Prioritization of Preventive Health Services

Supplementary Information and Technical Report

Matt Pappas and James Michaelson, PhD

Life expectancy calculations were performed in Microsoft Excel, using tables and methods as follows:

Column A: Age	**Column B:** Probability of dying between ages x and x+1	**Column C:** Number surviving to age x	**Column D:** Number dying between ages x and x+1	**Column E:** Person-years lived between ages x and x+1	**Column F:** Total number of person-years lived above age x	**Column G:** Expectation of life at age x, in years
0	0.007475	100,000	748	99,626	7,517,771	75.2
1	0.000508	99,253	50	99,227	7,418,145	74.7
2	0.000326	99,202	32	99,186	7,318,917	73.8
3	0.000250	99,170	25	99,157	7,219,731	72.8
4	0.000208	99,145	21	99,135	7,120,574	71.8
5	0.000191	99,124	19	99,115	7,021,439	70.8
6	0.000182	99,105	18	99,096	6,922,325	69.8
7	0.000171	99,087	17	99,079	6,823,228	68.9
8	0.000152	99,070	15	99,063	6,724,149	67.9
9	0.000125	99,055	12	99,049	6,625,086	66.9
10	0.000105	99,043	10	99,038	6,526,037	65.9
11	0.000111	99,033	11	99,027	6,426,999	64.9
12	0.000162	99,022	16	99,014	6,327,972	63.9
13	0.000274	99,006	27	98,992	6,228,959	62.9
14	0.000431	98,978	43	98,957	6,129,967	61.9
15	0.000608	98,936	60	98,906	6,031,010	61.0
16	0.000777	98,876	77	98,837	5,932,104	60.0
17	0.000935	98,799	92	98,753	5,833,267	59.0
18	0.001064	98,706	105	98,654	5,734,514	58.1
19	0.001166	98,601	115	98,544	5,635,860	57.2
20	0.001266	98,486	125	98,424	5,537,317	56.2
21	0.001360	98,362	134	98,295	5,438,893	55.3
22	0.001419	98,228	139	98,158	5,340,598	54.4
23	0.001435	98,089	141	98,018	5,242,439	53.4
24	0.001419	97,948	139	97,878	5,144,421	52.5
25	0.001390	97,809	136	97,741	5,046,543	51.6
26	0.001365	97,673	133	97,606	4,948,802	50.7
27	0.001344	97,540	131	97,474	4,851,196	49.7
28	0.001336	97,408	130	97,343	4,753,722	48.8
29	0.001341	97,278	130	97,213	4,656,379	47.9
30	0.001352	97,148	131	97,082	4,559,165	46.9
31	0.001371	97,017	133	96,950	4,462,083	46.0
32	0.001408	96,884	136	96,815	4,365,133	45.1
33	0.001469	96,747	142	96,676	4,268,318	44.1
34	0.001553	96,605	150	96,530	4,171,642	43.2
35	0.001653	96,455	159	96,375	4,075,112	42.2
36	0.001770	96,296	170	96,210	3,978,737	41.3
37	0.001911	96,125	184	96,033	3,882,526	40.4
38	0.002075	95,941	199	95,842	3,786,493	39.5
39	0.002254	95,742	216	95,634	3,690,651	38.5
40	0.002438	95,526	233	95,410	3,595,017	37.6
41	0.002632	95,294	251	95,168	3,499,607	36.7
42	0.002853	95,043	271	94,907	3,404,439	35.8
43	0.003113	94,772	295	94,624	3,309,532	34.9
44	0.003412	94,477	322	94,315	3,214,908	34.0
45	0.003735	94,154	352	93,978	3,120,592	33.1
46	0.004071	93,803	382	93,612	3,026,614	32.3
47	0.004428	93,421	414	93,214	2,933,002	31.4
48	0.004806	93,007	447	92,784	2,839,788	30.5
49	0.005206	92,560	482	92,319	2,747,005	29.7
50	0.005648	92,078	520	91,818	2,654,686	28.8

51	0.006121	91,558	560	91,278	2,562,867	28.0
52	0.006594	90,998	600	90,698	2,471,589	27.2
53	0.007045	90,398	637	90,079	2,380,892	26.3
54	0.007488	89,761	672	89,425	2,290,813	25.5
55	0.007946	89,089	708	88,735	2,201,388	24.7
56	0.008459	88,381	748	88,007	2,112,653	23.9
57	0.009064	87,633	794	87,236	2,024,646	23.1
58	0.009810	86,839	852	86,413	1,937,410	22.3
59	0.010706	85,987	921	85,527	1,850,997	21.5
60	0.011763	85,066	1,001	84,566	1,765,471	20.8
61	0.012934	84,066	1,087	83,522	1,680,904	20.0
62	0.014159	82,978	1,175	82,391	1,597,382	19.3
63	0.015362	81,804	1,257	81,175	1,514,991	18.5
64	0.016558	80,547	1,334	79,880	1,433,816	17.8
65	0.017847	79,213	1,414	78,506	1,353,936	17.1
66	0.019331	77,799	1,504	77,048	1,275,430	16.4
67	0.020992	76,296	1,602	75,495	1,198,382	15.7
68	0.022858	74,694	1,707	73,840	1,122,888	15.0
69	0.024921	72,987	1,819	72,077	1,049,047	14.4
70	0.027065	71,168	1,926	70,205	976,970	13.7
71	0.029363	69,242	2,033	68,225	906,766	13.1
72	0.032031	67,208	2,153	66,132	838,541	12.5
73	0.035178	65,056	2,289	63,911	772,409	11.9
74	0.038734	62,767	2,431	61,552	708,497	11.3
75	0.042414	60,336	2,559	59,056	646,946	10.7
76	0.046171	57,777	2,668	56,443	587,889	10.2
77	0.050325	55,109	2,773	53,723	531,446	9.6
78	0.055085	52,336	2,883	50,894	477,724	9.1
79	0.060498	49,453	2,992	47,957	426,829	8.6
80	0.066557	46,461	3,092	44,915	378,872	8.2
81	0.072986	43,369	3,165	41,786	333,958	7.7
82	0.079682	40,203	3,203	38,602	292,171	7.3
83	0.086593	37,000	3,204	35,398	253,570	6.9
84	0.094013	33,796	3,177	32,207	218,172	6.5
85	0.102498	30,619	3,138	29,050	185,964	6.1
86	0.111640	27,480	3,068	25,946	156,915	5.7
87	0.121472	24,412	2,965	22,930	130,968	5.4
88	0.132023	21,447	2,832	20,031	108,038	5.0
89	0.143319	18,616	2,668	17,282	88,007	4.7
90	0.155383	15,948	2,478	14,709	70,725	4.4
91	0.168232	13,470	2,266	12,337	56,017	4.2
92	0.181880	11,204	2,038	10,185	43,680	3.9
93	0.196334	9,166	1,800	8,266	33,496	3.7
94	0.211592	7,366	1,559	6,587	25,229	3.4
95	0.227645	5,808	1,322	5,147	18,642	3.2
96	0.244476	4,486	1,097	3,937	13,496	3.0
97	0.262057	3,389	888	2,945	9,559	2.8
98	0.280351	2,501	701	2,150	6,614	2.6
99	0.299312	1,800	539	1,530	4,463	2.5
100 +	1	1,261	1,261	2,933	2,933	2.3

- Calculations were performed for each year of life from age 0 to age 100 (Column A).
- The probability of dying, by year, was taken from the National Vital Statistics Reports Life Tables for men and women (Column B).[1]
- The number dying at each age (Column D) was calculated by multiplying the number surviving to that age (Column A) by the probability of dying at that age (Column B).
- The number surviving to each age (Column C) was calculated by subtracting the number dying at the previous age (the previous row in Column D) from the number surviving to that age (the previous row in Column C). We began with a cohort of 100,000 people (Column C, age 0).

- The person-years lived at each age (Column E) was calculated by subtracting half the number dying at that age (½ · Column D) from the number surviving to that age (Column C).
- The total number of person-years lived above each age (Column F) is the sum of all person-years at and above that age (Column E).
- The expectation of life at each age (Column G) is the total number of person-years lived above that age (Column F) divided by the number surviving to that age (Column C).
- Data for age 100 and higher are empiric, rather than calculated, and from the National Vital Statistics Reports Life Tables.[2]

USPSTF A and B Recommendations

Abdominal Aortic Aneurysm Screening (recommended for male smokers aged 65 to 75)
Not considered.

Alcohol Misuse Screening and Behavioral Counseling Interventions
Same as the baseline life expectancy, except that the probability of dying at each age (Column B) was recalculated as follows:
- The sensitivity of questionnaires (70%) multiplied by the effectiveness of counseling at changing behavior (17.4%) yields the reduction in problem drinking achievable through screening and counseling (12.2%).[3]
- The percentage of deaths attributable to medium and high average daily alcohol consumption (data from the CDC[4]) was multiplied by the baseline probability of dying to yield the absolute probability of dying due to alcohol abuse at each age.
- The probability of dying due to alcohol abuse at each age was multiplied by 0.122. This value was subtracted from Column B for each age; the difference between this table and the baseline expectation of life is attributable to screening and counseling.

Aspirin for the Primary Prevention of Cardiovascular Events
Same as the baseline life expectancy, except the probability of dying (Column B) was multiplied by 0.93 at ages 40 through 99 for men and 50 through 99 for women (where 50 is a surrogate for menopause).[5] The difference between projected life expectancy after this reduction and the baseline projection is attributable to aspirin.

Breast Cancer, Chemoprevention
Not considered.

Breast Cancer, Screening
Life expectancy additions for screening mammography were taken directly from the annual values calculated by James Michaelson and colleagues.[6] The values presented here are the sum the annual benefits of mammography from a woman's present age through her life expectancy as given by the baseline table or age 85 (whichever is earlier).

Breast and Ovarian Cancer Susceptibility, Genetic Risk Assessment and BRCA Mutation Testing
Not considered.

Breastfeeding, Behavioral Interventions to Promote
Not considered.

Cervical Cancer, Screening
Same as the baseline life expectancy, but with the probability of dying at each age (Column B) reduced as follows:
- Age-specific rates of cervical cancer mortality were divided by (1-0.662) to yield an estimate of baseline mortality in the absence of Paps (which have been estimated to be 66.2% effective at preventing cervical cancer mortality as they are now used).[7] This value was multiplied by the estimated efficacy of complete screening (0.863), to yield the absolute reduction in mortality through complete screening.

- This estimated reduction in mortality was subtracted from the probability of dying (Column B).

Chlamydial Infection, Screening

Pregnancy rates (by age) were multiplied by the proportion of those that are ectopic (2%) and the mortality rate of ectopic pregnancies (0.00038) to calculate the annual mortality rate, by age, due to ectopic pregnancies.[8,9,10] That rate was multiplied by 0.252, one estimate of the number of ectopic pregnancies are attributable to chlamydia, to yield an absolute mortality rate due to chlamydia.[11] This rate was subtracted from Column B, above, from ages 15 through 44.

Colorectal Cancer, Screening

The annual mortality rate due to colorectal cancer, as reported in the 2000-2004 SEER dataset, was multiplied by the estimated effectiveness of colonoscopy at preventing CRC mortality (0.7).[12,13] This value was subtracted from the SEER CRC mortality rate, and the difference was subtracted from Column B, above, from ages 50 through 99.

Depression, Screening

We have followed the lead of Ezzati and colleagues, who estimated the mortality benefit of screening for unipolar depression as zero or unstable due to small numbers measured.[14]

Diabetes Mellitus in Adults, Screening for Type II

In their review of diabetes screening evidence for the USPSTF, Harris and colleagues conclude that "the magnitude of additional benefit of initiating tight glycemic control during the preclinical phase is uncertain but probably small."[15]

Diet, Behavioral Counseling in Primary Care to Promote a Healthy

Pignone and colleagues determined that, even though counseling appears to have small effects on dietary behavior, effects on health outcomes are unclear.[16]

Gonorrhea, Screening

Not considered.

High Blood Pressure, Screening

The prevalence of hypertension (by age) was multiplied by the sensitivity of blood pressure measurements for an estimate of the fraction of the population that would be identified as hypertensive through screening.[17,18] That fraction of the male population was multiplied by 0.0721, the apparent annual reduction in all-cause mortality from hypertension treatment, to yield a relative reduction in mortality.[19] The probability of dying, in Column B, was multiplied by (1 - 0.721) at ages 20-99; the calculations are otherwise identical.

The benefit for women was calculated in a similar fashion, using 0.0618 as the annual reduction in mortality.

HIV, Screening

Not considered.

Lipid Disorders, Screening

The prevalence of hypercholesterolemia, by age, was multiplied by the sensitivity of screening (which we've taken to be 74% for men and 70% for women).[20,21] The reduction in all-cause mortality attributable to statins has been estimatedat 21% over 5.4 years; this implies an annualized mortality reduction of approximately 3.9%.[22] The prevalence of hypercholesterolemia at each age was multiplied by the sensitivity; this is the population that will be treated. This was multiplied by the relative reduction in mortality through treatment (0.039) to yield the relative reduction in all-cause mortality in the entire population. This was subtracted from 1 and multiplied by the baseline probability of dying at that age. This value was used in Column B, as above, for ages 45-99 for women and 35-99 for men.

Obesity in Adults, Screening

We have assumed a causal link between weight loss and decreased mortality, and used published mortality rates by age and body-mass index (18.5 to 25, 25 to 30, 30 to 35, and over 35) to estimate achievable reductions in mortality.[23]

Because we used data that is not stratified by sex, we here applied reductions in mortality to the 2004 NVSR Overall Life Table, rather than a sex-specific one.

The prevalence and relative risk of each BMI category were multiplied to calculate a weighted average relative risk at each age. The category-specific relative risk was then divided by the weighted average relative risk and multiplied by the NVSR probability of dying at each age. These revised probabilities of death were used in Column B, above, from ages 25-99 to generate a life table for each BMI category.

The calculator displays the benefit of moving from one life table (e.g., BMI over 35) to a lower category (e.g., BMI 25 to 30). We display only the benefit of weight loss, not of weight gain for underweight patients or of moving from the 18.5 to 25 category to the 25 to 30 category.[24] Unfortunately, sustainable weight loss carries a low probability of success, reflected in the markedly lower values displayed for obesity screening and counseling.[25]

Osteoporosis in Postmenopausal Women, Screening

Women over 65 have an annual mortality rate due to falls of 31.1 per 100,000 person-years, and osteoporosis screening is approximately 2% effective at preventing fractures.[26,27] We multiplied 31.1 per 100,000 by 0.98, and subtracted the product from the probability of dying, Column B, at ages 65 through 99.

Syphilis Infection, Screening

Not considered.

Tobacco Use and Tobacco-Caused Disease, Counseling

The British physicians health study found that male smokers who quit at age 30, 40, 50, and 60 gain 10, 9, 6, and 3 years of life, respectively.[28] We linearly interpolated between these data points, and linearly extrapolated to age 70. Such an extrapolation predicts no benefit to smoking cessation after age 70. This is an extension of life, and is displayed directly.

Where smoking status is unknown, this value is multiplied by the prevalence of smoking at each age.

Selected Interventions Not Included in the USPSTF Recommendations

Get a vision screen:

Day and colleagues estimated a 4.4% decrease in falls from vision screening.[29] The annual U.S. mortality due to falls was multiplied by 0.044, and the product of this calculation was subtracted from Column B, above.[30]

Childhood Immunizations:

Mortality due to childhood vaccine-preventable diseases has been estimated at approximately 500 adults annually.[31] Accordingly, immunization of an adult for childhood diseases is unlikely to provide significant benefit for that adult. Of course, current mortality numbers would be markedly higher without existing immunization programs, but such an analysis would require models more sophisticated than ours at present.

Get a hearing screen:

The Partnership for Prevention has determined that screening adults over 65 for hearing loss can reduce the prevalence of undetected hearing loss by 3% (from a baseline of between 25 to 30%).[32] We do not foresee a mechanism for appreciable mortality reduction.

Take folic acid:

Folic acid is well-established to reduce the incidence of neural tube defects in a developing fetus. While a compelling intervention, any extension to the life of the mother are difficult to quantify.

Get a flu shot during flu season:

Annual influenza-related mortality rates from age 50 to 64 and over age 65 are 12.5 per 100,000 person-years and 132.5 per 100,000 person-years, respectively.[33] The effectiveness of the vaccine at preventing mortality in an average flu season has been estimated to be 42.9%.[34]

We used a life table, as above, to estimate the person-years lived at each age. Multiplying this value by the incidence rate of death yields the number of deaths in that cohort due to influenza. This number is multiplied by 0.429 to yield the number of deaths in that cohort preventable through vaccination. This value was divided by the total number of deaths in the cohort to yield influenza-vaccine-preventable deaths as a fraction of total deaths, subtracted from 1, and multiplied by the baseline value for the probability of dying. This was used in Column B, as above.

Get a pneumococcal vaccine:

Robinson and colleagues report an annual mortality rate due to pneumococcal pneumonia of 7.4 deaths per 100,000 people from ages 65 to 79, and 17.4 deaths 100,000 at age 80 and above.[35]

To estimate the efficacy of the vaccine at preventing pneumococcal pneumonia, we averaged published values from two credible papers, using the values for immunocompetent adults.[36,37] Applying this reduction in mortality to the current annual mortality rate gives the reduction in probability of dying; this was subtracted from baseline and used in Column B, above.[38]

Get a Tetanus/Diphtheria Booster:

According to the CDC, 2005 included 2 fatalities due to tetanus and no cases of diphtheria in the United States.[39] Estimating hypothetical mortality absent widespread immunization is beyond the scope of this project.

Sustainably Lose Weight or Maintain a Healthy Weight:

Our discussion of obesity screening, above, explains in full our methods and rationale here as well. At body mass indices above 30, our calculator displays the benefit of weight loss, rather than screening. At body-mass indices under 30, the benefit of maintaining that weight is displayed.

When height and weight are *not* provided, our calculator displays the benefit of weight screening. This calculation uses an estimate of the age-specific excess deaths attributable to obesity and pre-obesity, and multiplies this value by the apparent success rate of interventions (3%).[40, 41] This product is an absolute reduction in mortality, and is subtracted from Column B, above.

[1] Arias E. United States life tables, 2004. National vital statistics reports; vol. 56 no. 9. Hyattsville, MD: National Center for Health Statistics, 2007.

[2] Ibid.

[3] All estimates are from Solberg et al. Primary Care Intervention to Reduce Alcohol Misuse: Ranking Its Health Impact and Cost Effectiveness. Am J Prev Med February 2008 (Vol. 34, Issue 2, Pages 143-152.e3)

[4] Centers for Disease Control and Prevention, Alcohol-Related Disease Impact software. Online at: http://apps.nccd.cdc.gov/ardi/Homepage.aspx

[5] Hayden and colleagues suggest a 7% reduction in all-cause mortality in their meta-analysis of the topic (Hayden et al. Aspirin for the primary prevention of cardiovascular events: A summary of the evidence. Ann Intern Med. 2002;136(2): 161-172.)

[6] Michaelson et al. Computer Simulation Estimation of the Impact of Various Breast Cancer Screening Intervals in Women of Various Ages.

[7] Maciosek et al. Cervical Cancer Screening: Technical Report Prepared for the National Commission on Prevention Priorities. Available online at http://www.prevent.org/content/view/62/107/.

[8] Ventura et al. Revised pregnancy rates, 1990-1997, and new rates for 1998-1999: United States. National vital statistics reports; vol 52 no 7. Hyattsville, MD: National Center for Health Statistics. 2003.

[9] MMWR Morb Mortal Wkly Rep 1995 Jan 27;44(3):46-8.

[10] Surveillance for Ectopic Pregnancy -- United States, 1970-1989, MMWR 42(SS-6);73-85. Last accessed through CDC Wonder online database on August 28, 2008, http://wonder.cdc.gov/wonder/prevguid/m0031632/m0031632.asp#Table_4

[11] Coste J et al. Sexually transmitted diseases as major causes of ectopic pregnancy: results from a large case-control study in France. Fertil Steril. 1994 Aug;62(2):289-95.

[12] SEER Cancer Statistics Review 1975-2004. National Cancer Institute. Table VI-7: Colon and Rectum Cancer (Invasive).

[13] Maciosek MV et al. Colorectal cancer screening. Technical report prepared for the National Commission on Prevention Priorities, 2006. Accessed August 28, 2008 at: http://www.prevent.org/images/stories/clinicalprevention/colorectal.pdf.

[14] Ezzati M et al. Estimates of global and regional potential health gains from reducing multiple major risk factors. Lancet 2003; 362: 271–80.

[15] Harris R et al. Screening Adults for Type 2 Diabetes: A Review of the Evidence for the U.S. Preventive Services Task Force. Ann Intern Med. 2003;138:215-229.

[16] Pignone MP et al. Counseling to Promote a Healthy Diet in Adults: A Summary of the Evidence for the U.S. Preventive Services Task Force. Am J Prev Med 2003;24(1):75–92.

[17] National Center for Health Statistics. Health, United States, 2007, With Chartbook on Trends in the Health of Americans. Hyattsville, MD: 2007. We used the 2001-2004 data for men and women within given age ranges, found in Table 70.

[18] Marshall T. Misleading Measurements: Modeling the Effects of Blood Pressure Misclassification in a United States Population. Med Decis Making 2006;26:624–632. Marshall calculates the sensitivity (as well as other test characteristics) of blood pressure measurements by age range and gender.

[19] Sytkowski et al. Secular Trends in Long-term Sustained Hypertension, Long-term Treatment, and Cardiovascular Mortality: The Framingham Heart Study 1950 to 1990. Circulation. 1996;93:697-703. The authors reported ten year all-cause mortality for men to be 31% with blood pressure treatment and 43% without; we modeled the annual reduction in death as 31/43, divided over 10 years. Therefore, men identified through screening will receive a 7.21% reduction in overall mortality. Women in Sytkowski's analysis had an all-cause mortality of 21% with treatment and 34% without over the same time period, or a 6% annual reduction in mortality.

[20] National Center for Health Statistics. Health, United States, 2007, With Chartbook on Trends in the Health of Americans. Hyattsville, MD: 2007. Here we use Table 71.

[21] Wilson PWF et al. Prediction of Coronary Heart Disease Using Risk Factor Categories. Circulation. 1998;97:1837-1847. We've defined the population that can benefit from treatment as those with total cholesterol above 240.

[22] LaRosa JC et al. Effect of Statins on Risk of Coronary Disease: A Meta-analysis of Randomized Controlled Trials. JAMA 1999 Dec 22-29;282(24):2340-6.

[23] Flegal KM et al. Excess Deaths Associated With Underweight, Overweight, and Obesity. JAMA 2005;293:1861.

[24] Hu and colleagues, by contrast, report that mortality increases monotonically with BMI (beginning at 21) for women, and that the "overweight" category does not have a lower mortality rate than the "normal" category. While we can hypothesize many reasons for this discrepancy, we defer to experts in this area. (Hu FB et al. Adiposity as Compared with Physical Activity in Predicting Mortality among Women. N Engl J Med 2004;351:2694-703.)

[25]This method corresponds well with an earlier version of this calculator, in which we used Stevens and colleagues' estimates of "excess deaths" attributable to obesity and pre-obesity, along with Maciosek and colleagues' estimate of the success rate of interventions (3%), to find the absolute reduction in mortality. This model suggested benefits on the order of 30 days, on the same order of magnitude as when calculated as above and incorporating the probability of success.

[26] Fatalities and Injuries from Falls Among Older Adults --- United States, 1993--2003 and 2001--2005. MMWR, November 17, 2006. Accessed online, August 28, 2008, at http://www.cdc.gov/mmwr/preview/mmwrhtml/mm5545a1.htm.

[27] According to the Partnership for Prevention, in a yet-unpublished technical report. Accessed online, August 26, 2008, at http://www.prevent.org/content/view/83/82/.

[28] Doll R et al. Mortality in relation to smoking: 50 years' observations on male British doctors. 2004;328:1519-1528.

[29] Day L et al. Randomised factorial trial of falls prevention among older people living in their own homes. BMJ 2002 Jul 20;325(7356):128

[30] Annual US mortality due to falls was obtained from, as above: Fatalities and Injuries from Falls Among Older Adults --- United States, 1993--2003 and 2001--2005. MMWR, November 17, 2006. Accessed online, August 28, 2008, at http://www.cdc.gov/mmwr/preview/mmwrhtml/mm5545a1.htm.

[31] Briss PA. Reviews of Evidence Regarding Interventions to Improve Vaccination Coverage in Children, Adolescents, and Adults. Am J Prev Med 2000;18(1S):97–140.

[32] The Partnership for Prevention, in an as-yet unpublished technical report. Accessed online, August 15, 2008, at http://www.prevent.org/content/view/80/85/.

[33] Thompson WW et al. Mortality Associated With Influenza and Respiratory Syncytial Virus in the United States. JAMA. 2003;289:179-186.

[34] Maciosek MV et al. Influenza Vaccination: Health Impact and Cost Effectiveness Among Adults Aged 50 to 64 and 65 and Older. Am J Prev Med 2006;31(1):72–79.

[35] Robinson KA et al. Epidemiology of Invasive Streptococcus pneumoniae Infections in the United States, 1995-1998: Opportunities for Prevention in the Conjugate Vaccine Era. JAMA 2001;285:1729-1735.

[36] Butler JC et al. Pneumococcal polysaccharide vaccine efficacy: An evaluation of current recommendations. JAMA 1993;270 (15):1826-1831.

[37] Shapiro ED et al. The protective efficacy of polyvalent pneumococcal polysaccharide vaccine. N Engl J Med. 1991;325(21): 1453-60.

[38] As with cervical cancer screening, the existing use of the intervention decreases baseline mortality and diminishes the apparent value of the intervention. Therefore, this model likely understates the true benefit of vaccination.

[39] Centers for Disease Control and Prevention. Summary of notifiable diseases—United States, 2005. Published March 30, 2007, for MMWR 2005;54(No. 53).

[40] Stevens et al. Consequences of the Use of Different Measures of Effect to Determine the Impact of Age on the Association between Obesity and Mortality. Am J Epidemiol 1999; 150:399-407.

[41] McTigue et al. Screening and Interventions for Obesity in Adults: Summary of the Evidence for the U.S. Preventive Services Task Force. Ann Intern Med. 2003;139:933-949. The authors reviewed 24 RCTs in which counseling led to weight loss of 2 to 3%. Note, though, that their review "did not find direct evidence that behavioral interventions lower mortality or morbidity from obesity"; even our 3% model may overstate the benefits of this intervention.