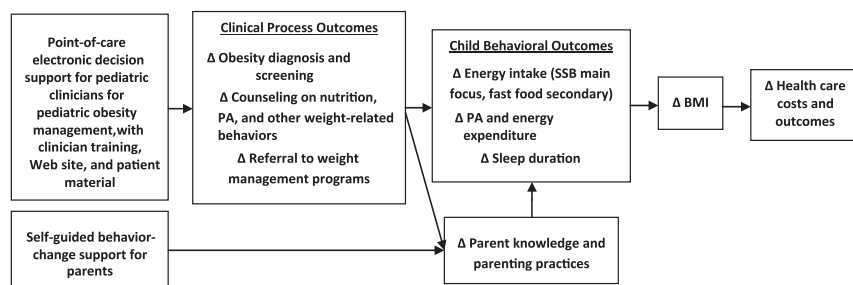


Supplemental Information



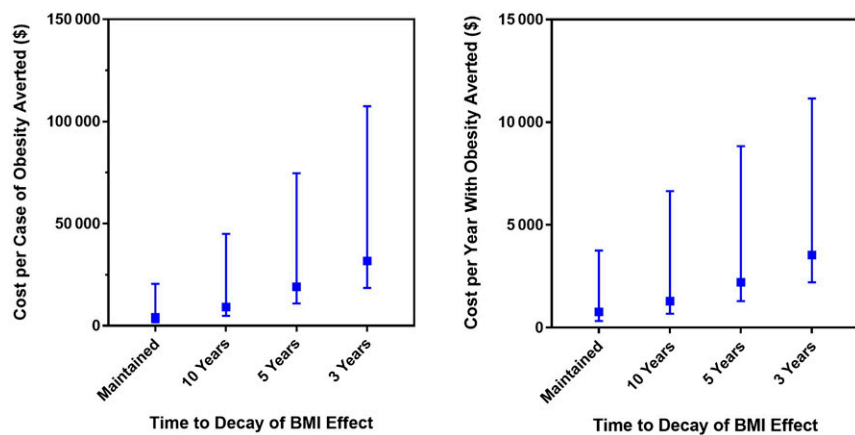
SUPPLEMENTAL FIGURE 2

Logic pathway linking the STAR intervention to change in obesity-related health care costs. Δ, change; PA, physical activity; SSB, sugar-sweetened beverages.



SUPPLEMENTAL FIGURE 3

Hierarchical representation of the target population for the national implementation of the STAR intervention.



SUPPLEMENTAL FIGURE 4

Cost-effectiveness outcomes of the sensitivity analysis, varying the assumption that the effect of the STAR clinical childhood obesity intervention on BMI is maintained throughout the 10-year microsimulation models (2015–2025).

SUPPLEMENTAL TABLE 4 Microsimulation Modeling Parameters for Intervention Effect, Reach, and Cost Associated With the National Implementation of the STAR Clinical Childhood Obesity Intervention

Parameter	Estimate	Description and Sources
Effect estimate		
Change in BMI over 1 y among intervention participants relative to usual care	−0.51 (95% CI, −0.91 to −0.11)	Based on the STAR trial intention-to-treat results from multivariable linear regression models adjusted for clustering by practice site and for patient and parent demographic characteristics. ¹⁶ This effect estimate is based on a single study for evidence of effectiveness that is of high quality, a cluster-randomized trial with pre- and posttest and control groups.
Population reach (Supplemental Fig 3)		
No. of practicing pediatric PCPs in the United States	44 933	Estimate from the Agency for Healthcare Research and Quality, 2010. ²⁶
Proportion of PCPs in various practice setting types	1–2 physicians in practice = 0.180 3–5 physicians in practice = 0.207 ≥6 physicians in practice = 0.213 Multispecialty group and HMO practices = 0.205 Medical school, hospital, or clinic = 0.195	Proportion of pediatric generalist providers in various practice setting types from Lehmann et al. ²⁵
Proportion of pediatric PCPs with fully functional EHRs by practice setting type	1–2 physicians in practice = 0.033 3–5 physicians in practice = 0.058 ≥6 physicians in practice = 0.056 Multispecialty group and HMO practices = 0.301 Medical school, hospital, or clinic = 0.235	Fully functional EHR adoption among pediatricians by practice setting type based on 2012 estimates from Lehmann et al. ²⁵ For scenario analyses 2 and 3, we calculated a slope of change in EHR adoption from 2009 to 2012 as reported by Lehmann et al. ²⁵ and extrapolated 2015 rates of EHR adoption as follows: Unchanged for 1–2 and 3–4 physicians in practice ≥6 physicians in practice = 0.112 Multispecialty group and HMO practices = 0.457 Medical school, hospital, or clinic = 0.367 For scenario analyses 4, we set fully functional EHR adoption to equal 0.65 based on the US Department of Health and Human Services 2014 goal for EHR adoption among office-based PCPs. ³³ We did not account for geographic variation in EHR adoption given the absence of pediatric-specific data stratified by practice type. Estimates of the average no. of patients seen by pediatric PCPs for well-child care in each of the practice setting types from Bocian et al. ²⁷
No. of patients seen for well-child care per year by pediatric PCPs in each of the practice setting types	1–2 physicians in practice = 1900 3–5 physicians in practice = 1500 ≥6 physicians in practice = 1400 Multispecialty group and HMO practices = 1400 Medical school, hospital, or clinic = 1400	
Proportion of child patients age 6–12 y seen by pediatric PCPs for well-child care	0.34	Bocian et al. ²⁷
Proportion of US children ages 6–12 y seen by PCPs using fully functional EHRs implementing the intervention	Base case = 0.1047 Scenario analysis 1 = 0.080 Scenario analysis 2 = 0.157 Scenario analysis 3 = 0.123 Scenario analysis 4 = 0.194	No. of US children ages 6–12 y is 28.7 million, per 2010 US census
Intervention costs		

TABLE 4 Continued

Parameter	Estimate	Description and Sources
IT programming cost of EHR modifications (start-up cost)	Base case scenario: \$23 542 per PCP group sharing an EHR system ^a	The base case scenario cost is based on the IT programming cost of implementing EHR modifications comparable to the STAR intervention at a clinical practice by using the eClinicalWorks EHR software (Westborough, MA) as part of another study. ⁶
	Scenario analyses with implementation at large practices only	The cost for the scenario analyses involving implementation at large practices only is based on the cost of EHR modifications as part of the STAR trial, which took place in a large practice setting using the EpicCare EHR. In all scenarios, we excluded the cost of general EHR implementation and only counted intervention-specific IT costs, assuming the existence of an EHR platform to be a prerequisite for intervention implementation.
	\$5242 per PCP group sharing an EHR system ^a	—
Web developer time for Web site development (start-up cost)	\$33.02 per h × 173 h per PCP group sharing an EHR system ^a	Hourly wage was extrapolated from a lump sum contract for Web site development (\$6576.60) for the STAR trial by using US BLS occupation 15–1154 salary for the Boston and Cambridge area of \$38.05 per h and \$79 140 per y. National costs were then estimated by using state-level salaries for the same BLS occupation code (15–1134, Web developer, national mean hourly wage) plus 45.6% fringe added per June 2014 US BLS report of employer costs for employee compensation.
RA time for Web site development (start-up cost)	\$20.71 per h × 60 h per PCP group sharing an EHR system ^a	Estimate of RA time spent during the STAR trial developing the list of local weight management programs and the searchable database of local physical activity programs included on the intervention Web site. RA salary taken from the US BLS (occupation 19–4061, social science RA, national mean hourly wage) with 45.6% fringe added per June 2014 US BLS report of employer costs for employee compensation.
Project manager time for developing PCP training materials (start-up cost)	\$32.56 per h × 2 h per PCP group sharing an EHR system ^b	Estimate of project manager time spent during the STAR trial developing materials for PCP training. Project manager salary taken from the US BLS (occupation 11–9151, social and community service managers, national mean hourly wage) with 45.6% fringe added per June 2014 US BLS report of employer costs for employee compensation.
Project manager time conducting PCP training (start-up cost)	\$32.56 per h × 1 h per PCP practice ^b	Estimate of project manager time spent during the STAR trial conducting PCP training sessions. Project manager salary taken from the US BLS (occupation 11–9151, social and community service managers, national mean hourly wage) with 45.6% fringe added per June 2014 US BLS report of employer costs for employee compensation.
Materials for PCP training (start-up cost)	\$7.06 per PCP ^c	Cost from the STAR trial for providing each PCP with printed handouts (\$2.26 each) and flash drives with files (\$4.80 each).
RA time preparing materials for PCP training (start-up cost)	\$20.71 per h × 0.05 h per PCP ^c	Estimate of RA time spent during the STAR trial preparing PCP materials.
PCP time attending training (start-up cost)	\$84.33 per h × 0.5 h per PCP practice ^b	Estimate of PCP time spent during the STAR trial attending training sessions. PCP salary taken from the US BLS (occupation 29–1065, general pediatrician, national mean hourly wage) with 45.6% fringe added per June 2014 US BLS report of employer costs for employee compensation.
Color posters for display at participating practices (start-up cost)	\$36 for large posters and \$1.28 for small posters; 2 large and 20 small posters per PCP practice ^b	Printing costs from the STAR trial.
Health educator time developing materials for parent mailings (start-up cost)	\$26.57 per h × 56 h per PCP group sharing an EHR system ^a	Estimate of health educator time spent during the STAR trial developing materials to support parents in helping their children make health behavior changes. Estimated at 14 h per newsletter and a total of 4 newsletters. Health educator’s salary taken from the US BLS (occupation 21–1091, health educator, national mean hourly wage) with 45.6% fringe added per June 2014 US BLS report of employer costs for employee compensation.
Web developer time for Web site maintenance (ongoing cost)	\$33.02 per h × 30 h per PCP group sharing an EHR system ^a	Estimate of Web developer hours spent maintaining Web site from the OSNAP intervention (http://osnap.org/). Salary taken from the US BLS (occupation 15–1154, Web developer, national mean hourly wage) with 45.6% fringe added per June 2014 US BLS report of employer costs for employee compensation.

TABLE 4 Continued

Parameter	Estimate	Description and Sources
RA time for Web site maintenance (ongoing cost)	\$20.71 per h × 30 h per PCP group sharing an EHR system ^a	Estimate of RA time spent during the STAR trial maintaining the list of local weight management programs and the searchable database of local physical activity programs included on the intervention Web site. RA salary taken from the US BLS (occupation 19–4061, social science RA, national mean hourly wage) with 45.6% fringe added per June 2014 US BLS report of employer costs for employee compensation.
Project manager time conducting annual PCP training sessions and sending biweekly performance feedback e-mails (ongoing cost)	\$32.56 per h × 1 h per PCP practice ^b	Estimate of project manager time spent during the STAR trial conducting PCP training sessions (1 h) and sending e-mails (15 min) to each practice twice a month with performance feedback regarding how well clinicians were completing billing codes for obesity management, project manager labor. Project manager salary taken from the US BLS (occupation 11–9151, social and community service managers, national mean hourly wage) with 45.6% fringe added per June 2014 US BLS report of employer costs for employee compensation.
Food for PCP training (ongoing cost)	\$3 per PCP ^c	Cost from the STAR trial providing PCPs with food and coffee.
PCP time attending training (ongoing cost)	\$84.33 per h × 0.167 h per PCP practice ^b	Estimate of PCP time spent during the STAR trial attending refresher training sessions. PCP salary taken from the US BLS (occupation 29–1065, general pediatrician, national mean hourly wage) with 45.6% fringe added per June 2014 US BLS report of employer costs for employee compensation.
Additional time spent by PCP per child (ongoing cost)	\$84.33 per h × mean time 0.069 h (95% UI, –0.021 to 0.144) per child ^d	Estimate of additional time spent by PCP in clinical visits due to the intervention on the basis of reasonable assumption and consultation with stakeholders. Given uncertainty around these time estimates, we used a β distribution (parameterized from a Triangular distribution) with mode = 5 min, minimum = –5 min (ie, time savings), and maximum = 10 min per child. The goal of CDS is to improve both the quality and efficiency of clinical care. In the best case, the EHR-based CDS tools are well-integrated and supportive of clinician workflow such that they save the PCPs time during clinical visits (eg, by providing resources at the point of care that the clinician would otherwise spend time acquiring such as patient growth data, clinical reference materials or patient handouts). On the other hand, EHR CDS tools may consume additional PCP time by adding to or interrupting workflows. PCP salary taken from the US BLS (occupation 29–1065, general pediatrician, national mean hourly wage) with 45.6% fringe added per June 2014 US BLS report of employer costs for employee compensation.
RA time on parent mailings (ongoing cost)	\$20.71 per h × 0.4 h per child ^d	Estimate of RA time spent during the STAR trial preparing each of 8 mailings (4 newsletters and 4 healthy eating magazines) sent to parents. RA salary taken from the US BLS (occupation 19–4061, social science RA, national mean hourly wage) with 45.6% fringe added per June 2014 US BLS report of employer costs for employee compensation.
Materials and postage for parent mailings (ongoing cost)	\$39.52 per child ^d	Cost from the STAR trial for mailing 1 parent of each child enrolled for 4 newsletters (\$1.97 each plus \$0.49 postage) and 4 healthy eating magazines (\$5.90 plus \$1.52 postage).

BLS, Bureau of Labor Statistics; CI, confidence interval; HMO, health maintenance organization; IT, information technology; OSNAP, Out-of-School Nutrition and Physical Activity; RA, research assistant; —, not applicable.

^a Number of PCP groups sharing an EHR system (defined here as groups of PCPs sharing an EHR system such that investments in EHR modifications would be shared) were estimated at 524 in the base case scenario. This number was approximated on the basis of the typical number of pediatric PCPs in each of the various practice setting types based on (1) the American Academy of Pediatrics Periodic Survey of Fellows for pediatric practice groups^{25,48}; (2) Internet searches examining clinician rosters for 1 or 2 medical school, hospital, and clinic settings in each state; and (3) Internet searches and phone calls to multispecialty group and health maintenance organization clinical sites associated with members of the Health Maintenance Organization Research Network, since renamed the Health Care Systems Research Network.⁴⁹

^b Number of PCP practices (defined as groups of PCPs practicing in a single physical location) were estimated at 781 in the base case scenario. We used the same estimates as PCP groups sharing an EHR system except in the case of multispecialty group and health maintenance organization settings, where we estimated that on average 10 pediatric PCPs would share a single office site.

^c Number of PCPs estimated at 6174 in the base case scenario.

^d Number of children (ie, population reach) estimated by microsimulation model at ~2 million in the base case scenario.

SUPPLEMENTAL TABLE 5 Scenario Analysis Results for Population Reach, Cost, and Effectiveness Results From a 10-Year Microsimulation Model of the National Implementation of the STAR Clinical Childhood Obesity Intervention, 2015–2025

	Base Case: National Implementation	Scenario 1:	Scenario 2:	Scenario 3:	Scenario 4:
		Implementation at Large Practices Only	Extrapolated 2015 EHR Adoption	Large Practices and Extrapolated 2015 EHR Adoption	Large Practices and 2014 HHS EHR Adoption Goal
Population reach					
10-y reach, millions	2.0 (1.8 to 2.2)	1.5 (1.4 to 1.7)	3.0 (2.7 to 3.2)	2.4 (2.2 to 2.5)	3.7 (3.4 to 4.0)
First-year reach, millions	0.6 (0.5 to 0.6)	0.4 (0.4 to 0.5)	0.9 (0.8 to 1.0)	0.7 (0.6 to 0.7)	1.1 (1.0 to 1.2)
Intervention effect					
1-y BMI change	−0.5 (−0.9 to −0.1)	−0.5 (−0.9 to −0.1)	−0.5 (−0.9 to −0.1)	−0.5 (−0.9 to −0.1)	−0.5 (−0.9 to −0.1)
Intervention costs					
10-y total cost, millions of dollars	239 (186 to 292)	173 (134 to 216)	353 (274 to 435)	266 (204 to 329)	420 (323 to 518)
Annual costs, millions of dollars	24 (19 to 29)	17 (13 to 22)	35 (27 to 44)	27 (20 to 33)	42 (32 to 52)
Cost per child, dollars	119 (94 to 145)	113 (87 to 138)	118 (92 to 143)	113 (87 to 138)	113 (88 to 139)
10-y totals (2015–2025)					
Years with obesity averted, thousands	226.0 (56.6 to 323.7)	173.2 (43.6 to 249.2)	338.7 (84.0 to 476.6)	266.3 (69.9 to 380.1)	418.4 (103.7 to 593.8)
Obesity costs averted, millions of dollars	64 (16 to 92)	49 (12 to 70)	96 (24 to 135)	75 (20 to 108)	118 (29 to 168)
Net costs difference, millions of dollars	175 (105 to 263)	124 (71 to 191)	257 (151 to 386)	191 (108 to 293)	302 (172 to 461)
Health care costs saved per dollar invested, dollars	0.27 (0.06 to 0.45)	0.28 (0.06 to 0.48)	0.27 (0.06 to 0.46)	0.28 (0.06 to 0.48)	0.28 (0.06 to 0.48)
2025 projected obesity prevalence					
Overall obesity prevalence reduction, %	0.01 (0.00 to 0.02)	0.01 (0.00 to 0.02)	0.02 (0.01 to 0.03)	0.02 (0.00 to 0.02)	0.03 (0.01 to 0.04)
Cases of obesity averted, thousands	42.9 (9.8 to 63.9)	32.8 (8.1 to 48.1)	64.2 (15.8 to 93.4)	50.5 (12.1 to 74)	79.2 (20.0 to 114.9)
Child obesity prevalence reduction, %	0.05 (0.01 to 0.08)	0.04 (0.01 to 0.06)	0.08 (0.02 to 0.11)	0.06 (0.02 to 0.09)	0.10 (0.03 to 0.14)
Cases of child obesity averted, thousands	37.9 (9.0 to 55.5)	29.0 (7.4 to 41.9)	56.7 (14.5 to 80.8)	44.6 (11.0 to 64.1)	70.0 (18.4 to 98.5)
Cost-effectiveness ratios^a					
Intervention cost per BMI unit reduction per child, dollars	237 (106 to 1276)	224 (98 to 1207)	234 (103 to 1269)	224 (99 to 1208)	225 (98 to 1224)
Cost per y with obesity averted, dollars	774 (327 to 3763)	718 (290 to 3548)	759 (314 to 3617)	717 (288 to 3374)	722 (290 to 3436)
Cost per case of obesity averted, dollars	4262 (1859 to 20234)	3972 (1616 to 20465)	4183 (1848 to 20742)	3955 (1728 to 18543)	3989 (1677 to 19080)

All data mean (95% UI). HHS, Health and Human Services. Costs are in 2014 dollars and discounted at 3% per year.

^a Incremental cost-effectiveness ratios of comparing the intervention to usual care.

SUPPLEMENTAL TABLE 6 Population Reach, Cost, and Effectiveness Results From 10-Year Microsimulation Models of the STAR Clinical Childhood Obesity Intervention Compared With 13 Other Childhood Obesity Interventions, 2015–2025

	Population Reach	Intervention Effect	Intervention Cost	10-y Totals (2015–2025)			2025 Projected Obesity Prevalence			Cost-Effectiveness Ratios ^a		
				1-y BMI Change	Health Care Costs Saved per Dollar Invested, \$	Overall Obesity Prevalence Reduction, %	Cases of Obesity Averted, Thousands	Child Obesity Prevalence Reduction, %	Cases of Child Obesity Averted, Thousands	Intervention Cost per BMI Unit Reduction per Child, \$	Net Cost per Year With Obesity Averted, \$	
STAR	2	-0.5	119	0.27	0.01	0.05	42.8	0.05	37.9	237 ^b	774	
Bariatric surgery	0.021	-14.5	14223	0	0	0	0.092	0	0	1611	15466	
Sugar-sweetened beverage excise tax	344	-0.125	1.38	30.78	0.8	0.81	2487	0.81	576	2.49	-795	
Nutrition standards for all other food and beverages sold in schools	77	-0.162	2.9	4.56	0.18	0.49	569	0.49	345	6.1	-221	
Nutrition standards for school meals	77	-1.49	234	0.42	0.88	2.57	2757	2.57	1816	53.2	385	
Elimination of the tax subsidy for advertising unhealthy food to children	109	-0.034	0.08	32.53	0.06	0.18	173	0.18	129	0.66	-197	
Improved early care and education policies and practices (NAP SACC)	5.8	-0.21	129	0.04	0.01	0.05	38	0.05	38	613	3127	
Restaurant menu calorie labeling	344	-0.048	2.78	5.9	0.22	0.06	684	0.06	41	13.09	-968	
Active physical education	54	-0.011	17	0.04	0.01	0.02	19.3	0.02	13.7	8.18	6887	
Active recess	26	-0.021	25	0.07	0.01	0.03	25.2	0.03	24.7	5.41	3720	
Active school day	58	-0.034	263	0.01	0.03	0.1	95	0.1	73.6	2825	23685	
Healthy after school	0.2	-0.29	255	0.08	0	0	2.6	0	2.6	255	3121	
New after school	7.5	-0.327	-6153	Cost saving ^c	0.04	0.15	112000	0.15	110	Cost saving ^c	Cost saving ^c	
HipHop to health	22	-0.125	50	0.06	0.03	0.13	93	0.13	93	361	1950	

From Gortmaker et al.¹⁸ and Craddock et al.³⁹ Costs are in 2014 dollars and discounted at 3% per year. NAP SACC, Nutrition and Physical Activity Self-Assessment for Child Care.

^a Incremental cost-effectiveness ratios of comparing the intervention to usual care.

^b Calculated as the estimated cost per child divided by the relative reduction in BMI over 1 y compared with usual care.

^c This intervention was cost saving because of the efficiency of the intervention, not because of the health care cost savings due to intervention effectiveness.³⁹

SUPPLEMENTAL REFERENCES

48. American Academy of Pediatrics
Division of Health Services Research.
Periodic survey of fellows. 2013.
Available at: www.aap.org/en-us/professional-resources/Research/pediatrician-surveys/PublishingImages/slide3a_2013.jpg. Accessed February 22, 2015
49. HMO Research Network. Members.
Available at: www.hmoresearchnetwork.org/en/. Accessed July 31, 2015
50. Taveras EM, Blaine RE, Davison KK, et al; MA-CORD Study Group. Design of the Massachusetts Childhood Obesity Research Demonstration (MA-CORD) study. *Child Obes*. 2015;11(1):11–22