7): Estimate reflects assumption that screening is limited to 55-year-olds with hypertension. Policy evaluated includes ages 30+.
Cancer				
Colorectal cancer screening	$14K (2)	$12K–$36K per Life Year (2)	$2K–$21K per Life Year (8)	
Breast cancer screening	$58K (2,5)	$39K–$101K per Life Year (2,3,7)	$31K per Life Year (8)	NCPP (5): 60% of eligible population already receives intervention. NBGH (7): CE ratio is for women ages 65+ but intervention described is for women ages 40–80.
Cervical cancer screening	$21K (2,5)	$14K (2,3,8)	$41K per Life Year (8)	NCPP (5): 78% of eligible population already receives intervention.
Sexually transmitted diseases				
Gonorrhea screening	Not reported	Cost-saving (7)	Not reported	NBGH (7): Estimate based on analysis of screening women ages 15–29 in urban emergency departments only.
HIV screening	Not reported	Cost-saving (2,3)	$35K–$68K (8)	NBGH value is for screening of pregnant women; Russell value is for screening of general population.
Hepatitis B screening in pregnant women	Not reported	$240 per Life Year (2,3,8)	Not reported	
Chlamydia screening	< $17K (6)	< $30K (7)	Not reported	NBGH (7): Estimate assumes annual screening of women ages 15–29 only and semiannual screening of women with infection history.
Pediatric health				
Prenatal neural tube defect and chromosomal abnormality screening	Not reported	Cost-saving (2,3,8)	Not reported	NBGH: Estimate of cost savings reflects costs avoided following assumed voluntary pregnancy termination.
Lead exposure screening	Not reported	Cost-saving (7,8)	Not reported	NBGH (7): Estimate reflects assumed prevalence of elevated blood lead levels substantially exceeding current national average. NBGH does not specify remediation conducted if child with elevated lead levels is identified.
Newborn screening for metabolic disorders	Not reported	Cost-saving to $35K per Life Year or QALY (depends on intervention)	Not reported	NBGH: Costs and benefits depend on which disorder is screened for. Reasonable evidence to support cost-effectiveness of intervention.
Vision screening	< $17K (6)	$3K (7,8)	Not reported	NBGH (7): Estimate accounts for treatment costs but not screening costs. Analysis pertains to only one type of disorder (amblyopia).

Table 5: Cost-effectiveness: screening (continued)

Intervention	NCPP	NBGH	Russell	Comments / Limitations
Adult health — Other				
Vision screening — ages ≥ 65	Cost-saving (6)	Not reported	Not reported	
Abdominal aortic aneurysm screening for men 60–74	Not reported	$16K–$23K (2)	$22K per Life Year (8)	NBGH restricts attention to individuals who have smoked, but Russell does not.
Screen adults for depression	$200K–$540K (6)	Not reported	Not reported	
Screen adults for hearing loss	$42K–$200K (6)	Not reported	Not reported	
Screen women for osteoporosis	$42K–$200K (6)	Cost-effectiveness discussed but not quantified	Not reported	

Note: Cost savings or cost-effectiveness ratio is in $/QALY unless otherwise indicated. All figures are in 2007 dollars. See text box for an explanation of the limitations, identified here by number.

Table 6: Cost-effectiveness: lifestyle modifications

Intervention	NCPP	NBGH	Russell	Comments / Limitations
Problem drinking screening and counseling	Cost-saving (1,2,4)	Cost-saving (2,8)	Not reported	NCPP (1): Uncertainty attending assumptions regarding the impact of behavior on health and the impact of intervention on behavior was not adequately addressed.
Counsel parents on breast-feeding	Not reported	Cost-saving (7,8)	Not reported	NBGH (3): Based on savings to federal Women, Infants and Children (WIC) program. NBGH (7): Does not account for counseling costs or imperfect adherence.
Tobacco screening and prevention	Cost-saving (1,2,4)	Cost-saving (2)	$5K (8)	NCPP (1): Cost-effectiveness appears favorable but cost savings uncertain. Assumed effectiveness of repeated counseling not robust. NBGH (3): Estimate based on a study from an employer perspective.
Counsel parents on motor vehicle injury prevention	$17K–$42K (6)	Cost-saving (8)	Not reported	
Adult obesity screening followed by lifestyle counseling, medications or surgery	$42K–$200K (6)	Cost-effectiveness discussed but not quantified	Not reported	NBGH qualified conclusion because its estimate is based on studies outside of U.S., limiting their applicability in the U.S. (differences in payment system). Analysis was limited to treatment of morbidly obese (BMI > 40).
Diet counseling for adults with CVD and diet-related risk factors	$200K–$540K (6)	Cost-saving (2,3,7,8)	$190K (7,8)	NBGH (7): Evidence is for program used in a low-income population. Generalizability to entire population not clear. Russell (7): Estimate is based on analysis of diet and exercise counseling offered to middle-aged, overweight individuals at risk for diabetes based on an oral glucose test.

Note: Cost savings or cost-effectiveness ratio is in $/QALY unless otherwise indicated. All figures are in 2007 dollars. See text box for an explanation of the limitations, identified here by number.

Findings

Cost-saving interventions

A substantial number of interventions are described as cost-saving by one or more of the three literature reviews. Two interventions – counseling on the use of low dose aspirin to reduce coronary heart disease and childhood immunizations – were estimated to be cost-saving by all three reviews. Many of the analyses claiming cost savings have important limitations, however. For example, competing risk costs are not addressed by analyses of programs to counsel adults about low dose aspirin use to prevent coronary heart disease (CHD), adult immunization against pneumococcus, and tobacco screening and prevention programs.

Another common problem is inconsistency between the interventions described and the interventions evaluated. For example, the NBGH evaluation of folic acid supplementation *counseling* looked at the impact of folic acid *use*. In short, it assumed that counseling will alter behavior with 100% effectiveness.

Analyses described by NCPP use the average population results to estimate cost-effectiveness for the remaining portion of the population not yet receiving an intervention. However, when the segment of the population not yet receiving the service is small, this approach may be inaccurate. For example, increasing the childhood vaccination rate may involve costs not incurred to achieve vaccination among children who already receive immunizations. Note that expanded service provision may still be desirable to decision-makers even if it is less efficient than the existing provision of services. For example, less stringent cost-effectiveness requirements may be appropriate if the newly served populations are socioeconomically disadvantaged.

Finally, some results are questionable because they lack evidence that uncertain assumptions have been adequately accounted for or there is no evidence that the findings are representative of the literature. Evaluations of lifestyle modification interventions, such as alcohol use counseling and tobacco prevention or cessation programs, are relatively uncertain. This problem stems in part from the challenge posed by conducting randomized studies of behavioral interventions.

Interventions with good value (cost-effectiveness ratio ≤ $100,000/QALY)

Although the cost-effectiveness evidence for a number of interventions is limited, the evidence for others is more compelling. These include: counseling women to use calcium supplements, colorectal cancer screening, hepatitis B screening in pregnant women, and counseling parents about motor vehicle injury prevention. Cervical cancer screening and breast cancer screening may also be cost-effective if average population cost-effectiveness estimates reported by NCPP are applicable to women not yet receiving these services.

Expensive interventions (cost-effectiveness ratio > $100,000/QALY)

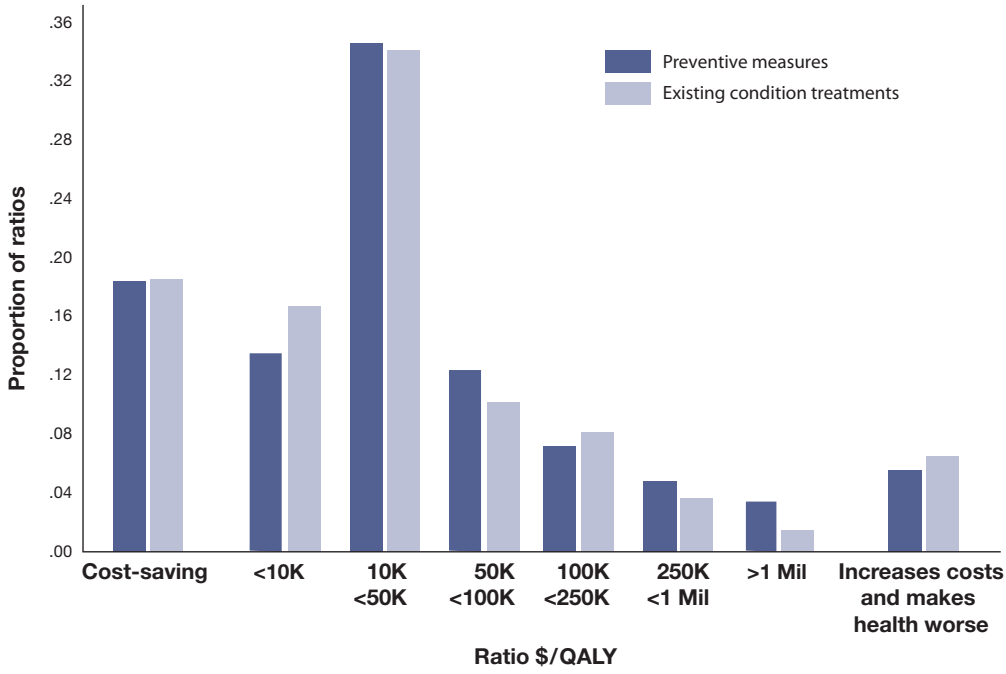
Several interventions are included on lists recommending their use because of their efficacy despite evidence that they cost a lot relative to their health benefits. Examples include adult tetanus-diphtheria booster shots every 10 years (Immunizations, in Table 4) and some of the screening of adults for depression, hearing loss, and osteoporosis (women), which cost several hundred thousand dollars per QALY (Adult health – Other, in Table 5).

The fact that the number of interventions identified as "expensive" by these reviews is relatively small may reflect the selection process. Both NCPP and NBGH focused on preventive services already determined to be effective. Cohen et al. (9), however, determined that a substantial proportion of preventive measures evaluated in the health economics literature have unfavorable cost-effectiveness ratios (see *The distribution of cost-effectiveness ratios*).

The distribution of cost-effectiveness ratios: A survey of the health economics literature

Using information recorded in the Tufts Medical Center Cost-Effectiveness Analysis Registry, Cohen et al. (9) compared the distribution of cost-effectiveness ratios for preventive measures and for treatment. Figure 2 is based on that analysis, which reflected articles published through the end of 2005. As the figure illustrates, there is no evidence based on this dataset that preventive measures are more efficient than disease and condition treatments.

Figure 2: Distribution of cost-effectiveness ratios for prevention and treatment interventions



Notes: Based on data from Cohen et al. (9). "Preventive" measures include primary and secondary interventions, while "treatments" include tertiary interventions.

Several factors limit this analysis. First, the analysis included only cost-utility analyses (cost-effectiveness studies that quantify health benefits in terms of quality adjusted life years). Relative to their disease burden, this literature underrepresents interventions to address mental health and substance abuse (33). Moreover, a select subset of the preventive measures (e.g., those recommended by the US Preventive Services Task Force) might have a more favorable distribution of cost-effectiveness ratios. On the other hand, a comparable set of "recommended" treatments might also have a more favorable distribution of cost-effectiveness ratios. Second, the included studies did not always compare interventions with the relevant alternative (i.e., no prevention). For example, studies sometimes compared universal screening with targeted screening (20). Third, because the findings are based on a secondary analysis of the literature, they reflect the limitations of the primary analyses (e.g., omission of productivity impacts and care costs associated with longer life). Finally, differences in methodology across studies can make it difficult to meaningfully compare ratios.

How could cost-effectiveness reviews be improved?

The limitations noted for many of the evaluations listed in Tables 4–6 qualify the reported estimates of cost savings and cost-effectiveness. The NCPP evaluations are the most reliable because their use of a uniform methodology ensures the intervention and population reflected in the analysis match the intended intervention and population. The NCPP evaluations also generally do a good job at systematically surveying the literature and characterizing the impact of important sources of uncertainty on their reported estimates. Because NBGH and Russell rely on published analyses, they do not perform as well with respect to these characteristics.

The NCPP evaluations could be made more useful as follows.

- First, they could include a version of the analysis that explicitly accounts for worker productivity gains. That information would be useful to employers.

- Second, the evaluations could include a version of the analysis that accounts for the impact of competing risks. Competing risk costs are real and of particular relevance to the Medicare program because it is responsible for health care costs that occur late in life.

- Third, in addition to estimating an intervention's average costs and savings for the entire population, the evaluations could include a separate analysis describing how these costs and benefits may differ for members of the population who do not yet receive the intervention. Those costs and benefits are the most relevant estimates for the purpose of determining the economic impact of expanded investments in prevention.

Finally, the systematic approach used by NCPP and applied to a list of clinical measures recommended by the U.S. Preventive Services Task Force, could be expanded. For example, the NBGH review addresses many interventions not evaluated by NCPP. In addition, this approach could be used to evaluate nonclinical preventive measures. The data for community interventions are more limited. Systematic analysis of these measures would provide useful estimates, however, and would help to identify important data gaps so that future data gathering efforts could be prioritized.

Conclusion

While the achievement of cost savings through prevention is beneficial, it is important to keep in mind that the goal of prevention, like other health initiatives, is to improve health (15). Even those interventions that cost more than they save can still be desirable. Because health care resources are finite, however, it is useful to identify those interventions that deliver the greatest health benefits relative to their incremental costs. In addition, it may be possible to improve intervention cost-effectiveness by targeting higher-risk populations, although identifying high-risk individuals may itself consume substantial resources, depending on how difficult this task is.

Ultimately, identifying interventions that are cost-saving or cost-effective is only part of the problem. Decision-makers must also understand which desirable interventions are already reaching the vast majority of the eligible population, and which could achieve greater benefit by increasing their use among people not yet served – recognizing that those people may be costly to reach. Finally, incentives may be necessary to encourage use of the most favorable preventive services. Taken together, these steps can help maximize the health benefits that can be achieved through prevention while ensuring that limited economic resources are wisely used.

Implications for Policy-Makers

Based on the literature synthesized in this report, there are relatively few clinical preventive interventions for which there is strong evidence of cost savings. Moreover, many preventive interventions that do save money are already in widespread use (e.g., childhood immunizations), thus limiting the potential for additional savings. For these reasons, it is unlikely that substantial cost savings can be achieved by increasing the level of investment in clinical preventive measures. On the other hand, this review has shown that many preventive measures deliver substantial health benefits given their costs. Keeping this in mind, the following policy implications can be drawn from this synthesis:

- **By playing a role in the production of cost-effectiveness information, the federal government could help to ensure its relevance and the transparency of its methodology.** The federal government has produced some of this information through research sponsored by the Agency for Health Care Research and Quality (AHRQ) and the National Institutes of Health (NIH), but a greater role would help ensure decision-makers have access to analyses that evaluate services of greatest salience, that those services are compared with the most relevant alternatives, and that the analyses are supported by the best available science.
- **Systematic evaluations of preventive measures can help identify promising opportunities to invest society's health care resources.** For example, Congress has at times added preventative benefits to the Medicare program (e.g., mammography screening, cardiovascular screening tests and diabetes screening). In addition, the Medicare Improvement and Patient Protection Act of 2008 (MIPPA) authorized the Department of Health and Human Services (HHS) to include clinical preventive services with high ratings from the U.S. Preventive Services Task Force (USPSTF) in Medicare's national coverage determinations. Use of cost-effectiveness analysis by the Centers for Medicare and Medicaid Services (CMS) to evaluate additional candidate measures would help Congress better understand the merits of alternative program options.
- **Developers of clinical guidelines should incorporate cost-effectiveness information into their reviews.** For example, USPSTF presents cost-effectiveness information (separately from its recommendations) for measures with evidence of effectiveness. This information helps the medical community understand where limited resources would have the largest impact on population health. Moreover, the role of the USPSTF in the MIPPA legislation could facilitate HHS's use of the cost-effectiveness information USPSTF gathers.

Importantly, policy-makers should consider whether an emphasis on achieving savings from preventive medicine is appropriate. After all, society invests in health care not to save money, but to improve health. A better question to ask – of both preventive medicine and of treatments – is whether current expenditures deliver good value even they do not achieve savings. Focusing on value, rather than on savings, can reduce the risk of overlooking helpful preventive measures. Emphasizing the more realistic goal of good value for all medical care holds the most promise for improving health in a fiscally sustainable manner.

Key Questions About Cost-Effectiveness Analyses

For policy-makers to be critical consumers of cost-effectiveness information, the following questions should be considered:

- How robust are the findings in light of the assumptions that underlie estimates of cost savings or cost-effectiveness? Has the analysis taken into account potentially important sources of uncertainty, such as plausible alternative model structures, the range of plausible parameter values, and modeling methodology assumptions (e.g., the use of Markov models)?
- What intervention does the analysis actually evaluate? What are the implementation details (e.g., type of drug, screening frequency, intensity of counseling)? What population is targeted?
- What perspective does the analysis assume? Does the analysis account for relevant costs and savings, such as productivity impacts? Accounting for productivity impacts should receive greater attention in the health economics literature.
- If the preventive service has the potential to increase life expectancy, does the analysis account for the impact of competing risks (i.e., additional care costs associated with longer life)? If so, what discount rate was used? The impact of competing risks should also receive greater attention in the health economics literature.
- Are conclusions based on a comprehensive review of the literature? At the very least, is the cited evidence consistent with other studies that are not discussed?

In addition, policy-makers should understand how widespread current use is for different preventive measures. This information, together with information on cost-effectiveness, can help policy-makers understand the budget impacts of shifts in medical practices, and what the potential population health benefits will be.

Appendix I References

1. Alemayehu B, and Warner KE. "The Lifetime Distribution of Health Care Costs." *Health Services Research* vol. 39, no. (3): 627–642. 2004.
2. Avorn J. "In Defense of Pharmacoepidemiology — Embracing the Yin and Yang of Drug Research." *New England Journal of Medicine* vol. 357, no. (22): 2219–2221. 2007.
3. Braithwaite RS, Meltzer DO, King JT, Jr., Leslie D, Roberts MS. "What Does the Value of Modern Medicine Say About the $50,000 Per Quality-Adjusted Life-Year Decision Rule?" *Medical Care* vol. 46, no. (4): 349–356. 2008.
4. Brouwer WB, Koopmanschap MA, Rutten FF. "Productivity Costs Measurement Through Quality of Life? A Response to the Recommendation of the Washington Panel." *Health Economics* vol. 6, no. (3): 253–259. 1997.
5. Carande-Kulis VG, Maciosek MV, Briss PA, Teutsch SM, Zaza S, Truman BI, Messonnier ML, Pappaioanou M, Harris JR, Fielding J. "Methods for Systematic Reviews of Economic Evaluations for the Guide to Community Preventive Services. Task Force on Community Preventive Services." *American Journal of Preventive Medicine* vol. 18, no. (1 Suppl): 75–91. 2000.
6. Chapman RH, Berger M, Weinstein MC, Weeks JC, Goldie S, Neumann PJ. "When Does Quality-Adjusting Life-Years Matter in Cost-Effectiveness Analysis?" *Health Economics* vol. 13, no. (5): 429–436. 2004.
7. Claxton G, Gabel J, DiJulio B, Pickreign J, Whitmore H, Finder B, Jacobs P, Hawkins S. "Health Benefits in 2007: Premium Increases Fall to an Eight-Year Low, While Offer Rates and Enrollment Remain Stable." *Health Affairs (Millwood.)* vol. 26, no. (5): 1407–1416. 2007.
8. Claxton K, Cohen JT, Neumann PJ. "When Is Evidence Sufficient?" *Health Affairs (Millwood.)* vol. 24, no. (1): 93–101. 2005.
9. Cohen JT, Neumann PJ, Weinstein MC. "Does Preventive Care Save Money? Health Economics and the Presidential Candidates." *New England Journal of Medicine* vol. 358, no. (7): 661–663. 2008.
10. Cutler DM, Rosen AB, Vijan S. "The Value of Medical Spending in the United States, 1960–2000." *New England Journal of Medicine* vol. 355, no. (9): 920–927. 2006.
11. Diehr P, Patrick DL, Bild DE, Burke GL, Williamson JD. "Predicting Future Years of Healthy Life for Older Adults." *Journal of Clinical Epidemiology* vol. 51, no. (4): 343–353. 1998.
12. Drummond M, Sculpher M, Torrance G, O'Brien B, and Stoddart G. *Methods for the Economic Evaluation of Health Care Programmes*. Oxford UK: Oxford University Press, 2005.
13. Ford ES, Ajani UA, Croft JB, Critchley JA, Labarthe DR, Kottke TE, Giles WH, Capewell S. "Explaining the Decrease in U.S. Deaths From Coronary Disease, 1980–2000." *New England Journal of Medicine* vol. 356, no. (23): 2388–2398. 2007.
14. Ginsburg P. *High and Rising Health Care Costs: Demystifying U.S. Health Care Spending*. Washington, DC: Robert Wood Johnson Foundation, 2008.
15. Goetzel RZ. "Do Prevention or Treatment Services Save Money? The Wrong Debate." *Health Affairs (Millwood.)* vol. 28, no. (1): 37–41. 2009.
16. Gold M, Siegel JE, Russell L.B., and Weinstein MC. *Cost-Effectiveness in Health and Medicine*. New York: Oxford University Press, 1996.
17. Goldhaber-Fiebert JD, Stout NK, Ortendahl J, Kuntz KM, Goldie SJ, Salomon JA. "Modeling Human Papillomavirus and Cervical Cancer in the United States for Analyses of Screening and Vaccination." *Population Health Metrics* vol. 5: 11. 2007.
18. Halpern MT, McKenna M, Hutton J. "Modeling in Economic Evaluation: an Unavoidable Fact of Life." *Health Economics* vol. 7, no. (8): 741–742. 1998.
19. Hirth RA, Chernew ME, Miller E, Fendrick AM, Weissert WG. "Willingness to Pay for a Quality-Adjusted Life Year: in Search of a Standard." *Medical Decision Making* vol. 20, no. (3): 332–342. 2000.
20. Hoerger TJ, Harris R, Hicks KA, Donahue K, Sorensen S, Engelgau M. "Screening for Type 2 Diabetes Mellitus: a Cost-Effectiveness Analysis." *Annals of Internal Medicine* vol. 140, no. (9): 689–699. 2004.
21. Holahan J, and Cook A. "The U.S. Economy and Changes in Health Insurance Coverage, 2000–2006." *Health Affairs (Millwood.)* vol. 27, no. (2): w135–w144. 2008.
22. Jacobs RJ, Greenberg DP, Koff RS, Saab S, Meyerhoff AS. "Regional Variation in the Cost Effectiveness of Childhood Hepatitis A Immunization." *Pediatric Infectious Disease Journal* vol. 22, no. (10): 904–914. 2003.
23. Jonsson B, Carides GW, Burke TA, Dasbach EJ, Lindholm LH, Dahlof B. "Cost Effectiveness of Losartan in Patients With Hypertension and LVH: an Economic Evaluation for Sweden of the LIFE Trial." *Journal of Hypertension* vol. 23, no. (7): 1425–1431. 2005.

Appendix I References

24. Kim JJ, Kuntz KM, Stout NK, Mahmud S, Villa LL, Franco EL, Goldie SJ. "Multiparameter Calibration of a Natural History Model of Cervical Cancer." *American Journal of Epidemiology* vol. 166, no. (2): 137–150. 2007.

25. Lipscomb J, Weinstein MC, and Torrance GW. Time preference. In *Cost-Effectiveness in Health and Medicine*, eds M Gold, J Siegel, L Russell and M Weinstein, 214–246. New York: Oxford University Press. 1996.

26. Lubitz J, Cai L, Kramarow E, Lentzner H. "Health, Life Expectancy, and Health Care Spending Among the Elderly." *New England Journal of Medicine* vol. 349, no. (11): 1048–1055. 2003.

27. Luce B, Manning W, Siegel J, and Lipscomb J. Estimating the costs in cost-effectiveness analysis. In *Cost-Effectiveness in Health and Medicine*, eds M Gold, J Siegel, L Russell and M Weinstein, 176–213. New York: Oxford University Press. 1996.

28. Maciosek MV, Coffield AB, Edwards NM, Flottemesch TJ, Goodman MJ, Solberg LI. "Priorities Among Effective Clinical Preventive Services: Results of a Systematic Review and Analysis." *American Journal of Preventive Medicine* vol. 31, no. (1): 52–61. 2006a.

29. Maciosek MV, Edwards NM, Coffield AB, Flottemesch TJ, Nelson WW, Goodman MJ, Solberg LI. "Priorities Among Effective Clinical Preventive Services: Methods." *American Journal of Preventive Medicine* vol. 31, no. (1): 90–96. 2006b.

30. Medicare Payment Advisory Commission. *Increasing the Value of Medicare*. Washington, DC, 2006.

31. Meltzer D, and Johannesson M. "Inconsistencies in the "Societal Perspective" on Costs of the Panel on Cost-Effectiveness in Health and Medicine." *Medical Decision Making* vol. 19, no. (4): 371–377. 1999.

32. National Business Group on Health. A Purchaser's Guide to Clinical Preventive Services: Moving Science into Coverage., 2007.

33. Neumann PJ, Rosen AB, Greenberg D, Olchanski NV, Pande R, Chapman RH, Stone PW, Ondategui-Parra S, Nadai J, Siegel JE, Weinstein MC. "Can We Better Prioritize Resources for Cost-Utility Research?" *Medical Decision Making* vol. 25, no. (4): 429–436. 2005.

34. Olsen J. Disease prevention and control of non-communicable diseases. In *Oxford Textbook of Public Health*, eds R Detels, J McEwen, R Beaglehole and H Tanaka, 1811–1822. New York: Oxford University Press. 2002.

35. Orszag PR, and Ellis P. "The Challenge of Rising Health Care Costs — a View From the Congressional Budget Office." *New England Journal of Medicine* vol. 357, no. (18): 1793–1795. 2007.

36. Philips Z, Ginnelly L, Sculpher M, Claxton K, Golder S, Riemsma R, Woolacoot N, Glanville J. "Review of Guidelines for Good Practice in Decision-Analytic Modelling in Health Technology Assessment." *Health Technology Assessment* vol. 8, no. (36): iii–xi, 1. 2004.

37. Prosser LA, Stinnett AA, Goldman PA, Williams LW, Hunink MG, Goldman L, Weinstein MC. "Cost-Effectiveness of Cholesterol-Lowering Therapies According to Selected Patient Characteristics." *Annals of Internal Medicine* vol. 132, no. (10): 769–779. 2000.

38. Ramsey SD. "Methods for Reviewing Economic Evaluations of Community Preventive Services: a Cart Without a Horse?" *American Journal of Preventive Medicine* vol. 18, no. (1 Suppl): 15–17. 2000.

39. Rothermich EA, and Pathak DS. "Productivity-Cost Controversies in Cost-Effectiveness Analysis: Review and Research Agenda." *Clinical Therapy* vol. 21, no. (1): 255–267. 1999.

40. Russell LB. "Preventing Chronic Disease: an Important Investment, but Don't Count on Cost Savings." *Health Affairs (Millwood.)* vol. 28, no. (1): 42–45. 2009.

41. Russell L. *Prevention's Potential for Slowing the Growth of Medical Spending*. Washington, DC: National Coalition on Health Care, 2007.

42. Schoen C, Collins SR, Kriss JL, Doty MM. "How Many Are Underinsured? Trends Among U.S. Adults, 2003 and 2007." *Health Affairs (Millwood.)* vol. 27, no. (4): w298–w309. 2008.

43. Sloan F, Ostermann G, Conover C, and Taylor D. *The Price of Smoking*. Cambridge, MA: The MIT Press, 2004.

44. US Department of Health and Human Services. Healthy People 2010. 2nd ed. With Understanding and Improving Health and Objectives for Improving Health. 2 vols. Washington, DC: Government Printing Office, 2000.

45. van Baal PH, Polder JJ, de Wit GA, Hoogenveen RT, Feenstra TL, Boshuizen HC, Engelfriet PM, Brouwer WB. "Lifetime Medical Costs of Obesity: Prevention No Cure for Increasing Health Expenditure." *PloS Medicine* vol. 5, no. (2): e29. 2008.

46. Weinstein M, and Feinberg H. *Clinical Decision Analysis*. Philadelphia, PA: WB Saunders Company, 1980.

47. Zaza S, Briss P, and Harris K. *Preventive Services: What Works to Promote Health*. New York: Oxford University Press, 2005.

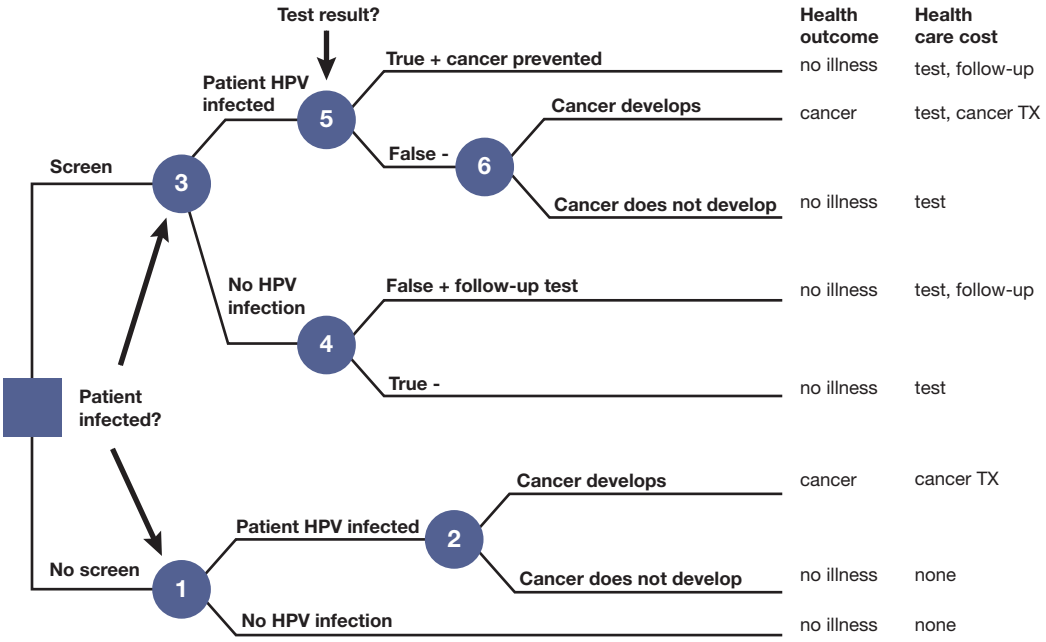
Appendix II Decision Analysis Models

This appendix describes two examples of decision analysis models to evaluate the cost-effectiveness of screening women for human papillomavirus (HPV), an infection that can cause cervical cancer. The first model helps to illustrate how decision models can be used to compare the costs and health benefits of alternative treatments. The second example illustrates a more realistic (and complex) model. Finally, this appendix discusses the use of assumptions in decision analysis models and how they contribute to uncertainty.

Simple model

Figure 2.1 illustrates a simple decision analysis model to evaluate a cervical cancer screening program.

Figure 2.1: Simple decision analysis model for cervical cancer screening



The "decision tree" in Figure 2.1 starts at the left side of the figure at the square "decision" node. This decision can be thought of as applying to a series of patients. The fate of patients who undergo screening can be compared with the fate of patients who do not. After the screening decision is made for an individual patient, that patient travels along either the top or bottom branch emanating from the square decision node and next encounters a round "chance" node representing the possibility that she is infected with HPV or is not.

No screen option: HPV-positive patients may develop cancer. Each patient who develops cancer incurs costs associated with cancer treatment and suffers the health effects associated with cancer. For HPV-negative patients, there are no further health impacts and no additional health care costs.

Screen option: Patients who are HPV-infected undergo screening. If the test result is (true) positive, treatment is initiated that is assumed to be 100% effective at preventing cancer from developing. These patients incur the costs associated with the screening test, a follow-up test, and cancer-prevention therapy. They do not suffer any further health effects. For HPV-infected patients who test (false) negative, cancer may develop. If cancer develops, cancer treatment costs are incurred in addition to screening test costs. If cancer does not develop, only screening test costs are incurred. Patients who are not HPV-infected undergo screening. If the screening test reports a (false) positive result, follow-up test and possibly cancer-prevention therapy costs are incurred in addition to the original screening test costs. If the test reports a (true) negative result, only the original screening test costs are incurred.

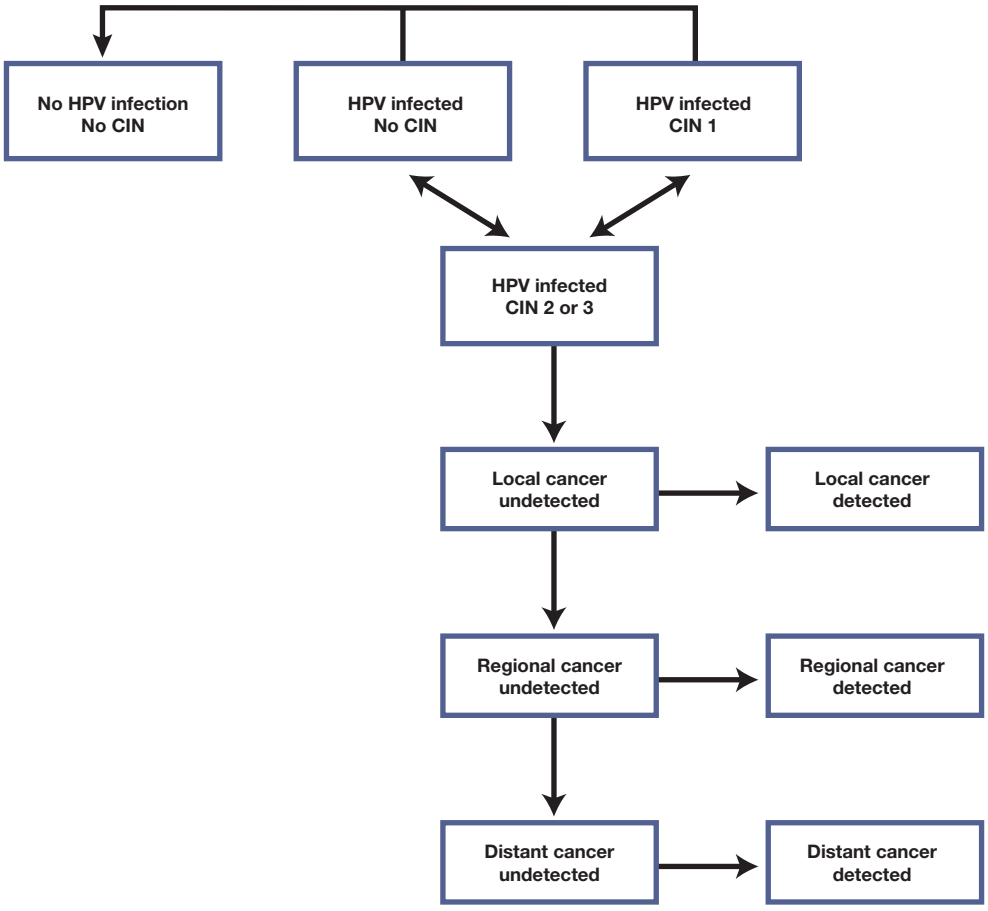
The path taken through the tree for any particular member of each group of patients depends on the random outcomes at each chance node. Using a computer to simulate the outcomes for a large number of patients, it is possible to estimate the average outcomes and costs associated with each of the two intervention options (screen and no screen). The cost-effectiveness ratio is the difference between the average costs for the screened and unscreened groups divided by the difference in average health benefits for these two groups.

More sophisticated models:

The example illustrated above embodies a simplified description of cervical cancer disease progression. Specifically, all patients are uninfected, HPV-infected, or have cancer. A more sophisticated model takes into account the fact that HPV infection can progress to cancer only after reaching a sufficiently advanced cervical intraepithelial neoplasia (CIN) grade, and that the severity of the resulting cancer depends on its stage.

Goldhaber-Fiebert et al. (17) used Markov modeling, a common technique, to better characterize HPV and cervical cancer disease progression. The model divided "HPV infection" into three states: no CIN, grade 1 CIN, and grade 2 or 3 CIN. It divided cancer into three states (local, regional, or severe). Each of these cancer states was further divided into two substates, corresponding to whether the cancer has been detected or not. Figure 2.2 illustrates this model.

Figure 2.2: Goldhaber-Fiebert cervical cancer model



The model, which is implemented as a computer simulation, assumes that all women start in the uninfected state. It then models progression of time as a series of fixed (one month) steps. During each month, each woman has a certain probability of transitioning from uninfected to infected (no CIN). Once infected, women can progress to grade 1 CIN or to grade 2/3 CIN. Women who reach grade 2/3 CIN can progress to local cancer. Alternatively, HPV-infected women can return to the uninfected state. Women who reach the local cancer state can proceed to regional or distant cancer. At any of these stages, the cancer may be detected.

As the simulation progresses, it keeps track of how much time women spend in each of the states. The more time women spend in the cancer states, the greater the loss of health benefits (measured in terms of QALYs) because these states are associated with diminished quality of life. Progressing to the cancer states also increases the chance of earlier death. The model accounts for changes in the level of sexual activity women experience over their lifetime by making the probability of progressing from the uninfected state to the HPV-infected state dependent on age. The model also accounts for the presence of different types of HPV. The probability of progressing to the HPV-infected (no CIN) state depends on the HPV type. Moreover, the risk of developing cancer depends on the type of HPV a woman becomes infected with.

Appendix II Decision Analysis Models

Use of assumptions

As the examples illustrate, developing a decision analysis model requires assumptions. For example, to characterize disease progression, the second model makes assumptions about the probability of HPV infection by age, how rapidly that infection will progress to more advanced grades, and how likely it is for the infection to either resolve or give rise to cancer. The model also assumes its structure captures all important aspects of the disease progression process. For example, the second model designates three HPV infection grades. In concept, this level of granularity may obfuscate clinically important differences and make the model projections inaccurate. Finally, this kind of model (a "Markov" model) assumes that the probability of moving from one health state to another does not depend on how long the person has been in their current health state. For example, this model assumes that all women with localized cancer have the same probability of developing regional cancer over the next month, regardless of how long they have had localized cancer.

In some cases, data are available to assign values to model parameters, and to check if the model's structure is realistic. Model accuracy can be evaluated by comparing its projections (e.g., for disease prevalence rates) to empirical data. Adjustment of parameter assumptions ("calibration") to achieve a better fit to empirical data can improve the assumptions (17, 24). In many cases, however, ideal data (e.g., appropriate randomized controlled trial [RCT] results) are not available. Moreover, even results from a RCT may not be ideal information if the population studied does not match the population to be evaluated in the model, or if the clinical setting in the RCT does not match the "real world" conditions (18). Adjusting RCT results, or using either non-trial data (e.g., observational studies) or expert opinion introduces other sources of uncertainty, however.

Although the projections made by decision analysis models are often uncertain, decision analysis models do not introduce that uncertainty. Instead, the uncertainty reflects the state of the available data needed to answer the question the model addresses. The decision analysis model makes the uncertainty explicit, quantifies it, and helps decision-makers understand if there is enough information to confidently distinguish the costs and health benefits of the available alternatives. It also helps researchers to identify research priorities (8).

Appendix III List of interventions evaluated

This appendix lists the interventions as they are described in the original documents for NCPP (28) (Table 2), NBGH (32) and Russell (41) (Table 1). The table numbers below indicate where the interventions are summarized in the main text of this report.

Table 4: Medications

Counsel adults about low dose aspirin use to prevent CHD

NCPP: For men ≥ 40, women ≥ 50, and others at elevated risk, discuss the benefits and risks of daily aspirin use.

NBGH: Starting at age 30, provide counseling once every 5 years to discuss the risks and benefits of aspirin use. Additional counseling should be provided if a cardiovascular risk factor is detected (p. 51).

Russell: Treat men age 45 with a 10-year risk > 5.0% of coronary heart disease.

Counsel women on contraception use

NBGH: Provide contraception counseling once annually for individuals ages 13 to 55 (p. 57).

Counsel women on folic acid supplementation

NCPP: For women of childbearing age, provide counseling on the use of folic acid supplements to prevent birth defects.

NBGH: Provide counseling to promote folic acid supplement use for pregnant women (through first trimester) and all women considering pregnancy. Provide supplements when indicated (p. 60).

Counsel women to use calcium supplements

NCPP: Provide adult and adolescent women counseling on use of calcium supplements to prevent bone fractures.

Table 4: Immunizations

Childhood immunizations

NCPP: Immunize children for diphtheria, tetanus, pertussis, measles, mumps, rubella, inactivated polio virus, Haemophilus influenzae type b, hepatitis B, varicella, pneumococcal conjugate, and influenza.

NBGH: Provide the following immunizations: “hepatitis B, diphtheria, tetanus, pertussis, Haemophilus influenzae type b, polio, measles, mumps, rubella, varicella, pneumococcal disease, influenza, meningococcal disease, hepatitis A, rotavirus… ” (p. 66).

Russell: Provide varicella vaccination for all school-age children.

Adult immunizations — pneumococcal disease

NCPP: Provide vaccination against pneumococcus (p. 66).

Adult immunizations — influenza

NCPP: Provide annual influenza vaccination to adults ≥ 50.

NBGH: Provide influenza vaccination to adults (p. 66).

Tetanus-Diphtheria booster

NCPP: Provide adults a tetanus-diphtheria booster shot every 10 years.

Appendix III List of interventions evaluated

Table 5: Screening — Coronary heart disease

Hypertension screening for all adults

NCPP: Routinely screen all adults for elevated blood pressure. Treat with antihypertensive medications when indicated.

NBGH: Provide blood pressure screening up to six times per year. Counsel patients as appropriate to promote lifestyle changes, provide medications, and monitor blood pressure (p. 65–66).

Russell: Use beta blockers to treat individuals ages 35 to 64 with diastolic blood pressure exceeding 95 mm Hg and no known coronary heart disease.

Cholesterol screening; medications for adults with elevated lipid levels

NCPP: Screen men ≥ 35 and women ≥ 45 for elevated cholesterol levels and provide cholesterol lowering drugs when medically indicated.

NBGH: Screening of adults age 20 and older every five years or as medically indicated for total cholesterol, low density cholesterol, high density cholesterol, and triglycerides. Counsel patients as appropriate to promote lifestyle changes, provide medications, and monitor lipid levels (p. 66–67).

Russell: Identify and treat individuals ages 45 to 54 at high risk.

Diabetes screening

NCPP: Screen for diabetes in adults with elevated blood pressure or hyperlipidemia, and treat to lower these levels.

NBGH: Screen for diabetes every 1 to 3 years for patients of any age who have hypertension or hyperlipidemia. Starting at age 30, screen every 1 to 2 years for patients at "high" risk. Starting at age 45, screen every 3 years for patients at normal risk (p. 58).

Russell: Screen 55-year-olds with high blood pressure.

Table 5: Screening — Cancer

Colorectal cancer screening

NCPP: Screen adults ≥ 50.

NBGH: Provide colorectal cancer screening for men and women ≥ 50, or starting at an earlier age for individuals with risk factors. Screening frequency depends on the technology used (p. 57).

Russell: Screen white men starting at age 50. Frequency depends on screening technology.

Breast cancer screening

NCPP: Routinely screen women ages ≥ 50; discuss age to start screening with women ages 40 to 49.

NBGH: Provide annual breast cancer screening for women ages 40 to 80. Screen women at high risk starting at an earlier age (p. 52).

Russell: Screen women every two years from age 50 to 79.

Cervical cancer screening

NCPP: Screen women ≥ 21 or within 3 years of sexual activity onset.

NBGH: Provide screening every 1 to 3 years for women ages 21 to 65, or at other ages if indicated by risk or sexual activity (p. 53).

Russell: Screen women every three years from ages 20 to 75.

Appendix III List of interventions evaluated

Table 5: Screening — Sexually transmitted diseases

Gonorrhea screening

NBGH: Provide annual screening for women age 25 and younger, and for older women if medically indicated (p. 69).

HIV screening

NBGH: Provide screening once during pregnancy, and more often if indicated by behavioral risk factors (p. 62).

Russell: Provide one-time one-day rapid screening for HIV.

Hepatitis B screening in pregnant women

NBGH: Provide screening once during pregnancy, and more often if indicated by behavioral risk factors. Provide post-exposure hepatitis B immune globulin to mother (p. 61).

Chlamydia screening

NCPP: Routinely screen women < 25.

NBGH: Provide annual screening for women age 25 and younger, and for older women if medically indicated (p. 69).

Table 5: Screening — Pediatric health

Prenatal neural tube defect and chromosomal abnormality screening

NBGH: Provide chromosomal abnormality screening for all pregnant women over age 35. Provide neural tube defect screening for women at elevated risk. Provide genetic counseling when medically indicated (p. 63).

Lead exposure screening

NBGH: Provide screening at ages 12, 24, and 36–72 months for all children at risk for lead exposure (p. 54).

Metabolic disorders in newborns

NBGH: Screen newborns for "phenylketonuria (PKU), congenital hypothyroidism (CH), galactosemia, sickle cell disease (SCD) and other hemoglobin disorders, congenital adrenal hyperplasia (CAH), biotinidase deficiency, and medium chain acyl-coA dehydrogenase (MCAD) deficiency." Treat as medically indicated (p. 55).

Vision screening

NCPP: Screen children < 5 for amblyopia, strabismus, and visual acuity defects.

NBGH: Between birth and 3 years, screen vision by taking an ocular history and conducting: a vision assessment, external eye lid inspection, ocular motility assessment, pupil examination, and reflex examination. Between ages 3 and 5, make appropriate visual acuity measurements (using the Snellen chart, Tumbling E chart, HOTV test, Allen cards, or LH symbols) and ophthalmoscopy (p. 56).

Appendix III List of interventions evaluated

Table 5: Screening — Adults (other conditions)

Vision screening — age ≥ 65

NCPP: Routinely screen adults ≥ 65 for diminished visual acuity (Snellen chart).

Abdominal aortic aneurysm screening for men 60–74

NBGH: Provide "one-time screening ultrasound to look for abdominal aortic aneurysm in men ages 65 to 75 who have smoked at any time in their lives" (p. 51).

Russell: Screen men ages 60–74 for abdominal aortic aneurysm.

Screen adults for depression

NCPP: Screen adults for depression in clinical settings with established appropriate systems to ensure accurate diagnosis.

Screen adults for hearing loss

NCPP: Screen adults ≥ 65 for hearing impairment and refer patients to specialists.

Screen adults for osteoporosis

NCPP: Routinely screen all women ages ≥ 65 and women at elevated risk ages ≥ 60 for osteoporosis.

NBGH: Screen for osteoporosis once every two years (or less): women ages ≥ 65 at normal risk, men age 70 at normal risk, and women age ≥ 60 at high risk. Provide medication to treat condition if indicated.

Table 6: Lifestyle modifications

Problem drinking screening and counseling

NCPP: Routinely screen adults for problem drinking risk factors and provide brief counseling with follow-up.

NBGH: Provide annual screening for alcohol misuse starting at age 18 for normal risk individuals. Start earlier for high-risk individuals. If necessary, provide up to eight counseling sessions per year, including "very brief" interventions (5 minutes, no follow-up), "brief" (15 minutes, no follow-up), or multi-contact (≥ 15 minutes, followed by several additional contacts) (p. 51).

Counsel parents on breast-feeding

NBGH: Provide counseling to promote breast-feeding (p. 59).

Tobacco screening and prevention

NCPP: Screen adults, provide brief counseling, and offer medications to assist with tobacco use cessation.

NBGH: Provide tobacco use screening at every clinical encounter starting at age 18, or earlier if indicated by risk. If necessary, provide brief counseling in person and intensive counseling in person or over the phone. Provide nicotine replacement products and smoking cessation medications (p. 71).

Russell: Result is the average over 19 programs.

Table 6: Lifestyle modifications (continued)

Counsel parents on motor vehicle injury prevention	
	NCPP: Provide parents of children < 5 with counseling on proper car seat use and other measures to reduce injury risk, including window and stair guards, pool fences, poison control, hot water temperature, and use of bicycle helmets. NBGH: Provide annual counseling when individuals 1) learn to drive, 2) first become parents, 3) seek preventive services for their young children, 4) present with alcohol or drug dependencies, or 5) receive care for alcohol-related injuries (p. 67).
Adult obesity screening followed by diet and exercise	
	NCPP: Routinely screen all adults for obesity and offer obese patients high intensity counseling about diet and exercise for at least 1 year. NBGH: Screen individuals starting at age 2 for obesity (BMI and waist measurement). Provide up to six counseling sessions per year for individuals with BMI > 30. Provide FDA-approved medications for individuals with BMI > 30, or for individuals with BMI from 27 to 29 and at least one additional factor for cardiovascular disease. Provide surgical intervention for individuals with BMI > 40 (pp. 67–68).
Diet counseling	
	NCPP: Provide intensive diet counseling for adult patients with hyperlipidemia and other risk factors for cardiovascular disease and chronic disease related to dietary factors. Russell: Provide diet and exercise counseling to middle-aged individuals who are overweight and who have been identified as being at high risk for developing diabetes based on oral glucose test results.

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THE SYNTHESIS PROJECT

NEW INSIGHTS FROM RESEARCH RESULTS

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