Alcohol Misuse Screening and Behavioral Counseling: Technical Report Prepared for the National Commission on Prevention Priorities

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A. United States Preventive Services Task Force (USPSTF) Recommendation

The USPSTF recommends screening and behavioral counseling interventions to reduce alcohol misuse by adults, including pregnant women, in primary care settings. (B recommendation).[1] The USPSTF found good evidence that screening in primary care settings can accurately identify patients whose levels or patterns of alcohol consumption do not meet criteria for alcohol dependence, but place them at risk for increased morbidity and mortality, and good evidence that brief behavioral counseling interventions with follow-up produce small to moderate reductions in alcohol consumption that are sustained over 6- to 12-month periods or longer. The USPSTF found some evidence that interventions lead to positive health outcomes 4 or more years post-intervention, but found limited evidence that screening and behavioral counseling reduce alcohol-related morbidity.

B. Choice of Interventions to Study

We focused our literature review and estimates on randomized controlled trials of interventions that could be conducted in busy primary care practices on most of their alcohol-misusing patients and that were tested under conditions consistent with those criteria. Trials of more intensive counseling or of interventions that involved many follow-up contacts were eliminated as not feasible in practice and outside the scope of the USPSTF recommendation. Like tobacco, there are no studies that duplicate real-life practice where there are repeated contacts with patients over years, nor studies with long-term patient follow-up (beyond 3 to 4 years) to detect either relapse or new reductions in alcohol use. Therefore, our estimates are limited by the assumption that the effectiveness obtained at 12 months was the long-term level of effectiveness of this intervention.

C. Literature Search and Abstraction

C.1. Effectiveness Literature:

The literature examining treatments for alcohol misuse is considerable. To most efficiently identify key studies on the treatment of alcohol misuse, we performed Level 1 and Level 2 literature searches[2;3] to identify meta-analyses and systematic reviews of alcohol misuse treatments. These searches identified 70 articles in PubMed from January 1992 through September 3, 2004, and those articles were examined to identify key alcohol misuse trials. To identify any additional trials published since those reported in the systematic reviews and meta-analyses, we conducted Level 1 and Level 2 searches[2;3] from January 2000 through October 25, 2004 that identified 1667 articles from PubMed. As a result of these searches plus review of references in identified articles, we identified a total of 101 articles for potential abstraction.[4-104] These articles were then reviewed, using the following criteria for deciding whether they should be abstracted for possible inclusion in this study:

1. The treatment must be delivered in the primary care setting
2. The study must include the proportion of the study population no longer misusing alcohol as outcomes
3. The population must not to be restricted to those dependent on alcohol
4. There must be a control group receiving no intervention
5. Each intervention arm must have at least 25 participants
6. Outcomes must be measured in a way that allows tabulation of the percent of problem drinkers at baseline who were no longer problem drinkers at follow-up
7. Outcomes must be measured 6 or more months following intervention.

A total of 15 articles met these criteria and were abstracted by two reviewers independently.[6;16;23;28-30;36;51;65;71;82;84;92;100;102] An additional article was subsequently identified, which reported 12 months results of the Ockene article,[65] so this article was also abstracted,[105] for a total of 16 abstracted articles.

C.2. Cost Effectiveness Literature:

In order to identify cost-effectiveness articles, we performed Level 1 and Level 2 literature searches[2;3] from January 1992 through December 5, 2004. These searches identified 1672 articles from PubMed. From these articles plus references in their bibliographies, we identified 28 studies for potential abstraction.[106-133] However, none of the studies identified were eligible for abstraction because they were:

1. conducted on non-U.S. populations and reported costs in non-U.S. dollars
2. studies of only alcoholism or alcohol dependence
3. cost analysis studies (not cost effectiveness)
4. delivered in a setting other than primary care

D. Clinically Preventable Burden (CPB) Estimate

CPB is the population burden addressed by the service multiplied by the effectiveness of the service. To calculate CPB, we first estimated the burden of disease attributable to alcohol use. These estimates are shown in Table 1 (years of life lost attributable to alcohol) and Table 2 (quality of life reductions attributable to alcohol). The results shown in Tables 1 and 2 were then entered into the CPB calculation shown in Table 3.

D.1. Alcohol Attributable Burden

The alcohol attributable fractions (AAF) in Tables 1 and 2 were taken from direct AAFs reported on the Alcohol-Related Disease Impact (ARDI) website,[134] but when ARDI reported indirect AAFs, we calculated AAFs from information provided on the ARDI website (dividing the number of alcohol attributable deaths from the condition by the total deaths from that same condition). The AAFs were based upon the portion of mortality attributable to alcohol use and misuse (technically speaking, they are population attributable fractions). We limited our analysis of conditions to those conditions in which the alcohol attributable mortality reported by ARDI was greater than zero. Lacking other data for most alcohol attributable illnesses and injuries, we applied the mortality-based AAFs to morbidity data.

As with most other services in this project, we estimated the projected life-long burden of disease of a birth cohort using annual incidence rates over all relevant age groups. This provided an approximately correct estimate of the number of years of life lost both overall and for each age group. For this service, the quality of this approximation varies from condition to condition, as previous risk factors and the medical technologies available to current cross-section of age-groups differ from those that a single birth cohort would face over time. In addition, the applicability of AAFs varies with changes in the alcohol use rates and other risk factors in the population. AAFs that reflect the age distribution of the hypothetical birth cohort are likely to be somewhat different than the average AAFs used here, which reflect the age distribution of the current U.S. cross-section.

D.1.1. Life Years Lost (Mortality) (Table 1)

The life years (LYs) lost due to alcohol attributable mortality were calculated as shown in Table 1 and the total is entered in rows a1 and a2 of Table 3. For most conditions, we calculated the life years lost as the number of years of life lived by a birth cohort of 4 million after the age of 20 years for chronic conditions, and for acute conditions the years of life lived after age 15. For low birth weight/prematurity, child maltreatment, and motor vehicle traffic crashes, we used years of life lived from birth. Mortality is estimated from 1998 death rate data, using the CDC Wonder engine[135] which included mortality data for the same ICD-9 codes for the conditions as listed in the Alcohol-Related Disease Impact report.[134] Whenever U.S. population estimates were needed for calculations, the 2000 census data were used.[136] Although the calculations in Tables 1 through 3 below are presented at the aggregate level, they reflect weighted averages based on age and sex specific data whenever available. None of the alcohol attributable fractions presented are age-specific estimates.

D.1.2. Quality of Life Reduction (Morbidity) (Table 2)

The quality-adjusted life years (QALYs) lost due to alcohol attributable morbidity were calculated as shown in Table 2. For chronic conditions we used the number of years lived after the age of 20, and for acute conditions we used the number of years lived after age 15. For each condition, alcohol attributable incidence was calculated as (the number of life years lived by a birth cohort of 4 million) × (the annual incidence of disease) × (the alcohol attributable fraction). For example, among adults 20 years of age and older, the annual incidence of acute pancreatitis is 109.5 per 100,000. From life tables,[137] we estimated that there would be 225,142,437 years of life lived after the age of 20 in a birth cohort of 4 million. An estimated 24% of acute pancreatitis cases are attributable to alcohol.[134] Thus, approximately 225,142,437 × 0.001095 × 0.24 = 59,157 cases of alcohol attributable acute pancreatitis are predicted to occur over the lifetime of a birth cohort of 4 million. Cases for low birth weight/prematurity, child maltreatment, and motor vehicle traffic crashes were calculated using the number of years of life lived from birth rather than age 15 or 20.

Alcohol attributable QALYs lost to morbidity are the product of life-time incidence of alcohol attributable disease, duration of disease, and the associated quality of life reduction (QALY weight). Continuing the example using the data in Table 2 for acute pancreatitis, .0577 x 0.3 = 0.01731 QALYs are lost to morbidity for each case, and a total of 59,157 x 0.01731 = 1,024 QALYs are lost due to alcohol attributable acute pancreatitis over the lifetime of the birth cohort.

The annual incidence rate for cancer cases was based on 2002 incidence rates, age-adjusted to the 2000 population (unadjusted rates were not reported).[138] Stroke incidence was approximated by the incidence of first stroke.[139] Incidence data for many chronic conditions are not available, so when necessary, we substituted the estimate of annual inpatient stays. Thus, we may overstate or understate incidence, depending upon how many individuals have an inpatient stay with a listed primary diagnosis during the course of their disease and how many have more than one such stay. To determine morbidity for the various conditions listed by the Alcohol-Related Disease Impact report, we used the following three references:

- for inpatient stays we used the 2001 National Hospital Discharge Survey,[140]
- for emergency department visits we used the 2003 National Hospital Ambulatory Medical Care Survey,[141] and
- for detailed injury reports by age we used a MMWR report on injury surveillance.[142]

We tried to match each condition listed by ARDI with the closest condition in our three reference sources. The following conditions do not have detailed incidence information on morbidity in the three references listed above: alcoholic cardiomyopathy, alcoholic polyneuropathy, chronic hepatitis, esophageal varices, fetal alcohol syndrome, portal hypertension, excessive blood alcohol level, motor-vehicle non-traffic crashes, hypothermia, and other road vehicle crashes. The non-fatal burden of these conditions is therefore not reflected in our estimates.

The duration of illness for many conditions (all cancers, mental disorders, stroke, cirrhosis of liver) were taken from closely corresponding (i.e., not always identical) disease categories of the Global Burden of Disease for Established Market Economies.[143] The basis for injury duration is self-reported days of restricted activity. Hospitalizations other than injuries were assigned a duration of 3 weeks in order to be consistent with other services.

Estimates of the QALYs lost per year lived with an illness ("QALY Weight" in Table 2) are the standard weights used in this report for acute conditions (0.1 to 0.5, midpoint 0.3) and chronic conditions (0.1 to 0.3, midpoint 0.2). Cancers of duration shorter than 2 years, which is indicative of low survival rates, were treated as acute illnesses, as were alcohol abuse, alcohol dependence syndrome, and alcoholic psychosis. We used an alternative estimate of QALYs lost per year for stroke of 0.40 (range 0.25 to 0.55) based on published estimates from utility scales.[144-150]

For morbidity of chronic conditions, our estimates of the number of episodes in Table 2 may be overstated because rates of hospitalizations that are limited to the age group to which the alcohol attributable fractions apply were not available. However, for the vast majority of such conditions, the episodes occur in the age groups of the ARDI report, and therefore the overstatement is very small.

D.2. Calculation of CPB (Table 3)

Table 3 shows the calculation of CPB based upon the burden of illness data presented above. The data points in Table 3 are either estimates from the literature or are calculated based upon other data in the table. The *Base Case* column shows either the point estimate for each variable used in our calculation of CPB or the result of a calculation. For data points taken from the literature, the *Data Source* column in Table 3 shows the reference numbers on which the estimate is based. For data points that are calculated within the table, the *Data Source* column shows the calculation formula. The alphanumerics in the formula refer to the row labels in the left most column for the data points on which the calculation was made. The *Range* column shows the range over which the point estimates were explored in our sensitivity analysis. We created additional tables (not shown) to summarize the evidence and perform supporting calculations. In the following text, we describe relevant content from these tables.

D.2.1. Adjustment for Current Screening and Brief Counseling (rows a6-a7):

The estimates of QALYs lost attributable to alcohol has been reduced by current screening and counseling practices. In order to estimate the total value of the service, we first predict what the number of deaths would be in the absence of screening. Current mortality is influenced by the portion of the population screened and counseled, the effectiveness of counseling in changing behavior, and the effect of changing behavior in reducing burden. The equation used to predict QALYs lost in the absence of treatment using these factors is shown in row a7. The equation is based on algebraic manipulation of an equation that expresses QALYs lost as a weighted average of QALYs lost that occur among those with and without screening and counseling. Current QALYs lost = (percent screened and counseled) x (QALYs lost in those screened and counseled) + (percent not screened and counseled) x (QALYs lost in those not screened and counseled), where the QALYs lost in those screened and counseled = (QALYs lost in those not counseled) x (1 – effectiveness of counseling).

A recent study by D'Amico et al. reported the prevalence of screening with adequate counseling among problem drinkers (dependent and non-dependent) from the nationally representative Healthcare for Communities Survey.[151] In the survey sample, 8.7% (row a6) of problem drinkers reported having been asked about drinking and receiving advice beyond simply to stop drinking. This estimate is adjusted to estimate advice received among all problem drinkers, not just those seen by a primary care physician. The adjustment is likely to slightly understated receipt of advice because the adjustment implicitly assumes that those not seen by a primary care physician did not receive screening and counseling from health professionals such as OBGYNs and mental health professionals, or in other settings such as urgent care, emergency rooms, and hospitals. The estimates of effectiveness of counseling used in the adjustment equation to predict QALYs lost in the absence of screening (i.e. a10*a13) are explained in the effectiveness section below. After adjustment for screening and counseling, the predicted QALYs lost attributable to non-dependent hazardous drinking in the absence of current provision of the service is 2,644,000 (row a7).

D.2.2. Effectiveness of Screening and Adherence

The effectiveness of screening depends on four factors. They are addressed here in the chronologic order in which they produce improved health: adherence with screening, sensitivity of screening tools, effectiveness of counseling in producing behavior change, and efficacy of behavior change in reducing the health consequences of hazardous drinking.

D.2.3. Adherence with Screening (row a8):

Four studies on the effectiveness of brief advice for nondependent problem drinkers reported completion rates for questionnaires which included alcohol-related questions.[28;29;71;84] Completion rates in these studies were 77%, 87%, 88%, and 92% (either as reported or as we calculated). In the three studies with the highest completion rates, alcohol questions were included as part of a general health assessment questionnaire. In the study with the lowest completion rate,[84] individuals were screened with an Alcohol Use Disorders Identification Test (AUDIT) questionnaire. Of 9,548 patients in this study, 14% refused, 2% returned incomplete questionnaires, and 7% said they had previously completed the questionnaire, but no completed questionnaire was found. We used the mean of these estimates (86%) as our base case estimate (row a8).

D.2.4. Sensitivity of the Screen (row a9):

The four question CAGE instrument is the most popular screening tool used in primary care to detect alcohol dependent drinkers. CAGE is a mnemonic for questions about attempts to Cut back on drinking, being Annoyed at criticisms about drinking, feeling Guilty about drinking, and using alcohol as an Eye opener. A systematic review found that the sensitivity of the CAGE ranged from 43% to 94%.[152] However, the instrument emphasizes symptoms of alcohol dependence rather than early drinking problems. The 10-item AUDIT questionnaire focuses instead on drinking in the past year and includes questions about quantity, frequency, and binge behavior as well as symptoms of alcohol dependence. In the same systematic review, the sensitivity of this instrument was found to range from 51% to 97%.[152] Sensitivity varies by screening tool and type of problem drinking. Although the AUDIT questionnaire is more focused on hazardous drinking patterns, the USPSTF suggests clinicians choose a questionnaire based upon clinic population and setting. Therefore we use 70%, the midpoint of the combined sensitivity ranges for the AUDIT and CAGE, as our base-case estimate (row a9).

D.2.5. Effectiveness of Primary Care Interventions (row a10):

Most of the randomized clinical trials that met our criteria for feasibility in primary care practice studied heavy drinking and/or hazardous drinking. Heavy drinking is defined in different ways among these studies, but focuses on those drinking more than a certain quantity of alcohol per week, while hazardous drinking focuses on those drinking more than a certain amount per occasion. An additional complication is that most of the studies had <100% of subjects at baseline having whichever of these two problems were being tested. Therefore, we had to adjust the outcome rates for this difference in order to be equivalent to a baseline frequency of 100%.

A total of 6 abstracted studies were excluded from the effectiveness calculation. Heather et al. had too few subjects per study arm, less than half in the intervention arm completed the full intervention, and the doctors could enroll patients not meeting eligibility requirements.[36] Scott and Anderson was excluded as they did not report whether subjects were receiving the intervention as intended.[82] In addition, two studies were restricted to those age 65 years or over.[16;29] These two studies had additional problems: the Burton study[16] did not provide baseline data to permit a calculation of effectiveness, and the Fleming study[29] findings were not consistent with the other studies indicating that the results from this population may not be generalizable to populations at greatest risk of hazardous drinking. Therefore, the Burton study and the Fleming study were not included in the analysis of effectiveness. The fifth study excluded from a effectiveness calculation was a study by Senft et al.[84] which did not report baseline information so we were not able to adjust the results to calculate an effectiveness score. Finally the results from Ockene et al. article[65] were not used in the effectiveness calculation, but rather the results reported in the Reiff-Hekking et al. article[105] were used, as they reported a longer follow-up of 12 months.

The final summary of effectiveness, then, is based on the average effectiveness in 10 studies of reduction in heavy drinking,[6;23;28;30;51;71;92;100;102;105] and 7 studies of reduction in hazardous drinking. [6;23;28;30;51;102;105] The mean rate of effectiveness (adjusted for the fact that most studies did not have 100% of subjects filling the definition at baseline) for the heavy drinking studies is 17.3% and that for the hazardous drinking studies is 17.6%, for a composite effectiveness rate of 17.4% (row a10).

These estimates reflect behavior change at 6 months to 2 years post-intervention. We found no data on the long-term effectiveness of repeated counseling and therefore were unable to determine whether the effectiveness of counseling declines overtime or increases with repeated (i.e. annual) alcohol use assessment and brief counseling. In the base-case we assumed that the rate of 17.4% would be maintained with repeated assessment and counseling. In sensitivity analysis we allowed for the possibility that effectiveness will wane to 10% over time or double to 35% with repeated intervention.

It is important to note that, in general, these studies included both dependent and non-dependent drinkers, while the USPSTF recommendation focuses on non-dependent drinkers. Most studies did not attempt to explicitly exclude dependent drinkers, and other studies are likely to have failed to exclude many dependent drinkers due to the difficulty of distinguishing between dependent and non-dependent problem drinkers using relatively simple study eligibility screening tools. Therefore, we assumed that 17.4% represents the effectiveness of primary care intervention averaged across both dependent and non-dependent problem drinkers. The burden of disease used to tabulate CPB includes the alcohol-attributable health burden among both dependent and nondependent problem drinkers. This produces an adequate estimate of the average benefit to dependent and nondependent problem drinkers combined, although the health benefits to one group of problem drinkers may be more substantial for one group than the other. A more precise and clinically meaningful estimate could be obtained from effectiveness and burden data that are specific to each group if such data were available in adequate quantity and quality.

D.2.6. Efficacy of behavior change in improving health (rows a11-13):

Data on the efficacy of behavior change in reducing the health consequences of alcohol misuse are sporadically available for a limited set of the many alcohol-attributable conditions shown in Tables 1 and 2. Therefore, we assumed that burden for acute alcohol-attributable conditions, which are all accidental and intentional injuries, would be reduced by 90% among individuals who adhere with clinician advice to moderate drinking to safe levels (row a11). Injuries not prevented through behavior change would be alcohol-attributable injuries - those that still occur at lower-levels of alcohol consumption. Because chronic alcohol-attributable disease occurs largely among dependent drinkers and the prevention of chronic conditions requires long-term behavior change, we assume that chronic conditions are less amenable to reduction through brief counseling in primary care, so they were assigned an estimate of 25% (row a12). These assumptions are explored thoroughly in sensitivity analysis. The average efficacy of behavior change is 63.6% (row a13) when these assumed values are weighted by the relative contributions of acute and chronic conditions to QALYs lost.

D.3 Final CPB calculation (row a14):

The product of the effectiveness of counseling in changing behavior and the efficacy of behavior change in reversing health risks (rows a10*a13) is the overall estimate of the effectiveness of counseling in improving health that was used in the adjustment for row a7. We did not include adherence with screening or sensitivity of the screen in this adjustment because the 8.7% screen and counsel rate from D'Amico et al. (row a6) already reflects these two elements of effectiveness.

CPB was calculated as the predicted QALYs lost in the absence of screening and counseling (row a7) multiplied by each of the components of effectiveness (rows a8, a10 and a13). The result is 176,000 QALYs saved over the lifetime of a birth cohort of 4,000,000 (row a14).

D.4. CPB Sensitivity Analysis

For sensitivity analysis, we combined chronic and acute years of life saved into a single variable to assess the potential for systematic error in the estimation method and we combined quality of life lost to chronic and acute conditions for the same reason. In single variable sensitivity analysis, CPB was found to be highly sensitive to the effectiveness of counseling at changing behavior. CPB varied by -43% to +103% within the range specified for this variable in Table 3. CPB was only slightly or moderately sensitive to all other variables. The variables to which CPB was moderately sensitive (up to -18% and +29% change in CPB with changes to variables inside their sensitivity analysis ranges) include:

- total alcohol attributable LYs lost;
- the sensitivity of screening questionnaires;
- the efficacy of behavior change in reducing the burden of chronic conditions; and
- the efficacy of behavior change in reducing the burden of acute conditions.

In multivariate sensitivity analysis, several combinations of three of these variables led to changes in CPB of -60% at the low end and nearly 210% at the high end. Each of the combinations of variables that led to changes this large included the effectiveness of counseling at changing behavior. In the positive direction, the largest change results from simultaneously changing the total alcohol attributable LYs lost, the sensitivity of screening questionnaires along with the effectiveness of counseling. In the negative direction, the largest change is derived from changing the same three variables, but other combinations of three variables produce a similar magnitude of change in CPB. These combinations produced our overall range from multiple variable sensitivity analysis that we used as our key indicator of uncertainty of CPB in comparing services: 71,200 to 542,000 QALYs saved.

We found no data to support estimates of the efficacy of behavior change in reducing acute and chronic alcohol-attributable conditions. CPB is moderately sensitive to assumed values within plausible ranges for both data points. While neither has a large enough impact to be among the three variables that produce the widest sensitivity analysis ranges, we did find that the upper estimate of the multiple-variable sensitivity analysis could nearly be reached by doubling the efficacy estimate for reductions in chronic conditions from 25% to 50% while simultaneously increasing the sensitivity of screening and the effectiveness of counseling in producing behavior change.

E. Cost Effectiveness (CE) Estimate

We produced a CE estimate based upon the health benefits estimate for CPB because no published estimates are available of the CE of screening and counseling to prevent hazardous drinking delivered repeatedly over multiple years. We estimated the cost-effectiveness of screening by adding service costs, cost-savings, and discounting to the estimate of CPB. We estimated CE over the recommended screening ages over the lifetime of a birth cohort of 4,000,000. Our methods for producing consistent estimates of CE across preventive services are outlined in a methods article and a more detailed methods technical report.[3;153] These methods are consistent with the 'reference case' of the Panel on Cost-Effectiveness in Health and Medicine.[154] The methods include use of a 3% discount rate for both costs and health benefits, the exclusion of productivity losses from disease costs, and the exclusion of medical costs that are not related to the conditions prevented by the service. We used year 2000 dollars for all cost data. This estimate is outlined in Table 4, which builds on data points and calculated variables in Tables 1-3. The alphanumerics of Table 3 is continued in Table 4 and some equations reported in the Data Source column refer to rows in Table 3.

<u>E.1. Years of Life at Risk (rows a15-a18):</u>

To simplify calculations of the costs of screening, monitoring, and pharmaceutical treatment over the lifetime of a birth cohort of 4,000,000, we compute the years of life lived after the age of 18 from U.S. life tables[137] and the portion of these years for which individuals in the birth cohort engage in hazardous drinking. This is calculated for two age groups, as shown in rows a15-a18 in order to tabulate different frequencies of screening at younger and older ages. We based the distribution of years of life with and without risky or harmful drinking on the age group and gender-specific estimates of the prevalence of heavy drinking on at least one occasion per year for 2003 from the National Health and Nutritional Examination Survey (NHANES) by the National Institute on Alcohol Abuse and Alcoholism.[155] This estimate may miss some dependent drinkers who consistently consume less than 5 drinks per day and may include others who engage in binge drinking too infrequently to be identified as a problem drinker at the time of an office visit.

E.2. Costs of Screening and Counseling (rows a19-a28)

We computed the costs of screening and counseling in two components, the lifetime costs of initial screening using brief tools such as CAGE or AUDIT and the lifetime costs of evaluation, counseling, and follow-up for those who screen positive. The costs of screening include patient time for travel and medical appointment, and physician time for screening. To improve consistency across the preventive services included in our study, we used a standard method of valuing time for patients to travel to the clinic and receive the service. In this method, we assumed that it takes 2 hours for travel and clinic appointment and we used average hourly earnings plus benefits in 2000 to estimate the value of patient time.[156] The resulting estimate was $42.32 per office visit in year 2000 dollars (row a20). However we assume that only 10% of this time was attributable to screening (row a21) because all patients will receive other services at the same time. We assumed that 10% of a 10-minute evaluation and management office visit for an established patient (CPT4 99219) is required for initial screening. The cost of this visit is estimated as the average of Medicare reimbursement and the median of private sector charges.[157] The USPSTF did not specify an interval for screening but noted that clinicians may screen less frequently in lower-risk groups such as older patients.[1] Therefore, we assumed that annual screening and counseling would be necessary from ages 18-54 to obtain the health benefits estimated in CPB above. However screening and counseling every other year would be sufficient after the age of 54 when the prevalence of heavy drinking falls to one third the rate of ages 18-34. These frequencies are recorded in rows a24 and a25.

False positives increase the costs of screening. The systematic review by Fiellin et al. found that the specificity of the CAGE ranged from 70% to 97% and the specificity of the AUDIT ranged from 78% to 96%.[152] As with sensitivity, we used the midpoint value of the combined ranges for both screening tools (85%) to approximate the average specificity of the mix of CAGE and AUDIT questionnaires that would be used in usual practice (row a26). We assumed that false positives require an additional 20% of a 10-minute office visit, including the cost of patient time and travel (row a22). We assumed that true positive cases require an additional 50% of a 10-minute visit for complete alcohol use history and brief counseling consistent with the ‘Five As’ (row a23).[1] We presume that some individuals will be resistant to complete history and counseling and will use less clinic time, while others will be engaged in each of the Five As and require more time.

The calculations of the cost of initial screening and follow-up (including false positives) are shown in rows a27 and a28.

E.3. Financial Savings (rows a29-a35):

Harwood has estimated the societal costs of alcohol abuse in the United States in 1998.[158] In calculating the cost-savings from screening and counseling we included the medical costs of alcohol attributable disease (row a29) and, under a category of 'other costs' (row a30), the costs of alcohol-related crimes (including productivity losses associated with alcohol-related crimes), motor vehicle crashes, fire destruction, and social welfare administration (not transfer payments of social welfare). We excluded productivity losses associated with health related disease and life lost in order to maintain consistency across preventive services analyzed in the prevention priorities project. We updated medical costs to year 2000 dollars using the medical consumer price index (M-CPI), and we updated 'other costs' using the CPI for all items.

The age groups in the current population that are at highest risk for alcohol misuse belong to birth cohorts of approximately 4,000,000. Therefore, the number of person-years in the highest risk groups during 1998 is approximately the same as the person-years during the same years of age by a birth cohort of 4,000,000. For this reason, we used the estimated annual costs in the current cross-section as the estimate for costs over the lifetime of a birth cohort without further adjustment. As a result, we somewhat understated the costs of alcohol misuse at older ages in the birth cohort. Age-group specific estimates of the costs would be necessary to make an accurate adjustment.

We used the estimates of adherence with screening, sensitivity of screening, and effectiveness of counseling in producing behavior change to estimate the costs savings achieved by screening and counseling. We used the same assumption for the reduction in medical costs achieved by behavior change as we used for the reduction in health related QALYs lost achieved by behavior change (row a13), and we assumed that 90% of 'other costs' are preventable through behavior change (row a34). With these parameters, an estimated $1.37 billion in medical costs (row a33) and $3.45 billion in other costs (row a35) would be saved through screening and brief counseling.

<u>E.4. Discounting and CE Calculation (rows a36-57):</u>

We discounted all costs and benefits to their present value at the age of 18, using a 3% discount rate. Because building year-by-year Markov models for each service is beyond the Prevention Priorities Project's scope, we developed alternate discounting techniques as described in our methods technical report.[3] To discount the costs of screening, we estimated the difference between median year of screening and age 18 (row a36), using U.S. life tables[137] and age group-specific screening frequencies. Then we applied an appropriate discount factor based upon an annual discount rate of 3% (row a37), using present value tables developed for the Prevention Priorities Project.[3] Similarly, we used the life tables and age distribution of years with heavy drinking[155] to determine the median year from age 18 for follow-up with true positives and false positives and the corresponding discount factor.

We found virtually no difference in the median ages for screening and for follow-up (row a38) because false positives are a high proportion of all screenings needing follow-up (50% overall) and because false positives increase with age as true positives decline. We used the underlying age distribution of the year of death from all causes listed in Table 1 and remaining life-expectancy at the age of death to determine a discount factor for years of life saved. We used the age distribution of hospitalizations to determine a discount factor for quality of life improvements achieved through reducing acute events. Because we lack data on the age distribution of the onset of many chronic conditions, we assumed that the median year of quality of life reduction for chronic conditions occurred 10 years after the median year for acute events.

Likewise, lacking age-specific data on medical and other costs, we assumed that the median dollar saved from acute and chronic medical care prevented occurred five years after the median acute event, and that the median dollar saved from other costs prevented occurred in the same year as the median dollar for acute events. These discounted factors were applied to the relevant cost or health benefit in rows a53-a56. The CE ratio is calculated by dividing the net discounted costs by the discounted QALYs saved (row a57). However, the CE ratio is undefined (logically, though not mathematically) when net costs are negative. Therefore, we express the extent of net savings on a per-person basis, $254, as reported in row a58.

E.5. CE Sensitivity Analysis

Due to the magnitude of costs and savings relative to net costs, the CE ratio varies greatly in relation to changes in several variables. Discounted costs and savings are very high and very similar, and therefore net costs are small as a percent of both costs and savings. As a result, changes to variables that impact the estimates of service costs or savings can result in extremely large changes to net costs and the CE ratio. In single-variable sensitivity analysis, several variables changed net costs by more than 50% in either a positive or negative direction. They were:

- sensitivity of screening;
- effectiveness of counseling at changing behavior;
- portion of a 10-minute office visit needed for screening;
- frequency of screening (combined for both age groups); and
- other, non-medical alcohol attributable costs;

In multivariate sensitivity analysis, the combination of the effectiveness of counseling at changing behavior, the portion of a 10-minute office visit needed for screening, and the frequency of screening (combined for both age groups) produced the highest CE ratio of $99,000/QALY saved. When changing variables in a direction that would improve the CE estimate, changes to three variables simultaneously revealed several combinations which produced cost-savings of about $1,300 per person screened. These combinations produced our overall range from multiple variable sensitivity analysis that we used as our key indicator of uncertainty of CE in comparing services. This was a particularly wide range (-$1,300/person to +$99,000/QALY) that is attributable to the magnitude of costs and savings relative to net costs, and not to unusual uncertainty in the underlying data points. However it is worth noting that one of the more influential variables for both CPB and CE was effectiveness of repeated (annual) counseling in producing sustained behavior change. There is a lack of studies that measure effectiveness with a time frame and frequency that reflect how the service would be delivered if it became an integral part of primary care.

F. Scoring

We ranked services in the Prevention Priorities Project based upon scores for CPB and CE rather than point estimates.[2;3] For each measure, we assigned scores according to the quintile in which the service's CPB and CE estimates fall among all services included in the study scope. Services having the highest CPB or lowest cost-effectiveness ratios received a score of 5.

The base case estimate of 176,000 QALYs saved resulted in a CPB score of 4. The base-case was somewhat lower than the other 4 services that received a score of 4 (range 240,000 to 355,000 QALYs saved). Nevertheless, multivariate sensitivity analysis indicated that it was not possible to rule-out CPB estimates that would be high enough to make alcohol screening the lowest among services that receive a CPB score of 5. Changes to any single variable by itself did not increase the CPB score to 5. Both single and multivariate sensitivity analyses indicated that an estimate consistent with a CPB score of 3 was also possible. No multivariate sensitivity analysis produced an estimate that was lower than those of services that received a score of 3.

The base case CE estimate of $254 saved per person resulted in a CE score of 5. Three services had base-case savings per person that were higher than $254. As discussed above, the CE estimate was very unstable due to the magnitude of both intervention costs and savings relative to the size of net costs. Therefore a wide range of CE scores are plausible. CE scores of 4 could be obtained by changing one of two variables by themselves. Multivariate sensitivity analysis revealed several scenarios in which the CE score would have been 3. Thus, the CE score for this service is one of the estimates in the ranking that could plausibly differ from the base-case score by more than one. Multivariate sensitivity analysis did reveal one scenario in which the CE estimate was consistent with a score of 2.

The base case estimates for CPB and CE produced a total score of 9, and the multivariate sensitivity analysis indicated that a total score as high as 10 and as low as 5 are possible. Multiple scenarios are possible that would produce total scores of 10, 9, 7, and 6. Again, this wide range was primarily attributable to the instability of the CE estimate, and secondarily to the uncertainty of the effectiveness of repeated counseling in producing long-term behavior change.

G. Limitations

The precision of the estimates was limited by dependence on highly aggregate data. The USPSTF focuses on non-dependent alcohol misuse, but studies on the effectiveness of brief counseling for people with non-dependent alcohol misuse generally include dependent drinkers in the study population. Therefore, the estimates of these studies reflect the average effectiveness in dependent and non-dependent problem drinkers. In usual practice, primary care clinicians will have limited ability to distinguish dependent and non-dependent problem drinkers. Therefore, averaging across both groups likely provides a realistic estimate of overall effect. However, precision is lost in not being able to separately estimate the benefits to dependent and non-dependent drinkers.

Data on the health and financial burden by type of alcohol misuse are also limited to a subset of the consequences of alcohol misuse. As discussed in the methods technical report, for most preventive services we lack data on the relationship between an individual's disease risk and the probability of adhering with the steps necessary to achieve risk reduction. For this service, differences in adherence between dependent and non-dependent alcohol misuse could be significant. The results of studies that use intention-to-treat analysis in entire populations and measure final health outcomes, reflect differential adherence with subpopulations. Such studies would allow this modeling step to be bypassed. However, very few studies of brief counseling for alcohol misuse measure health outcomes, and none have long-enough follow-up to observe differences in chronic conditions and associated mortality.

Similarly, individuals with high baseline alcohol use are likely to have larger health benefits from moderating behavior than individuals with lower use. If, as some data suggest, the relationship between alcohol use and health risks is not linear, our simple population average estimates would tend to understate the benefits of behavior change. Whether or not CPB and CE are ultimately understated depends on whether or not individuals with higher baseline alcohol use are equally likely to adhere with clinician advice as individuals with lower baseline use.

Relative to some behavioral services, the literature on the effectiveness of clinician counseling in producing changes to hazardous drinking among non-dependent drinkers is strong. However the available studies with longer term follow-up indicate that effectiveness may wane after 12 months, and there are no studies of the long-term effectiveness (5 or more years) with repeated screening and counseling. Therefore, the effectiveness of repeated interventions is unknown. In the base-case, we assumed that the 12 month rates reported in the literature would be maintained over time with repeated counseling, and for consistency, our CE estimate reflects the costs of repeated interventions. It is not known whether effectiveness would decline after 12 months despite repeated interventions, or whether effectiveness would increase as individuals who were unprepared to change at previous screenings become more amenable to change at subsequent encounters. Both the uncertainty of the long term effectiveness with repeated screening and counseling and the cumulative costs of repeated intervention over the lifetime of the birth cohort contribute to the uncertainty of the CE estimate. Other variables for which data are sparse are the proportion of non-fatal conditions which are attributable to alcohol (we applied the mortality attributable fractions), and the efficacy of reducing alcohol misuse in preventing all alcohol attributable morbidity, mortality, and costs. As described above, the relationships between baseline behavior and both disease risk and the likelihood of adhering with clinician advice to moderate alcohol use are unclear.

However, CE is highly unstable because net costs are very small relative to the costs of the service and the financial savings, and not because some data points are uncertain. Small changes to variables that impact either total costs or savings can have a large impact on net costs and the CE ratio.

The benefits and costs of the service for dependent problem drinkers is limited to what they would derive from brief counseling from a primary care clinician (as reflected in the estimate of effectiveness in counseling averaged across both dependent and non-dependent problem drinkers). In practice, clinicians will usually refer the portion of dependent problem drinkers who are identified by screening and history taking to outside resources. For the portion that adheres to clinician recommendations to seek additional help, such services may lead to additional service costs, health benefits, and financial savings. These effects were not included in our estimates, due to data limitations. First, we found no estimates of rates of adherence with referrals from primary care clinicians that could be generalized to the primary care setting. Studies that provide rates of successful referral relate to patients seen in emergency rooms and hospitals[21;27;159;160]or are limited to patients with prior trauma.[40] They show that referrals of patients seen in these settings result in approximately 25% keeping the first appointment with treatment for dependence and generally do not report adherence with subsequent appointments or program completion. We would expect that individuals with dependence that are identified through a screen in primary care would be even less likely to follow through on a referral than individuals seen in these settings, but we found little data to support or refute this hypothesis. One study in a Veterans Administration primary care clinic observed that 4 of 11 individuals who were referred for treatment enrolled in a treatment program.[161] All eleven individuals had previously completed a related telephone survey and consented to study participation. Thus, the evidence we found in primary care appears to be limited to a very small, select population at a single care site.

This limitation section addresses concerns that are specific to the estimates for this service. Other limitations that are common to all models are addressed in the methods technical report.

Table 1. Years of Life Lost Attributable to Alcohol Use in a Birth Cohort of 4,000,000					
Conditions	**Alcohol Attribut. Fraction**	**Total Deaths**	**Alcohol Attribut. Deaths**	**Average Life Expectancy**	**Alcohol Attrib. Life Years Lost**
Chronic					
Acute pancreatitis	0.24	4,069	977	13.8	13,501
Alcohol abuse	1	1,004	1,004	27.8	27,915
Alcoholic cardiomyopathy	1	1,028	1,028	20.8	21,396
Alcohol dependence syndrome	1	0	0		0
Alcoholic polyneuropathy	1	7	7	15.0	106
Alcoholic gastritis	1	61	61	22.4	1,366
Alcoholic liver disease	1	15,026	15,026	22.0	330,216
Alcoholic psychosis	1	585	585	13.4	9,565
Breast cancer	0.0085	60,048	510	15.4	7,869
Chronic hepatitis	0.013	332	4	15.0	65
Chronic pancreatitis	0.84	398	334	17.1	5,715
Epilepsy	0.15	1,569	235	23.3	5,487
Esophageal cancer	0.036	18,564	668	13.4	8,972
Esophageal varices	0.4	301	120	15.8	1,905
Fetal alcohol syndrome	1	0	0		0
Gastroesophageal hemorrhage	0.47	100	47	11.9	557
Hypertension	0.025	77,563	1,939	9.9	19,104
Ischemic heart disease	0.0018	817,988	1,472	9.1	13,425
Laryngeal cancer	0.061	6,022	367	14.0	5,135
Liver cancer	0.052	19,439	1,011	13.2	13,304
Liver cirrhosis unspecified	0.4	19,342	7,737	15.7	121,366
Low birth weight/prematurity	0.033	4,180	138	77.9	10,607
Oropharyngeal cancer	0.057	10,121	577	14.0	8,080
Portal hypertension	0.4	162	64	15.5	1,002
Prostate cancer	0.0076	64,912	493	7.6	3,728
Stroke, hemorrhagic	0.051	52,620	2,683	12.5	33,608
Stroke, ischemic	0.031	46,636	1,445	7.7	11,064
Supraventricular cardiac dysrhythmia	0.017	13,959	237	6.6	1,574
Chronic Total		**1,236,036**	**38,769**		**676,632**
Acute					
Air space transport	0.18	782	141	28.8	4,050
Alcohol poisoning	1	300	300	33.3	9,969
Aspiration	0.18	1,633	294	13.6	3,988
Child maltreatment	0.16	1,177	188	72.1	13,569
Drowning	0.34	3,309	1,125	34.1	38,357
Excessive blood alcohol level	1	7	7	21.9	144
Fall injuries	0.32	28,972	9,271	9.4	87,553
Fire injuries	0.42	3,626	1,523	20.2	30,823
Firearm injuries	0.18	810	146	38.8	5,660
Homicide	0.47	17,355	8,157	41.5	338,551
Hypothermia	0.42	619	260	15.9	4,126
Motor vehicle non-traffic crashes	0.18	1,312	236	28.8	6,812
Motor vehicle traffic crashes (men)	0.33	33,051	10,886	37.0	402,763

Motor vehicle traffic crashes (women)	0.2	16,529	3,249	41.3	134,198
Occupational and machine injuries	0.18	1,871	337	25.2	8,479
Other road vehicle crashes	0.18	760	137	34.0	4,653
Poisoning (not alcohol)	0.29	11,038	3,201	34.1	109,314
Suicide	0.23	35,263	8,111	29.5	239,341
Water transport	0.18	744	134	33.5	4,486
Acute Total		**159,158**	**47,703**		**1,446,836**
Grand Total (Acute + Chronic)		**1,395,194**	**86,472**		**2,123,468**

Table 2. Quality of Life Reduction Attributable to Alcohol Use in a Birth Cohort of 4,000,000							
Conditions	**Alcohol Attrib. Fraction**	**Incidence Rate**	**Al. Attrib. Disease Cases**	**Type**	**Duration**	**QALY Weight**	**AA QALYs Lost**
Chronic							
Acute pancreatitis	0.24	0.001095	59,157	inpatient stays	0.058	0.3	1,024
Alcohol abuse	1	0.0003334	75,067	inpatient stays	1.6	0.3	36,032
Alcohol dependence syndrome	1	0.0005872	132,207	inpatient stays	1.6	0.3	63,459
Alcoholic gastritis	1	0.00002986	6,722	inpatient stays	0.058	0.3	116
Alcoholic liver disease	1	0.0002787	62,742	inpatient stays	7.8	0.2	97,878
Alcoholic psychosis	1	0.0006021	135,568	inpatient stays	1.6	0.3	65,073
Breast cancer	0.009	0.0009926	972	new cases	4.3	0.2	836
Chronic pancreatitis	0.84	0.00009953	18,823	inpatient stays	0.058	0.3	326
Epilepsy	0.15	0.0002687	9,075	inpatient stays	9.2	0.2	16,698
Esophageal cancer	0.036	0.00006302	511	new cases	1.8	0.3	278
Gastroesophageal hemorrhage	0.47	0.00006469	6,846	inpatient stays	0.058	0.3	118
Hypertension	0.025	See strokes below					
Ischemic heart disease	0.002	0.01041	4,217	inpatient stays	0.058	0.3	73
Laryngeal cancer	0.061	0.00004902	673	new cases	4.3	0.2	579
Liver cancer	0.052	0.00007703	902	new cases	1.77	0.3	479
Liver cirrhosis unspecified	0.4	0.0001692	15,237	inpatient stays	7.8	0.2	23,770
Low birth weight/ prematurity	0.033	0.0001543	1,146	inpatient stays	0.25	0.3	86
Oropharyngeal cancer	0.057	0.0001513	1,941	new cases	4.3	0.2	1,669
Prostate cancer	0.008	0.002514	2,092	new cases	4.5	0.2	1,883
Stroke	0.043	0.002488	24,089	1st strokes	7.8	0.4	75,156
Supraventricular cardiac dysrhythmia	0.017	0.002234	8,552	inpatient stays	0.058	0.3	148
Chronic Total			**566,539**				**385,681**
Acute							
Air space transport	0.18	0.002333	98,660	injuries	0.077	0.3	2,277
Alcohol poisoning	1	See poisoning below					
Aspiration	0.18	0.0001112	5,662	injuries	0.077	0.3	131
Child maltreatment	0.16	0.004571	42,994	injuries	0.115	0.3	1,488
Drowning	0.34	0.00000456	379	injuries	0.077	0.3	9
Fall injuries	0.32	0.02411	2,103,914	injuries	0.077	0.3	48,552
Fire injuries	0.42	0.001658	159,787	injuries	0.077	0.3	3,687
Firearm injuries	0.18	0.00005806	2,408	injuries	0.115	0.3	83
Homicide and assault	0.47	0.007039	721,369	injuries	0.115	0.3	24,970
Motor vehicle traffic crashes	0.29	0.009639	929,430	injuries	0.077	0.3	21,448
Occupational and machine injuries	0.18	0.001329	54,408	injuries	0.077	0.3	1,256
Poisoning	0.29	0.001829	121,870	injuries	0.077	0.3	2,812
Suicide and self harm	0.23	0.001385	69,540	injuries	0.115	0.3	2,407
Water transport	0.18	included in air space transport above				0.3	
Acute Total			**4,310,421**				**109,120**

Grand Total			**4,876,960**				**494,801**

Table 3. CPB of Screening and Counseling to Reduce Alcohol Misuse for a Birth Cohort of 4,000,000				
Row Label	**Variable**	**Base Case**	**Data Source**	**Range for Sensitivity Analysis**
	Burden of disease attributable to non-dependent hazardous drinking			
a1	Alcohol-attributable life years lost to chronic conditions	676,632	Table 1	+/- 20%
a2	Alcohol-attributable life years lost to acute conditions	1,446,836	Table 1	+/- 20%
a3	Alcohol-attributable morbidity-related QALYs lost from chronic conditions	385,681	Table 2	+/- 40%
a4	Alcohol-attributable morbidity-related QALYs lost from acute conditions	109,120	Table 2	+/- 40%
a5	Total alcohol-attributable QALYs lost	2,618,269	=a1+a2+a3+a4	
a6	Delivery of screening and counseling	8.7%	[151]	5% to 25%
a7	Predicted alcohol-attributable QALYs lost	2,643,761	=a5/(1-a6*a10*a13)	
	Adherence, effectiveness, and efficacy			
a8	Adherence with screening	86.0%	[28;29;71;84]	80% to 95%
a9	Average sensitivity of CAGE & AUDIT questionnaires	70%	[152]	60% to 90%
a10	Effectiveness of counseling at changing behavior	17.4%	[6;23;28;30;51;71;84;92;100;102;105]	10% to 35%
a11	Efficacy of behavior change at reducing acute conditions	90%	Assumed	75% to 100%
a12	Efficacy of behavior change at reducing chronic conditions	25%	Assumed	10% to 50%
a13	Weighted efficacy of behavior change at reducing total alcohol-attributable QALYs lost	63.6%	=(a11*(a2+a4)+a12*(a1+a3))/a5	
a14	**QALYs gained, CPB**	**176,203**	=a7*a8*a9*a10*a13	

Table 4. CE of Screening and Counseling to Reduce Alcohol Misuse for a Birth Cohort of 4,000,000				
Row Label	**Variable**	**Base case**	**Data Source**	**Range for Sensitivity Analysis**
a15	Years of life in birth cohort between ages 18-54	142,513,132	[137]	
a16	Years of life in birth cohort ages 55+	93,098,716	[137]	
a17	Portion of person-years with alcohol misuse, ages 18-54	25.01%	[137;155]	20% to 30%
a18	Portion of person-years with alcohol misuse, ages 55+	6.47%	[137;155]	4% to 10%
	Costs of screening and counseling			
a19	Cost of 10-minute office visit	$43.63	[157]	+/-33%
a20	Value of patient time and travel for office visit	$42.32	[156]	+/-50%
a21	Portion of 10-minute office visit for screen	10%	Assumed	5% to 20%
a22	Portion of 10-minute office visit for history for false positives	20%	Assumed	10% to 25%
a23	Portion of 10-minute office visit for history and counseling for true positives	50%	Assumed	25% to75%
a24	Screens per year ages 18-54	1.0	Assumed	.5 to 2
a25	Screens per year ages 55+	0.5	Assumed	.2 to 1.0
a26	Average specificity of CAGE & AUDIT questionnaires	85%	[152]	75% to 95%
a27	Cost of screening over lifetime of birth cohort	$1,397,545,384	=(a15*a24+a16*a25)* a8*(a19+a20)*a21	
a28	Cost of thorough history and counseling, including false positives, over lifetime of birth cohort	$1,333,561,912	=(a15*a24*a17+a16*a25*a18) *a8*a9*(a19+a20)*a23+ (a15*a24*(1-a17)+a16*a25* (1-a18))*a8* (1-a26)*(a19+a20)*a22	
	Financial savings			
a29	Alcohol-attributable medical costs	$20,329,688,558	[158]	'+/- 33%
a30	Other alcohol-attributable costs, including alcohol-related crimes, motor vehicle crashes, fire destruction and social welfare administration	$36,107,065,031	[158]	'+/- 33%
a31	Predicted alcohol-attributable medical costs in the absence of current screening	$20,527,407,072	=a29/(1-a6*a10*a13)	
a32	Predicted other alcohol-attributable costs in the absence of current screening	$36,605,789,630	=a30/(1-a6*a10*a11)	
a33	Prevented alcohol-attributable medical costs	$1,368,121,206	=a31*a8*a9*a10*a13	
a34	Portion of other (non-medical) alcohol-attributable costs preventable through behavior change	90%	Assumed	75% to 100%
a35	Prevented other (non-medical) alcohol attributable costs	$3,450,944,927	=a32*a8*a9*a10*a34	
	Discounting and CE calculation			
a36	Median year for screen from age 18	24	[137]	
a37	Corresponding discount factor for 3% annual rate	0.49	Present value tables	.45 to .55
a38	Median year for follow-up history and counseling from age 18	24	[137;155]	
a39	Corresponding discount factor for 3% rate	0.49	Present value tables	.45 to .55
a40	Median year for LYs saved	47	[135;137]	
a41	Corresponding discount factor for 3% rate	0.25	Present value tables	.20 to .30
a42	Median year for acute QALYs saved	23	[137;140-142]	
a43	Corresponding discount factor for 3% rate	0.51	Present value tables	.45 to .55

a44	Median year for chronic QALYs saved	33	= acute + 10	
a45	Corresponding discount factor for 3% rate	0.38	Present value tables	.30 to .50
a46	Median year for medical costs prevented	28	= acute + 5	
a47	Corresponding discount factor for 3% rate	0.44	Present value tables	.35 to .55
a48	Median year for non-medical costs prevented	23	= acute	
a49	Corresponding discount factor for 3% rate	0.51	Present value tables	.40 to .60
a50	Portion of QALYs saved from LYs saved (acute and chronic)	0.88	=(a1*a12+a2*a11)/(a5*a13)	
a51	Portion of QALYs saved from acute morbidity prevented	0.06	=(a4*a11)/(a5*a13)	
a52	Portion of QALYs saved from chronic morbidity prevented	0.06	=(a3*a12)/(a5*a13)	
a53	Discounted cost of initial screen	$687,499,723	=a27*a37	
a54	Discounted costs of follow-up history and counseling	$656,024,094	=a28*a39	
a55	Discounted costs saved	$2,346,539,293	=a33*a47+a35*a49	
a56	Discounted QALYs saved	47,897	=a14*(a50*a41+a51*a43+a52*a45)	
a57	**CE ($/QALY saved)**	**Not Defined**	=(a53+a54-a55)/a56	
a58	Net cost per person ever screened	-$254		

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