

Supplemental materials for:

Maciosek MV, LaFrance A, Dehmer SP, McGree D, Flottemesch TJ, Xu Z, Solberg LI. Updated priorities among effective clinical preventive services. *Ann Fam Med*. 2017;15(1):14-22.

Appendix

Scope of preventive services

The clinical preventive services considered for this update included “A” and “B” grade recommended services of the USPSTF for the general population and for those at increased risk for cardiovascular disease (CVD) or sexually transmitted infections (STIs), as well as ACIP recommendations for the general population. Services for the general population include evidence-based primary and secondary clinical preventive services for which the recommended population is limited only by age or sex criteria. The services recommended for those at increased risk for CVD or STIs were included because those populations are generally large enough to be included in an evaluation of services for the general population and are important at-risk populations for providers, health systems, employers and public health agencies. Services that are routinely co-occurring, such as childhood vaccines, were evaluated as one service.

Two groups of services were evaluated as one because they are typically delivered together. The childhood immunization series is delivered with multiple vaccinations in a single visit, and vaccine administration costs are lower for any subsequent vaccines provided in a visit. In addition, new combination vaccines – such as the combined measles, mumps, rubella (MMR) and varicella vaccine – take advantage of evidence-based vaccination timing to reduce the number of shots and vaccine administration costs. Similarly, the USPSTF now recommends chlamydia and gonorrhea screening as a single service. These screenings have the same recommended populations, and the services would be provided simultaneously.

Four recommended services that meet those criteria could not be included during the timeline for this update. They are: fluoride varnish, intimate partner violence screening, STD prevention counseling, and screening for abnormal blood glucose in overweight and obese. In addition, our estimate for the HPV vaccine includes only females at this time. We intend to analyze and include these services with incremental updates to the ranking as discussed below.

We excluded preventive services receiving “C,” “D,” and “I” grades from the USPSTF, services recommended by the USPSTF for newborns and delivered in hospital settings, and services recommended for pregnant women and delivered during prenatal care visits. USPSTF recommendations for high-risk groups other than those at increased risk for CVD or STIs also were not included, such as risk factor screening for women who have family members with breast, ovarian, tubal, or peritoneal cancer history. Catch-up vaccinations and vaccinations recommended by ACIP for higher-risk populations – including health care workers and travelers – were excluded to focus on services for the general population.

Important influences on estimates

Close attention to the specifics of the USPSTF or ACIP recommendation, knowledge of the evidence base and an understanding of the limitations of the model for each service are necessary to fully understand the ranking. We provide reports for quantitative estimates of CPB and CE for services online. However, Table A1 provides some of the most important considerations for each service for those who wish to more quickly obtain a better understanding of the ranking or the scores of a particular service.

Rankings over time

Table A2 highlights changes in total scores since the previous rankings in 2001 and 2006 for services in the current ranking. Services declared inactive since the previous ranking were excluded. In cases where total scores change by two points over time, there was a significant change to either the recommended population, the evidence available for modeling or the underlying burden of disease.

Only two services had a change of score of more than two since the 2006 ranking. Counseling on healthy diet for those at increased risk for CVD had significant changes in both the recommended population and the evidence available for modeling. The introduction of the youth pneumococcal conjugate vaccine (PCV13) into the routine childhood immunization schedule substantially reduced the burden of disease among older adults. Then, in 2014, ACIP added the PCV13 vaccine to the prior recommendation of 23-valent pneumococcal polysaccharide vaccine for older adults. Even though the addition of PCV13 was shown to be cost-effective,⁴⁷ it reduced the overall cost-effectiveness of this service.

Counseling to discourage tobacco initiation is once again in the ranking based on an updated evidence review, and receives the highest possible total score of 10. The service was included in the 2001 ranking based on the USPSTF's prior grading method, which gave it an "A" grade for evidence that changing behavior would improve health and a "C" for insufficient evidence that clinician counseling reduced tobacco initiation. It received a total score of 8 in 2001 using conservative assumptions of counseling effectiveness. The recommendation was retired when the USPTF revised its evidence grading methods. Since then, new studies have shown that brief counseling for youth can reduce the probability of initiation by about 20%⁴⁸ (about 2 percentage points) and our microsimulation model indicates that counseling youth will produce substantial health benefits and cost-savings over the long-term.

Some services had significant changes without affecting scores. For example, starting with the 2006 ranking, we interpreted the USPSTF recommendation for breast cancer screening to include women ages 40-49, who elect to be screened following a shared decision-making process with a provider. This increased the estimate of CPB and decreased the estimate of cost-effectiveness without changing the total score of six. In the current ranking, breast cancer screening receives a five. That change is primarily due to the addition of other services and changes to the estimates of previously recommended services.

Table A1. Services and Considerations on Estimations and Scoring

Services (short name)	Description	Changes and other factors that affect estimation and scoring	CPB	CE	Total Score
Childhood immunization series	ACIP childhood immunization series. Estimate includes all recommended vaccines up to 10 years of age (Diphtheria, tetanus, pertussis; measles, mumps, rubella; inactivated polio virus; Haemophilus influenzae type b; Hepatitis A; Hepatitis B; varicella; pneumococcal conjugate; influenza; and rotavirus) plus influenza vaccination to age 18.	Combined into a single series because multiple vaccines are frequently delivered in a single visit and well-child care visits are often organized around the vaccine schedule. In estimating cost of the series, we took into account savings from providing multiple vaccines in a single visit and using newer combined vaccines that reduce vaccine administration costs. If estimated separately, each individual series of vaccinations would not fare as well as the overall series.	5	5	10
Tobacco use, brief prevention	Provide interventions to prevent initiation,	Estimated benefits are based on smoking-attributable diseases that don't develop during adult years when	5	5	10

counseling, youth	including education or brief counseling.	prevented initiation avoids years of increased risk of living as a current or former smoker. New evidence indicates a larger impact of brief counseling on youth initiation than used in estimates for the 2001 ranking.			
Tobacco use screening and brief counseling, adults	Screen adults for tobacco use and provide brief cessation counseling and pharmacotherapy.	Benefits reflect the health improvement from smokers becoming a former smoker at an earlier age than they would without brief intervention. Estimated benefits are from brief intervention (not from multiple-counseling cessation), but do reflect repeated brief intervention for as many years as an individual remains a smoker.	5	5	10
Alcohol misuse screening and brief intervention	Screen adults' misuse and provide brief counseling to reduce alcohol use.	Estimates reflect the impact of only brief intervention in reducing risky drinking such as binge drinking. They reflect neither the costs nor the benefits of treating alcohol dependence. Estimated benefits reflect repeated brief interventions over a lifetime. Financial benefits include substantial reductions in non-medical direct costs, such as from prevented automobile and other property damage. The CE ratio is relatively unstable because costs and financial benefits are nearly equal and are large relative to the QALYs saved; therefore in sensitivity analysis, changes to model inputs that affect net costs create large changes in the CE ratio.	3	5	8 ^a
Aspirin chemoprevention for those at higher risk of CVD	Low-dose aspirin use for primary prevention of CVD in adults ages 50-59 with 10% or greater 10-year CVD risk and other factors.	Reflects the new provisional recommendation of the USPSTF. The new recommendation is more targeted, which results in greater savings per person but lower population health impact when compared to our prior estimates for this service.	3	5	8
Cervical cancer screening	Screen for cervical cancer in women ages 21 to 65 with cytology (Pap smear) every three years.	Estimates reflect the fact that the HPV vaccine was not available to the age group at greatest risk for cervical cancer at the time they were adolescents.	4	4	8
Colorectal cancer screening	Screen adults 50-75 years routinely.	Estimates reflect a mix of endoscopy and FOBT testing. The increased uncertainty of the total score reflects possibility of both CPB and CE score being reduced by 1 in sensitivity analysis.	4	4	8 ^a
Chlamydia and gonorrhea screening	Screen for chlamydia and gonorrhea in sexually active women ages 24 and younger, and in older women at increased risk for infection.	Chlamydia was estimated by itself in prior rankings. The USPSTF now recommends chlamydia and gonorrhea screening as a combined service, with both screenings to be provided to the same population. Uncertainty on the health-related quality-of-life effects of infertility increases the uncertainty of scores.	3	4	7 ^a
Cholesterol screening	Screen routinely for lipid disorders for men aged 35+, and younger men and women of all ages who are at increased risk of CHD. Treat with lipid-lowering medications.	Compared to the recommendation used in our prior analysis, the updated USPSTF recommendation calls for more targeted screening in women.	4	3	7
Hypertension screening	Measure blood pressure routinely in all adults and treat with anti-hypertensive medication to prevent the incidence of CVD.		4	3	7
AAA screening	Screen men ages 65-75	Higher uncertainty of total score reflects potential for	2	4	6 ^a

	who have ever smoked one time for abdominal aortic aneurysm, using ultrasonography.	CE score to fall by 2 in sensitivity analysis due to dense distribution of CE estimates among many services in the is range.			
Healthy diet and physical activity counseling for those at higher risk of CVD	Offer or refer adults who are overweight or obese with additional CVD risk factors to intensive behavioral counseling to promote healthful diet and physical activity.	Compared to its prior recommendation, the USPSTF's updated recommendation is for a more targeted population of overweight or obese people with at least one other CVD risk factor. Costs include a substantial time cost for patients to participate in intensive intervention and out-of-pocket costs for physical activity and improved diet. Therefore, the service would be more cost-effective from a medical payer's perspective that excludes these costs. Impact now includes direct impact on blood pressure, cholesterol and diabetes risk. In prior estimates, impact was limited to health improvements obtained though BMI reduction.	5	1	6
HIV screening	Screen for HIV infection in adolescents and adults aged 15 to 65 years. Frequency varies by risk level.	Estimates are based on one-time screening for the general population and annual screening for those at increased risk for HIV. The increased uncertainty of total score reflects potential for CE score to fall by 2 due to dense distribution of CE estimates among many services in the range and also reflects greater uncertainty related to deriving estimates that are consistent with those for other services in this list from a published study that used different methods.	2	4	6 ^a
HPV immunization	Administer a 3-dose series of HPV vaccine to all females aged 11-12 years.	Estimates reflect the marginal impact of HPV immunization in a population of women that is assumed will maintain historically high cervical cancer screening rates as they age. The estimates do not reflect either the costs or benefits of recommended HPV immunization for adolescent males. Benefits are limited to cervical cancer reduction. Although health benefits from preventing other HPV-associated diseases that are not included are likely to be small, the impacts on cost may be more substantial and might increase the CE score by one point.	3	3	6
Influenza immunization, adults	Immunize all adults against influenza annually.	Expansion of the ACIP recommendation to all adults modestly increased health impact and reduced cost-effectiveness. The increased uncertainty of the total score reflects uncertainty of the effectiveness of the vaccine in preventing mortality.	4	2	6 ^a
Obesity screening, adults	Screen all adults routinely for obesity. Refer patients with a BMI of 30 kg/m ² or higher to intensive behavioral interventions.	Estimated benefits are limited to those who enroll in and complete an intensive intervention, typically of 6 to 12 months long. Costs include a substantial time cost for patients to participate in intensive intervention and out-of-pocket costs for physical activity and an improved diet. Therefore, the service would be more cost-effective from a medical payer's perspective that excludes these costs. The increased uncertainty of total score reflects potential for CE score to increase by 2 due to dense distribution of CE estimates among many services in the range.	5	1	6 ^a
Syphilis screening	Screen all persons at increased risk for syphilis infection.	Estimated benefits are based on reduced HIV incidence among those who contract syphilis and reflect higher susceptibility to HIV among those with untreated syphilis. The impact on health from earlier identification and treatment of syphilis itself is not	1	5	6

		included in the estimates. Screening pregnant women to prevent congenital syphilis is not addressed by this analysis.			
Vision screening, children	Screen children between ages 3 and 5 routinely to detect amblyopia.	Substantial variation in plausible ranges for the benefits of earlier detection through screening rather than treating only with symptomatic presentation result in a wide range of possible CE ratios.	2	4	6 ^a
Breast cancer screening	Biennial mammography for women aged 50-74 years; screening prior to age 50 an individual decision.	Although a C grade recommendation from the USPSTF for women ages 40-49, we include biennial screening for this age group in our estimate because screening during this age range is covered under the Affordable Care Act and 70% of women 40-49 currently elect to be screened. The increased uncertainty of the total score reflects based case estimates for both CPB and CE that are near the top of their scoring range.	3	2	5 ^a
Depression screening, adolescents	Screen adolescents ages 12-18 for depression with systems to assure accurate diagnosis, treatment, and follow-up.	The increased uncertainty of the total score reflects the potential for both CPB and CE scores to change in the same direction in multivariate sensitivity analysis.	2	3	5 ^a
Depression screening, adults	Screen adults for depression with systems to assure accurate diagnosis, treatment, and follow-up.	Compared to screening in adolescents, a larger age-range produces greater overall health benefit, but a lower incidence rate combined with higher portion of cases recognized without screening reduces cost-effectiveness. The increased uncertainty of the total score reflects the potential for both CPB and CE scores to change in the same direction in multivariate sensitivity analysis.	3	2	5 ^a
Obesity screening, children and adolescents	Screen children ages 6 and older for obesity. Offer or refer obese children to comprehensive, intensive behavioral intervention.	Benefits reflect reduced adiposity-related diseases of adulthood. In the base case, we presume that 50% of children who enroll in and complete intensive intervention maintain the reduction in weight through adult years. Benefits do not include any impact independent of weight change on blood pressure, cholesterol or diabetes, such as those included in the adult intervention. Costs include a substantial time cost for parents to accompany children in intensive intervention and out-of-pocket costs for physical activity and improved diet. Therefore, the service would be more cost-effective from a medical payer's perspective that excludes these costs.	4	1	5
Pneumococcal immunization, adults	Immunize adults aged 65+ against pneumococcal disease with PCV13 and PPSV23.	Introduction of the PCV13 vaccine in the childhood immunization series had a substantial impact on disease incidence in older adults, reducing the impact of the adult pneumococcal vaccine compared to our prior estimates. Addition of the PCV13 vaccine for adults in 2014, while shown to be CE, also reduced the overall cost-effectiveness of pneumococcal vaccinations for older adults. The increased uncertainty of the total score reflects a wide plausible range of CE scores in multivariate sensitivity analysis.	2	3	5 ^a
Herpes zoster immunization	Single dose of vaccine for adults 60 and older.		1	3	4
Osteoporosis screening	Screen women ages 65 and older and younger women whose fracture risk is equal to or greater than that of 65-year-old	Introduction of generic alendronate did not substantially improve cost-effectiveness when assuming that just 10% of patients cannot tolerate generic alendronate and switch to much more expensive therapy.	2	2	4

	white women with no additional risk factors.				
Folic acid chemo-prevention	Women planning or capable of pregnancy should take a daily supplement with 0.4 to 0.8 mg of folic acid.	Estimates of greater-than-expected impact from the food fortification program introduced in 1998 resulted in a lower potential impact of folic acid supplements.	1	2	3
Meningococcal immunization	A single dose of quadrivalent vaccine recommended for 11-12-year-olds, with a booster at age 16.		1	1	2
Tdap/Td booster	One time Tdap and Td booster every 10 years.	Addition of one-time Tdap into the Td booster series, while shown to be cost-effective, did not substantially improve the CE of the series.	1	1	2

^a Sensitivity analysis indicated that a change of score of 2 or more is possible.

Table A2. Evolving Prevention Priorities: Previous scores for current rankings

Service name (shortened)	2016	2006	2001	Significant changes to service
Childhood immunization series	10	10	10	Vaccines changed for each analysis.
Tobacco use, brief counseling to prevent initiation by children, adolescents	10	^a	8	New evidence of larger effectiveness of counseling than modeled in 2001.
Tobacco use screening and brief cessation intervention, adults	10	10	9	
Alcohol misuse screening and brief intervention	8	8	7	
Aspirin chemoprevention for those at higher risk of CVD	8	10	N/A	Significant change to recommended target population.
Cervical cancer screening	8	7	8	
Colorectal cancer screening	8	8	8	
Chlamydia and gonorrhea screening	7	6	7	Gonorrhea added for 2016 ranking.
Cholesterol screening	7	7	7	Significant change in screening criteria for women.
Hypertension screening	7	8	8	
AAA screening	6	N/A	N/A	
Healthy diet counseling for those at higher risk of CVD	6	2	N/A	Significant change to recommended target population and evidence base expanded to include direct impact on blood pressure, lipids and diabetes.
HIV screening	6	N/A	N/A	
HPV immunization	6	N/A	N/A	
Influenza immunization, adults	6	8	8	Was adults ages 50+ in 2006; was adults ages 65+ in 2001.
Obesity screening, adults	6	5	N/A	Evidence base expanded to include direct impact on blood pressure, lipids and diabetes.
Syphilis screening	6	N/A	N/A	
Vision screening, children	6	6	6	

Breast cancer screening	5	6	6	Younger women added.
Depression screening, adolescents	5	N/A	N/A	
Depression screening, adults	5	4		Recommendation no longer limited to primary care systems that already have systems in place to ensure follow-up.
Obesity screening, children and teens	5	N/A	N/A	
Pneumococcal immunization, adults	5	8	7	Vaccination age previously 65+.
Herpes zoster immunization	4	N/A	N/A	
Osteoporosis screening	4	4		Introduction of generic alendronate.
Folic acid chemoprevention	3	5	4	National food fortification program reduced underlying risk.
Meningococcal immunization	2	N/A	N/A	
Tdap/Td booster	2	2	2	

^a In 2003, the USPSTF concluded that the evidence was insufficient to recommend for or against routine screening for tobacco use or interventions to prevent and treat tobacco use and dependence in children or adolescents (I statement). That recommendation was in effect at the time of the 2006 rankings.