Obesity in Children and Adolescents: Screening and Management

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This report summarizes estimates of health impact and cost-effectiveness that were created to assess the relative value of most of the clinical preventive services recommended by the United States Preventive Services Task Force (USPSTF) and the Advisory Committee on Immunization Practices (ACIP). This ranking of clinical prevention priorities is guided by the National Commission on Prevention Priorities (NCPP).

A. USPSTF Recommendation

In 2010, the U.S. Preventive Services Task Force (USPSTF) updated its 2005 recommendation of screening for and management of obesity in children and adolescents (1, 2). The Task Force found adequate evidence that moderate-to-highly intensive, multi-component behavioral interventions for obese children and adolescents can lead to improvements in weight status with no greater than small risk for harms (a "B" recommendation). The update contrasts with the prior recommendation that found insufficient evidence to recommend for or against screening and interventions for overweight in children and adolescents (an "I" recommendation).

B. Choice of Population

Based on the Task Force recommendation, we evaluate screening for and management of obesity among children and adolescents aged 6 to 18 with an age- and sex-specific body mass index (BMI) at the 95th percentile or higher (i.e., a positive screen for obesity). Health outcomes and costs are evaluated for adults age 18 and older with a history of screening for and management of obesity between ages 6 to 18.

C. Model Type

Analyses in this study were conducted using the HealthPartners Institute ModelHealth^{TM}: Cardiovascular disease microsimulation model. ModelHealth: CVD is an annual-cycle microsimulation model, parameterized to estimate the lifetime incidence of CVD events and associated costs in a cross-section of individuals representative of the U.S. population. Additional model details are included in the ModelHealth: CVD Technical Supplement.

Disease outcomes in ModelHealth: CVD include incidence of myocardial infarction, stroke, congestive heart failure, angina pectoris, intermittent claudication, and CVD-related death. Events are predicted by one-year risk equations estimated specifically for the model from Framingham Heart Study data (3, 4). Event risk is based on a person's age, sex, BMI, systolic blood pressure (SBP), high- and low-density lipoprotein (HDL and LDL) cholesterol, smoking status, and history of CVD.

The annual progression of BMI is derived from recall data reported in the Behavioral Risk Factor Surveillance System (5), and the natural history of SBP and cholesterol is estimated using Framingham Heart Study data (3, 4). Tobacco initiation, cessation and relapse probabilities are derived from the National Health Interview Survey data (6) and published estimates from longitudinal studies (7, 8). Screening and treatment for hypertension and dyslipidemia in the model are consistent with national clinical guidelines (9, 10), and identification and treatment adherence patterns are consistent with the rates observed within the National Health and Nutrition Examination Survey (NHANES) (11-15). Use of antihypertensive drugs and lipid-acting agents is modeled as an exogenous treatment effect on SBP and cholesterol, respectively, and alters disease risk accordingly.

Disease costs in ModelHealth: CVD were estimated using data from the Medical Expenditure Panel Survey (MEPS) (16). First-year and ongoing costs are distinguished, and the cost of drug treatment and

monitoring are accounted for separately. Pharmacy costs and clinic and lab fees associated with monitoring drug therapy are derived from nationally representative sources (17-19).

D. Analysis Design

All analyses are conducted for a 4 million person birth cohort with demographic and underlying health characteristics representative of the U.S. population of age 18 with a history of screening for and management of obesity beginning at age 6. Analyses compare outcomes for a simulated population with access to screening and intensive management services for obesity from ages 6 to 18 to the same population, all else held equal, without access to this clinical service. We assume that the screening rate for obesity is 100%; however, not all children and adolescents who are screened positive for obesity will accept enrollment in an intensive, multi-component behavioral intervention program to manage the condition. Specifically, we assume that 55% of children and adolescents positively screened for obesity will ever enroll in an obesity management program. We assume that children and adolescents will have up to three opportunities to enroll in an obesity management program and that the completion rate at each opportunity is 75%. As such, 75% of the 55% positively screened children and adolescents who enroll in the obesity program will complete on the first try, 19% will complete on the second try, and 5% will complete on the third try, with intervention costs from partial and full completion accounted for accordingly. Cumulatively, 99% of the 55% of the children and adolescents who attempt an obesity program will have eventually completed the program and are assumed to realize benefits from this into adulthood. In the base case, we assume that half of the weight change achieved from a successfully completed yearlong childhood obesity intervention is maintained into adulthood.

Analyses were conducted from the societal perspective, which includes patient time costs, and in accordance with the "reference case" of the Panel on Cost Effectiveness in Health and Medicine (20). All costs are expressed in 2012 U.S. dollars. Primary outcomes are clinically preventable burden (CPB) and the incremental cost-effectiveness (CE) ratio. CPB is given by

$$\mathrm{CBP} = \sum_{\mathrm{it}} \mathrm{QALY}_{\mathrm{it1}} - \sum_{\mathrm{it}} \mathrm{QALY}_{\mathrm{it0}}$$

where QALY represents the quality-adjusted measure for a person's life year, i is a person identifier, t denotes time, 1 represents the case with access to the specified clinical preventive service, and 0 represents the case without access to the service. Similarly, CE is given by

$$\mathrm{CE} = \frac{\sum_{\mathrm{it}} \frac{\mathrm{QALY}_{\mathrm{it1}}}{(1+\mathrm{r})^{\mathrm{t}}} - \sum_{\mathrm{it}} \frac{\mathrm{QALY}_{\mathrm{it0}}}{(1+\mathrm{r})^{\mathrm{t}}}}{\sum_{\mathrm{it}} \frac{\mathrm{Costs}_{\mathrm{it1}}}{(1+\mathrm{r})^{\mathrm{t}}} - \sum_{\mathrm{it}} \frac{\mathrm{Costs}_{\mathrm{it0}}}{(1+\mathrm{r})^{\mathrm{t}}}}$$

where *Costs* represents total intervention, treatment and management, and disease costs for a person, *r* denotes the discount rate, which is set to 3 percent. As described in further detail below, screening for and management of obesity between ages 6 and 18 affects BMI into adulthood. Deterministic (one-way) sensitivity analyses of key parameters were conducted by replicating simulations with all other parameters, probabilities, and population characteristics held equal.

Treatment effects

Whitlock et al. conducted the systematic evidence review for the USPSTF recommendation. Evidence was strongest for medium-to-high intensity obesity interventions, which were defined by involving more

than 26 hours of treatment contact. Three study interventions met this criterion (21-23) and had an average effect of reducing BMI by 2.47 kg/m^2 over 12 months. We assume the persisting effect of such a program into adulthood is half this amount, or 1.23 kg/m^2, with all else held equal.

Intervention costs

Intervention costs are summarized in **Table 1**. The additional cost of screening for obesity is assumed to be zero, as measurement of height and weight is routine to clinical care. Few studies directly report costs of intensive obesity interventions and reporting on intervention resource requirements is particularly scarce for youth interventions. Therefore, we used cost estimates based upon obesity interventions for adults that were of similar intensity to the youth interventions the met the inclusion criteria noted above. We estimated standardized program costs based upon program components and resource use reported in studies of intensive interventions from which we estimated intervention effectiveness for adults and from studies of similar intensity that were excluded from our estimation of effect size due to differences in the population to whom they were targeted. Direct medical costs for intensive obesity interventions were estimated from the combination of two components: (a) the cost for health professional services (including dietitian, behavioral therapist, and athletic trainer) and (b) a standard cost for printed program materials (which we estimated to average $16 in 2012 dollars) (24). We determined hours of health professional time from study reports and assigned costs to health professional time based on average earnings for each profession, plus total benefits costs, based on National Occupational Employment and Wage Estimates and Employer Costs for Employee Compensation (25, 26). We used occupation code 29-1031 for dietitians, codes 19-3031 and 21-1011 for psychologist counselors, and 29-9091 for athletic trainers. We added a 50% indirect rate for these labor costs to approximate facility costs and intervention support staff.

Direct costs incurred by participants consist of extra costs associated with exercise and healthy diet. Costs of a gym membership (assumed to be $45 per month) or portion of a gym membership for interventions with less intensive exercise component, were added to capture average out-of-pocket costs for physical activity. For interventions with a diet component, we approximated the cost of an improved diet from two studies. From a study by Monsivais et al. (27), we estimated incremental annual dietary costs of moving from a lower tercile to the next highest tercile of food cost and healthiness where the terciles were derived from a dietary survey and local food prices in King County, Washington. From a study by Rehm et al. (28), we estimated the incremental cost of improved diet from the margin between the 2nd and 4th quintiles of energy-adjusted diet cost where the quartiles were derived from 2001-2002 National Health and Nutrition Examination Survey and national food price data. The average incremental cost for higher quality diet we derived from these estimates was $819 per year.

Time costs incurred by participants include time spent with health professionals, additional time costs for tracking diet and preparing healthy meals and for physical activity. Patient time was valued at the average hourly earnings plus benefits of all U.S. employees ($31 per hour) (26).

Our standardized costs reflect total costs for patients with complete adherence with study protocol. The model incorporates adherence explicitly. Thus, average costs per patient will be lower than our standardized costs as those failing to adhere to the entire intervention will be allotted only a portion of the intervention costs.

Table 1: Annual costs for enrollment in an intensive adult obesity management intervention

	Annual Cost	Source
Direct Medical Costs		
Dietician Costs (including overhead)	$ 230	(24, 29-39)
Behavioral Therapist Costs (including overhead)	$ 166	(24, 29-39)
Athletic Trainer Costs	$ 497	(24, 29-39)
Literature/Books/Misc	$ 3	(24)
Total Direct Medical Costs	**$ 896**	
Direct Non-Medical Costs (Excluding Patient Time)		
Athletic Club Membership	$ 540	Assumed
Food Costs	$ 819	(27, 28)
Transportation Costs	$ 297	Assumed
Total Direct Non-Medical Costs	**$ 1,656**	
Patient Time Costs		
Behavioral and Dietary Change Classes	$ 1,035	(24, 26, 29-38)
Exercise Sessions	$ 3,894	(24, 26, 29-38)
Total Patient Time Costs	**$ 4,929**	

Notes: All costs are expressed in 2012 U.S. dollars.

E. Clinically Preventable Burden (CPB) Estimate

Our estimate of lifetime CPB for a birth cohort of 4 million persons initially aged 18 with a history of screening for and management of obesity between ages 6 to 18 is 193,790 QALYs. In sensitivity analysis, this estimate ranged from 98,265 to 288,478 QALYs.

F. Cost-Effectiveness (CE) Estimate

Our estimate of the incremental cost-effectiveness of screening for and management of obesity in adults is $208,603 per QALY. In sensitivity analysis, this estimate ranged from $88,582 to $ 428,734 per QALY.

G. Limitations

The microsimulation model design and the results of these analyses are limited by the quality of data and evidence used to inform them. Our sensitivity analysis results indicate that CPB estimates are most sensitive to the assumed long-term persisting effect of childhood enrollment in an obesity management program on BMI in adulthood, and CE estimates are most sensitive to assumptions regarding obesity intervention efficacy and costs. The marginal benefit of obesity screening and management is dependent on the progression of risk factors and disease rates as children and adolescents age into adulthood, but ModelHealth: CVD is shown to validate reasonably well with U.S. data (**Technical Supplement, Table 30**).

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