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Cost-Effectiveness Analysis of the Federal Menu Calorie Labeling and Obesity-Associated Cancer Burdens in the United States

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Cost-Effectiveness Analysis of the Federal Menu Calorie Labeling and Obesity-Associated **Cancer Burdens in the United States** Mengxi Du, doctoral candidate¹, Christina F. Griecci, postdoctoral fellow¹, Frederick F. Cudhea, statistician¹, Heesun Eom, research assistant^{1,2}, John B. Wong, director of comparative effectiveness research³, Parke Wilde, professor of food and nutrition policy¹, David D. Kim, assistant professor of medicine⁴, Dominique S. Michaud, professor of public health and community medicine⁵, Y. Claire Wang, associate professor, vice president of research, evaluation and policy ^{2,6}, Dariush Mozaffarian, dean and Jean Mayer professor of nutrition¹, Fang Fang Zhang, Neely Family professor of nutrition and cancer¹ on behalf of the Food-PRICE Project 1. Friedman School of Nutrition Science & Policy, Tufts University, Boston, MA 2. New York Academy of Medicine, New York, NY 3. Division of Clinical Decision Making, Tufts Medical Center, Boston, MA 4. Center for the Evaluation of Value and Risk in Health, Institute for Clinical Research and Health Policy Studies, Tufts Medical Center, Boston, MA 5. Department of Public Health and Community Medicine, School of Medicine, Tufts University, Boston, MA 6. Department of Health Policy and Management, Mailman School of Public Health, Columbia University, New York, NY Short Running Head: Cost-Effectiveness of Menu Calorie Labeling to Prevent Cancer Word Count: 3367

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- 24 (<u>fang_fang.zhang@tufts.edu</u>). Phone: 617-636-3740; Fax: 617-636-3727
- 25 Abbreviations: AMPM, Automated Multiple Pass Method; BMI, Body Mass Index; CDC,
- 26 Centers of Disease Control and Prevention; CI, Confidence Interval; DiCOM, Diet and Cancer
- 27 Outcome Model; FDA, Food and Drug Administration; FNDDS, Food and Nutrient Database for
- 28 Dietary Studies; MEC, Mobile Examination Center; NCHS, National Center for Health
- 29 Statistics; NHANES, National Health and Nutrition Examination Survey; PSA, Probabilistic
- 30 sensitivity analysis; SD, Standard Deviation; SE, Standard Error; USDA, United States
- 31 Department of Agriculture; UI, Uncertainty Interval

32 ABSTRACT

33 Objective To assess the impact of menu calorie labeling on reducing obesity-associated cancer
34 burdens in the United States (US).

Design Cost-effectiveness analysis using a probabilistic cohort state-transition model.

Setting Policy intervention.

Participants 235 million adults aged 20+ years.

Interventions The policy effects on reducing 13 obesity-associated cancers among US adults

39 and population subgroups by age, sex, and race/ethnicity over a simulated lifetime were

40 evaluated in two scenarios: (1) effects on consumer behaviors; and (2) additional effects on

41 industry reformulation. The model integrated nationally representative demographics, calorie

42 intake from restaurants, cancer statistics, associations of policy with calorie intake, dietary

43 change with BMI change, BMI with cancer rates, and policy and healthcare costs.

Main outcome measures Health and economic gains were estimated among the total population

45 and population subgroups defined by age, sex, and race/ethnicity. Net costs and incremental cost-

46 effectiveness ratio were assessed from societal and health care perspectives. Probabilistic

47 sensitivity analyses incorporated uncertainty in input parameters and generated 95% uncertainty

48 intervals (UIs).

49 Results Considering consumer behavior alone, the menu calorie labeling was estimated to be 50 associated with a reduction of 28 000 (95% UI: 16 300-39 100) new cancer cases and 16 700 51 (9610-23 600) cancer deaths, a gain of 111 000 (64 800-158 000) quality-adjusted life years, and 52 a saving of \$1480 million (\$884 million-\$2080 million) in cancer-related medical costs among 53 US adults. The policy was associated with net cost savings of \$1460 (\$864-\$2060) million and 54 \$1350 (\$486-\$2260) million from healthcare and societal perspectives, respectively. Additional

1 2		
2 3 4	55	industry reformulation would substantially increase policy impact. Greater health gains and cost
5 6	56	savings were observed among young adults, Hispanic and non-Hispanic Black individuals.
7 8 9	57	Conclusions Study findings suggest that menu calorie labeling is associated with lower obesity-
10 11	58	related cancer burdens and reduced healthcare costs. Policymakers may prioritize nutrition
12 13	59	policies for cancer prevention in the US.
14 15 16	60	(Word Count: 299)
17 18	61	Keywords: obesity, cost-effectiveness, menu calorie labeling, cancer incidence, cancer death,
19 20	62	medical cost
21 22 23	63	Keywords: obesity, cost-effectiveness, menu calorie labeling, cancer incidence, cancer death, medical cost
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64 INTRODUCTION

Obesity affects 1 in 3 Americans and is an established risk factor for 13 types of cancers, such as endometrial, liver, breast, prostate, and colorectal cancers.¹ Obesity-associated cancer represents 40% of all newly diagnosed cancer cases and contributes to \$147 billion in costs in healthcare each year.¹⁻⁶ Rates of obesity-associated cancers are also rising disproportionally among young adults.^{5 7} Substantial health and economic burdens highlight the need to prioritize cost-effective strategies to reduce obesity-associated cancers in the US.

Diet is one of the few modifiable factors for both obesity and obesity-associated cancers.²⁸ Restaurant meals account for 1 in 5 calories consumed by US adults, including 9% of calories from full-service restaurants and 12% from fast-food restaurants,⁹ is an important target for improving population diet. Restaurant meals can have very high calories, with a mean energy of 1362 kcal/meal and 969 kcal/meal in popular meals from randomly selected full-service and fast-food restaurants, respectively.¹⁰ Consistently, individuals who cook less frequently at home consume more daily calories than those who cook more at home.¹¹ Thus, reducing calories consumed from restaurant meals has the potential to reduce daily calorie intake and subsequent obesity and obesity-related cancer burdens.

To help consumers make lower-calorie choices, the Affordable Care Act mandated that all chain restaurants with 20 or more outlets post calorie information on menus and menu boards for all standard menu items.¹² The FDA published the final rules for this policy in 2016, which was subsequently implemented in 2018. Interventional studies demonstrate that menu calorie labeling reduces total energy intake by consumers.¹³ ¹⁴ Such policy can also motivate restaurant Page 7 of 99

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87 reformulation to lower calorie contents or introduce healthier food options.¹⁵⁻²⁰ Prior research 88 suggests that this policy is associated with substantial reductions in incident cardiovascular 89 diseases and type 2 diabetes and net savings of over \$10 billion.²¹ However, the health and 90 economic benefits of the policy for obesity-associated cancers have not been evaluated. This 91 study aimed to address the knowledge gap by evaluating the cost-effectiveness of the federal 92 menu calorie labeling and obesity-associated cancer burdens among US adults.

94 METHODS

95 Study Overview

The Diet and Cancer Outcome (DiCOM), a probabilistic cohort state-transition model,^{22 23} was used to perform an economic evaluation of the menu calorie labeling and obesity-associated cancer rates among 235 million US adults over a simulated lifetime (Supplementary Figure 1). The model integrated independent parameters from different data sources, including nationally representative population demographics, dietary intake, and cancer statistics; association estimates of policy intervention with diet, diet change with body mass index (BMI), and BMI with cancer risks; and policy and health-related costs from established sources (Table 1). This study used de-identified datasets and was exempt from institutional review board review and follows the Consolidated Health Economic Evaluation Reporting Standards (CHEERS) reporting guidelines.

Table 1. Key input parameters and data sources in the Dietary Cancer Outcome Model (DiCOM)

Model Input	Outcome	Estimates	Distribution	Comments	Data Source
1. Simulated population	Population	Mean consumption of calories was 332 kcal/d from full-service or fast-food restaurants (Supplementary Tables 1, 8-9)	Ŷ	Stratified by age, sex, race/ethnicity; 32 subgroups	NHANES 2013-2016
2. Policy effect ¹					Meta-analysis of labeling
a) Consumer behavior	Policy effect	7.3% (4.4%-10.1%)	β	One-time effect	interventions on reducing calor intake, Shangguan et al., 2019 American Journal of Preventati Medicine
b) Industry response	Policy effect	5% (Appendix 1 and Appendix Table 1)	β	Assumption: no reformulation in the 1st year of policy intervention; Restaurants will replace the high-calorie menu items with low-calorie options or reformulate the menu items in years 2 to 5 of the intervention to achieve a 5% reduction in calorie contents	Calorie changes in large chain restaurants from 2008 to 2015 Bleich et al. 2017, Prev Med; Higher-Calorie Menu Items Eliminated in Large Chain Restaurants, Bleich et al. 2018 American Journal of Preventat Medicine
3. Effect of added sugar intake on BMI (kg/m²) ¹	Dietary effect	Among individuals with: BMI <25: 0.0015 per kcal BMI ≥25: 0.003 per kcal	Normal	Assumption: 55 kcal per day reduction in calorie intake would lead to 1 pound weight loss within 1 year, with no further weight loss in the future	Hall et al., 2018, JAMA; Hall et 2011, Lancet
4. Etiologic effect of BMI on cancer outcomes ¹	Cancer outcome	RRs ranged from 1.05 to 1.50 (Supplementary Table 2)	Lognormal	BMI change and cancer incidence	Continuous Update Project (Cl conducted by the World Cance Research Fund (WCRF)/Amer

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1 2						
2 3 4 5						Institute for Cancer Research (AICR)
6 7 8 9 10 11	5. Cancer statistics ¹	Cancer incidence ³ and survival	Appendixes 2-3, Appendix Tables 2-3 and Supplementary Tables 3-4	β	Stratified by age, sex, and race/ethnicity	NCI's Surveillance, Epidemiology, and End Results Program (SEER) Database; CDC's National Program of Cancer Registries (NPCR) Database
12 13 14 15 16 17 18	6. Healthcare related costs ^{1,2}	Medical expenditures, productivity loss, and patient time costs	Appendix 6, Appendix Table 6 and Supplementary Tables 6-7	Y	Stratified by age, and sex	NCI's Cancer Prevalence and Cost of Care Projections; Published literature
19 20 21 22 23 24 25	7. Policy costs ^{1,2}	For government and industry	Appendix 5 and Appendix Tables 4-5	e v	Administration and monitoring costs for government; compliance and reformulation costs for industry	FDA's budget report; Nutrition Review Project; and FDA's RIA
25 26 27 28	8. Health-related quality of life (HRQOL) ¹	For 13 types of cancers	Ranged from 0.64 to 0.86 (Appendix 4 and Supplementary Table 5)	β	EQ-5D ⁴ data from published literature by cancer type	Published literature
29 30 31 32 33 34 35 36	 Uncertainty distributions were in If the source did not provide un Time-varying input parameter, 1 	ncorporated in the prol certainty estimates, we for which the model ac	Drug Administration; NCI, National Cance babilistic sensitivity analyses. Uncertaintic e assumed the standard errors were 20% ecounted the secular trends. Details were e EuroQol Group as a measure of health-	es in each paramet of the mean estim provided in the Su	ter were presented in supplemental r late to generate gamma distribution. pplements.	naterials (Table TS3 and Tables S3-9).
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Simulated US Population

107 Because FDA's final rules on menu calorie labeling were published in 2016 and implemented in 108 2018, we used 2015-2016 as the baseline and assumed a closed cohort for this analysis. We 109 combined the 2013-2016 National Health and Nutrition Examination Survey (NHANES) to 110 approximate the baseline and simulate the US adult population aged 20+ years in 32 subgroups 111 stratified by age (20-44, 45-54, 55-64, 65+), sex (men, women), and race/ethnicity (non-Hispanic 112 White, non-Hispanic Black, Hispanic, Other) (Supplementary Table 1). This closed cohort of US 113 adults was modeled through their lifetime up to 80 years from baseline or until death. 114 115 **Calorie Consumption from Restaurants** 116 Mean calorie consumption from full-service and fast-food restaurants, demographics, and 117 prevalence of overweight or obesity were estimated using data collected from participants with at 118 least one valid 24-hour diet recall, in every 32 strata. Following FDA's estimates,¹² we assumed that policy would affect 56.5% of calories consumed at full-service restaurants and 100% at fast-119 120 food restaurants. The National Cancer Institute method was used to estimate the usual intake 121 distribution by statistically adjusting for within vs. between variance in dietary recalls.²⁴⁻²⁶ The 122 complex survey design was incorporated in all statistical analyses to ensure the 123 representativeness of study findings to the non-institutionalized US adults. 124 125 **Policy Association with Calorie Consumption** 126 Policy association was obtained from a systematic review and meta-analysis of food labeling 127 interventions that reported a 7.3% (95% CI: 4.4%-10.1%) reduction in calories consumed per 128 meal following calorie labeling (Appendix 1 and Appendix Table 1).¹⁴ We assumed that the

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policy would have a one-time effect over one year, with no further change over time. Potential policy impact on industry reformulation was derived from studies of restaurant menu items following the passage and initial period of partial implementation of the final rules. Between 2012-2014, among 66 of the 100 largest US chain restaurants, replacing higher-calorie menu items with lower-calorie items led to a 1-5% calorie reduction per menu item.^{18 19} Among 44 chain restaurants with menu calorie information available in 2008, the calories per menu item fell by 7% between 2008 and 2015.¹⁷ Therefore, we chose 5% as the mid-point for the potential policy impact on industry response, which may include discontinuation of existing high-calorie menu items and/or introduction of lower-calorie menu items. For both scenarios, we conservatively assumed that there would be some compensatory increased calorie intake outside of restaurants so that only half of all calories reduced from restaurant meals would translate into long-term reductions in daily calories. **Calorie Reduction and Obesity-Associated Cancer Risk** To estimate the relationships between calorie intake and obesity-associated cancers, we associated the multivariate-adjusted association of change in calorie intake (kcal/day) with change in BMI (kg/m²) and the estimates of BMI and cancer risks. Based on an established energy-weight dynamic model that accounted for long-term impacts of calorie reduction on weight and metabolic expenditure, we assumed that each 55 kcal/day calorie reduction leads to 1 pound weight loss over one year among overweight or obese adults, with no further reduction thereafter.^{27 28} Because long-term observational studies suggest that weight change for an equivalent change in dietary intake is about twice as large in overweight or obese adults than normal-weight adults,^{29 30} we conservatively applied half of this estimate to individuals with

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normal weight. For each of 13 obesity-related cancers, the estimated change in risk for each 5 kg/m² change in BMI was derived from the systematic reviews and meta-analyses of multivariable-adjusted prospective cohort studies conducted by the World Cancer Research Fund/American Institute for Cancer Research Continuous Update Project and the International Agency for Research on Cancer (Supplementary Table 2).²

Cancer Incidence, Mortality, and Health-Related Quality of Life

Age-adjusted cancer incidences in 2015 were obtained from the National Program of Cancer Registries and the Surveillance, Epidemiology, and End Results (SEER) program. We projected the cancer incidence from 2015 to 2030 based on the 2006-2014 trend using the Average Annual Percent Change method.³¹ We then combined the projected incidence rates with the projected US population from the National Interim Projections³² to account for changes in population age distribution over time. We further applied the cohort-period method to estimate cancer incidence in the closed cohort of US adults in each of 32 groups as they age (Appendix 2, Appendix Table 2, and Supplementary Table 3). The 5-year relative survival rates for each cancer were extracted and converted to an annual probability of death (Appendix 3, Appendix Table 3, and Supplementary Table 4).³³⁻³⁵ Health-related quality of life data were obtained from publications that reported EuroQol-5 Dimension utility weights for each cancer among US patient population (Appendix 4 and Supplementary Table 5).

- - **Policy and Health-Related Costs**

Policy costs included government costs to administer, monitor, and evaluate the policy and industry costs to comply with the policy and reformulate their products (in scenario 2).

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3 4	175	Government costs were estimated from FDA's budget report and Nutrition Review Project
5 6	176	(Appendix 5 and Appendix Tables 4-5). ^{36 37} Industry compliance and reformulation costs were
7 8	177	based on the FDA's regulatory impact analysis that included initial and recurring nutrition
9 10 11	178	analysis of standard menu items and menu replacement, provision of nutrition information,
12 13	179	employee training, and legal review and accounted for restaurant size and type, reformulation
14 15	180	type, and compliance period. ¹²
16 17 18	181	
19 20	182	Direct medical costs for cancer care were extracted from the SEER-Medicare linked database for
21 22	183	three phases of cancer care: initial, continuing, and end-of-life (Appendix 6, Appendix Table 6,
23 24	184	and Supplementary Tables 6-7). ^{31 38} For individuals without cancer, the direct medical costs were
25 26 27	185	estimated based on Medical Expenditure Panel Survey (MEPS) data and insurance claims. ^{23 39 40}
28 29	186	Indirect costs including productivity loss due to disability or missed workdays and patient time
30 31	187	costs were derived from publications using MEPS data.41-44
32 33 34	188	
35 36	189	Cost-Effectiveness Analysis
37 38	190	Following the guidelines on cost-effectiveness in health and medicine, ⁴⁵ we evaluated the policy
39 40 41	191	impact by projecting the numbers of new cancer cases and cancer deaths averted and quality-
42 43	192	adjusted life-years (QALYs) gained and cost-effectiveness from both healthcare and societal
44 45	193	perspectives. The healthcare perspective assessed net costs as the difference between government
46 47 48	194	costs for implementing the policy and the direct medical costs of cancer care. The societal
49 50	195	perspective assessed the net costs as the difference between total policy costs (including both
51 52	196	government and industry costs) and health-related costs saved (including direct and indirect costs
53 54 55	197	of cancer care). All costs were inflated to 2015 US dollars using the Consumer Price Index or
55 56 57		
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Personal Health Care Index, with all costs and QALYs discounted at 3% annually.⁴⁵ Incremental
cost-effectiveness ratios (ICERs) were calculated as net costs divided by the difference in
QALYs between policy vs. no policy. ICERs falling below a willingness-to-pay threshold of
\$150,000 per QALY gained were considered to be cost-effective.^{46 47} Cost-effectiveness analysis
was further conducted among population subgroups by age, sex, and race/ethnicity to evaluate
policy associations with health disparities.

One-way sensitivity analyses were performed by varying input parameters, including reducing the outside-the-restaurant calorie compensation level to 25% or increasing it to 75%, altering coverage of the FDA's final rule to all calories from full-service restaurants, reducing the diet-BMI associations to half or doubling the estimates, incorporating an estimated 2% annual increase in medical expenditures associated with cancer care, and altering annual discounting rates from 3% to 0% or 5%. We also evaluated impacts at a 10-year time horizon for stakeholders interested in shorter-term health gains and economic benefits. Probabilistic sensitivity analyses (PSAs) were conducted to incorporate uncertainty in all input parameters jointly (Table 1). A total of 1000 Monte Carlo simulations were performed, and 95% uncertainty intervals (UIs) were estimated based on the 2.5 and 97.5 percentiles of 1,000 simulations. All analyses were conducted using SAS (Version 9.4) and R (Version 3.3.1).

217 Patient and Public Involvement

This study used de-identified datasets and did not involve patients or the public in the design, orconduct, or reporting, or dissemination plans of our research.

2 3	220	RESULTS
4 5	221	Population Characteristics
6 7	221	The simulated cohort of US adults in 2015-2016 had a mean age of 47.8 years, with 65.0% being
8 9 10		
10 11 12	223	non-Hispanic white adults and 71.4% were overweight or obese (Supplementary Tables 8-9). A
12 13 14	224	mean of 332 daily calories was consumed from full-service or fast-food restaurants. Higher
14 15 16	225	levels were consumed among younger adults aged 20-44 years (425 kcal/day), men (388
17 18	226	kcal/day), non-Hispanic black (361 kcal/day), and Hispanic (367 kcal/day) adults, in comparison
19 20	227	to other corresponding subgroups.
21 22	228	
23 24		
25 26	229	Health Gains
27 28	230	The menu calorie labeling was estimated to reduce calories consumed from restaurants by a
29 30	231	mean of 24 kcal/day (7.2% of calories consumed from restaurants) among US adults, and total
31 32	232	daily calories by 12 kcal/day. Accounting for potential industry reformulation would reduce the
33 34 35	233	mean intake by an additional 16 kcal/day, and total daily calories by 8 kcal/day.
36 37	234	
38 39	235	Based on changes in consumer behavior alone, the policy was associated with a reduction of
40 41 42	236	28,000 (95% UI: 16,300-39,100) new cancer cases and 16,700 (9,610-23,600) cancer deaths, and
43 44	237	a gain of 111,000 (64,800-158,000) QALYs among 235 million US adults over a median follow-
45 46	238	up of 34.4 years (Table 2 and Figure 1). By cancer type, the greatest numbers of new cancer
47 48	239	cases averted were cancers of endometrial (N [95% UI]: 5,700 [2,380-9,190]), liver (5,180
49 50 51	240	[2,800-7,730]), kidney (5,090 [2,670-7,730]), post-menopausal breast (4,840 [2,010-8,230]), and
52 53	241	pancreas (1,400 [756-2,100]). The greatest numbers of prevented cancer deaths were estimated
54 55	242	for cancers of liver (4,530 [2,410-6,760]), post-menopausal breast (3,080 [861-5,650]),
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2 3 4	243	endometrial (2,060 [957-3,220]), kidney (1,980 [1,080-2,920]), and pancreas (1,230 [661-
5 6	244	1,830]).
7 8	245	
9 10 11	246	Based on additional industry response, the total estimated health gains approximately doubled,
12 13	247	preventing 47,300 (35,400-59,100) new cancer cases and 28,200 (21,100-35,300) cancer deaths,
14 15	248	and gaining 189,000 (140,000-236,000) QALYs, with similar rankings of the types of new
$\begin{array}{c} 16\\ 17\\ 18\\ 19\\ 20\\ 21\\ 22\\ 23\\ 24\\ 25\\ 26\\ 27\\ 28\\ 29\\ 30\\ 31\\ 32\\ 33\\ 34\\ 35\\ 36\\ 37\\ 38\\ 940\\ 41\\ 42\\ 43\\ 445\\ 46\\ 47\\ 48\\ 950\\ 51\\ 52\\ 53\\ 54\\ 55\end{array}$	249	cancer cases and cancer deaths prevented.
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Table 2. Estimated health gains and costs of the federal menu calorie labeling on reducing the obesity-related cancer burdens in the US over 10 years and a lifetime (US population=235,162,844)¹

6—	Menu Calorie Labeling Policy					
/— 8		10 Y		Lifetime		
o 9		Consumer Behavior	Consumer Behavior +	Consumer Behavior	Consumer Behavior +	
10		Median (2.5% to 97.5%)	Industry Response	Median (2.5% to 97.5%)	Industry Response	
			Median (2.5% to 97.5%)		Median (2.5% to 97.5%)	
12	New Cancer Cases Averted, N (959	% UI)				
13	Endometrial cancer	692 (276 to 1100)	1130 (716 to 1550)	5700 (2380 to 9190)	9920 (6630 to 13600)	
14	Liver cancer	366 (144 to 615)	626 (386 to 887)	5180 (2800 to 7730)	8550 (5960 to 11300)	
	Kidney cancer	584 (290 to 884)	980 (689 to 1280)	5090 (2670 to 7470)	8620 (6200 to 11000)	
15	Breast cancer (postmenopausal)	670 (256 to 1110)	1080 (658 to 1520)	4840 (2010 to 8230)	8520 (5610 to 12200)	
16	Pancreatic cancer	170 (83 to 257)	273 (183 to 367)	1400 (756 to 2100)	2380 (1690 to 3140)	
17	Esophageal adenocarcinoma	179 (56 to 304)	286 (159 to 411)	1350 (485 to 2230)	2330 (1440 to 3280)	
18		189 (97 to 284)	319 (225 to 418)	1050 (561 to 1600)	1780 (1230 to 2370)	
19	Multiple myeloma	75 (37 to 117)	122 (81 to 169)	690 (384 to 1090)	1150 (775 to 1630)	
20	Stomach cancer (cardia)	54 (6 to 109)	98 (51 to 165)	647 (261 to 1140)	1090 (644 to 1660)	
21	Thyroid cancer	105 (58 to 161)	176 (123 to 243)	516 (206 to 914)	951 (576 to 1420)	
22	Advanced prostate cancer	66 (17 to 118)	107 (57 to 162)	339 (138 to 561)	577 (352 to 836)	
23	Gallbladder cancer	29 (16 to 42)	46 (34 to 60)	314 (213 to 438)	512 (399 to 648)	
24	Ovarian cancer	33 (15 to 56)	53 (33 to 78)	147 (44 to 282)	254 (110 to 420)	
25	Total	3300 (1750 to 4720)	5230 (3870 to 6790)	28000 (16300 to 39100)	47300 (35400 to 59100)	
26 Cancer Deaths Prevented, N (95% UI)						
27	Liver cancer	168 (59 to 287)	287 (174 to 410)	4530 (2410 to 6760)	7510 (5200 to 9980)	
28	Breast cancer (postmenopausal)	68 (33 to 106)	111 (74 to 149)	3080 (862 to 5650)	5590 (3230 to 8310)	
29	Endometrial cancer	52 (20 to 86)	87 (55 to 121)	2060 (957 to 3220)	3520 (2390 to 4700)	
30	Kidney cancer	70 (29 to 110)	114 (74 to 154)	1980 (1080 to 2920)	3320 (2430 to 4300)	
31	Pancreatic cancer	88 (38 to 138)	143 (93 to 195)	1230 (661 to 1830)	2080 (1480 to 2740)	
	Esophageal adenocarcinoma	76 (21 to 131)	122 (69 to 178)	1150 (403 to 1930)	1990 (1210 to 2820)	
32	Colorectal cancer	34 (17 to 53)	57 (40 to 77)	706 (369 to 1080)	1200 (839 to 1600)	
33	Stomach cancer (cardia)	22 (2 to 48)	40 (19 to 68)	541 (230 to 947)	907 (538 to 1400)	
34	Multiple myeloma	18 (8 to 30)	29 (18 to 42)	420 (239 to 662)	691 (481 to 980)	
35	Gallbladder cancer	13 (7 to 20)	21 (15 to 28)	267 (181 to 369)	436 (341 to 551)	
36	Advanced prostate cancer	9 (3 to 15)	13 (7 to 19)	163 (65 to 280)	273 (163 to 404)	
37	Ovarian cancer	8 (3 to 15)	13 (7 to 20)	107 (39 to 191)	181 (94 to 290)	
38	Thyroid cancer	1 (1 to 2)	2 (1 to 3)	23 (11 to 38)	38 (24 to 58)	
39	Total	654 (320 to 970)	1080 (746 to 1400)	16700 (9610 to 23600)	28200 (21100 to 35300)	
40	_ife Years Gained	678 (288 to 1040)	1120 (738 to 1490)	76400 (43400 to 109000)	130000 (96900 to 162000)	
	QALYs Gained	4280 (2170 to 6250)	7030 (4960 to 9090)	111000 (64800 to 158000)	189000 (140000 to 236000)	
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emental Cost-Effectiveness Ratio; QALY, quality-adjusted life years. estimates (95% uncertainty intervals) of each distribution of 1000 simulation of 1000 simulations so may not add up to totals. n 1000 simulations so may not add up to totals. ted as policy costs minus health-related costs from reduced cancer bu mentation costs; the government perspective included policy costs rele aluated at \$150,000/QALY. Dominant represents less costly and more	mulations.) index. Policy intervention costs were inflate purden. The societal perspective includes hea elevant to policy implementation and program	althcare costs, patient time costs, productivity n monitoring and evaluation, and medical scenario.

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3 4 5	250	Economic Impacts
6 7	251	Implementing the policy would cost the government \$19 (95% UI: \$15-25) million and the
8 9	252	restaurant industry, \$820 (\$762-889) million in compliance costs over a lifetime (Table 2). The
10 11 12	253	policy was associated with savings of \$1480 (\$884-2080) million in direct medical costs, \$608
13 14	254	(\$363-865) million in productivity loss costs, and \$102 (\$62-144) million in patient time costs.
15 16	255	Potential industry reformulation would cost the restaurant industry an additional \$296 (\$249-
17 18 19	256	353) million to implement but would also result in greater healthcare savings, including \$2,500
20 21	257	(\$1,900-3,090) million, \$1,030 (\$780-1,290) million and \$172 (\$131-216) million in reduced
22 23	258	direct medical, productivity loss, and patient time costs, respectively.
24 25 26	259	
26 27 28	260	From both the healthcare and social perspectives, implementing the menu calorie labeling policy
29 30	261	among US adults over a lifetime would be cost-saving. With changes in consumer behavior
31 32	262	alone, the net cost savings were estimated to be \$1,460 (\$864-2,060) million and \$2,480 (\$1,880-
33 34 35	263	3,070) million from the healthcare and societal perspective, respectively. With additional
36 37	264	industry response, estimated cost savings increased to \$1,350 (\$486-2,260) million from the
38 39	265	healthcare perspective and \$2,570 (\$1,650-3,460) million from the societal perspective.
40 41 42	266	
43 44 45	267	Policy Impacts Among Population Subgroups
46 47	268	Among population subgroups, the consumer response to the policy was estimated to result in
48 49	269	greater health gains per 100,000 individuals among adults aged 20-44 years (15 new cancer cases
50 51 52	270	averted) and 55-64 years (16 new cancer cases averted) than older age groups (aged 65+ years; 6
52 53 54	271	new cancer cases averted); Hispanic and non-Hispanic Black individuals than Non-Hispanic
55 56 57	272	White group (22 vs. 9 and 17 vs. 9 new cancer cases averted) (Table 3). The numbers of cancer
58 50		10

deaths averted, life-years and QALYs gained, health-related costs saved, and net costs among population subgroups followed a similar pattern (Supplementary Tables 10-11 and Supplementary Figures 2-5). For instance, the policy was associated with more cancer deaths prevented per 100,000 individuals among younger adults aged 20-44 years than older adults aged 65+ years (10 vs. 3 cancer deaths averted) and Hispanic and non-Hispanic Black adults than non-Hispanic White individuals (14 vs. 5 and 11 vs. 5 cancer deaths averted). Adding potential industry reformulations resulted in larger health gains among adults aged 45-54 (128% increase in new cancer cases averted) and non-Hispanic White adults (84% increase in new cancer cases aver. averted).

Table 3. Estimated new cancer cases and deaths prevented by the federal menu calorie labeling policy in the US by age, sex, and race/ethnicity, over a lifetime¹

	Consume	r Behavior	Consumer Behavior	r + Industry Response
	N (95% UI)	Per 100,000 individuals (95% UI)	N (95% UI)	Per 100,000 individuals (95% UI)
New Cancer Cases Averted				
Age				
20-44	15700 (6170 to 25100)	15.0 (5.89 to 24.0)	28000 (18000 to 37500)	26.7 (17.2 to 35.8)
45-54	2810 (-2110 to 8030)	6.61 (-4.97 to 18.9)	6420 (1390 to 11600)	15.1 (3.27 to 27.2)
55-64	6330 (3540 to 9400)	15.7 (8.76 to 23.3)	8640 (5790 to 11800)	21.4 (14.3 to 29.1)
≥65	2740 (795 to 4650)	5.77 (1.68 to 9.80)	4060 (2070 to 5950)	8.55 (4.36 to 12.6)
Sex		· · · · ·	, , , , , , , , , , , , , , , , , , ,	
Female	15100 (6650 to 24000)	12.5 (5.51 to 19.8)	25900 (17400 to 34900)	21.4 (14.4 to 28.9)
Male	12500 (4920 to 20100)	10.9 (4.30 to 17.6)	21100 (13500 to 29100)	18.4 (11.8 to 25.4)
Race/Ethnicity	,	Ň,		
Non-Hispanic White	14300 (4310 to 24500)	9.16 (2.77 to 15.7)	26300 (16000 to 36700)	16.9 (10.3 to 23.6)
Non-Hispanic Black	4720 (1820 to 8100)	16.6 (6.37 to 28.4)	7630 (4750 to 11100)	26.8 (16.7 to 38.9)
Hispanic	7700 (3560 to 11500)	21.5 (9.93 to 32.2)	11200 (7060 to 15300)	31.3 (19.7 to 42.6)
Other	1150 (-240 to 2440)	7.60 (-1.59 to 16.2)	1990 (652 to 3310)	13.2 (4.33 to 22.0)
Cancer Deaths Prevented				
Age				
20-44	10200 (4170 to 16400)	9.73 (3.98 to 15.7)	18100 (11700 to 24500)	17.3 (11.2 to 23.4)
45-54	1730 (-853 to 4240)	4.07 (-2.01 to 9.97)	3650 (1040 to 6240)	8.58 (2.44 to 14.7)
55-64	3320 (1760 to 4930)	8.21 (4.36 to 12.2)	4480 (2890 to 6090)	11.1 (7.15 to 15.1)
≥65	1200 (285 to 2130)	2.53 (0.60 to 4.48)	1800 (848 to 2720)	3.79 (1.79 to 5.73)
Sex		· · · · ·		
Female	7810 (3290 to 12600)	6.47 (2.73 to 10.5)	13400 (8850 to 18500)	11.1 (7.33 to 15.3)
Male	8510 (3500 to 13900)	7.44 (3.06 to 12.1)	14400 (9300 to 20000)	12.6 (8.13 to 17.5)
Race/Ethnicity	````			
Non-Hispanic White	7920 (2180 to 13900)	5.08 (1.40 to 8.94)	14700 (8770 to 20900)	9.45 (5.64 to 13.5)
Non-Hispanic Black	3010 (1000 to 5370)	10.6 (3.51 to 18.8)	4990 (2950 to 7380)	17.5 (10.4 to 25.9)
Hispanic	4960 (2360 to 7560)	13.8 (6.58 to 21.1)	7190 (4480 to 9870)	20.0 (12.5 to 27.5)
Other	565 (-246 to 1350)	3.75 (-1.63 to 8.97)	1070 (273 to 1870)	7.12 (1.81 to 12.4)

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32 **Sensitivity Analyses**

(Figure 2).

33 In PSA, based on consumer responses alone, the menu calorie labeling was cost-saving over a 34 lifetime in 93% of 1000 simulations and cost-effective (<\$150,000/QALY) in the remaining 7% 35 from the societal perspective, and was cost-saving in over 98% of 1000 simulations from the 86 healthcare perspective. Adding the additional industry response increased the probability of cost-37 savings to nearly 100% of the simulations for both the societal and healthcare perspectives

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Evaluating health gains, costs, and cost-effectiveness at 10 years, the policy remained cost-90 91 saving from the healthcare perspective and was cost-effective from the societal perspective, with 92 an ICER of \$64,500 (26,100-187,000) per QALY based on consumer response alone and 93 \$33,600 (13,300-72,400) per QALY with additional industry response. The cost-effectiveness of 94 this policy was most sensitive to varied assumptions of the diet-BMI estimates and annual 95 discounting rates (Supplementary Tables 12-13 and Supplementary Figure 6).

97 **DISCUSSION**

98 This study estimated that the federal menu calorie labeling policy, based on consumer response 99 alone, was associated with a reduction of approximately 28,000 new cancer cases and 16,700 00 cancer deaths among US adults over a lifetime, and net savings of \$1,350 and \$1,460 million from societal and healthcare perspectives, respectively. Incorporating additional modest industry)1)2 responses, these health and economic gains were approximately doubled. Greater health gains)3 were expected among younger, middle-aged subgroups, Hispanic, and non-Hispanic Black

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304 individuals compared with other subgroups. Findings were robust to a range of probabilistic and 305 one-way sensitivity analyses.

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307 Our study findings supported that nutrition policies can have meaningful health and economic 308 impacts on cancer prevention in the US. In this case, a modest change in mean calorie 309 consumption, distributed across the population, was estimated to achieve important reductions in 310 obesity-related cancer burdens among US adults. Using the best available estimates, our study 311 further suggested that the federal menu calorie labeling policy is cost-effective in the short term 312 and cost-saving in the long term in reducing obesity-associated cancer burdens. Many preventive 313 medical screenings are cost-effective, but none of them achieve net savings. For example, among 314 a large cohort of women born in the 1960s over a lifetime, mammography screening starting at 315 age 45 years was estimated to have an ICER of \$40 135/QALY.⁴⁸ Colonoscopy screening starting at age 45 years among U.S. adults achieved an ICER of \$33 900/QALY.⁴⁹ Prostate-316 317 specific antigen screening had an ICER of \$70 831 to \$136 332/QALY among U.S. males 318 beginning at 40 years of age over a lifetime.⁵⁰ In contrast, population-based nutrition 319 interventions could be a cost-saving strategy for cancer prevention. Thus, while we shall 320 continue the efforts of increasing the screening rates, we also need to consider population-based 321 strategies to improve nutrition for cancer prevention in the US.

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323 Our findings also indicated the importance of assessing potential industry response, which could 324 nearly double health and economic benefits. The additional impacts of industry reformulation in 325 response to nutrition-related policies have been reported in other studies focused on obesityassociated cancer, diabetes, and cardiovascular diseases.^{21 51-53} Our new findings build on this 326

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327 recent work and highlight the importance of potential strategies to encourage industry 328 reformulation under the federal menu calorie labeling framework to further improve the health 329 benefits and cost-effectiveness of such policies. 330 331 In addition, our results showed that population-based nutrition policies such as menu calorie 332 labeling can potentially narrow diet-associated cancer disparities. We found greater health gains 333 and economic impacts among racial/ethnic minorities compared to non-Hispanic whites, likely due to higher diet-associated cancer burdens among minorities.⁵⁴ However, labeling policies may 334 335 have fewer effects on food purchasing behaviors among minorities or socioeconomically 336 disadvantaged groups. Prior studies reported that individuals with higher education and income 337 attainment were more likely to notice and use the menu calorie labels when ordering foods in fast-food or full-service restaurants compared to socioeconomically disadvantaged groups.55-57 338 339 and multi-racial individuals were less likely to notice and use menu calorie labels in fast food 340 restaurants than non-Hispanic whites.⁵⁵ Previous studies also showed that literacy or numeracy 341 could be a barrier to label use.^{58 59} Thus, it is important for labeling policies to be paired with 342 nutrition education to effectively reduce diet-associated health disparities. 343 344 Potential limitations should be considered. First, as a modeling study, our investigation does not 345 provide the impact of real-world policy implementation on the health and economic outcomes of 346 federal menu calorie labeling. However, conducting randomized controlled trials of national 347 nutrition policy interventions is extremely difficult and often implausible while simulation 348 modeling can provide complementary evidence with the flexibility to assess different policy 349 scenarios that help inform policymaking. Second, this evaluation did not include the potential

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benefits of menu calorie labeling on other health outcomes such as diabetes and cardiovascular diseases. Considering such outcomes is likely to be associated with greater health gains and cost savings.^{21 60 61} Third, menu calorie labeling could have a greater effect among subgroups with higher levels of income and education and non-Hispanic white adults⁵⁵⁻⁵⁷ and thus exacerbating health disparities. Due to the lack of consistent policy effect sizes among populations with different socioeconomic statuses, we were unable to integrate this into our modeling. Forth, we only modeled the impact of menu calorie labeling on calories although the policy may also result in potential changes in the nutritional quality of the restaurant meals. The majority of current restaurant meals consumed by American adults - 70% of meals consumed from fast-food restaurants and 50% consumed from full-service restaurants – are of poor nutritional quality, and the remainder is only of intermediate nutritional quality, with very few being ideal.⁹ If the policy also improves the quality of restaurant meals, the total reduction in obesity-associated cancer burdens could be greater than our current estimates.

364 CONCLUSIONS

365 Study findings suggest that menu calorie labeling is associated with lower obesity-related cancer
366 rates and reduced costs. Policymakers may prioritize nutrition policies for cancer prevention in
367 the US.

SUMMARY BOXES

What is already known on this topic

- Obesity-associated cancer burdens are rising in the US and restaurant meals often contain high levels of calories, increasing the risk of obesity.
- The federal menu calorie labeling policy may reduce obesity-associated cancer rates by helping consumers identify lower-calorie choices and spurring restaurant reformulations.
- The potential health and economic impact of this policy on reducing the obesity-related cancer burden in the US and cancer disparity among demographic populations remain unknown.

What this study adds

- Our novel findings suggest that the federal menu calorie labeling policy would prevent meaningful numbers of obesity-related cancers and produce net cost savings in the US;
 Greater health gains and net savings were observed among young adults and racial/ethnic minorities.
- Our results suggest the need to consider and prioritize nutrition-related policy interventions as cost-effective or cost-saving strategies for cancer prevention; government and advocacy strategies to ensure and encourage industry reformulations should be prioritized.

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Ethics approval: This study used de-identified datasets and was exempt from institutional review board review.

Data sharing: Data described in the manuscript, codebook, and analytic code will be made available upon request.

Transparency Statement: The author affirms that this manuscript is an honest, accurate, and transparent account of the study being reported; that no important aspects of the study have been omitted; and that any discrepancies from the study as planned have been explained.

Dissemination Declaration: Dissemination to the simulated population is not applicable. **Contributors**: MD contributed to the data curation, formal analysis, visualization, original draft preparation, review and editing; CFG contributed to the data curation, review and editing; FFC, HE and DDK contributed to software; JBW, PW, DDK, DSM, YCW, and DM contributed to the review and editing; FFZ contributed the conceptualization, methodology, review and editing, supervision, and funding acquisition. All authors approved the final version. FFZ acts as the guarantor of the study.

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Figure 1. Estimated New Cancer Cases and Deaths Prevented by Federal Menu Calorie Labeling Policy in the US by Cancer Type over a Lifetime

Figure 2. Probabilistic Sensitivity Analyses (PSA) for Cost-Effectiveness of the Federal Menu Calorie Labeling Policy over 10 years and a Lifetime

Legend: Values are presented in cost-effectiveness planes of net costs (\$millions) versus incremental quality-adjusted life years (QALYs). For each policy scenario, each colored dot represents one of the 1000 simulations, with the largest dot showing the median incremental cost-effectiveness ratio (ICER, \$/QALY); and the ellipse representing the 95% UIs. Results are presented from the societal perspective and the healthcare perspective. Negative values indicate cost savings.

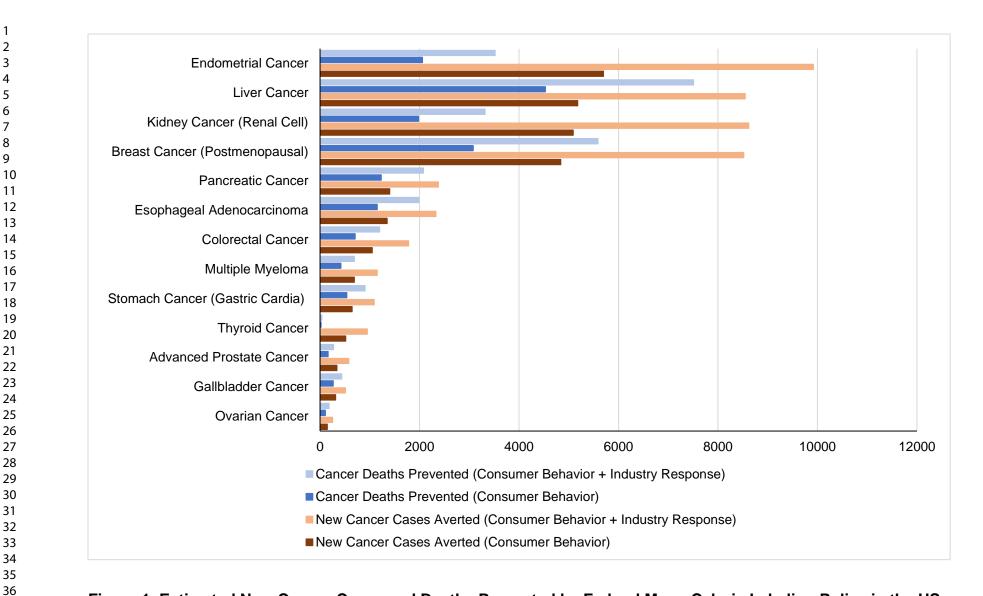
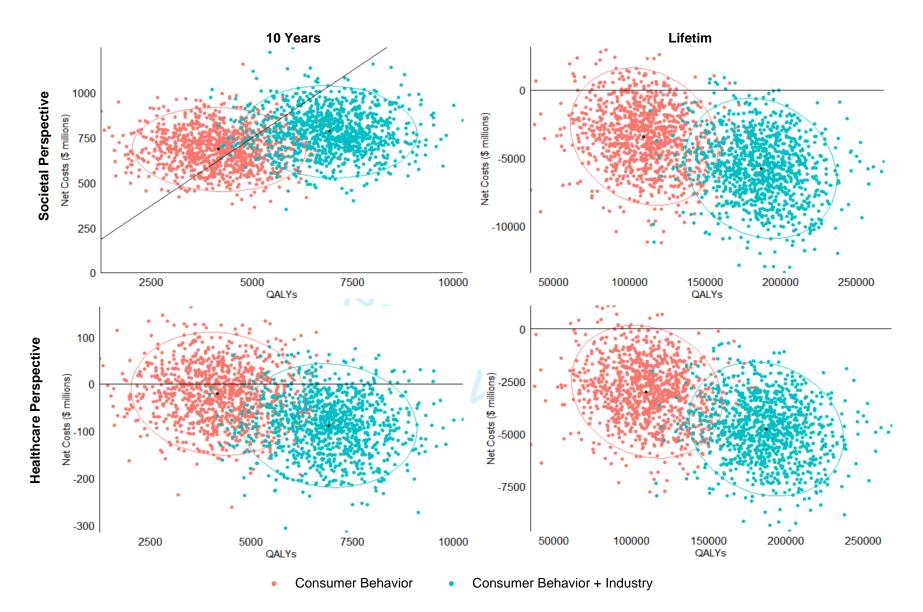


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2 3 Title Cost-Effectiveness Analysis of the Federal Menu Calorie Labeling and Obesity-Associated Cancer 4 Burdens in the United States 5 6 7 **Supplementary Table 1**. Defining Population and 32 Subgroups 8 Supplementary Table 2. Relative Risk Estimates of Etiologic Relationships Between Body Mass Index 9 (BMI) and 13 Types of Cancers 10 Supplementary Table 3. Baseline Incidence Rates of 13 Cancers among US Adults by 32 Subgroups 11 12 Supplementary Table 4. Baseline 5-year Relative Survival Rates of 13 Cancers among US Adults by 13 32 Subgroups 14 Supplementary Table 5. Health-Related Quality of Life Among US Cancer Patients Aged 20 Years or 15 Older, by Cancer Type and Phase of Care 16 17 Supplementary Table 6. Baseline Medical Costs, Productivity Loss, and Patient Time Costs Among 18 US Cancer Patients Aged 20 Years or Older, by Cancer Type and Phase of Care 19 Supplementary Table 7. Baseline Medical Costs, Productivity Loss, and Patient Time Costs Among 20 the General Population Aged 20 Years or Older in the US, by 32 Subgroups 21 Supplementary Table 8. Characteristics of US Adults Aged 20 Years or Older Participated in the 22 23 NHANES, 2013-2016 24 Supplementary Table 9. Consumption of Calories from Full-Service and Fast-Food Restaurants among 25 US Adults Participated in 2013-2016 NHANES, by 32 Subgroups 26 Supplementary Table 10. Estimated New Cancer Cases Averted by the Federal Menu Calorie Labeling 27 28 in the US by Age, Sex, Race/Ethnicity, and Cancer Type, Over a Lifetime 29 **Supplementary Table 11**. Estimated Cancer Deaths Reduced by the Federal Menu Calorie Labeling in 30 the US by Age, Sex, Race/Ethnicity, and Cancer Type, Over a Lifetime 31 Supplementary Table 12. Estimated Health Gains and Costs Associated with the Federal Menu Calorie 32 Labeling on Reducing Cancer Burdens in the US Over a Lifetime, One-Way Sensitivity Analyses at 33 34 25% and 75% Calorie Compensations Outside the Restaurant Settings 35 Supplementary Table 13. Estimated Health Gains and Costs Associated with the Federal Menu Calorie 36 Labeling on Reducing Cancer Burdens in the US Over a Lifetime, One-Way Sensitivity Analysis, 37 Assuming all Full-Service and Fast-Food Restaurants were Covered by the Policy 38 39 40 Supplementary Figure 1. Diet and Cancer Outcome Model (DiCOM) 41 Supplementary Figure 2. Estimated Reduced New Cancer Cases and Deaths Associated with the 42 Federal Menu Calorie Labeling in the US by Age, Sex, Race/Ethnicity, and Cancer Type, Over a 43 44 Lifetime 45 **Supplementary Figure 3**. Estimated life Years and OALYs Gained Associated with the Federal Menu 46 Calorie Labeling in the US by Age, Sex, and Race/Ethnicity, Over a Lifetime. 47 Supplementary Figure 4. Estimated Changes of Health-Related Costs Associated with the Federal 48 Menu Calorie Labeling in the US by Age, Sex, Race/Ethnicity, and Cancer Type, Over a Lifetime 49 50 Supplementary Figure 5. Estimated Net Costs from Societal and Healthcare Perspectives Associated 51 with the Federal Menu Calorie Labeling in the US by Age, Sex, and Race/Ethnicity, Over a Lifetime 52 Supplementary Figure 6. One-Way Sensitivity Analysis of Net Costs of the Federal Menu Calorie 53 Labeling and Obesity-Associated Cancer Rates to Varying Assumptions of Key Input Parameters From 54 (A) Societal Perspective and (B) Healthcare Perspective 55 56 57 58 1 59 For peer review only - http://bmjopen.bmj.com/site/about/guidelines.xhtml 60

Subgroups	Age	Sex	Race/Ethnicity
1	20-44y	Female	NHW
2	20-44y	Female	NHB
3	20-44y	Female	HISP
4	20-44y	Female	OTH
5	20-44y	Male	NHW
6	20-44y	Male	NHB
7	20-44y	Male	HISP
8	20-44y	Male	OTH
9	45-54y	Female	NHW
10	45-54y	Female	NHB
11	45-54y	Female	HISP
12	45-54y	Female	OTH
13	45-54y	Male	NHW
14	45-54y	Male	NHB
15	45-54y	Male	HISP
16	45-54y	Male	OTH
17	55-64y	Female	NHW
18	55-64y	Female	NHB
19	55-64y	Female	HISP
20	55-64y	Female	OTH
21	55-64y	Male	NHW
22	55-64y	Male	NHB
23	55-64y	Male	HISP
24	55-64y	Male	OTH
25	65+y	Female	NHW
26	65+y	Female	NHB
27	65+y	Female	HISP
28	65+y	Female	OTH
29	65+y	Male	NHW
30	65+y	Male	NHB
31	65+y	Male	HISP
32	65+y	Male	ОТН

Supplementary Table 1. Defining population and 32 subgroups

 Supplementary Table 2. Relative risk estimates of etiologic relationships between body mass index (BMI) and 13 types of cancers

Cancer Type	No. of Studies	No. of Events	Source	Evidence Grading	RR (95% CI) Per 5 kg/m²	Statistical Heterogeneity
Endometrial	26	18,717	CUP, 2013	Convincing ↑risk	1.50 (1.42-1.59)	I ² =86.2% P<0.0001
Esophageal (adenocarcinoma)	9	1,725	CUP, 2016	Convincing ↑risk	1.48 (1.35-1.62)	l ² =36.7% P=0.13
Kidney	23	15,575	CUP, 2015	Convincing ↑risk	1.30 (1.25-1.35)	l ² =38.8% P=0.03
Liver	12	14, 311	CUP, 2015	Convincing ↑risk	1.30 (1.16-1.46)	l ² =78.3% P=0.000
Gallbladder	8	6,004	CUP, 2015	Probable ↑risk	1.25 (1.15-1.37)	l²=52.3% P=0.04
Stomach (cardia)	7	2,050	CUP, 2016	Probable ↑risk	1.23 (1.07-1.40)	l²=55.6% P=0.04
Breast (post- menopausal)	56	80,404	CUP, 2017	Convincing ↑risk	1.12 (1.09-1.15)	l²=75% P<0.001
Pancreas	23	9,504	CUP, 2011	Convincing ↑risk	1.10 (1.07-1.14)	l ² =19% P=0.20
Multiple myeloma	20	1,388	IARC, 2016 ³⁰	Sufficient (IRAC) ↑risk	1.09 (1.03-1.16)	Not reported
Prostate (advanced)	24	11,149	CUP, 2014	Probable ↑risk	1.08 (1.04-1.12)	l ² =18.8% P=0.21
Thyroid	22	3,100	IARC, 2016 ³⁰	Sufficient (IARC) ↑risk	1.06 (1.02-1.10)	Not reported
Ovary	25	15,899	CUP, 2013	Probable ↑risk	1.06 (1.02-1.11)	l ² =55.1% P=0.001
Colorectal	38	71,089	CUP, 2017	Convincing ↑risk	1.05 (1.03-1.07)	l ² =74.2% P=0.000

Supplementary Table 3. Baseline incidence rates of 13 cancers among US adults by 32 subgroups

Subgroup	Color Can		Endor Car	netrial ncer	Esoph Ade carcin	•	Female (Postr	Breast meno.)	Gallbl Car	adder ncer	Kidney	Cancer	Liver C	ancer		tiple loma	Ovarian	cancer	Panc Car		Pros	anced state ncer	Cancer	mach (Gastric rdia)	Thyroid	Cancer
	Rate	SE	Rate	SE	Rate	SE	Rate	SE	Rate	SE	Rate	SE	Rate	SE	Rate	SE	Rate	SE	Rate	SE	Rate	SE	Rate	SE	Rate	SE
1	8.53	0.38	6.54	3.66	0.05	4.18	0.00	0.00	0.05	2.57	3.83	3.16	0.49	4.18	0.38	4.66	4.31	0.27	1.07	3.46	0.00	0.00	0.10	3.82	28.97	0.69
2	7.78	0.74	5.04	0.59	0.03	0.20	0.00	0.00	0.07	2.46	3.57	0.50	0.56	0.20	1.02	0.27	2.98	0.45	1.03	0.26	0.00	0.00	0.09	2.25	13.12	0.95
3	6.09	0.55	7.49	3.32	0.03	3.07	0.00	0.00	0.06	2.48	3.73	3.16	0.42	3.07	0.33	3.71	3.95	0.46	0.86	0.87	0.00	0.00	0.09	2.27	20.97	1.13
4	6.36	1.10	6.56	1.13	0.02	0.15	0.00	0.00	0.07	2.58	1.87	0.40	0.32	0.15	0.38	0.23	4.49	0.70	0.74	0.25	0.00	0.00	0.09	2.36	24.88	2.21
5	9.20	0.39	0.00	0.00	0.42	5.22	0.00	0.00	0.04	0.02	5.91	4.53	0.60	5.22	0.48	5.26	0.00	0.00	1.22	2.06	0.21	0.02	0.43	4.32	6.93	0.34
6	7.94	0.78	0.00	0.00	0.29	0.30	0.00	0.00	0.04	0.02	5.47	0.65	1.17	0.30	1.48	0.34	0.00	0.00	1.00	0.28	0.56	0.09	0.34	3.42	2.36	0.42
7	6.15	0.54	0.00	0.00	0.31	3.85	0.00	0.00	0.04	0.02	4.04	3.82	0.82	3.85	0.57	0.18	0.00	0.00	0.83	0.20	0.13	0.68	0.34	3.53	3.80	0.44
8	6.21	0.85	0.00	0.00	0.31	0.47	0.00	0.00	0.05	0.02	3.68	1.04	1.59	0.47	0.70	1.40	0.00	0.00	0.82	0.29	0.41	0.09	0.36	3.52	5.70	0.84
9	41.27	0.76	38.53	0.73	1.03	0.21	124.56	1.28	0.68	5.99	14.03	0.44	3.10	0.21	3.60	0.22	17.09	0.49	7.70	0.32	0.00	0.00	0.88	6.74	37.84	0.73
10	53.14	1.92	25.73	1.34	0.59	0.60	121.73	2.88	1.54	5.87	16.08	1.06	5.17	0.60	11.29	0.89	11.75	0.90	10.91	0.87	0.00	0.00	0.94	5.38	25.80	1.34
11	33.92	1.78	33.43	1.53	0.59	0.52	77.25	3.45	2.27	1.93	16.00	1.04	3.83	0.52	4.86	0.58	14.57	1.00	6.26	0.66	0.00	0.00	0.81	5.61	37.29	1.84
12	35.77	3.15	35.84	3.07	0.65	0.66	91.82	4.82	1.70	6.05	7.78	1.92	3.27	0.66	2.55	0.70	17.07	1.51	5.17	0.81	0.00	0.00	0.85	5.53	37.73	2.90
13	53.97	0.87	0.00	0.00	5.61	0.36	0.00	0.00	0.36	7.15	29.16	0.64	9.24	0.36	5.09	0.27	0.00	0.00	10.63	0.38	10.88	0.16	3.65	0.23	13.29	0.43
14	61.29	2.20	0.00	0.00	1.50	1.02	0.00	0.00	0.47	5.07	32.82	1.61	13.29	1.02	12.34	0.99	0.00	0.00	14.12	1.05	25.31	0.58	1.90	0.33	6.41	0.71
15	38.05	1.94	0.00	0.00	2.75	1.06	0.00	0.00	0.43	4.83	24.48	1.27	16.38	1.06	5.23	0.60	0.00	0.00	7.95	0.74	6.02	0.38	1.96	0.34	8.56	0.76
16 17	42.81 59.74	3.85 0.89	0.00	0.00	2.88	2.28	0.00	0.00	0.37 1.75	4.93	18.63 26.14	3.06	18.71 9.41	2.28 0.35	3.70	0.82 0.34	0.00 26.19	0.00	7.62 21.78	1.05	3.70 0.00	0.50	2.51	0.17 0.15	12.57 34.42	1.36
17	86.11	2.62	90.00 83.71	1.09 2.60	2.12 1.30	0.35	305.45 306.22	2.02 4.92	4.08	0.15 0.57	31.53	0.59 1.58	9.41 18.22	1.21	8.68 23.28	1.37	19.79	0.59 1.25	31.37	0.54 1.58	0.00	0.00	1.72 1.92	0.15	27.72	0.67 1.48
19	58.14	2.02	69.51	3.28	1.64	1.21	218.85	7.01	4.08	0.57	29.93	1.73	17.38	1.21	9.33	0.97	21.29	1.45	17.15	1.32	0.00	0.00	1.92	0.39	39.44	1.40
20	52.83	4.48	60.22	4.45	1.49	1.33 1.97	233.48	8.33	2.44	0.00	13.91	2.72	12.58	1.97	6.13	0.96	23.98	2.79	13.44	1.43	0.00	0.00	1.57	0.13	41.74	3.08
21	88.14	1.10	0.00	0.00	15.54	0.73	0.00	0.00	0.93	0.00	53.65	0.87	37.93	0.73	13.24	0.43	0.00	0.00	29.95	0.65	47.05	0.34	9.19	0.36	16.24	0.48
22	121.39	3.41	0.00	0.00	4.30	2.72	0.00	0.00	2.06	0.41	69.05	2.57	75.50	2.72	30.69	1.71	0.00	0.00	39.72	1.95	91.41	1.22	4.87	0.68	9.12	0.92
23	84.75	3.65	0.00	0.00	8.01	2.98	0.00	0.00	1.07	0.11	51.05	2.35	61.05	2.98	13.65	1.22	0.00	0.00	23.36	1.58	32.10	1.21	5.15	0.70	11.12	1.09
24	83.77	5.72	0.00	0.00	4.97	4.85	0.00	0.00	1.22	0.11	27.95	3.81	54.13	4.85	10.32	1.39	0.00	0.00	19.14	2.87	22.70	1.31	5.16	0.96	16.04	1.75
25	147.25	1.98	86.90	1.40	4.53	0.62	429.43	3.20	5.87	0.40	42.37	1.02	15.56	0.62	20.59	0.73	38.18	0.97	55.49	1.20	0.00	0.00	4.36	0.34	24.59	0.74
26	155.86	5.74	100.81	4.21	3.10	1.98	398.07	8.74	9.68	1.43	50.03	3.07	20.61	1.98	50.31	3.20	29.78	2.45	71.93	3.94	0.00	0.00	3.41	0.52	22.57	1.98
27	117.47	5.72	66.40	4.47	3.61	3.17	285.07	11.57	11.44	1.75	45.35	3.33	38.69	3.17	24.20	2.52	32.78	2.88	51.54	3.79	0.00	0.00	3.89	0.60	29.50	2.55
28	109.32	10.15	52.12	5.29	3.51	4.72	266.14	14.52	7.02	1.70	26.14	4.17	35.77	4.72	14.41	2.43	23.90	2.89	46.15	5.64	0.00	0.00	4.11	0.28	28.15	3.08
29	181.07	2.47	0.00	0.00	29.02	1.10	0.00	0.00	3.59	0.36	88.69	1.63	40.30	1.10	34.26	1.07	0.00	0.00	72.36	1.53	80.74	0.61	19.38	0.77	17.34	0.69
30	217.23	8.36	0.00	0.00	7.29	3.98	0.00	0.00	6.24	1.14	97.13	5.16	68.31	3.98	69.18	4.66	0.00	0.00	75.66	4.94	130.67	2.34	8.81	1.55	10.03	1.60
31	182.00	9.21	0.00	0.00	15.50	5.01	0.00	0.00	6.79	1.64	87.20	5.26	78.18	5.01	33.10	3.44	0.00	0.00	61.88	4.77	66.33	2.57	11.49	1.78	15.87	2.11
32	144.37	13.43	0.00	0.00	10.56	7.52	0.00	0.00	4.75	1.02	54.45	7.24	79.16	7.52	22.48	3.35	0.00	0.00	51.45	6.82	51.84	2.78	11.34	2.12	13.86	2.28

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Supplementary Table 4. Baseline 5-year relative survival rates of 13 cancer	rs among US adults by 32 subgroups
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Subgroup	Color Can		Endon Car		Ade	nageal eno- noma	Female (Postr	Breast neno.)	Gallbl Car		Kidney	Cancer	Liver (Cancer		tiple Ioma	Ova Car			reatic ncer	Pro	anced state ncer	Car	stric		rroid ncer
	Rate	SE	Rate	SE	Rate	SE	Rate	SE	Rate	SE	Rate	SE	Rate	SE	Rate	SE	Rate	SE	Rate	SE	Rate	SE	Rate	SE	Rate	SE
1	0.740	0.012	0.916	0.009	0.223	0.018	0.000	0.000	0.095	0.095	0.953	0.009	0.409	0.057	0.852	0.043	0.780	0.015	0.379	0.038	0.000	0.000	0.477	0.099	1.000	0.001
2	0.652	0.024	0.775	0.027	0.223	0.018	0.000	0.000	0.286	0.064	0.856	0.029	0.144	0.113	0.837	0.048	0.736	0.036	0.530	0.064	0.000	0.000	0.502	0.205	0.993	0.004
3	0.659	0.022	0.900	0.013	0.223	0.018	0.000	0.000	0.309	0.092	0.864	0.021	0.403	0.081	0.713	0.075	0.716	0.024	0.493	0.062	0.000	0.000	0.236	0.116	0.992	0.002
4	0.694	0.027	0.910	0.016	0.223	0.018	0.000	0.000	0.286	0.064	0.819	0.043	0.321	0.077	0.787	0.122	0.737	0.029	0.371	0.076	0.000	0.000	0.667	0.193	1.000	0.002
5	0.682	0.012	0.000	0.000	0.140	0.034	0.000	0.000	0.302	0.117	0.886	0.010	0.251	0.037	0.696	0.041	0.000	0.000	0.275	0.032	0.768	0.057	0.284	0.045	0.997	0.002
6	0.601	0.027	0.000	0.000	0.160	0.031	0.000	0.000	0.357	0.096	0.779	0.027	0.157	0.045	0.606	0.057	0.000	0.000	0.151	0.046	0.780	0.086	0.672	0.274	0.949	0.025
7	0.621	0.022	0.000	0.000	0.330	0.108	0.000	0.000	0.357	0.096	0.847	0.020	0.227	0.047	0.635	0.064	0.000	0.000	0.157	0.044	0.470	0.118	0.152	0.055	0.993	0.007
8	0.635	0.029	0.000	0.000	0.287	0.172	0.000	0.000	0.357	0.096	0.840	0.033	0.152	0.032	0.649	0.108	0.000	0.000	0.230	0.066	0.805	0.180	0.545	0.133	0.992	0.008
9	0.738	0.007	0.889	0.006	0.300	0.065	0.918	0.003	0.153	0.045	0.846	0.011	0.283	0.027	0.682	0.027	0.614	0.012	0.195	0.017	0.000	0.000	0.384	0.060	0.997	0.002
10	0.666	0.015	0.751	0.022	0.290	0.174	0.810	0.009	0.155	0.059	0.834	0.025	0.145	0.035	0.626	0.034	0.497	0.034	0.177	0.029	0.000	0.000	0.457	0.144	0.990	0.008
11	0.725	0.016	0.869	0.012	0.751	0.217	0.881	0.008	0.224	0.062	0.879	0.018	0.242	0.038	0.617	0.047	0.595	0.025	0.209	0.035	0.000	0.000	0.257	0.079	0.983	0.005
12	0.731	0.018	0.893	0.012	0.308	0.060	0.926	0.007	0.210	0.082	0.810	0.037	0.287	0.051	0.686	0.071	0.640	0.027	0.307	0.055	0.000	0.000	0.357	0.152	0.991	0.005
13	0.704	0.007	0.000	0.000	0.255	0.020	0.000	0.000	0.321	0.072	0.790	0.009	0.171	0.011	0.627	0.023	0.000	0.000	0.136	0.012	0.858	0.010	0.253	0.024	0.964	0.007
14	0.612	0.015	0.000	0.000	0.186	0.085	0.000	0.000	0.371	0.127	0.793	0.020	0.117	0.019	0.616	0.037	0.000	0.000	0.138	0.022	0.814	0.020	0.148	0.059	0.970	0.027
15	0.652	0.015	0.000	0.000	0.222	0.050	0.000	0.000	0.151	0.082	0.742	0.019	0.181	0.016	0.640	0.044	0.000	0.000	0.101	0.021	0.729	0.029	0.257	0.060	0.945	0.019
16	0.721	0.017	0.000	0.000	0.308	0.110	0.000	0.000	0.751	0.153	0.799	0.027	0.239	0.023	0.594	0.066	0.000	0.000	0.162	0.039	0.865	0.040	0.298	0.080	0.960	0.018
17	0.694	0.007	0.878	0.004	0.322	0.043	0.918	0.002	0.273	0.035	0.793	0.010	0.208	0.015	0.630	0.019	0.531	0.011	0.117	0.009	0.000	0.000	0.334	0.041	0.994	0.002
18	0.621	0.014	0.667	0.015	0.298	0.039	0.830	0.007	0.151	0.043	0.805	0.022	0.219	0.028	0.609	0.027	0.371	0.028	0.112	0.018	0.000	0.000	0.440	0.113	0.971	0.012
19	0.673	0.016	0.816	0.013	0.241	0.131	0.879	0.006	0.173	0.044	0.769	0.021	0.211	0.025	0.535	0.042	0.473	0.025	0.104	0.019	0.000	0.000	0.279	0.101	0.969	0.009
20	0.714	0.017	0.847	0.013	0.298	0.039	0.911	0.006	0.151	0.061	0.785	0.032	0.288	0.033	0.631	0.0 <mark>5</mark> 1	0.555	0.031	0.164	0.027	0.000	0.000	0.281	0.140	0.987	0.008
21	0.666	0.006	0.000	0.000	0.257	0.013	0.000	0.000	0.190	0.045	0.760	0.008	0.202	0.007	0.603	0.016	0.000	0.000	0.111	0.007	0.878	0.006	0.255	0.016	0.954	0.009
22	0.579	0.013	0.000	0.000	0.178	0.072	0.000	0.000	0.261	0.105	0.758	0.019	0.140	0.012	0.545	0.028	0.000	0.000	0.080	0.014	0.786	0.014	0.148	0.046	0.945	0.039
23	0.628	0.014	0.000	0.000	0.135	0.033	0.000	0.000	0.203	0.081	0.717	0.018	0.170	0.013	0.541	0.037	0.000	0.000	0.078	0.015	0.777	0.017	0.281	0.053	0.899	0.028
24	0.654	0.015	0.000	0.000	0.237	0.082	0.000	0.000	0.148	0.069	0.698	0.025	0.268	0.017	0.485	0.050	0.000	0.000	0.122	0.023	0.885	0.019	0.257	0.061	0.967	0.022
25	0.610	0.005	0.799	0.006	0.182	0.024	0.907	0.003	0.179	0.018	0.679	0.010	0.119	0.010	0.420	0.012	0.323	0.008	0.057	0.003	0.000	0.000	0.231	0.023	0.958	0.005
26	0.551	0.012	0.552	0.016	0.170	0.143	0.806	0.008	0.217	0.043	0.709	0.024	0.097	0.020	0.407	0.022	0.210	0.021	0.059	0.009	0.000	0.000	0.264	0.068	0.894	0.023
27	0.579	0.013	0.699	0.017	0.190	0.073	0.858	0.008	0.125	0.023	0.677	0.022	0.087	0.014	0.353	0.027	0.298	0.022	0.049	0.009	0.000	0.000	0.257	0.060	0.889	0.020
28	0.599	0.013	0.735	0.020	0.180	0.022	0.900	0.007	0.115	0.030	0.614	0.032	0.187	0.017	0.440	0.040	0.356	0.029	0.043	0.008	0.000	0.000	0.187	0.067	0.858	0.023
29	0.615	0.005	0.000	0.000	0.212	0.011	0.000	0.000	0.134	0.025	0.680	0.008	0.119	0.007	0.402	0.011	0.000	0.000	0.075	0.004	0.717	0.007	0.220	0.013	0.935	0.015
30	0.498	0.014	0.000	0.000	0.164	0.069	0.000	0.000	0.209	0.076	0.705	0.024	0.134	0.019	0.459	0.027	0.000	0.000	0.049	0.011	0.569	0.017	0.174	0.052	0.810	0.068
31	0.544	0.013	0.000	0.000	0.155	0.035	0.000	0.000	0.144	0.046	0.668	0.020	0.107	0.012	0.398	0.028	0.000	0.000	0.066	0.011	0.674	0.017	0.141	0.032	0.786	0.048
32	0.625	0.013	0.000	0.000	0.126	0.049	0.000	0.000	0.263	0.071	0.653	0.026	0.182	0.014	0.431	0.037	0.000	0.000	0.080	0.013	0.733	0.020	0.255	0.042	0.800	0.039

Supplementary Table 5. Health-related quality of life among US cancer patients aged 20 years or older, by cancer type and phase of care

Cancer Type	Cancer Phase	Health Related Quality of Life mean (SE)	Source
Endometrial	Overall	0.80 (0.14)	Naik et al. ³¹
Esophageal Adenocarcinoma	Overall	0.69 (0.26)	Wildi et al.32
Kidney	Overall	0.78 (0.14)	Pickard et al.33
Liver	Overall	0.79 (0.19)	Naik et al.31
Gallbladder	Overall	0.79 (0.19)	Naik et al. ³¹
Stomach (gastric cardia)	Initial: Continuous: End of Life:	0.84 (0.25) 0.86 (0.24) 0.65 (0.33)	Zhou et al. ³⁴
Female Breast (post-menopausal)	Initial: Continuous: End of Life:	0.78 (0.19) 0.81 (0.20) 0.64 (0.16)	Yabroff et al. ³⁵
Pancreas	Overall	0.65 (0.30)	Müller-Nordhorn et al. ³⁶
Multiple myeloma	Overall	0.79 (0.19)	Naik et al. ³¹
Advanced Prostate	Initial: Continuous: End of Life:	0.78 (0.20) 0.76 (0.19) 0.59 (0.15)	Yabroff et al. ³⁵
Thyroid	Overall	0.85 (0.13)	Naik et al. ³¹
Ovary	Overall	0.77 (0.17)	Pickard et al.33
Colorectal	Initial: Continuous: End of Life:	0.760 (0.19) 0.835 (0.20) 0.643 (0.26)	Färkkilä et al. ³⁷

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Supplementary Table 6. Baseline medical costs, productivity loss, and patient time costs among US cancer patients aged 20 years or older, by cancer type

Concerture	Carr	A	Medical costs Pro				Productivity los	S	I	Patient time cost			
Cancer type	Sex	Age	Initial	Continuous	End-of-life	Initial	Continuous	End-of-life	Initial	Continuous	End-of-life		
Esophageal Adenocarcinoma	Female	<65	95439	6853	156417	4884	3757	15027	650	500	2001		
		≥65	79532	6853	104278	6984	5372	21489	1187	913	3652		
	Male	<65	95787	6450	155612	4884	3757	15027	650	500	2001		
		≥65	79822	6450	103742	6984	5372	21489	1187	913	3652		
Stomach (Gastric Cardia)	Female	<65	85291	3977	155636	4884	3757	15027	650	500	2001		
		≥65	71076	3977	103758	6984	5372	21489	1187	913	3652		
	Male	<65	94144	4282	160695	4884	3757	15027	650	500	2001		
		≥65	78453	4282	107130	6984	5372	21489	1187	913	3652		
Liver	Female	<65	40173	5859	95782	4884	3757	15027	650	500	2001		
		≥65	40173	5859	95782	6984	5372	21489	1187	913	3652		
	Male	<65	41161	7363	97473	4884	3757	15027	650	500	2001		
		≥65	41161	7363	97473	6984	5372	21489	1187	913	3652		
Pancreatic	Female	<65	112154	8672	164911	4884	3757	15027	650	500	2001		
		≥65	93462	8672	109941	6984	5372	21489	1187	913	3652		
	Male	<65	112911	11697	169673	4884	3757	15027	650	500	2001		
		≥65	94092	11697	113115	6984	5372	21489	1187	913	3652		
Advanced Prostate	Male	<65	23652	3201	93363	3715	2858	11432	650	500	2001		
		≥65	19710	3201	62242	6549	5038	20152	1187	913	3652		
Colorectal	Female	<65	61593	3159	126778	10330	7946	31784	650	500	2001		
		≥65	51327	3159	84519	7479	5753	23012	1187	913	3652		

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2		Male	<65	62174	4595	128507	10330	7946	31784	650	500	2001
3			≥65	51812	4595	85671	7479	5753	23012	1187	913	3652
4 5												
6	Endometrial	Female	<65	32129	1535	105262	4884	3757	15027	650	500	2001
7			≥65	26775	1535	70175	6984	5372	21489	1187	913	3652
8 9												
10	Ovarian	Female	<65	98788	8296	149573	4884	3757	15027	650	500	2001
11 12			≥65	82324	8296	99715	6984	5372	21489	1187	913	3652
12										-		
14 15	Gallbladder	Female	<65	40173	5859	95782	4884	3757	15027	650	500	2001
15 16			≥65	40173	5859	95782	6984	5372	21489	1187	913	3652
17		Male	<65	41161	7363	97473	4884	3757	15027	650	500	2001
18 19			≥65	41161	7363	97473	6984	5372	21489	1187	913	3652
20												
21	Kidney (Renal Cell)	Female	<65	46077	6255	110765	4884	3757	15027	650	500	2001
22 23			≥65	38397	6255	73843	6984	5372	21489	1187	913	3652
24		Male	<65	46048	6018	117123	4884	3757	15027	650	500	2001
25 26			≥65	38374	6018	78082	6984	5372	21489	1187	913	3652
27												
28	Breast (Postmenopausal)	Female	<65	27693	2207	94284	5985	4604	18416	650	500	2001
29 30			≥65	23078	2207	62856	4752	3655	14620	1187	913	3652
31												
32 33	Thyroid	Female	<65	40173	5859	95782	4884	3757	15027	650	500	2001
34			≥65	40173	5859	95782	6984	5372	21489	1187	913	3652
35		Male	<65	41161	7363	97473	4884	3757	15027	650	500	2001
36 37			≥65	41161	7363	97473	6984	5372	21489	1187	913	3652
38			-00	11101	1000	01 110	0001	0012	21100	1107	010	0002
39	Multiple Myeloma	Female	<65	40173	5859	95782	4884	3757	15027	650	500	2001
40 41		1 officio	<00 ≥65	40173	5859	95782	6984	5372	21489	1187	913	3652
41			200	40173	0009	33102	0304	JJ1 Z	21403	1107	313	3002
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1 2 3	Male	<65 ≥65	41161 41161	7363 7363	97473 97473	4884 6984	3757 5372	15027 21489	650 1187	500 913	2001 3652
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Supplementary Table 7. Baseline medical costs, productivity loss, and patient time cost among general population aged 20 years or older in the US, by 32 subgroups

Age group,		Race/ethnici	Medical of	costs	Product	ivity loss	Patient tin	ne cost
years	Sex	ty	Annual general	End-of-life	Annual general	End-of-life costs	Annual general	End-of-lif
years		-	costs	costs	costs		costs	costs
		NHW	4020	40000	2040	8160	226	904
	Female	NHB	3100	40000	2040	8160	226	904
	i emale	Hispanic	2355	40000	2040	8160	226	904
20-44		Other	2617	40000	2040	8160	226	904
20-44		NHW	2022	40000	2040	8160	226	904
	Male	NHB	2279	40000	2040	8160	226	904
	Male	Hispanic	1145	40000	2040	8160	226	904
		Other	1803	40000	2040	8160	226	904
							226	904
		NHW	5371	40000	2040	8160	226	904
	Fomala	NHB	5712	40000	2040	8160	226	904
	Female	Hispanic	3196	40000	2040	8160	226	904
		Other	4082	40000	2040	8160	226	904
45-54		NHW	3812	40000	2040	8160	226	904
	Mala	NHB	3639	40000	2040	8160	226	904
	Male	Hispanic	3612	40000	2040	8160	226	904
		Other	2560	40000	2040	8160	226	904
							226	904
		NHW	7300	40000	2040	8160	226	904
		NHB	5479	40000	2040	8160	226	904
	Female	Hispanic	4607	40000	2040	8160	226	904
55.04		Other	3951	40000	2040	8160	226	904
55-64		NHW	6519	40000	2040	8160	226	904
	Mala	NHB	6455	40000	2040	8160	226	904
	Male	Hispanic	5077	40000	2040	8160	226	904
		Other	6320	40000	2040	8160	226	904
		NHW	8997	40000	4409	8160	607	904
	E a secolo	NHB	9585	40000	4409	8160	607	904
	Female	Hispanic	8847	40000	4409	8160	607	904
205		Other	8625	40000	4409	8160	607	904
≥65		NHW	9334	40000	4409	8160	607	904
		NHB	7367	40000	4409	8160	607	904
	Male	Hispanic	5640	40000	4409	8160	607	904
		Other	7461	40000	4409	8160	607	904

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Supplementary Table 8. Characteristics of US adults aged 20 years or older participated in the NHANES, 2013-2016

Characteristics (N=10064)		Calorie Consumption, kcal/day
Age, years	47.8 ± 0.41	
Age groups, years, N (%)		
20-44	4319 (44.5)	425 ± 4.38
25-54	1704 (18.3)	315 ± 5.39
55-64	1725 (17.3)	271 ± 4.90
≥65	2316 (19.9)	192 ± 3.83
Sex, N (%)		
Male	4829 (48.3)	388 ± 4.53
Female	5235 (51.7)	279 ± 4.04
Race/ethnicity, N (%)		
Non-Hispanic White	3944 (65.0)	320 ± 4.76
Non-Hispanic Black	2069 (11.2)	361 ± 6.55
Hispanic	2668 (14.9)	367 ± 4.44
Other	1383 (8.90)	325 ± 8.12
Education, N (%)		
Less than high school graduate	2178 (14.2)	311 ± 5.14
High school graduate	2249 (21.6)	332 ± 5.72
Some college	3070 (33.1)	341 ± 4.92
College graduate	2562 (31.0)	332 ± 7.10
Family income to poverty ratio, N (%)		
<1.30	3862 (28.3)	325 ± 4.87
1.30-1.84	2842 (26.7)	333 ± 4.55
1.85-2.99	1725 (20.4)	344 ± 6.73
≥3.00	1635 (24.5)	328 ± 7.01
Body mass index (BMI), kg/m ²	29.3 ± 0.16	
Weight status, N (%)		
Underweight (BMI<18.5)	145 (1.36)	341 ± 17.5
Normal weight (BMI=18.5-24.9)	2671 (27.2)	327 ± 4.81
Overweight/Obese (BMI≥25)	7163 (71.4)	→ 334 ± 4.01



Supplementary Table 9. Consumption of calories from full-service and fast-food restaurants among US adults participated in 2013-2016 NHANES by 32 subgroups

Age group, years			Baseline consumption, g/da (mean ± SE)
20-44	Female	NHW	357 ± 6.47
		NHB	397 ± 8.98
		Hispanic	364 ± 6.77
		Other	334 ± 11.3
	Male	NHW	485 ± 9.00
		NHB	508 ± 12.3
		Hispanic	500 ± 13.7
		Other	466 ± 14.1
45-54	Female	NHW	270 ± 9.38
		NHB	266 ± 7.85
		Hispanic	265 ± 9.11
		Other	228 ± 14.6
	Male	NHW	374 ± 11.3
		NHB	388 ± 17.4
		Hispanic	355 ± 15.0
		Other	338 ± 20.2
55-64	Female	NHW	231 ± 5.25
		NHB	249 ± 9.58
		Hispanic	234 ± 7.99
		Other	216 ± 10.2
	Male	NHW	315 ± 9.55
		NHB	314 ± 18.3
		Hispanic	307 ± 9.90
		Other	298 ± 11.1
≥65	Female	NHW	164 ± 4.71
		NHB	156 ± 6.07
		Hispanic	158 ± 5.27
		Other	137 ± 5.43
	Male	NHW	235 ± 7.43
		NHB	220 ± 7.07
		Hispanic	218 ± 8.07
		Other	198 ± 20.0

Supplementary Table 10. Estimated new cancer cases averted by the federal menu calorie labeling in the US by age, sex, race/ethnicity, and cancer type, over lifetime (U.S. population=235,162,844)¹

Cancor Tuna	Policy	20-44 y	,	45-54	у	55-64	у	65 + <u>y</u>	/
Cancer Type	Scenario	Female	Male	Female	Male	Female	Male	Female	Male
Endometrial									
Age	consumer	0000 (000 (COOO)	F04 / 000 to	24.00)	44 40 / 400 1	1010		4400)
0	behavior	3300 (696 to	6090)	591 (-990 to	2160)	1140 (433 to	5 1940)	656 (107 to	1190)
	+industry	E060 (2260 to	9900)	1240 (200 +	2000	1600 (020 to	2420)	026 (206 to	1460)
Race/Ethnicity	response	5960 (3360 to	6690)	1340 (-208 to	5 2960)	1600 (928 to) 2430)	926 (396 to	1460)
Non-									
Hispanic	consumer	1630	0	-136	0	757	0	572	0
White	behavior	(-711 to 4080)	Ū	(-1590 to 1430)	U U	(140 to 1500)	Ū	(38 to 1070)	Ũ
	+industry	3080		369	0	1110	0	780	0
	response	(829 to 5780)	0	(-1100 to 1950)	0	(463 to 1830)	0	(245 to 1290)	0
Non-	consumer	763		<u>ُ</u> 258 ´	0	283	0	47	0
Hispanic Black	behavior	(-157 to 1710)	0	(-23 to 543)	U	(73 to 528)	0	(-43 to 150)	0
·	+industry	1240	0	372	0	355	0	77	0
	response	(316 to 2200)	0	(93 to 668)	0	(146 to 604)	0	(-13 to 176)	U
Hispanic	consumer	910	0	290	0	42	0	43	0
пізрапіс	behavior	(74 to 1790)	0	(-48 to 596)	0	(-83 to 185)	0	(-16 to 102)	U
	+industry	1460	0	399	0	89	0	64	0
	response	(580 to 2340)	-	(66 to 703)		(-35 to 233)	-	(5 to 122)	•
Other	consumer	19	0	165	0	54	0	-6	0
	behavior	(-312 to 402)	-	(41 to 319)		(3 to 109)	-	(-26 to 14)	-
	+industry	150 (174 to 546)	0	191 (68 to 214)	0	68 (18 to 124)	0	0 (21 to 21)	0
	response	(-174 to 546)		(68 to 344)		(18 to 124)		(-21 to 21)	
Breast									
(Postmenopa									
usal)									
	consumer								
Age	behavior	2530 (263 to	5040)	373 (-1070 to	o 1950)	1210 (480 to	o 2130)	742 (137 to	1380)
	+industry		,		,		,	(- /
	response	4670 (2330 to	7350)	1040 (-390 to	o 2680)	1710 (1010 t	o 2640)	1040 (433 to	o 1700)
Race/Ethnicity									
Non-	consumer	1370	r.	-224		832	-	660	-
Hispanic	behavior	(-659 to 3750)	0	(-1570 to 1210)	0	(170 to 1670)	0	(57 to 1280)	0
White				· · · · · ·		,		, , , , , , , , , , , , , , , , , , ,	
	+industry	2660 (400 to 5220)	0	234	0	1200 (525 to 2040)	0	902 (201 to 1570)	0
Non	response	(490 to 5220)		(-1130 to 1770)		(535 to 2040)		(291 to 1570)	
Non- Hispapie Black	consumer	567 (110 to 1200)	0	182 (24 to 421)	0	267 (89 to 487)	0	43 (40 to 136)	0
Hispanic Black	behavior	(-110 to 1300)		(-34 to 431)		(09 10 407)		(-40 to 136)	
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1	+industry response	912 (240 to 1680)	0	271 (55 to 536)	0	329 (149 to 554)	0	71 (-13 to 166)	0
2	consumer	581		231		32.9		42	
² Hispanic	behavior	(44 to 1200)	0	(-14 to 474)	0	(-72 to 154)	0	(-12 to 100)	0
4	+industry	934	0	312	0	76	•	61	0
5	response	(368 to 1600)	0	(71 to 563)	0	(-34 to 198)	0	(6 to 123)	0
6	consumer	` 1 ´	0	` 182 ́	0	`	0	`-7 [′]	0
Other	behavior	(-310 to 384)	0	(40 to 353)	0	(9 to 148)	0	(-35 to 22)	0
8	+industry	128	0	210	0	94	0	<u> </u>	0
9	response	(-187 to 541)	0	(71 to 386)	0	(29 to 170)	0	(-27 to 31)	0
10									
11 Kidney									
12 (Renal Cell)	oonoumor								
13 Age	consumer behavior	2930 (864	t_{0} 5040)	581 (-364	to 1540)	1180 (526	to 1810)	428 (28	to 805)
14	+industry	2950 (004	10 3040)	501 (-504	10 1340)	1100 (520	10 1010)	420 (20	10 003)
15	response	5240 (311)) to 7390)	1230 (244	to 2210)	1590 (941	to 2250)	651 (248	to 1030)
¹⁶ 17 Race/Ethnicity	100001100	0210 (011		1200 (211	10 2210)	1000 (011	10 2200)	001 (210	
¹⁷ Non-									
¹⁸ Hispanic	consumer	338	1040	-42	53	172	677	147	192
¹⁹ White	behavior	(-137 to 844)	(-536 to 2790)	(-332 to 273)	(-791 to 884)	(34 to 339)	(88 to 1240)	(18 to 280)	(-170 to 536)
20	+industry	646	2020	58	379	251	898	199	320
21	response	(173 to 1180)	(410 to 3750)	(-236 to 383)	(-452 to 1250)	(109 to 420)	(326 to 1470)	(72 to 335)	(-35 to 661)
²² Non-	consumer	170	88	60	136	79	85	13	44
²³ Hispanic Black	behavior	(-35 to 384)	(-454 to 620)	(-5 to 128)	(-96 to 410)	(26 to 139)	(-81 to 258)	(-12 to 40)	(9 to 79)
24	+industry	280	343	87	203	97	119	21	56
25	response	(69 to 502)	(-202 to 898)	(22 to 157)	(-30 to 475)	(43 to 157)	(-45 to 295)	(-4 to 48)	(22 to 90)
26 ₂₇ Hispanic	consumer	267	895	92	230	14	94	15	9
27	behavior	(21 to 527)	(-21 to 1920)	(-4 to 184)	(-25 to 503)	(-27 to 60)	(8 to 196)	(-6 to 36)	(-29 to 50)
28	+industry	425	1290	123	305	29	127 (11 to 020)	22	21
29	response	(166 to 697)	(371 to 2320)	(27 to 218) 34	(49 to 570)	(-12 to 76)	(41 to 232) 33	(2 to 44)	(-17 to 63)
³⁰ Other	consumer behavior	5 (-47 to 66)	75 (-103 to 274)	(12 to 59)	3 (-64 to 77)	13 (2 to 25)	/10 to 58	-1 (-6 to 4)	8 (-18 to 37)
31	+industry	27	147	38	(-04 10 77) 17	(2 10 23)	41	(-0 (0 4)	11
32	response	(-26 to 89)	(-29 to 347)	(17 to 64)	(-52 to 91)	(5 to 28)	(19 to 67)	(-4 to 6)	(-15 to 40)
33 34	response	(201000)	(2010047)	(17 10 04)	(02 10 01)	(0 (0 20)	(10.00.07)	(+ 10 0)	(101040)
₃₅ Liver	oonoumor								
36 Age	consumer behavior	3210 (100	1 to 5540	701 (-200	to 1760)	1000 (477	' to 1580)	275 (17	to 551)
37	+industry	5210 (1000	5 (0 5540)	701 (-200	10 1700)	1000 (477	10 1000)	275(17	10 001)
38	response	5560 (3130) to 8130)	1340 (397	' to 2480)	1340 (804	to 1950)	432 (174	4 to 719)
³⁹ Race/Ethnicity	100001100	0000 (010)		1010 (001	10 2 100)	1010 (001	101000)	102 (17	
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Non-	consumer	170	4450	40	00	110	500	75	440
¹ Hispanic	behavior	170	1150	18	-82	113	520	75	116
2 White		(-125 to 597)	(-258 to 3130)	(-168 to 236)	(-844 to 807)	(36 to 227)	(108 to 1020)	(6 to 155)	(-110 to 365)
3	+industry	367	2120	78	215	159	668	100	198
4	response	(53 to 855)	(498 to 4300)	(-105 to 319)	(-537 to 1150)	(77 to 280)	(287 to 1220)	(35 to 189)	(-26 to 454)
5 Non-	consumer	143	85	53	213	51	118	7	37
6 Hispanic Black	behavior	(-27 to 346)	(-678 to 1050)	(2 to 120)	(-146 to 705)	(14 to 100)	(-112 to 393)	(-7 to 26)	(-4 to 88)
7	+industry	231	429	74	306	63	163	12	52
8	response	(53 to 458)	(-312 to 1460)	(24 to 147)	(-41 to 823)	(28 to 115)	(-58 to 447)	(-2 to 32)	(11 to 107)
⁹ Hispanic	consumer	239	1150	99	321	14	113	17	8
10	behavior	(19 to 570)	(93 to 2490)	(3 to 215)	(15 to 703)	(-30 to 72)	(19 to 233)	(-5 to 41)	(-33 to 54)
11	+industry	384	1600	132	409	31	150	25	20
12	response	(132 to 756)	(529 to 3050)	(36 to 257)	(106 to 820)	(-13 to 90)	(55 to 276)	(3 to 50)	(-19 to 70)
13 Other	consumer	2	99	38	-1	15	38	0	9
14	behavior	(-56 to 82)	(-125 to 379)	(9 to 77)	(-101 to 125)	(0 to 34)	(5 to 76)	(-8 to 7)	(-28 to 53)
15	+industry	26	183	43	18	19	48	2	14
16	response	(-32 to 108)	(-31 to 483)	(15 to 85)	(-80 to 152)	(5 to 40)	(17 to 91)	(-5 to 10)	(-23 to 59)
17									
¹⁷ Pancreatic									
19 Age	consumer								
20	behavior	764 (262	to 1340)	81.6 (-18	6 to 388)	404 (193	3 to 651)	148 (21	to 286)
	+industry								1
21	+industry response	1350 (820) to 1990)	269 (4	to 595)	540 (327	' to 793)	227 (96	to 370)
21 22 Race/Ethnicity		1350 (820) to 1990)	269 (4	to 595)	540 (327	′ to 793)	227 (96	to 370)
21 ²² Race/Ethnicity ²³ Non-	response	· ·		C	L:	, , , , , , , , , , , , , , , , , , ,	,	,	
21 ²² Race/Ethnicity ²³ Non- ²⁴ Hispanic	response consumer	121	247	-48	-16	87	218	63	58
21 22 Race/Ethnicity 23 Non- 24 Hispanic 25 White	response consumer behavior	121 (-44 to 367)	247 (-120 to 768)	-48 (-159 to 87)	-16 (-246 to 245)	87 (26 to 175)	218 (48 to 432)	63 (3 to 131)	58 (-54 to 189)
21 22 Race/Ethnicity 23 Non- 24 Hispanic 25 White 26	response consumer behavior +industry	121 (-44 to 367) 229	247 (-120 to 768) 490	-48 (-159 to 87) -11	-16 (-246 to 245) 73	87 (26 to 175) 122	218 (48 to 432) 283	63 (3 to 131) 87	58 (-54 to 189) 98
21 22 Race/Ethnicity 23 Non- 24 Hispanic 25 White 26 27	response consumer behavior +industry response	121 (-44 to 367) 229 (50 to 493)	247 (-120 to 768) 490 (99 to 1060)	-48 (-159 to 87) -11 (-124 to 134)	-16 (-246 to 245) 73 (-154 to 363)	87 (26 to 175) 122 (56 to 218)	218 (48 to 432) 283 (115 to 507)	63 (3 to 131) 87 (27 to 163)	58 (-54 to 189) 98 (-12 to 238)
21 22 Race/Ethnicity 23 Non- 24 Hispanic 25 White 26 27 28 Non-	response consumer behavior +industry response consumer	121 (-44 to 367) 229 (50 to 493) 60	247 (-120 to 768) 490 (99 to 1060) 18	-48 (-159 to 87) -11 (-124 to 134) 24	-16 (-246 to 245) 73 (-154 to 363) 30	87 (26 to 175) 122 (56 to 218) 32	218 (48 to 432) 283 (115 to 507) 19	63 (3 to 131) 87 (27 to 163) 5	58 (-54 to 189) 98 (-12 to 238) 10
21 22 Race/Ethnicity 23 Non- 24 Hispanic 25 White 26 27	response consumer behavior +industry response consumer behavior	121 (-44 to 367) 229 (50 to 493) 60 (-10 to 158)	247 (-120 to 768) 490 (99 to 1060) 18 (-80 to 128)	-48 (-159 to 87) -11 (-124 to 134) 24 (-1 to 54)	-16 (-246 to 245) 73 (-154 to 363) 30 (-20 to 87)	87 (26 to 175) 122 (56 to 218) 32 (9 to 63)	218 (48 to 432) 283 (115 to 507) 19 (-16 to 62)	63 (3 to 131) 87 (27 to 163) 5 (-6 to 19)	58 (-54 to 189) 98 (-12 to 238) 10 (2 to 19)
21 22 Race/Ethnicity 23 Non- 24 Hispanic 25 White 26 27 28 Non- 29 Hispanic Black 30	response consumer behavior +industry response consumer behavior +industry	121 (-44 to 367) 229 (50 to 493) 60 (-10 to 158) 98	247 (-120 to 768) 490 (99 to 1060) 18 (-80 to 128) 64	-48 (-159 to 87) -11 (-124 to 134) 24 (-1 to 54) 34	-16 (-246 to 245) 73 (-154 to 363) 30 (-20 to 87) 44	87 (26 to 175) 122 (56 to 218) 32 (9 to 63) 39	218 (48 to 432) 283 (115 to 507) 19 (-16 to 62) 27	63 (3 to 131) 87 (27 to 163) 5 (-6 to 19) 9	58 (-54 to 189) 98 (-12 to 238) 10 (2 to 19) 13
21 22 Race/Ethnicity 23 Non- 24 Hispanic 25 White 26 27 28 Non- 29 Hispanic Black	response consumer behavior +industry response consumer behavior +industry response	121 (-44 to 367) 229 (50 to 493) 60 (-10 to 158) 98 (21 to 207)	247 (-120 to 768) 490 (99 to 1060) 18 (-80 to 128) 64 (-36 to 184)	-48 (-159 to 87) -11 (-124 to 134) 24 (-1 to 54) 34 (9 to 67)	-16 (-246 to 245) 73 (-154 to 363) 30 (-20 to 87) 44 (-4 to 102)	87 (26 to 175) 122 (56 to 218) 32 (9 to 63) 39 (17 to 72)	218 (48 to 432) 283 (115 to 507) 19 (-16 to 62) 27 (-9 to 70)	63 (3 to 131) 87 (27 to 163) 5 (-6 to 19) 9 (-2 to 23)	58 (-54 to 189) 98 (-12 to 238) 10 (2 to 19) 13 (5 to 23)
21 22 Race/Ethnicity 23 Non- 24 Hispanic 25 White 26 27 28 Non- 29 Hispanic Black 30 31	response consumer behavior +industry response consumer behavior +industry response consumer	121 (-44 to 367) 229 (50 to 493) 60 (-10 to 158) 98 (21 to 207) 68	247 (-120 to 768) 490 (99 to 1060) 18 (-80 to 128) 64 (-36 to 184) 194	-48 (-159 to 87) -11 (-124 to 134) 24 (-1 to 54) 34 (9 to 67) 26	-16 (-246 to 245) 73 (-154 to 363) 30 (-20 to 87) 44 (-4 to 102) 46	87 (26 to 175) 122 (56 to 218) 32 (9 to 63) 39 (17 to 72) 4	218 (48 to 432) 283 (115 to 507) 19 (-16 to 62) 27 (-9 to 70) 18	63 (3 to 131) 87 (27 to 163) 5 (-6 to 19) 9 (-2 to 23) 6	58 (-54 to 189) 98 (-12 to 238) 10 (2 to 19) 13 (5 to 23) 2
21 22 Race/Ethnicity 23 Non- 24 Hispanic 25 White 26 27 28 Non- 29 Hispanic Black 30 31	response consumer behavior +industry response consumer behavior +industry response consumer behavior	$ \begin{array}{c} 121\\ (-44 \text{ to } 367)\\ 229\\ (50 \text{ to } 493)\\ 60\\ (-10 \text{ to } 158)\\ 98\\ (21 \text{ to } 207)\\ 68\\ (5 \text{ to } 150) \end{array} $	247 (-120 to 768) 490 (99 to 1060) 18 (-80 to 128) 64 (-36 to 184) 194 (13 to 422)	-48 (-159 to 87) -11 (-124 to 134) 24 (-1 to 54) 34 (9 to 67) 26 (-4 to 60)	-16 (-246 to 245) 73 (-154 to 363) 30 (-20 to 87) 44 (-4 to 102) 46 (-5 to 105)	87 (26 to 175) 122 (56 to 218) 32 (9 to 63) 39 (17 to 72) 4 (-11 to 22)	218 (48 to 432) 283 (115 to 507) 19 (-16 to 62) 27 (-9 to 70) 18 (-3 to 44)	63(3 to 131)87(27 to 163)5(-6 to 19)9(-2 to 23)6(-2 to 14)	58 (-54 to 189) 98 (-12 to 238) 10 (2 to 19) 13 (5 to 23) 2 (-8 to 12)
21 22 Race/Ethnicity 23 Non- 24 Hispanic 25 White 26 27 28 Non- 29 Hispanic Black 30 31 32 Hispanic	response consumer behavior +industry response consumer behavior +industry response consumer behavior +industry	$ \begin{array}{c} 121\\ (-44 \text{ to } 367)\\ 229\\ (50 \text{ to } 493)\\ 60\\ (-10 \text{ to } 158)\\ 98\\ (21 \text{ to } 207)\\ 68\\ (5 \text{ to } 150)\\ 108\\ \end{array} $	247 (-120 to 768) 490 (99 to 1060) 18 (-80 to 128) 64 (-36 to 184) 194 (13 to 422) 273	$\begin{array}{r} -48 \\ (-159 \text{ to } 87) \\ -11 \\ (-124 \text{ to } 134) \\ 24 \\ (-1 \text{ to } 54) \\ 34 \\ (9 \text{ to } 67) \\ 26 \\ (-4 \text{ to } 60) \\ 36 \end{array}$	$\begin{array}{r} -16 \\ (-246 \text{ to } 245) \\ 73 \\ (-154 \text{ to } 363) \\ 30 \\ (-20 \text{ to } 87) \\ 44 \\ (-4 \text{ to } 102) \\ 46 \\ (-5 \text{ to } 105) \\ 63 \end{array}$	87 (26 to 175) 122 (56 to 218) 32 (9 to 63) 39 (17 to 72) 4 (-11 to 22) 10	218 (48 to 432) 283 (115 to 507) 19 (-16 to 62) 27 (-9 to 70) 18 (-3 to 44) 26	$\begin{array}{c} 63\\ (3 \text{ to } 131)\\ 87\\ (27 \text{ to } 163)\\ 5\\ (-6 \text{ to } 19)\\ 9\\ (-2 \text{ to } 23)\\ 6\\ (-2 \text{ to } 14)\\ 8\end{array}$	58 (-54 to 189) 98 (-12 to 238) 10 (2 to 19) 13 (5 to 23) 2 (-8 to 12) 5
21 22 Race/Ethnicity 23 Non- 24 Hispanic 25 White 26 27 28 Non- 29 Hispanic Black 30 31 32 Hispanic 33	response consumer behavior +industry response consumer behavior +industry response consumer behavior +industry response	$ \begin{array}{c} 121\\ (-44 \text{ to } 367)\\ 229\\ (50 \text{ to } 493)\\ 60\\ (-10 \text{ to } 158)\\ 98\\ (21 \text{ to } 207)\\ 68\\ (5 \text{ to } 150)\\ 108\\ (40 \text{ to } 201) \end{array} $	$\begin{array}{c} 247 \\ (-120 \text{ to } 768) \\ 490 \\ (99 \text{ to } 1060) \\ 18 \\ (-80 \text{ to } 128) \\ 64 \\ (-36 \text{ to } 184) \\ 194 \\ (13 \text{ to } 422) \\ 273 \\ (92 \text{ to } 518) \end{array}$	$\begin{array}{c} -48 \\ (-159 \text{ to } 87) \\ -11 \\ (-124 \text{ to } 134) \\ 24 \\ (-1 \text{ to } 54) \\ 34 \\ (9 \text{ to } 67) \\ 26 \\ (-4 \text{ to } 60) \\ 36 \\ (7 \text{ to } 70) \end{array}$	$\begin{array}{c} -16 \\ (-246 \text{ to } 245) \\ 73 \\ (-154 \text{ to } 363) \\ 30 \\ (-20 \text{ to } 87) \\ 44 \\ (-4 \text{ to } 102) \\ 46 \\ (-5 \text{ to } 105) \\ 63 \\ (11 \text{ to } 124) \end{array}$	87 (26 to 175) 122 (56 to 218) 32 (9 to 63) 39 (17 to 72) 4 (-11 to 22) 10 (-5 to 28)	218 (48 to 432) 283 (115 to 507) 19 (-16 to 62) 27 (-9 to 70) 18 (-3 to 44) 26 (6 to 53)	$\begin{array}{c} 63\\ (3 \text{ to } 131)\\ 87\\ (27 \text{ to } 163)\\ 5\\ (-6 \text{ to } 19)\\ 9\\ (-2 \text{ to } 23)\\ 6\\ (-2 \text{ to } 14)\\ 8\\ (0 \text{ to } 18)\end{array}$	58 (-54 to 189) 98 (-12 to 238) 10 (2 to 19) 13 (5 to 23) 2 (-8 to 12) 5 (-5 to 15)
21 22 Race/Ethnicity 23 Non- 24 Hispanic 25 White 26 27 28 Non- 29 Hispanic Black 30 31 32 Hispanic 33 34 35	response consumer behavior +industry response consumer behavior +industry response consumer behavior +industry response consumer	121(-44 to 367)229(50 to 493)60(-10 to 158)98(21 to 207)68(5 to 150)108(40 to 201)-2	$\begin{array}{c} 247 \\ (-120 \text{ to } 768) \\ 490 \\ (99 \text{ to } 1060) \\ 18 \\ (-80 \text{ to } 128) \\ 64 \\ (-36 \text{ to } 184) \\ 194 \\ (13 \text{ to } 422) \\ 273 \\ (92 \text{ to } 518) \\ 18 \end{array}$	$\begin{array}{r} -48 \\ (-159 \text{ to } 87) \\ -11 \\ (-124 \text{ to } 134) \\ 24 \\ (-1 \text{ to } 54) \\ 34 \\ (9 \text{ to } 67) \\ 26 \\ (-4 \text{ to } 60) \\ 36 \\ (7 \text{ to } 70) \\ 17 \end{array}$	$\begin{array}{r} -16 \\ (-246 \text{ to } 245) \\ 73 \\ (-154 \text{ to } 363) \\ 30 \\ (-20 \text{ to } 87) \\ 44 \\ (-4 \text{ to } 102) \\ 46 \\ (-5 \text{ to } 105) \\ 63 \\ (11 \text{ to } 124) \\ 0 \end{array}$	87 (26 to 175) 122 (56 to 218) 32 (9 to 63) 39 (17 to 72) 4 (-11 to 22) 10 (-5 to 28) 8	218 (48 to 432) 283 (115 to 507) 19 (-16 to 62) 27 (-9 to 70) 18 (-3 to 44) 26 (6 to 53) 10	$\begin{array}{c} 63\\ (3 \text{ to } 131)\\ 87\\ (27 \text{ to } 163)\\ 5\\ (-6 \text{ to } 19)\\ 9\\ (-2 \text{ to } 23)\\ 6\\ (-2 \text{ to } 14)\\ 8\\ (0 \text{ to } 18)\\ 0\end{array}$	58 (-54 to 189) 98 (-12 to 238) 10 (2 to 19) 13 (5 to 23) 2 (-8 to 12) 5 (-5 to 15) 2
21 22 Race/Ethnicity 23 Non- 24 Hispanic 25 White 26 27 28 Non- 29 Hispanic Black 30 31 32 Hispanic 33 34 35 36 Other	response consumer behavior +industry response consumer behavior +industry response consumer behavior +industry response consumer behavior	$ \begin{array}{c} 121\\ (-44 \text{ to } 367)\\ 229\\ (50 \text{ to } 493)\\ 60\\ (-10 \text{ to } 158)\\ 98\\ (21 \text{ to } 207)\\ 68\\ (5 \text{ to } 150)\\ 108\\ (40 \text{ to } 201)\\ -2\\ (-27 \text{ to } 30) \end{array} $	$\begin{array}{c} 247 \\ (-120 \text{ to } 768) \\ 490 \\ (99 \text{ to } 1060) \\ 18 \\ (-80 \text{ to } 128) \\ 64 \\ (-36 \text{ to } 184) \\ 194 \\ (13 \text{ to } 422) \\ 273 \\ (92 \text{ to } 518) \\ 18 \\ (-29 \text{ to } 72) \end{array}$	$\begin{array}{c} -48 \\ (-159 \text{ to } 87) \\ -11 \\ (-124 \text{ to } 134) \\ 24 \\ (-1 \text{ to } 54) \\ 34 \\ (9 \text{ to } 67) \\ 26 \\ (-4 \text{ to } 60) \\ 36 \\ (7 \text{ to } 70) \\ 17 \\ (4 \text{ to } 33) \end{array}$	$\begin{array}{c} -16 \\ (-246 \text{ to } 245) \\ 73 \\ (-154 \text{ to } 363) \\ 30 \\ (-20 \text{ to } 87) \\ 44 \\ (-4 \text{ to } 102) \\ 46 \\ (-5 \text{ to } 105) \\ 63 \\ (11 \text{ to } 124) \\ 0 \\ (-20 \text{ to } 23) \end{array}$	87 (26 to 175) 122 (56 to 218) 32 (9 to 63) 39 (17 to 72) 4 (-11 to 22) 10 (-5 to 28) 8 (1 to 16)	218 (48 to 432) 283 (115 to 507) 19 (-16 to 62) 27 (-9 to 70) 18 (-3 to 44) 26 (6 to 53) 10 (3 to 19)	$\begin{array}{c} 63\\ (3 \text{ to } 131)\\ 87\\ (27 \text{ to } 163)\\ 5\\ (-6 \text{ to } 19)\\ 9\\ (-2 \text{ to } 23)\\ 6\\ (-2 \text{ to } 14)\\ 8\\ (0 \text{ to } 18)\end{array}$	58 (-54 to 189) 98 (-12 to 238) 10 (2 to 19) 13 (5 to 23) 2 (-8 to 12) 5 (-5 to 15) 2 (-6 to 13)
21 22 Race/Ethnicity 23 Non- 24 Hispanic 25 White 26 27 28 Non- 29 Hispanic Black 30 31 32 Hispanic 33 34 35 36 Other 37	response consumer behavior +industry response consumer behavior +industry response consumer behavior +industry response consumer behavior +industry response consumer behavior +industry	$ \begin{array}{c} 121\\ (-44 \text{ to } 367)\\ 229\\ (50 \text{ to } 493)\\ 60\\ (-10 \text{ to } 158)\\ 98\\ (21 \text{ to } 207)\\ 68\\ (5 \text{ to } 150)\\ 108\\ (40 \text{ to } 201)\\ -2\\ (-27 \text{ to } 30)\\ 9\end{array} $	$\begin{array}{c} 247 \\ (-120 \text{ to } 768) \\ 490 \\ (99 \text{ to } 1060) \\ 18 \\ (-80 \text{ to } 128) \\ 64 \\ (-36 \text{ to } 184) \\ 194 \\ (13 \text{ to } 422) \\ 273 \\ (92 \text{ to } 518) \\ 18 \\ (-29 \text{ to } 72) \\ 36 \end{array}$	$\begin{array}{r} -48 \\ (-159 \text{ to } 87) \\ -11 \\ (-124 \text{ to } 134) \\ 24 \\ (-1 \text{ to } 54) \\ 34 \\ (9 \text{ to } 67) \\ 26 \\ (-4 \text{ to } 60) \\ 36 \\ (7 \text{ to } 70) \\ 17 \\ (4 \text{ to } 33) \\ 19 \end{array}$	$\begin{array}{c} -16 \\ (-246 \text{ to } 245) \\ 73 \\ (-154 \text{ to } 363) \\ 30 \\ (-20 \text{ to } 87) \\ 44 \\ (-4 \text{ to } 102) \\ 46 \\ (-5 \text{ to } 105) \\ 63 \\ (11 \text{ to } 124) \\ 0 \\ (-20 \text{ to } 23) \\ 4 \end{array}$	87 (26 to 175) 122 (56 to 218) 32 (9 to 63) 39 (17 to 72) 4 (-11 to 22) 10 (-5 to 28) 8 (1 to 16) 10	218 (48 to 432) 283 (115 to 507) 19 (-16 to 62) 27 (-9 to 70) 18 (-3 to 44) 26 (6 to 53) 10 (3 to 19) 13	$\begin{array}{c} 63\\ (3 \text{ to } 131)\\ 87\\ (27 \text{ to } 163)\\ 5\\ (-6 \text{ to } 19)\\ 9\\ (-2 \text{ to } 23)\\ 6\\ (-2 \text{ to } 14)\\ 8\\ (0 \text{ to } 18)\\ 0\\ (-4 \text{ to } 3)\\ 1\end{array}$	58 (-54 to 189) 98 (-12 to 238) 10 (2 to 19) 13 (5 to 23) 2 (-8 to 12) 5 (-5 to 15) 2 (-6 to 13) 4
21 22 Race/Ethnicity 23 Non- 24 Hispanic 25 White 26 27 28 Non- 29 Hispanic Black 30 31 32 Hispanic 33 34 35 36 Other 37 38	response consumer behavior +industry response consumer behavior +industry response consumer behavior +industry response consumer behavior	$ \begin{array}{c} 121\\ (-44 \text{ to } 367)\\ 229\\ (50 \text{ to } 493)\\ 60\\ (-10 \text{ to } 158)\\ 98\\ (21 \text{ to } 207)\\ 68\\ (5 \text{ to } 150)\\ 108\\ (40 \text{ to } 201)\\ -2\\ (-27 \text{ to } 30) \end{array} $	$\begin{array}{c} 247 \\ (-120 \text{ to } 768) \\ 490 \\ (99 \text{ to } 1060) \\ 18 \\ (-80 \text{ to } 128) \\ 64 \\ (-36 \text{ to } 184) \\ 194 \\ (13 \text{ to } 422) \\ 273 \\ (92 \text{ to } 518) \\ 18 \\ (-29 \text{ to } 72) \end{array}$	$\begin{array}{c} -48 \\ (-159 \text{ to } 87) \\ -11 \\ (-124 \text{ to } 134) \\ 24 \\ (-1 \text{ to } 54) \\ 34 \\ (9 \text{ to } 67) \\ 26 \\ (-4 \text{ to } 60) \\ 36 \\ (7 \text{ to } 70) \\ 17 \\ (4 \text{ to } 33) \end{array}$	$\begin{array}{c} -16 \\ (-246 \text{ to } 245) \\ 73 \\ (-154 \text{ to } 363) \\ 30 \\ (-20 \text{ to } 87) \\ 44 \\ (-4 \text{ to } 102) \\ 46 \\ (-5 \text{ to } 105) \\ 63 \\ (11 \text{ to } 124) \\ 0 \\ (-20 \text{ to } 23) \end{array}$	87 (26 to 175) 122 (56 to 218) 32 (9 to 63) 39 (17 to 72) 4 (-11 to 22) 10 (-5 to 28) 8 (1 to 16)	218 (48 to 432) 283 (115 to 507) 19 (-16 to 62) 27 (-9 to 70) 18 (-3 to 44) 26 (6 to 53) 10 (3 to 19)	$\begin{array}{c} 63\\ (3 \text{ to } 131)\\ 87\\ (27 \text{ to } 163)\\ 5\\ (-6 \text{ to } 19)\\ 9\\ (-2 \text{ to } 23)\\ 6\\ (-2 \text{ to } 14)\\ 8\\ (0 \text{ to } 18)\\ 0\end{array}$	58 (-54 to 189) 98 (-12 to 238) 10 (2 to 19) 13 (5 to 23) 2 (-8 to 12) 5 (-5 to 15) 2 (-6 to 13)
21 22 Race/Ethnicity 23 Non- 24 Hispanic 25 White 26 27 28 Non- 29 Hispanic Black 30 31 32 Hispanic 33 34 35 36 Other 37	response consumer behavior +industry response consumer behavior +industry response consumer behavior +industry response consumer behavior +industry response consumer behavior +industry	$ \begin{array}{c} 121\\ (-44 \text{ to } 367)\\ 229\\ (50 \text{ to } 493)\\ 60\\ (-10 \text{ to } 158)\\ 98\\ (21 \text{ to } 207)\\ 68\\ (5 \text{ to } 150)\\ 108\\ (40 \text{ to } 201)\\ -2\\ (-27 \text{ to } 30)\\ 9\end{array} $	$\begin{array}{c} 247 \\ (-120 \text{ to } 768) \\ 490 \\ (99 \text{ to } 1060) \\ 18 \\ (-80 \text{ to } 128) \\ 64 \\ (-36 \text{ to } 184) \\ 194 \\ (13 \text{ to } 422) \\ 273 \\ (92 \text{ to } 518) \\ 18 \\ (-29 \text{ to } 72) \\ 36 \end{array}$	$\begin{array}{r} -48 \\ (-159 \text{ to } 87) \\ -11 \\ (-124 \text{ to } 134) \\ 24 \\ (-1 \text{ to } 54) \\ 34 \\ (9 \text{ to } 67) \\ 26 \\ (-4 \text{ to } 60) \\ 36 \\ (7 \text{ to } 70) \\ 17 \\ (4 \text{ to } 33) \\ 19 \end{array}$	$\begin{array}{c} -16 \\ (-246 \text{ to } 245) \\ 73 \\ (-154 \text{ to } 363) \\ 30 \\ (-20 \text{ to } 87) \\ 44 \\ (-4 \text{ to } 102) \\ 46 \\ (-5 \text{ to } 105) \\ 63 \\ (11 \text{ to } 124) \\ 0 \\ (-20 \text{ to } 23) \\ 4 \end{array}$	87 (26 to 175) 122 (56 to 218) 32 (9 to 63) 39 (17 to 72) 4 (-11 to 22) 10 (-5 to 28) 8 (1 to 16) 10	218 (48 to 432) 283 (115 to 507) 19 (-16 to 62) 27 (-9 to 70) 18 (-3 to 44) 26 (6 to 53) 10 (3 to 19) 13	$\begin{array}{c} 63\\ (3 \text{ to } 131)\\ 87\\ (27 \text{ to } 163)\\ 5\\ (-6 \text{ to } 19)\\ 9\\ (-2 \text{ to } 23)\\ 6\\ (-2 \text{ to } 14)\\ 8\\ (0 \text{ to } 18)\\ 0\\ (-4 \text{ to } 3)\\ 1\end{array}$	58 (-54 to 189) 98 (-12 to 238) 10 (2 to 19) 13 (5 to 23) 2 (-8 to 12) 5 (-5 to 15) 2 (-6 to 13) 4

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Esophageal ¹ Adenocarcin ² oma									
³ Age	consumer behavior	715 (43	715 (43 to 1480)		92 (-296 to 501)		419 (136 to 719)		to 309)
6 7 Race/Ethnicity	+industry response	1300 (602	2 to 2100)	293 (-102	2 to 708)	556 (270) to 858)	206 (20	to 390)
 8 Non- 9 Hispanic 10 White 11 12 13 Non- 14 Hispanic Black 15 16 17 Hispanic 18 19 20 21 Other 22 23 24 	consumer behavior +industry response consumer behavior +industry response consumer behavior +industry response consumer behavior +industry response	$\begin{array}{c} 45 \\ (-25 \text{ to } 125) \\ 91 \\ (17 \text{ to } 179) \\ 10 \\ (-2 \text{ to } 22) \\ 16 \\ (4 \text{ to } 29) \\ 28 \\ (2 \text{ to } 57) \\ 44 \\ (17 \text{ to } 76) \\ -1 \\ (-10 \text{ to } 11) \\ 3 \\ (-6 \text{ to } 15) \end{array}$	$\begin{array}{c} 406 \\ (-228 \text{ to } 1100) \\ 815 \\ (174 \text{ to } 1560) \\ 10 \\ (-28 \text{ to } 50) \\ 28 \\ (-11 \text{ to } 69) \\ 196 \\ (-2 \text{ to } 414) \\ 280 \\ (80 \text{ to } 504) \\ 10 \\ (-16 \text{ to } 41) \\ 21 \\ (-6 \text{ to } 52) \end{array}$	$\begin{array}{c} -9 \\ (-55 \text{ to } 41) \\ 7 \\ (-40 \text{ to } 60) \\ 3 \\ (-1 \text{ to } 8) \\ 5 \\ (1 \text{ to } 9) \\ 9 \\ (-1 \text{ to } 20) \\ 13 \\ (2 \text{ to } 24) \\ 6 \\ (1 \text{ to } 11) \\ 75 \\ (2 \text{ to } 12) \end{array}$	$\begin{array}{c} 26 \\ (-368 \ {\rm to} \ 419) \\ 179 \\ (-210 \ {\rm to} \ 578) \\ 11 \\ (-7 \ {\rm to} \ 32) \\ 16 \\ (-7 \ {\rm to} \ 37) \\ 46 \\ (-7 \ {\rm to} \ 112) \\ 63 \\ (7 \ {\rm to} \ 130) \\ 0 \\ (-12 \ {\rm to} \ 13) \\ 2 \\ (-10 \ {\rm to} \ 15) \end{array}$	$\begin{array}{c} 30 \\ (7 \text{ to } 58) \\ 43 \\ (20 \text{ to } 73) \\ 5 \\ (2 \text{ to } 9) \\ 6 \\ (3 \text{ to } 11) \\ 2 \\ (-3 \text{ to } 8) \\ 3 \\ (-1 \text{ to } 10) \\ 2 \\ (0 \text{ to } 5) \\ 3 \\ (1 \text{ to } 6) \end{array}$	$\begin{array}{c} 345 \\ (64 \text{ to } 630) \\ 449 \\ (174 \text{ to } 739) \\ 67 \\ (-7 \text{ to } 22) \\ 9 \\ (-4 \text{ to } 25) \\ 24 \\ (3 \text{ to } 47) \\ 32 \\ (11 \text{ to } 56) \\ 7 \\ (2 \text{ to } 12) \\ 8 \\ (4 \text{ to } 13) \end{array}$	27 (5 to 50) 35 (14 to 59) 1 (-1 to 3) 1 (0 to 3) 2 (-1 to 4) 3 (0 to 5) 0 (-1 to 1) 0 (-1 to 1)	92 (-88 to 263) 155 (-17 to 330) 4 (0 to 7) 5 (2 to 8) 2 (-7 to 12) 4 (-4 to 15) 2 (-4 to 8) 2 (-3 to 9)
24 25 Colorectal									
²⁶ Age 27 Age 28 29	consumer behavior +industry response	584 (183 1050 (605	,	79 (-90 201 (23	,	251 (126	,	117 (19 175 (81	,
30 Race/Ethnicity 31 Non- 32 Hispanic 33 White 34 35 36 Non- 37 Hispanic Black 38 39 40 Hispanic 41 42	consumer behavior +industry response consumer	67 (-51 to 261) 144 (-2 to 382) 31 (-9 to 88) 53 (9 to 119) 45 (2 to 113)	169 (-107 to 569) 358 (40 to 790) 38 (-48 to 144) 78 (-8 to 203) 185 (25 to 409)	-35 (-106 to 64) -12 (-80 to 97) 11 (-1 to 29) 17 (4 to 36) 20 (1 to 43)	-17 (-151 to 163) 38 (-99 to 233) 26 (-13 to 79) 36 (-2 to 91) 57 (9 to 114)	52 (11 to 111) 75 (30 to 146) 19 (7 to 36) 23 (11 to 41) 3 (-7 to 16)	$ \begin{array}{r} 126\\ (21 \text{ to } 262)\\ 168\\ (62 \text{ to } 313)\\ 14\\ (-17 \text{ to } 49)\\ 20\\ (-9 \text{ to } 56)\\ 21\\ (2 \text{ to } 44) \end{array} $	55 (11 to 115) 73 (28 to 138) 3 (-4 to 12) 6 (-1 to 15) 4 (-1 to 11)	44 (-36 to 129) 70 (-7 to 162) 8 (1 to 17) 11 (3 to 21) 1 (-8 to 11)
43									16

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1 2 3 Other 4 5	+industry response consumer behavior +industry response	73 (18 to 155) -2 (-21 to 26) 6 (-13 to 36)	256 (84 to 504) 20 (-31 to 89) 41 (-9 to 115)	26 (8 to 51) 7 (-1 to 19) 9 (1 to 21)	70 (23 to 129) 1 (-20 to 26) 5 (-15 to 31)	6 (-3 to 20) 4 (0 to 11) 6 (1 to 12)	28 (10 to 53) 8 (1 to 16) 10 (4 to 19)	6 (1 to 13) -1 (-3 to 2) 0 (-2 to 3)	4 (-5 to 14) 3 (-6 to 13) 4 (-5 to 14)	
6 7 Thyroid										
8 Age 9 10	consumer behavior +industry	374 (114	,	10 (-69		84 (44 to 144)		34 (7 to 68)		
11 12 Race/Ethnicity	response	683 (349	to 1130)	67 (-17	to 200)	117 (70	to 187)	52 (22	to 91)	
13 Non- 14 Hispanic	consumer behavior	96 (-59 to 382)	52 (-59 to 273)	-28 (-85 to 56)	-15 (-64 to 58)	21 (1 to 62)	28 (1 to 73)	20 (2 to 47)	8 (-9 to 31)	
16 17 Non-	+industry response consumer	205 (-15 to 563) 29	(-26 to 395) 7	-8 (-63 to 92) 8	(-43 to 85) 3	(1 to 82) 33 (5 to 80) 12	40 (12 to 90) 2	28 (9 to 58) 1	(0 to 01) 14 (-3 to 40) 1	
¹⁸ Hispanic Black 19 20	behavior +industry response	(-10 to 113) 52 (-1 to 153)	(-10 to 36) 16 (-4 to 50)	(-1 to 24) 12 (2 to 30)	(-3 to 12) 5 (-1 to 15)	(6 to 22) 14 (8 to 26)	(-2 to 8) 3 (-1 to 10)	(-2 to 5) 2 (0 to 7)	(0 to 2) 2 (1 to 3)	
21 ₂₂ Hispanic 23	consumer behavior +industry	68 (1 to 201) 113	59 (6 to 151) 84) 15 (-5 to 39) 21	13 (2 to 30) 16	2 (-4 to 12) 4	4 (0 to 9) 5	2 (-1 to 6) 3	0 (-1 to 3) 1	
24 25 26 Other	response consumer behavior	(22 to 276) -4 (-38 to 59)	(26 to 189) 13 (-13 to 56)	(2 to 48) 6 (-4 to 20)	(6 to 35) 1 (-7 to 12)	(-2 to 15) 5 (2 to 10)	(2 to 12) 5 (3 to 8)	(0 to 8) -1 (-2 to 1)	(-1 to 3) 0 (-2 to 3)	
27 28 29	+industry response	12 (-25 to 82)	23 (-2 to 70)	8 (-1 to 23)	3 (-5 to 14)	6 (3 to 11)	6 (4 to 9)	0 (-2 to 2)	1 (-1 to 4)	
30 Multiple 31 Myeloma										
³² Age 33 34	consumer behavior +industry	370 (113	to 743)	78 (-46	to 242)	181 (85	to 308)	63 (7 t	o 128)	
35 36 Race/Ethnicity	response	653 (327	to 1120)	164 (29	to 357)	243 (142	to 385)	97 (41	to 169)	
³⁷ Hispanic ₃₈ White 39	consumer behavior +industry	27 (-34 to 138) 64	102 (-61 to 375) 207	-14 (-50 to 50) -1	-4 (-96 to 139) 29	24 (3 to 67) 36	96 (25 to 204) 125	20 (1 to 52) 28	23 (-23 to 83) 39	
40 41 42	response	(-22 to 204)	(0 to 544)	(-38 to 74)	(-60 to 199)	(9 to 87)	(52 to 246)	(8 to 65)	(-5 to 111)	
43 44				v http://bmicnon	hmi.com/sito/about	(quidalinas yhtml			17	

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Non-	consumer	39	22	14	27	19	11	4	10	
¹ Hispanic Black	behavior	(-9 to 135)	(-63 to 178)	(-1 to 43)	(-15 to 95)	(4 to 45)	(-22 to 60)	(-4 to 17)	(2 to 22)	
2	+industry	66	65	22	38	24	18	6	13	
3	response	(1 to 183)	(-30 to 242)	(4 to 55)	(-3 to 113)	(9 to 54)	(-13 to 71)	(-1 to 20)	(5 to 26)	
4 ₅ Hispanic	consumer	26	111	7	25	2	15	2		
5	behavior	(0 to 79)	(12 to 277)	(-5 to 24)	(-3 to 68)	(-4 to 11)	(3 to 32)	(-1 to 7)	(-5 to 7)	
6	+industry	43 (6 to 110)	154 (50 to 340)	10 (0 to 30)	33 (6 to 82)	4 (-2 to 15)	19 (8 to 39)	3 (0 to 9)	(-3 to 9)	
/	response consumer	0	(50 10 540)	(0 10 30)	0 10 82)	(-2 (0 15)	(8 10 39)	-0	(-3 10 9)	
8 Other	behavior	(-7 to 11)	(-11 to 41)	(3 to 12)	(-10 to 12)	(1 to 4)	(1 to 9)	(-1 to 1)	(-3 to 6)	
9 10	+industry	2	16	8	1	2	5	0	1	
10	response	(-4 to 16)	(-3 to 53)	(4 to 13)	(-8 to 15)	(0 to 5)	(2 to 11)	(-1 to 1)	(-2 to 6)	
12		Ϋ́Υ,			· · · ·	· · · ·	, , , , , , , , , , , , , , , , , , ,	(, ,	, , , , , , , , , , , , , , , , , , ,	
13 Stomach 14 (Gastric 15 Cardia)										
	consumer									
16 Age 17	behavior	338 (49	to 803)	58 (-99	to 264)	182 (70	to 347)	54 (-19 to 149)		
18	+industry									
10	response	607 (241	to 1140)	141 (-20	0 to 378)	240 (129	9 to 420)	86 (15	to 190)	
²⁰ Non- ²¹ Hispanic	consumer	18	200	0	24	15	145	14	34	
²² White	behavior	(-19 to 77)	208 (-55 to 648)	-9 (-31 to 25)	(-128 to 233)	15 (4 to 37)	(35 to 304)	(3 to 28)	(-36 to 124)	
23	+industry	43	380	-1	(-120 to 233) 86	22	187	18	58	
24	response	(-6 to 117)	(51 to 886)	(-24 to 38)	(-67 to 322)	(9 to 47)	(77 to 364)	(8 to 35)	(-9 to 160)	
25 Non-	consumer	7	6	2	7	3	3	0	3	
26 Hispanic Black	behavior	(-2 to 21)	(-19 to 44)	(0 to 6)	(-5 to 24)	(1 to 7)	(-6 to 15)	(0 to 2)	(1 to 5)	
27	+industry	`12 ´	` 19 ´	`3 ´	` 10	<u> </u>	5	`1 ´	`3 ´	
28	response	(2 to 28)	(-8 to 62)	(1 to 7)	(-2 to 29)	(2 to 8)	(-4 to 17)	(0 to 2)	(2 to 6)	
²⁹ Hispanic	consumer	15	63	5	16	1	7	1	1	
30	behavior	(1 to 39)	(-7 to 170)	(0 to 13)	(-4 to 45)	(-2 to 5)	(0 to 18)	(0 to 3)	(-3 to 5)	
31	+industry	24	95	7	22	2		1	2	
32	response	(6 to 52)	(21 to 214)	(2 to 16)	(3 to 54)	(-1 to 6)	(3 to 23)	(0 to 3)	(-2 to 7)	
³³ Other	consumer behavior	-1 (-7 to 10)	5 (-14 to 34)	5 (2 to 9)	0 (-8 to 12)	(0 to 3)	4 (1 to 9)	0 (-1 to 1)	1 (-3 to 6)	
34	+industry	2	(-14 to 34) 12	(2 (0 9)	(-0 (0 12)	(0 10 3)	(1109)	0	(-3100)	
35	response	(-5 to 14)	(-7 to 46)	(3 to 10)	(-6 to 15)	(0 to 4)	(2 to 10)	(-1 to 1)	(-2 to 7)	
36	100001100		(11010)				(2.10.10)	(1101)	(201)	
³⁷ Gallbladder										
	consumer									
39 Age 40	behavior	161 (67	to 263)	51 (8 1	to 100)	76 (47	to 109)	29 (11	to 51)	
40	+industry									
42	response	282 (181	to 396)	86 (43	to 138)	101 (73	to 137)	44 (25	to 66)	
43									18	
44										
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Race/Ethnicity Non- Hispanic White Non- Hispanic Black Hispanic Black Hispanic Hispanic Hispanic	consumer behavior +industry response consumer behavior +industry response consumer behavior +industry response consumer	$\begin{array}{c} 24 \\ (-10 \text{ to } 71) \\ 47 \\ (10 \text{ to } 99) \\ 27 \\ (-6 \text{ to } 70) \\ 45 \\ (11 \text{ to } 93) \\ 32 \\ (2 \text{ to } 73) \\ 53 \\ (19 \text{ to } 96) \\ 0 \end{array}$	$ \begin{array}{c} 19\\ (-13 \text{ to } 61)\\ 39\\ (5 \text{ to } 88)\\ 2\\ (-17 \text{ to } 26)\\ 11\\ (-8 \text{ to } 38)\\ 42\\ (-10 \text{ to } 106)\\ 65\\ (11 \text{ to } 130)\\ 3\\ \end{array} $	$\begin{array}{c} 0\\ (-25 \text{ to } 30)\\ 9\\ (-16 \text{ to } 42)\\ 11\\ (0 \text{ to } 24)\\ 15\\ (4 \text{ to } 29)\\ 10\\ (-4 \text{ to } 26)\\ 15\\ (1 \text{ to } 31)\\ 6\end{array}$	1.97 (-17 to 24) 9 (-10 to 34) 6 (-4 to 18) 9 (-1 to 21) 14 (-2 to 34) 19 (3 to 39) 0	$ \begin{array}{r} 19\\ (5 \text{ to } 38)\\ 27\\ (12 \text{ to } 48)\\ 14\\ (4 \text{ to } 26)\\ 17\\ (8 \text{ to } 30)\\ 3\\ (-5 \text{ to } 11)\\ 5\\ (-2 \text{ to } 14)\\ 3\\ \end{array} $	23 (6 to 42) 29 (13 to 50) 4 (-4 to 12) 5 (-2 to 14) 7 (1 to 15) 9 (3 to 18) 3	$ \begin{array}{r} 16\\(3 \text{ to } 31)\\21\\(8 \text{ to } 37)\\2\\(-2 \text{ to } 7)\\4\\(-1 \text{ to } 9)\\3\\(-1 \text{ to } 7)\\4\\(1 \text{ to } 9)\\0\end{array} $	$\begin{array}{c} 6\\ (-5 \text{ to } 17)\\ 9\\ (-1 \text{ to } 21)\\ 2\\ (0 \text{ to } 4)\\ 3\\ (1 \text{ to } 5)\\ 0\\ (-3 \text{ to } 4)\\ 1\\ (-2 \text{ to } 5)\\ 1\end{array}$
14 Other 15 16 17	behavior +industry response	(-11 to 18) 5 (-7 to 24)	(-6 to 15) 7 (-2 to 19)	(1 to 13) 7 (2 to 14)	(-4 to 5) 1 (-3 to 6)	(0 to 7) 4 (1 to 8)	(1 to 5) 3 (1 to 5)	(-1 to 1) 0 (-1 to 2)	(-1 to 3) 1 (-1 to 3)
¹⁸ Advanced ¹⁹ Prostate ₂₀ ₂₁ Age	consumer		C	er r					
217.90	behavior Lindustry	163 (9 t	o 360)	37 (-54	to 146)	106 (33	to 194)	35 (-14	4 to 91)
23	+industry response	300 (130	to 507)	85 (-6 1	to 203)	142 (67	to 240)	56 (91	to 119)
²⁴ Race/Ethnicity	response				.0 200,	1.12 (0)			
25 Non-	consumer								
26 Hispanic	behavior		86		-1		75		24
27 White		0	(-24 to 267)	0	(-80 to 98)	0	(9 to 162)	0	(-23 to 80)
28	+industry	0	162	0	30	0	100	0	40
29	response	•	(32 to 350)	•	(-48 to 144)		(36 to 199)	2	(-5 to 102)
30 Non-	consumer	0	3	0	21	0	16	0	8
31 Hispanic Black	behavior Lindustry	0	(-61 to 97)	0	(-17 to 69)		(-13 to 51)	0	(2 to 17)
32	+industry	0	34 (-33 to 145)	0	31 (-5 to 83)	0	22 (-7 to 57)	0	11 (4 to 20)
33	response consumer	0	(-33 to 143) 59	0	13	0	(-7 (0 57)	0	(4 10 20)
³⁴ Hispanic	behavior	0	(8 to 133)	0	(-3 to 37)	0	(2 to 20)	0	(-3 to 5)
35	+industry	0	82	0	18	0	12	0	2
36	response	Ū	(28 to 163)	Ũ	(1 to 44)	Ū	(5 to 23)	U U	(-2 to 7)
37	consumer	0	3	0	0	0	4	0	1
38 Other	behavior		(-10 to 21)		(-7 to 8)		(2 to 8)		(-3 to 5)
39	+industry	0	` 8 ́	0	`1 ´	0	`5´´	0	`2 ´
40	response		(-5 to 28)		(-5 to 9)		(3 to 9)		(-2 to 6)
41 42									
43									19
44									15
••			E						

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Ovarian 1 2 3 4 5 6	consumer behavior +industry response	66 (-10 to 129 (16 to		16 (-20 to 33 (-6 to		31 (11 to 45 (17 to		28 (11 to 37 (19 to	
7 Hispanic 8 White	consumer behavior	34 (-25 to 147)	0	-4 (-38 to 54)	0	20 (2 to 55)	0	25 (8 to 57)	0
9 10	+industry response	71 (-23 to 220)	0	7 (-30 to 72)	0	30 (6 to 71)	0	32 (15 to 70)	0
₁₁ Non- ₁₂ Hispanic Black	consumer behavior	11 (-5 to 41)	0	4 (0 to 13)	0	6 (3 to 13)	0	1 (-1 to 5)	0
13 14	+industry response	19 (-3 to 56)	0	6 (0 to 17)	0	8 (4 to 16)	0	2 (0 to 6)	0
15 Hispanic 16	consumer behavior	21 (-2 to 67)	0	8 (-1 to 21)	0	1 (-3 to 8) 3	0	1 (-1 to 5) 2	0
17 18	+industry response consumer	34 (1 to 91) -8	0	11 (3 to 26) 6	0	3 (-1 to 10) 2	0	2 (0 to 6) 0	0
19 Other 20	behavior +industry	-8 (-19 to 13) -3	0	(2 to 13)	0	(1 to 5) 3	0	(-1 to 1) 0	0
21 22 1. Values are th	response	(-15 to 21) es (95% uncertainty interva	0 als) of each distrib	(3 to 14)	0	(1 to 6)	0	(-1 to 2)	0
23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41									
42 43 44 45 46 47		Fc	or peer review o	nly - http://bmjopen.br	nj.com/site/ab	oout/guidelines.xhtml			20

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Supplementary Table 11. Estimated cancer deaths reduced by the federal menu calorie labeling in the US by age, sex, race/ethnicity,

	Policy	20-4	44 y	45	-54 y	55-6	4 у	65	+ y
Cancer Type	Scenario	Female	Male	Female	Male	Female	Male	Female	Ma
Breast (Postmenopa usal)									
Age	consumer behavior	2490 (260) to 4980)	151 (-2	04 to 521)	285 (129	to 479)	126 (30	0 to 227)
	+industry response	4610 (229	0 to 7240)	336 (-2	26 to 725)	396 (237	to 598)	178 (82	2 to 284)
Race/Ethnicity									
Non- Hispanic White	consumer behavior	1350 (-652 to 3690)	0	-55 (-373 to 278)	0	165 (33 to 327)	0	103 (10 to 204)	0
Winto	+industry response	2620 (480 to 5150)	0	54 (-264 to 419)	0	238 (105 to 401)	0	139 (47 to 244)	0
Non- Hispanic Black	consumer behavior	560 (-109 to 1280)	0	85 (-11 to 200)	0	95 (32 to 173)	0	13 (-12 to 40)	0
	+industry response	901 (238 to 1660)	0	126 (26 to 247)	0	117 (53 to 196)	0	21 (-4 to 49)	0
Hispanic	consumer behavior	572 (45 to 1180)	0	76 (-7 to 163)	0	9 (-21 to 44)	0	10 (-3 to 24)	C
	+industry response	922 (364 to 1570) 0	0	104 (21 to 193) 39	0	21 (-9 to 57) 15	0	15 (2 to 30) -1	0
Other	consumer behavior +industry	(-306 to 378) 125	0	(9 to 76) 45	0	(2 to 31) 19	0	(-6 to 3)	0
	response	(-185 to 532)	0	(16 to 84)	0	(6 to 35)	0	(-5 to 5)	0
Liver	consumer								
Age	behavior +industry		7 to 4890)		31 to 1570)	852 (411		·	8 to 455)
Race/Ethnicity	response	4900 (276	0 to 7190)	1200 (34	45 to 2210)	1140 (689	to 1650)	357 (14	6 to 587
Non- Hispanic White	consumer behavior	139 (-108 to 504)	1040 (-237 to 2780)	15 (-147 to 207)	-70 (-749 to 722)	98 (31 to 196)	440 (93 to 858)	63 (6 to 130)	97 (-88 to
	+industry response	310 (42 to 719)	1900 (449 to 3830)	67 (-93 to 276)	199 (-478 to 1040)	137 (67 to 240)	565 (241 to 1020)	85 (30 to 159)	16 (-18 to
							·/		

1 2 3 4 5 6 7	Non- Hispanic Black Hispanic	consumer behavior +industry response consumer behavior +industry response	134 (-25 to 317) 214 (51 to 425) 199 (17 to 473) 316 (111 to 623)	72 (-601 to 932) 382 (-273 to 1280) 1020 (88 to 2210) 1430 (482 to 2690)	49 (3 to 110) 68 (23 to 133) 87 (2 to 189) 116 (31 to 223)	193 (-133 to 632) 276 (-37 to 729) 285 (13 to 630) 365 (94 to 729)	43 (12 to 85) 54 (24 to 97) 12 (-26 to 62) 26 (-11 to 78)	100 (-95 to 336) 139 (-49 to 377) 99 (18 to 201) 131 (48 to 242)	6 (-6 to 22) 10 (-2 to 27) 15 (-4 to 35) 21 (3 to 43)	29 (-4 to 69) 41 (8 to 83) 6 (-28 to 46) 17 (-15 to 59)
8 9 10 11	Other	consumer behavior +industry response	2 (-47 to 68) 22 (-28 to 93)	90 (-110 to 339) 168 (-26 to 434)	32 (7 to 65) 36 (13 to 71)	-2 (-88 to 108) 15 (-70 to 130)	12 (0 to 28) 16 (4 to 32)	30 (4 to 61) 39 (14 to 74)	0 (-6 to 6) 1 (-4 to 8)	7 (-22 to 42) 11 (-18 to 46)
12 13	Endometrial									
14 15	Age	consumer behavior	1190 (30	9 to 2140)	251 (-24	48 to 785)	394 (177	to 659)	213 (51	to 378)
16		+industry response	2100 (120	00 to 3110)	512 (26	to 1060)	548 (325	to 817)	302 (13	9 to 472)
17 18 19 20	Race/Ethnicity Non- Hispanic White	consumer behavior	440 (-210 to 1170)	0	-42 (-511 to 440)	0	206 (36 to 399)	0	173 (13 to 319)	0
21 22		+industry response	858 (218 to 1620)	0	114 (-351 to 606)	0	298 (127 to 491)	0	234 (76 to 388)	0
23 24 25	Non- Hispanic Black	consumer behavior	412 (-90 to 937) 666	0	139 (-9 to 293) 201	0	157 (42 to 295) 195	0	26 (-24 to 83) 42	0
26 27		+industry response	(177 to 1210)	0	(51 to 361)	0	/ (81 to 338)	0	(-8 to 97)	0
28	Hispanic	consumer behavior	315 (22 to 645) 505	0	105 (-22 to 222) 144	0	16 (-33 to 70) 34	0	19 (-7 to 44) 28	0
29 30		+industry response consumer	(197 to 854) 8	0	(21 to 261) 51	0	(-14 to 89) 17	0	(3 to 54) -3	0
31 32	Other	behavior +industry	(-99 to 139) 50	0	(13 to 99) 58	0	(1 to 36) 22	0	-3 (-10 to 5) 0	0
33 34		response	(-56 to 187)	0	(21 to 107)	0	(6 to 41)	0	(-8 to 7)	0
35 36 37	Kidney (Renal Cell)									
38 39	Age	consumer behavior	1050 (28	4 to 1830)	263 (-15	53 to 695)	506 (225	to 778)	182 (20) to 338)
40 41		+industry response	1880 (110	00 to 2680)	539 (10	6 to 977)	679 (402	to 954)	276 (11	2 to 429)
42 43 44 45	Race/Ethnicity		F	or peer review only	/ - http://bmiopen	.bmj.com/site/abou	ıt/quidelines.xhtml			22
45 46										

1 2	Non- Hispanic White	consumer behavior	57 (-23 to 159)	332 (-183 to 922)	-16 (-128 to 106)	26 (-351 to 396)	72 (14 to 138)	287 (42 to 525)	66 (9 to 124)	81 (-68 to 219)
2	White	+industry	111	663	22	168	105	378	89	133
4		response	(27 to 224)	(123 to 1280)	(-90 to 146)	(-199 to 552)	(46 to 171)	(138 to 623)	(33 to 148)	(-12 to 272)
5	Non-	consumer	67	48	24	59	30	35	(00 10 140)	16
6	Hispanic Black	behavior	(-16 to 162)	(-225 to 326)	(-2 to 53)	(-40 to 171)	(10 to 56)	(-32 to 106)	(-5 to 16)	(3 to 28)
7		+industry	113	174	34	87	37	49	8	20
8		response	(25 to 218)	(-96 to 461)	(9 to 64)	(-14 to 199)	(17 to 63)	(-17 to 121)	(-2 to 20)	(7 to 33)
9	Hispania	consumer	`	367	30	<u></u> 118	6	`	7	4
10	Hispanic	behavior	(9 to 229)	(0 to 792)	(-3 to 62)	(-15 to 261)	(-13 to 29)	(5 to 98)	(-2 to 17)	(-12 to 23)
11		+industry	177	522	40	157	13	64	11	9
12		response	(67 to 305)	(168 to 968)	(8 to 74)	(23 to 303)	(-5 to 36)	(22 to 116)	(1 to 21)	(-7 to 28)
13	Other	consumer	3	33	15	0	5	16	-1	4
14	Othor	behavior	(-23 to 34)	(-40 to 122)	(5 to 28)	(-28 to 33)	(1 to 11)	(5 to 29)	(-3 to 2)	(-8 to 17)
15		+industry	13	63	17	6	6	20	0	5
16		response	(-12 to 45)	(-10 to 156)	(7 to 30)	(-22 to 39)	(2 to 12)	(9 to 33)	(-2 to 3)	(-6 to 18)
17	Demonsoria									
18	Pancreatic									
19	Age	consumer behavior	656 (220) to 1160)	74 (-16	6 to 350)	362 (175	to 581)	131 (2	0 to 250)
20		+industry			- h					
21		response	1160 (70	7 to 1730)	243 (1	to 535)	483 (293	to 708)	199 (8	7 to 321)
~~	Deee/Ethnicity									
22	Race/Ethnicity									
23	Non-	00000000	101	010	4.4	12	70	102	FC	FO
23 24		consumer	101 (40 to 310)	213 (100 to 659)	-44 (142 to 78)	-13 (216 to 221)	79 (24 to 158)	193 (44 to 384)	56 (3 to 117)	50 (45 to 162)
23 24 25	Non-	consumer behavior	(-40 to 310)	(-100 to 659)	(-143 to 78)	(-216 to 221)	79 (24 to 158)	(44 to 384)	(3 to 117)	50 (-45 to 162)
23 24 25 26	Non- Hispanic	behavior +industry	(-40 to 310) 196	(-100 to 659) 420	(-143 to 78) -10	(-216 to 221) 67	(24 to 158) 111	(44 to 384) 250	(3 to 117) 78	(-45 to 162) 84
23 24 25 26 27	Non- Hispanic White	behavior +industry response	(-40 to 310) 196 (42 to 425)	(-100 to 659) 420 (85 to 911)	(-143 to 78) -10 (-111 to 120)	(-216 to 221) 67 (-140 to 326)	(24 to 158) 111 (51 to 198)	(44 to 384) 250 (102 to 448)	(3 to 117) 78 (25 to 146)	(-45 to 162) 84 (-10 to 203)
23 24 25 26 27 28	Non- Hispanic White Non-	behavior +industry response consumer	(-40 to 310) 196 (42 to 425) 48	(-100 to 659) 420 (85 to 911) 16	(-143 to 78) -10 (-111 to 120) 22	(-216 to 221) 67 (-140 to 326) 27	(24 to 158) 111 (51 to 198) 29	(44 to 384) 250 (102 to 448) 18	(3 to 117) 78 (25 to 146) 5	(-45 to 162) 84 (-10 to 203) 9
23 24 25 26 27 28 29	Non- Hispanic White	behavior +industry response consumer behavior	(-40 to 310) 196 (42 to 425) 48 (-7 to 125)	(-100 to 659) 420 (85 to 911) 16 (-72 to 117)	(-143 to 78) -10 (-111 to 120) 22 (-1 to 49)	(-216 to 221) 67 (-140 to 326) 27 (-18 to 78)	(24 to 158) 111 (51 to 198) 29 (8 to 57)	(44 to 384) 250 (102 to 448) 18 (-15 to 56)	(3 to 117) 78 (25 to 146) 5 (-5 to 17)	(-45 to 162) 84 (-10 to 203) 9 (1 to 17)
23 24 25 26 27 28 29 30	Non- Hispanic White Non-	behavior +industry response consumer behavior +industry	(-40 to 310) 196 (42 to 425) 48 (-7 to 125) 78	(-100 to 659) 420 (85 to 911) 16 (-72 to 117) 57	(-143 to 78) -10 (-111 to 120) 22 (-1 to 49) 31	(-216 to 221) 67 (-140 to 326) 27 (-18 to 78) 39	(24 to 158) 111 (51 to 198) 29 (8 to 57) 36	(44 to 384) 250 (102 to 448) 18 (-15 to 56) 24	(3 to 117) 78 (25 to 146) 5 (-5 to 17) 8	(-45 to 162) 84 (-10 to 203) 9 (1 to 17) 12
23 24 25 26 27 28 29 30 31	Non- Hispanic White Non-	behavior +industry response consumer behavior +industry response	(-40 to 310) 196 (42 to 425) 48 (-7 to 125) 78 (18 to 162)	(-100 to 659) 420 (85 to 911) 16 (-72 to 117) 57 (-33 to 164)	(-143 to 78) -10 (-111 to 120) 22 (-1 to 49) 31 (9 to 62)	(-216 to 221) 67 (-140 to 326) 27 (-18 to 78) 39 (-3 to 91)	(24 to 158) 111 (51 to 198) 29 (8 to 57)	(44 to 384) 250 (102 to 448) 18 (-15 to 56) 24 (-8 to 63)	(3 to 117) 78 (25 to 146) 5 (-5 to 17) 8 (-1 to 20)	(-45 to 162) 84 (-10 to 203) 9 (1 to 17)
23 24 25 26 27 28 29 30 31 32	Non- Hispanic White Non-	behavior +industry response consumer behavior +industry response consumer	(-40 to 310) 196 (42 to 425) 48 (-7 to 125) 78 (18 to 162) 55	(-100 to 659) 420 (85 to 911) 16 (-72 to 117) 57 (-33 to 164) 175	(-143 to 78) -10 (-111 to 120) 22 (-1 to 49) 31 (9 to 62) 24	(-216 to 221) 67 (-140 to 326) 27 (-18 to 78) 39 (-3 to 91) 42	(24 to 158) 111 (51 to 198) 29 (8 to 57) 36 (15 to 65) 4	(44 to 384) 250 (102 to 448) 18 (-15 to 56) 24 (-8 to 63) 16	(3 to 117) 78 (25 to 146) 5 (-5 to 17) 8 (-1 to 20) 5	(-45 to 162) 84 (-10 to 203) 9 (1 to 17) 12 (4 to 19) 1
23 24 25 26 27 28 29 30 31 32 33	Non- Hispanic White Non- Hispanic Black	behavior +industry response consumer behavior +industry response consumer behavior	(-40 to 310) 196 (42 to 425) 48 (-7 to 125) 78 (18 to 162) 55 (5 to 118)	(-100 to 659) 420 (85 to 911) 16 (-72 to 117) 57 (-33 to 164) 175 (13 to 374)	(-143 to 78) -10 (-111 to 120) 22 (-1 to 49) 31 (9 to 62) 24 (-4 to 53)	(-216 to 221) 67 (-140 to 326) 27 (-18 to 78) 39 (-3 to 91) 42 (-5 to 97)	(24 to 158) 111 (51 to 198) 29 (8 to 57) 36 (15 to 65) 4 (-10 to 20)	(44 to 384) 250 (102 to 448) 18 (-15 to 56) 24 (-8 to 63) 16 (-2 to 40)	(3 to 117) 78 (25 to 146) 5 (-5 to 17) 8 (-1 to 20) 5 (-2 to 13)	(-45 to 162) 84 (-10 to 203) 9 (1 to 17) 12 (4 to 19) 1 (-7 to 10)
23 24 25 26 27 28 29 30 31 32 33 34	Non- Hispanic White Non- Hispanic Black	behavior +industry response consumer behavior +industry response consumer behavior +industry	(-40 to 310) 196 (42 to 425) 48 (-7 to 125) 78 (18 to 162) 55 (5 to 118) 88	(-100 to 659) 420 (85 to 911) 16 (-72 to 117) 57 (-33 to 164) 175 (13 to 374) 245	$\begin{array}{c} (-143 \text{ to } 78) \\ -10 \\ (-111 \text{ to } 120) \\ 22 \\ (-1 \text{ to } 49) \\ 31 \\ (9 \text{ to } 62) \\ 24 \\ (-4 \text{ to } 53) \\ 32 \end{array}$	(-216 to 221) 67 (-140 to 326) 27 (-18 to 78) 39 (-3 to 91) 42 (-5 to 97) 57	(24 to 158) 111 $(51 to 198)$ 29 $(8 to 57)$ 36 $(15 to 65)$ 4 $(-10 to 20)$ 9	(44 to 384) 250 (102 to 448) 18 (-15 to 56) 24 (-8 to 63) 16 (-2 to 40) 23	(3 to 117) 78 (25 to 146) 5 (-5 to 17) 8 (-1 to 20) 5 (-2 to 13) 8	(-45 to 162) 84 (-10 to 203) 9 (1 to 17) 12 (4 to 19) 1 (-7 to 10) 4
23 24 25 26 27 28 29 30 31 32 33 34 35	Non- Hispanic White Non- Hispanic Black Hispanic	behavior +industry response consumer behavior +industry response consumer behavior +industry response	(-40 to 310) 196 (42 to 425) 48 (-7 to 125) 78 (18 to 162) 55 (5 to 118) 88 (33 to 158)	$\begin{array}{c} (-100 \text{ to } 659) \\ 420 \\ (85 \text{ to } 911) \\ 16 \\ (-72 \text{ to } 117) \\ 57 \\ (-33 \text{ to } 164) \\ 175 \\ (13 \text{ to } 374) \\ 245 \\ (83 \text{ to } 462) \end{array}$	$\begin{array}{c} (-143 \text{ to } 78) \\ -10 \\ (-111 \text{ to } 120) \\ 22 \\ (-1 \text{ to } 49) \\ 31 \\ (9 \text{ to } 62) \\ 24 \\ (-4 \text{ to } 53) \\ 32 \\ (6 \text{ to } 63) \end{array}$	(-216 to 221) 67 $(-140 to 326)$ 27 $(-18 to 78)$ 39 $(-3 to 91)$ 42 $(-5 to 97)$ 57 $(10 to 113)$	(24 to 158) 111 $(51 to 198)$ 29 $(8 to 57)$ 36 $(15 to 65)$ 4 $(-10 to 20)$ 9 $(-5 to 25)$	(44 to 384) 250 (102 to 448) 18 (-15 to 56) 24 (-8 to 63) 16 (-2 to 40) 23 (5 to 48)	(3 to 117) 78 (25 to 146) 5 (-5 to 17) 8 (-1 to 20) 5 (-2 to 13) 8 (1 to 16)	(-45 to 162) 84 (-10 to 203) 9 (1 to 17) 12 (4 to 19) 1 (-7 to 10) 4 (-4 to 13)
23 24 25 26 27 28 29 30 31 32 33 34 35 36	Non- Hispanic White Non- Hispanic Black	behavior +industry response consumer behavior +industry response consumer behavior +industry response consumer	(-40 to 310) 196 (42 to 425) 48 (-7 to 125) 78 (18 to 162) 55 (5 to 118) 88 (33 to 158) -2	$\begin{array}{c} (-100 \text{ to } 659) \\ 420 \\ (85 \text{ to } 911) \\ 16 \\ (-72 \text{ to } 117) \\ 57 \\ (-33 \text{ to } 164) \\ 175 \\ (13 \text{ to } 374) \\ 245 \\ (83 \text{ to } 462) \\ 16 \end{array}$	$\begin{array}{c} (-143 \text{ to } 78) \\ -10 \\ (-111 \text{ to } 120) \\ 22 \\ (-1 \text{ to } 49) \\ 31 \\ (9 \text{ to } 62) \\ 24 \\ (-4 \text{ to } 53) \\ 32 \\ (6 \text{ to } 63) \\ 14 \end{array}$	(-216 to 221) 67 $(-140 to 326)$ 27 $(-18 to 78)$ 39 $(-3 to 91)$ 42 $(-5 to 97)$ 57 $(10 to 113)$ 0	(24 to 158) 111 $(51 to 198)$ 29 $(8 to 57)$ 36 $(15 to 65)$ 4 $(-10 to 20)$ 9 $(-5 to 25)$ 7	(44 to 384) 250 (102 to 448) 18 (-15 to 56) 24 (-8 to 63) 16 (-2 to 40) 23 (5 to 48) 9	(3 to 117) 78 $(25 to 146)$ 5 $(-5 to 17)$ 8 $(-1 to 20)$ 5 $(-2 to 13)$ 8 $(1 to 16)$ 0	(-45 to 162) 84 (-10 to 203) 9 (1 to 17) 12 (4 to 19) 1 (-7 to 10) 4 (-4 to 13) 2
23 24 25 26 27 28 29 30 31 32 33 34 35 36 37	Non- Hispanic White Non- Hispanic Black Hispanic	behavior +industry response consumer behavior +industry response consumer behavior +industry response consumer behavior	(-40 to 310) 196 (42 to 425) 48 (-7 to 125) 78 (18 to 162) 55 (5 to 118) 88 (33 to 158)	$\begin{array}{c} (-100 \text{ to } 659) \\ 420 \\ (85 \text{ to } 911) \\ 16 \\ (-72 \text{ to } 117) \\ 57 \\ (-33 \text{ to } 164) \\ 175 \\ (13 \text{ to } 374) \\ 245 \\ (83 \text{ to } 462) \\ 16 \\ (-23 \text{ to } 63) \end{array}$	$\begin{array}{c} (-143 \text{ to } 78) \\ -10 \\ (-111 \text{ to } 120) \\ 22 \\ (-1 \text{ to } 49) \\ 31 \\ (9 \text{ to } 62) \\ 24 \\ (-4 \text{ to } 53) \\ 32 \\ (6 \text{ to } 63) \\ 14 \\ (3 \text{ to } 27) \end{array}$	$\begin{array}{c} (-216 \text{ to } 221) \\ 67 \\ (-140 \text{ to } 326) \\ 27 \\ (-18 \text{ to } 78) \\ 39 \\ (-3 \text{ to } 91) \\ 42 \\ (-5 \text{ to } 97) \\ 57 \\ (10 \text{ to } 113) \\ 0 \\ (-18 \text{ to } 20) \end{array}$	(24 to 158) 111 $(51 to 198)$ 29 $(8 to 57)$ 36 $(15 to 65)$ 4 $(-10 to 20)$ 9 $(-5 to 25)$	(44 to 384) 250 (102 to 448) 18 (-15 to 56) 24 (-8 to 63) 16 (-2 to 40) 23 (5 to 48)	(3 to 117) 78 (25 to 146) 5 (-5 to 17) 8 (-1 to 20) 5 (-2 to 13) 8 (1 to 16)	(-45 to 162) 84 (-10 to 203) 9 (1 to 17) 12 (4 to 19) 1 (-7 to 10) 4 (-4 to 13) 2 (-5 to 11)
23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38	Non- Hispanic White Non- Hispanic Black Hispanic	behavior +industry response consumer behavior +industry response consumer behavior +industry response consumer behavior +industry	(-40 to 310) 196 $(42 to 425)$ 48 $(-7 to 125)$ 78 $(18 to 162)$ 55 $(5 to 118)$ 88 $(33 to 158)$ -2 $(-23 to 25)$ 7	$\begin{array}{c} (-100 \text{ to } 659) \\ 420 \\ (85 \text{ to } 911) \\ 16 \\ (-72 \text{ to } 117) \\ 57 \\ (-33 \text{ to } 164) \\ 175 \\ (13 \text{ to } 374) \\ 245 \\ (83 \text{ to } 462) \\ 16 \\ (-23 \text{ to } 63) \\ 32 \end{array}$	$\begin{array}{c} (-143 \text{ to } 78) \\ -10 \\ (-111 \text{ to } 120) \\ 22 \\ (-1 \text{ to } 49) \\ 31 \\ (9 \text{ to } 62) \\ 24 \\ (-4 \text{ to } 53) \\ 32 \\ (6 \text{ to } 63) \\ 14 \\ (3 \text{ to } 27) \\ 16 \end{array}$	(-216 to 221) 67 $(-140 to 326)$ 27 $(-18 to 78)$ 39 $(-3 to 91)$ 42 $(-5 to 97)$ 57 $(10 to 113)$ 0 $(-18 to 20)$ 3	(24 to 158) 111 $(51 to 198)$ 29 $(8 to 57)$ 36 $(15 to 65)$ 4 $(-10 to 20)$ 9 $(-5 to 25)$ 7 $(1 to 14)$ 9	(44 to 384) 250 (102 to 448) 18 (-15 to 56) 24 (-8 to 63) 16 (-2 to 40) 23 (5 to 48) 9 (3 to 17) 11	(3 to 117) 78 $(25 to 146)$ 5 $(-5 to 17)$ 8 $(-1 to 20)$ 5 $(-2 to 13)$ 8 $(1 to 16)$ 0 $(-3 to 3)$ 1	(-45 to 162) 84 $(-10 to 203)$ 9 $(1 to 17)$ 12 $(4 to 19)$ 1 $(-7 to 10)$ 4 $(-4 to 13)$ 2 $(-5 to 11)$ 3
23 24 25 26 27 28 29 30 31 32 33 34 35 36 37	Non- Hispanic White Non- Hispanic Black Hispanic	behavior +industry response consumer behavior +industry response consumer behavior +industry response consumer behavior	(-40 to 310) 196 (42 to 425) 48 (-7 to 125) 78 (18 to 162) 55 (5 to 118) 88 (33 to 158) -2 (-23 to 25)	$\begin{array}{c} (-100 \text{ to } 659) \\ 420 \\ (85 \text{ to } 911) \\ 16 \\ (-72 \text{ to } 117) \\ 57 \\ (-33 \text{ to } 164) \\ 175 \\ (13 \text{ to } 374) \\ 245 \\ (83 \text{ to } 462) \\ 16 \\ (-23 \text{ to } 63) \end{array}$	$\begin{array}{c} (-143 \text{ to } 78) \\ -10 \\ (-111 \text{ to } 120) \\ 22 \\ (-1 \text{ to } 49) \\ 31 \\ (9 \text{ to } 62) \\ 24 \\ (-4 \text{ to } 53) \\ 32 \\ (6 \text{ to } 63) \\ 14 \\ (3 \text{ to } 27) \end{array}$	$\begin{array}{c} (-216 \text{ to } 221) \\ 67 \\ (-140 \text{ to } 326) \\ 27 \\ (-18 \text{ to } 78) \\ 39 \\ (-3 \text{ to } 91) \\ 42 \\ (-5 \text{ to } 97) \\ 57 \\ (10 \text{ to } 113) \\ 0 \\ (-18 \text{ to } 20) \end{array}$	(24 to 158) 111 $(51 to 198)$ 29 $(8 to 57)$ 36 $(15 to 65)$ 4 $(-10 to 20)$ 9 $(-5 to 25)$ 7 $(1 to 14)$	(44 to 384) 250 (102 to 448) 18 (-15 to 56) 24 (-8 to 63) 16 (-2 to 40) 23 (5 to 48) 9 (3 to 17)	(3 to 117) 78 $(25 to 146)$ 5 $(-5 to 17)$ 8 $(-1 to 20)$ 5 $(-2 to 13)$ 8 $(1 to 16)$ 0 $(-3 to 3)$	(-45 to 162) 84 $(-10 to 203)$ 9 $(1 to 17)$ 12 $(4 to 19)$ 1 $(-7 to 10)$ 4 $(-4 to 13)$ 2 $(-5 to 11)$

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1 2	Esophageal Adenocarcin oma									
3 4	Age	consumer behavior	631 (33	8 to 1320)	78 (-25	55 to 423)	348 (113	8 to 584)	101 (-4	2 to 239)
5 6		+industry response	1150 (52	20 to 1870)	246 (-9	96 to 601)	457 (225	5 to 699)	161 (1	9 to 302)
7	Race/Ethnicity Non-									
8 9	Hispanic White	consumer behavior	40 (-23 to 112)	366 (-206 to 1000)	-8 (-47 to 36)	24 (-314 to 359)	24 (6 to 47)	283 (55 to 516)	22 (4 to 41)	71 (-65 to 202)
10 11	Winte	+industry	81	732	5	152	35	366	28	119
12		response	(15 to 160)	(157 to 1400)	(-34 to 51)	(-176 to 495)	(16 to 59)	(142 to 602)	(11 to 48)	(-13 to 253)
13	Non-	consumer	9	9	3	10	4	6	1	3
14	Hispanic Black	behavior	(-1 to 20)	(-25 to 45)	(0 to 7)	(-6 to 28)	(1 to 8)	(-6 to 18)	(-1 to 2)	(0 to 5)
15		+industry	14 (3 to 26)	25 (-10 to 62)	4 (1 to 8)	14 (-2 to 33)	5 (2 to 9)	8 (-3 to 21)	(0 to 3)	4 (1 to 6)
16		response consumer	(3 10 20)	164	3	40	(2 10 9)	21	(0.10.3)	(1100)
17	Hispanic	behavior	(2 to 52)	(2 to 354)	(-1 to 13)	(-7 to 99)	(-3 to 7)	(3 to 42)	(-1 to 4)	(-6 to 10)
18		+industry	40	235	5	55	3	28	2	4
19		response	(15 to 68)	(70 to 425)	(0 to 16)	(6 to 114)	(-1 to 8)	(10 to 50)	(0 to 4)	(-4 to 12)
20	Other	consumer	-1	9	5	-1	2	6	0	1
21	Other	behavior	(-9 to 10)	(-14 to 35)	(1 to 9)	(-10 to 10)	(0 to 4)	(2 to 10)	(-1 to 1)	(-3 to 7)
22 23		+industry	3	18	6	1	2	7	0	2
25 24		response	(-6 to 14)	(-5 to 46)	(2 to 10)	(-8 to 12)	(1 to 5)	(3 to 11)	(-1 to 1)	(-3 to 7)
25	Colorectal									
26		consumer	400 (40	$(0, t_{\tau}, \overline{770})$		0.45 (10.4)	450 (77	+= 0.44)	co (4)) to (10)
27	Age	behavior	430 (13	89 to 779)	56 (-48	8 to 184)	150 (77	to 241)	63 (13	3 to 119)
28 29		+industry response	764 (45)	0 to 1160)	133 (2	3 to 268)	203 (126	5 to 304)	95 (46	6 to 153)
30	Race/Ethnicity	response								
31	Non-		10	110		4.0				22
32	Hispanic	consumer	49 (26 to 181)	119 (-75 to 391)	-21 (-65 to 40)	-10 (-89 to 97)	32 (7 to 67)	72 (11 to 150)	31 (6 to 63)	22
33	White	behavior	(-36 to 181)	((-65 (0 40)	. ,	. ,	(11 to 150)	(0 10 03)	(-17 to 64)
34		+industry	106	248	-6	24	46	96	41	35
35		response	(4 to 261)	(28 to 545)	(-49 to 59)	(-60 to 140)	(20 to 85)	(36 to 176)	(16 to 76)	(-3 to 81)
36	Non-	consumer	26	27 (20 to 40 4)	8	18	13	9	2	5
37	Hispanic Black	behavior	(-7 to 70)	(-36 to 104)	(0 to 21)	(-9 to 53)	(4 to 24)	(-10 to 31)	(-2 to 7) 3	(0 to 10)
38		+industry	44 (9 to 94)	58 (-7 to 145)	12 (4 to 26)	25.1 (-1 to 61)	15 (7 to 27)	13 (-6 to 36)	(-1 to 9)	6 (2 to 12)
39		response consumer	(9 10 94) 36	136	13	37	(11021)	13	(-1 10 3)	(2 10 12)
40	Hispanic	behavior	(2 to 88)	(21 to 300)	(0 to 27)	(5 to 74)	(-4 to 10)	(2 to 28)	(-1 to 7)	(-5 to 6)
41			()	()	(****=*)	()	(,	()	(,	()
42										~ -
43										24
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45			I	e. peer review only			, garacine sixinti			

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1 2 3 4 5	Other	+industry response consumer behavior +industry response	58 (17 to 120) -1 (-15 to 20) 5 (-9 to 27)	188 (65 to 366) 16 (-21 to 65) 30 (-5 to 83)	16 (5 to 32) 5 (-1 to 11) 6 (1 to 13)	45 (14 to 84) 0 (-12 to 15) 2 (-9 to 17)	4 (-2 to 13) 2 (0 to 6) 3 (1 to 7)	18 (6 to 33) 5 (1 to 9) 6 (2 to 11)	4 (0 to 8) 0 (-2 to 1) 0 (-1 to 2)	2 (-3 to 8) 1 (-3 to 6) 2 (-2 to 7)
6 7 8 9	Stomach (Gastric Cardia)									
10 11	Age	consumer behavior	286 (45	to 672)	50 (-84	to 224)	149 (58	to 282)	42 (-14	4 to 113)
12 13	Dece/Ethnicity	+industry response	513 (19	6 to 965)	120 (-1-	4 to 321)	196 (105	to 342)	67 (13	8 to 145)
14 15 16	Race/Ethnicity Non- Hispanic White	consumer behavior	14 (-16 to 63)	178 (-46 to 545)	-7 (-26 to 20)	21 (-109 to 194)	13 (4 to 30)	118 (29 to 248)	11 (3 to 22)	27 (-26 to 95)
17 18 19	Non-	+industry response consumer	34 (-5 to 95) 5	322 (43 to 766) 2	-1 (-19 to 30) 2	74 (-58 to 270) 6	18 (7 to 38) 2	152 (63 to 296) 3	14 (6 to 27) 0	45 (-6 to 121) 2
20 21 22	Hispanic Black	behavior +industry response	(-1 to 17) 9 (2 to 22)	(-11 to 29) 7 (-5 to 43)	(0 to 5) 2 (1 to 6)	(-5 to 22) 9 (-2 to 26)	(1 to 5) 3 (2 to 6)	(-5 to 13) 4 (-3 to 15)	(0 to 1) 1 (0 to 2)	(1 to 4) 3 (1 to 5)
23 24 25	Hispanic	consumer behavior +industry	13 (1 to 35) 22	57 (-6 to 154) 86	5 (0 to 12) 6	14 (-3 to 38) 19	1 (-1 to 4) 1	6 (0 to 15) 8	1 (0 to 2) 1	0 (-2 to 4) 1
26 27 28 20	Other	response consumer behavior	(5 to 47) -1 (-5 to 7) 1	(20 to 194) 4 (-9 to 25) 9	(2 to 14) 4 (2 to 8) 4	(3 to 46) 0 (-7 to 10) 2	(-1 to 5) 1 (0 to 3)	(2 to 19) 3 (1 to 7)	(0 to 3) 0 (-1 to 1) 0	(-1 to 6) 1 (-2 to 5) 1
29 30 31		+industry response	(-3 to 9)	(-4 to 34)	(2 to 8)	(-5 to 12)	(0 to 3)	4 (2 to 8)	(0 to 1)	(-2 to 5)
32 33	Multiple Myeloma									
34 35	Age	consumer behavior	220 (65	5 to 441)	51 (-29	to 150)	112 (54	to 186)	42 (6	6 to 84)
36 37	Page/Ethnicity	+industry response	380 (202	2 to 657)	105 (20) to 215)	151 (89	to 232)	63 (27	′ to 111)
38 39 40 41	Race/Ethnicity Non- Hispanic White	consumer behavior	11 (-13 to 52)	59 (-34 to 221)	-8 (-32 to 31)	-3 (-59 to 83)	15 (2 to 41)	58 (15 to 123)	14 (1 to 35)	15 (-14 to 54)
42 43 44										25
44 45 46 47			F	or peer review only	y - http://bmjopen	.bmj.com/site/about	/guidelines.xhtm	I		

	+industry	26 (-7 to 81)	122 (1 to 321)	-1 (-23 to 45)	19 (-37 to 123)	22 (6 to 53)	75 (32 to 147)	19 (6 to 44)	26 (-3 to 71)
Non-	response consumer	17	(110 321)	10	(-37 10 123)	(0 10 53)	(32 10 147)	(0 (0 44)	(-3 (0 7 1)
Hispanic Black	behavior	(-4 to 63)	(-40 to 115)	(0 to 29)	(-10 to 59)	(3 to 28)	(-14 to 38)	(-3 to 11)	(1 to 12)
	+industry	29	44	15	24	15	11	4	7
;	response	(1 to 83)	(-20 to 159)	(3 to 37)	(-1 to 70)	(6 to 34)	(-8 to 45)	(-1 to 13)	(3 to 15)
	consumer	` 16 ́	`	` 5 ´	` 15 ´	` 1 <i>´</i>	` 10 ´	2	0
, Hispanic	behavior	(0 to 51)	(9 to 193)	(-3 to 17)	(-2 to 42)	(-3 to 8)	(2 to 22)	(-1 to 5)	(-3 to 5)
}	+industry	28	100	7	21	3	13	3	<u>1</u>
)	response	(5 to 71)	(31 to 244)	(0 to 21)	(4 to 51)	(-1 to 10)	(5 to 26)	(0 to 6)	(-2 to 6)
0 Other	consumer	0	5	4	0	1	3	0	1
1	behavior	(-3 to 6)	(-7 to 27)	(2 to 7)	(-6 to 7)	(0 to 2)	(1 to 6)	(-1 to 1)	(-2 to 4)
2	+industry	1	10	4	1	1	4	0	1
3	response	(-2 to 8)	(-2 to 36)	(2 to 8)	(-5 to 9)	(0 to 3)	(2 to 7)	(-1 to 1)	(-1 to 4)
4									
5 Gallbladder									
6 Age	consumer	136 (58	3 to 229)	44 (7	to 86)	65 (40	to 93)	24 (9) to 41)
7	behavior	· ·			,	,	,	· ·	,
8	+industry	239 (15	3 to 341)	74 (36	to 119)	86 (61	to 117)	36 (20	0 to 53)
9 Race/Ethnicity	response								
0 Non-									
¹ Hispanic	consumer	22	15	0	2	16	19	13	5
² White	behavior	(-10 to 64)	(-10 to 52)	(-23 to 27)	🚽 (-14 to 19)	(4 to 32)	(6 to 36)	(2 to 25)	(-4 to 14)
3	+industry	43	32	8	8	23	24	17	8
4	response	(9 to 90)	(4 to 72)	(-15 to 37)	(-8 to 27)	(10 to 40)	(11 to 42)	(6 to 30)	(-1 to 18)
5 Non-	consumer	24	2	10	4	12	3	2	2
6 Hispanic Black	behavior	(-5 to 61)	(-14 to 21)	(0 to 21)	(-3 to 14)	(4 to 23)	(-3 to 10)	(-2 to 6)	(0 to 3)
7	+industry	4 0	9	`14 ´	6	15	`4 ´	`3 ´	2
3	response	(10 to 80)	(-7 to 31)	(4 to 27)	(-1 to 17)	(7 to 26)	(-2 to 12)	(0 to 7)	(1 to 4)
9 Hispanic	consumer	28	33	9	12	2	6	2	0
) Thispanic	behavior	(2 to 63)	(-8 to 85)	(-4 to 23)	(-2 to 30)	(-4 to 10)	(1 to 13)	(-1 to 6)	(-2 to 3)
1	+industry	45	51	13	16	4	8	4	1
2	response	(16 to 83)	(9 to 106)	(1 to 28)	(3 to 35)	(-2 to 13)	(3 to 16)	(0 to 8)	(-1 to 4)
³ Other	consumer	0	2	5	0	3	2	0	0
4	behavior	(-10 to 16)	(-5 to 12)	(1 to 11)	(-2 to 2)	(0 to 6)	(1 to 4)	(-1 to 1)	(-1 to 2)
5	+industry	4	5	6	0	4	3	0	1
5	response	(-6 to 21)	(-2 to 15)	(2 to 12)	(-1 to 3)	(1 to 7)	(1 to 5)	(-1 to 2)	(-1 to 2)
Advanced Prostate									
9	consumer								
0 Age	behavior	101 (13	3 to 214)	18 (-17	7 to 58)	33 (11	to 58)	15 (-4	4 to 38)
1	Sonavior								
2 3									26
-5 4									20
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1 2	Race/Ethnicity	+industry response	174 (80	to 304)	37 (1	to 83)	43 (22 to	o 71)	24 (6	to 48)
3 4 5	Non- Hispanic White	consumer behavior	0	43 (-13 to 140)	0	0 (-29 to 35)	0	20 (3 to 42)	0	10 (-9 to 32)
6 7 8	Non-	+industry response consumer	0 0	82 (16 to 192) 2	0 0	11 (-17 to 50) 9	0 0	27 (10 to 51) 7	0 0	16 (-2 to 40) 4
9 10 11	Hispanic Black	behavior +industry response	0	(-31 to 51) 17 (-16 to 75)	0	(-7 to 30) 13 (-2 to 36)	0	(-5 to 20) 9 (-3 to 23)	0	(1 to 9) 6 (2 to 11)
12 13 14	Hispanic	consumer behavior +industry	0	47 (7 to 103) 64	0 0	7 (-2 to 20) 10	0 0	4 (1 to 9) 6	0 0	0 (-1 to 3) 1
15 16 17	Other	response consumer behavior	0	(23 to 127) 1 (-4 to 12)	0	(1 to 25) 0 (-2 to 3)	0	(2 to 11) 1 (0 to 2)	0	(-1 to 3) 0 (-1 to 2)
18 19 20		+industry response	0	2 (-1 to 16)	0	0 (-2 to 3)	0	1 (1 to 2)	0	1 (-1 to 2)
20	Ovarian	consumor								
22	Age	consumer behavior	45 (-3 1	o 114)	13 (-1	4 to 54)	24 (9 to	51)	21 (8	to 46)
23		+industry	87 (19	to 175)	25 (-4	4 to 75)	34 (14 to	64)	28 (15	5 to 56)
24 25	Race/Ethnicity	response			20 (01(114		20 (10	
26 27	Non- Hispanic	consumer behavior	21 (-15 to 89)	0	-3 (-29 to 38)	0	15 (2 to 41)	0	19 (6 to 43)	0
28 29 30	White	+industry response	45 (-10 to 131)	0	5 (-21 to 52)	0	22 (5 to 51)	0	25 (11 to 52)	0
31 32	Non- Hispanic Black	consumer behavior	7 (-3 to 27)	0	3 (0 to 11)	0	5 (2 to 11)	0	(-1 to 4)	0
33 34	·	+industry response	13 (-1 to 38) 15	0	5 (1 to 13) 6	0	7 (3 to 13)	0	1 (0 to 5)	0
35 36	Hispanic	consumer behavior	(0 to 48)	0	(-1 to 16)	0	(-2 to 6)	0	(-1 to 4)	0
37 38		+industry response	25 (2 to 64)	0	8 (2 to 20)	0	2 (-1 to 8)	0	2 (0 to 5) 0	0
39	Other	consumer behavior	-5 (-13 to 9)	0	5 (1 to 10)	0	2 (0 to 4)	0	(-1 to 1)	0
40 41 42		+industry response	-1 (-9 to 15)	0	5 (2 to 11)	0	2 (1 to 4)	0	0 (0 to 1)	0
43										27
44 45 46 47			Fo	or peer review only	y - http://bmjopen	.bmj.com/site/abou	t/guidelines.xhtml			

1	Thyroid									
2 3	Age	consumer behavior	9 (2	to 22)	3 (-4 to	o 11)	6 (3 to	9 12)	4 (1	to 7)
4 5		+industry response	16 (7	to 33)	6 (0 to	16)	9 (5 to	9 15)	5 (3	8 to 9)
6 7 8	Race/Ethnicity Non- Hispanic	consumer behavior	0 (0 to 2)	0 (-1 to 5)	0 (-1 to 1)	-2 (-7 to 5)	0 (0 to 1)	3 (0 to 8)	1 (0 to 4)	1 (-1 to 3)
9 10 11 12 13 14 15 16 17 18 19 20 21	White Non- Hispanic Black Hispanic Other	+industry response consumer behavior +industry response consumer behavior +industry response consumer behavior	$\begin{array}{c} 0 \\ (0 \text{ to } 3) \\ 1 \\ (0 \text{ to } 5) \\ 2 \\ (0 \text{ to } 7) \\ 3 \\ (0 \text{ to } 10) \\ 5 \\ (1 \text{ to } 14) \\ 0 \end{array}$	$ \begin{array}{c} 1\\ (0 \text{ to } 9)\\ 1\\ (-2 \text{ to } 7)\\ 2\\ (-1 \text{ to } 10)\\ 1\\ (0 \text{ to } 9)\\ 2\\ (0 \text{ to } 12)\\ 0\\ (-1 \text{ to } 3) \end{array} $	0 (-1 to 2) 0 (0 to 1) 0 (0 to 2) 1 (0 to 3) 1 (0 to 3) 1 (0 to 4) 0 (0 to 1)	$ \begin{array}{c} 0\\ (-5 \text{ to } 9)\\ 0\\ (0 \text{ to } 2)\\ 0\\ (0 \text{ to } 2)\\ 2\\ (0 \text{ to } 5)\\ 2\\ (1 \text{ to } 7)\\ 0\\ (-1 \text{ to } 1) \end{array} $	$ \begin{array}{c} 1\\ (0 \text{ to } 2)\\ 1\\ (0 \text{ to } 2)\\ 1\\ (0 \text{ to } 2)\\ 0\\ (0 \text{ to } 1)\\ 0\\ (0 \text{ to } 1)\\ 0\\ (0 \text{ to } 1)\\ 0\\ (0 \text{ to } 1) \end{array} $	4 (1 to 10) 0 (0 to 1) 0 (0 to 1) 1 (0 to 2) 1 (0 to 3) 0 (0 to 1)	$ \begin{array}{c} 2 \\ (1 \text{ to } 4) \\ 0 \\ (0 \text{ to } 1) \\ 0 \\ (0 \text{ to } 1) \\ 0 \\ (0 \text{ to } 1) \\ 1 \\ (0 \text{ to } 2) \\ 0 \\ \end{array} $	$ \begin{array}{c} 1\\ (0 \text{ to } 4)\\ 0\\ (0 \text{ to } 1)\\ 0\\ (0 \text{ to } 1) \end{array} $
22 23 24 25 26 27 28 29 30 31 32 33 34	1. Values are the me	+industry response dian estimates (95	0	0 (0 to 4) (als) of each distribution	0 (0 to 1) on of 1000 simulations.	0 (-1 to 2)	0 (0 to 1)	0 (0 to 1)	0	0 (0 to 1)

Supplementary Table 12. Estimated health gains and costs associated with the federal menu calorie labeling on reducing cancer burdens in the US over a lifetime, one-way sensitivity analyses at 25% and 75% calorie compensation outside restaurant settings (US population=235,162,844)¹

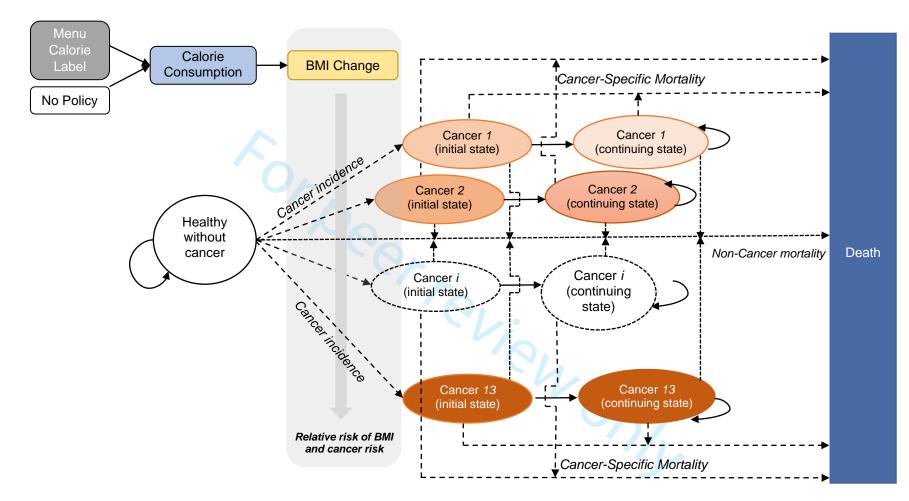
7	ettings (US population=235,		Labeling Policy	
3	75% Com			mpensation
9 10	Consumer Behavior Median (2.5% to 97.5%)	Consumer Behavior + Industry Response Median (2.5% to 97.5%)	Consumer Behavior Median (2.5% to 97.5%)	Consumer Behavior + Industry Response Median (2.5% to 97.5%)
2 New Cancer Cases Averted, N (95	% UI)			
² Liver cancer	2550 (265 to 5030)	4280 (2000 to 6770)	7760 (5160 to 10500)	12800 (9790 to 16000)
^o Endometrial cancer	2490 (-633 to 5890)	4640 (1570 to 8070)	8890 (5500 to 12700)	15100 (11800 to 19100)
⁴ Kidney cancer	2360 (65 to 4510)	4160 (1900 to 6410)	7810 (5230 to 10000)	13000 (10400 to 15300)
5 Breast cancer (postmenopausal)	2060 (-616 to 5280)	3930 (1260 to 7200)	7640 (4560 to 11400)	13000 (9700 to 17200)
Pancreatic cancer	638 (51 to 1280)	1140 (536 to 1800)	2140 (1490 to 2890)	3590 (2840 to 4460)
⁷ Esophageal adenocarcinoma	598 (-239 to 1400)	1100 (262 to 1930)	2130 (1200 to 3000)	3560 (2600 to 4520)
⁸ Colorectal cancer	480 (56 to 940)	851 (423 to 1330)	1600 (1060 to 2140)	2660 (2030 to 3310)
⁹ Multiple myeloma	343 (61 to 674)	576 (281 to 950)	1050 (677 to 1480)	1730 (1240 to 2340)
⁰ Stomach cancer (cardia)	312 (-42 to 736)	533 (192 to 998)	994 (555 to 1530)	1640 (1060 to 2300)
¹ Thyroid cancer	185 (-70 to 498)	406 (128 to 749)	851 (473 to 1310)	1470 (963 to 2100)
² Gallbladder cancer	165 (70 to 274)	266 (167 to 378)	468 (348 to 602)	758 (626 to 912)
³ Advanced prostate cancer	162 (-28 to 360)	282 (87 to 493)	519 (304 to 768)	868 (603 to 1160)
4 Ovarian cancer	65 (-17 to 179)	119 (26 to 245)	228 (96 to 398)	384 (196 to 617)
5 Total	12700 (2430 to 24200)	22600 (12400 to 34100)	42800 (30400 to 53900)	71500 (59100 to 82800)
6Cancer Deaths Prevented, N (95%	UI)		, , , , , , , , , , , , , , , , , , ,	
7 Liver cancer	2200 (199 to 4450)	3750 (1720 to 5970)	6790 (4490 to 9270)	11200 (8570 to 14100)
8 Breast cancer (postmenopausal)	1140 (-958 to 3640)	2420 (281 to 4990)	4980 (2540 to 7860)	8670 (6030 to 12000)
9 Endometrial cancer	980 (-69 to 2030)	1710 (675 to 2770)	3160 (2020 to 4450)	5270 (4120 to 6630)
0 Kidney cancer	939 (94 to 1820)	1630 (795 to 2520)	3020 (2080 to 3930)	4990 (4020 to 6020)
Pancreatic cancer	561 (54 to 1120)	996 (473 to 1590)	1870 (1300 to 2510)	3130 (2480 to 3890)
2 Esophageal adenocarcinoma	503 (-224 to 1190)	932 (203 to 1640)	1820 (1010 to 2580)	3050 (2220 to 3890)
3 Colorectal cancer	323 (41 to 640)	571 (280 to 910)	1080 (724 to 1440)	1800 (1390 to 2240)
4 Stomach cancer (cardia)	264 (-32 to 623)	446 (159 to 838)	824 (454 to 1280)	1360 (887 to 1910)
5 Multiple myeloma	213 (45 to 411)	350 (178 to 576)	635 (419 to 897)	1040 (757 to 1370)
6 Gallbladder cancer	141 (60 to 234)	226 (142 to 320)	398 (300 to 512)	644 (531 to 777)
	80 (-12 to 179)	135 (44 to 239)	246 (144 to 373)	410 (278 to 563)
7 Ovarian cancer	49 (-7 to 123)	87 (26 to 170)	162 (76 to 270)	272 (155 to 415)
⁸ Thyroid cancer	11 (1 to 24)	19 (8 to 33)	34 (21 to 53)	56 (39.9 to 81.8)
¹⁹ Total	7760 (1280 to 13900)	13600 (7160 to 20100)	25600 (17900 to 32300)	42500 (34600 to 49600)
^O Life Years Gained	34700 (5070 to 66300)	62200 (32500 to 93500)	118000 (82400 to 151000)	197000 (161000 to 232000)

1				
2				
³ QALYs Gained	51400 (9690 to 95700)	90500 (49300 to 135000)	171000 (119000 to 218000)	284000 (234000 to 334000)
⁴ Changes in Health-Related Cost				
⁵ Healthcare (medical) cost	-693 (-1250 to -138)	-1210 (-1770 to -660)	-2270 (-2850 to -1640)	-3760 (-4360 to -3140)
6 Patient time cost	-47.9 (-90.0 to -11.9)	-83.6 (-126 to -47.3)	-155 (-198 to -113)	-258 (-302 to -215)
7 Productivity loss	-279 (-527 to -56.6)	-490 (-743 to -271)	-929 (-1170 to -673)	-1550 (-1800 to -1290)
8 Policy Implementation Costs (\$,			, , , , , , , , , , , , , , , , , , ,	, , , , , , , , , , , , , , , , , , ,
9 Government cost	18.5 (14.5 to 25.1)	18.5 (14.4 to 25.5)	18.5 (14.5 to 25.1)	18.5 (14.4 to 25.5)
10 Administration	9.07 (8.61 to 9.56)	9.09 (8.62 to 9.55)	9.07 (8.61 to 9.56)	9.09 (8.62 to 9.55)
11 Monitoring	9.40 (5.45 to 16.1)	9.38 (5.30 to 16.3)	9.40 (5.45 to 16.1)	9.38 (5.30 to 16.3)
12 Industry cost	820 (762 to 889)	1120 (1040 to 1210)	820 (762 to 889)	1120 (1040 to 1210)
13 Compliance	820 (762 to 889)	823 (757 to 889)	820 (762 to 889)	823 (757 to 889)
14 Reformulation		296 (249 to 353)		296 (249 to 353)
15 Net Costs, Cancer Only (\$, millio	ons) ^{2,3,4}			
16 Societal perspective	-174 (-1032 to 639)	-653 (-1510 to 164)	-2520 (-3390 to -1590)	-4430 (-5310 to -3510)
17 Healthcare perspective	-674 (-1229 to -120)	-1190 (-1750 to -639)	-2250 (-2830 to -1620)	-3740 (-4350 to -3120)
¹⁷ ICER (dollars/QALY)⁵				
19 Societal perspective	Dominant	Dominant	Dominant	Dominant
Healthcare perspective	Dominant	Dominant	Dominant	Dominant
211. Values are the median es222. Health-related costs were233. Costs are medians from 1244. Net costs were calculated25costs, and policy implement265. ICER threshold was evaluted2728293031323334353637383939	ts represent savings. 1000 simulations so may not add up to total I as policy costs minus health-related costs	a distribution of 1000 simulations. onal Health Care (PHC) index. Policy interv ls. from reduced cancer burden. Societal per uded policy costs relevant to policy implem	vention costs were inflated to 2015 US dollarspective includes healthcare cost, patient ti nentation and program monitoring and evalue e "no-policy intervention" scenario.	me costs, productivity
40 41 42 43 44 45				30

Supplementary Table 13. Estimated health gains and costs associated with the federal menu calorie labeling on reducing cancer burdens in the US over a lifetime, one-way sensitivity analysis, assuming all full-service and fast-food restaurants were covered by the policy (US population=235,162,844)¹

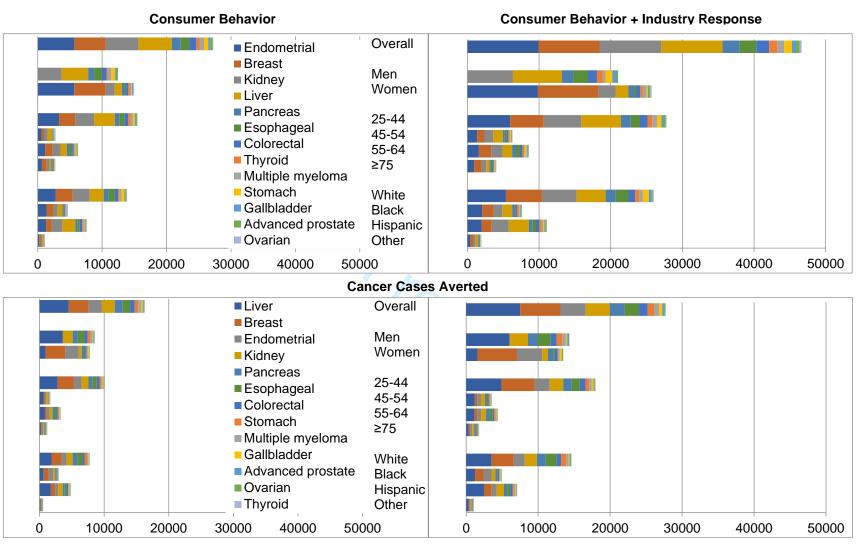
	Menu Calorie Labeling Policy	
	Consumer Behavior	Consumer Behavior + Industry Respon
	Median (2.5% to 97.5%)	Median (2.5% to 97.5%)
New Cancer Cases Averted, N (95% UI)		
Liver cancer	7280 (4690 to 10100)	11400 (8480 to 14400)
Kidney cancer	6820 (4180 to 9460)	11100 (8470 to 13700)
Endometrial cancer	5340 (1540 to 9220)	10400 (6690 to 14300)
Breast cancer (postmenopausal)	4920 (1580 to 8420)	9380 (5960 to 13100)
Esophageal adenocarcinoma	2060 (1170 to 3060)	3260 (2310 to 4330)
Pancreatic cancer	1810 (1150 to 2600)	3000 (2290 to 3870)
Colorectal cancer	1320 (772 to 1910)	2200 (1600 to 2880)
Stomach cancer (cardia)	938 (531 to 1510)	1480 (985 to 2140)
Thyroid cancer	746 (430 to 1180)	1270 (850 to 1820)
Multiple myeloma	710 (377 to 1150)	1270 (879 to 1820)
Advanced prostate cancer	430 (208 to 681)	715 (461 to 1010)
Gallbladder cancer	329 (201 to 457)	568 (435 to 708)
Ovarian cancer	133 (20.9 to 292)	263 (109 to 468)
Total	32900 (20300 to 46000)	56400 (43700 to 69300)
Cancer Deaths Prevented, N (95% UI)		, ,
Liver cancer	6460 (4170 to 8980)	10000 (7480 to 12800)
Breast cancer (postmenopausal)	3410 (701 to 6280)	6440 (3560 to 9750)
Kidney cancer	2620 (1610 to 3620)	4250 (3210 to 5300)
Endometrial cancer	1890 (654 to 3140)	> 3610 (2390 to 4900)
Esophageal adenocarcinoma	1800 (1030 to 2670)	2840 (2010 to 3750)
Pancreatic cancer	1580 (976 to 2250)	2620 (1990 to 3380)
Colorectal cancer	923 (560 to 1310)	1520 (1110 to 1970)
Stomach cancer (cardia)	785 (437 to 1270)	1240 (812 to 1790)
Multiple myeloma	431 (234 to 709)	762 (524 to 1100)
Gallbladder cancer	275 (170 to 385)	479 (366 to 601)
Advanced prostate cancer	219 (117 to 351)	353 (233 to 506)
Ovarian cancer	94 (18 to 197)	185 (91 to 317)
Thyroid cancer	27 (13 to 45)	45 (28 to 68)
Total	7760 (1280 to 13900)	34400 (26800 to 42400)
Life Years Gained	97300 (62300 to 135000)	162000 (126000 to 201000)
QALYs Gained	20500 (13100 to 28500)	230000 (178000 to 287000)
Changes in Health-Related Costs, Cancer Only (\$, n		
		:

Healthcare (medical) cost		-1820 (-2500 to -1180)	-3060 (-3740 to -2400)
Patient time cost		-112 (-160 to -62.7)	-197 (-245 to -148)
Productivity loss		-692 (-976 to -401)	-1210 (-1490 to -916)
Policy Implementation Costs ((\$, millions) ^{2,3}		х , , , , , , , , , , , , , , , , , , ,
Government cost	,	18.4 (14.7 to 25.7)	18.4 (14.7 to 25.7)
Administration		9.06 (8.56 to 9.52)	9.07 (8.60 to 9.56)
Monitoring		9.32 (5.61 to 16.5)	9.37 (5.64 to 16.6)
Industry cost		821 (764 to 888)	1120 (1040 to 1200)
Compliance		821 (764 to 888)	821 (763 to 886)
Reformulation			297 (248 to 350)
Net Costs, Cancer Only (\$, mil	lions) ^{2,3,4}		
Societal perspective		-1780 (-2790 to -831)	-1030 (-1590 to -549)
Healthcare perspective		-1800 (-2470 to -1160)	-1670 (-2120 to -1270)
ICER (dollars/QALY) ⁵			
Societal perspective		Dominant	Dominant
Healthcare perspective Abbreviations: ICER, Incremental Cos		Dominant	Dominant
costs, and policy implementation co	costs minus health-related costs osts; government perspective incl	s from reduced cancer burden. Societal perspectiv luded policy costs relevant to policy implementation ents less costly and more effective than the "no-policy of the second second second second seco	
 Net costs were calculated as policy costs, and policy implementation co 	lations so may not add up to tota costs minus health-related costs osts; government perspective incl	s from reduced cancer burden. Societal perspectiv luded policy costs relevant to policy implementation ents less costly and more effective than the "no-policy of the second second second second seco	n and program monitoring and evaluation and medi
 Net costs were calculated as policy costs, and policy implementation co 	lations so may not add up to tota costs minus health-related costs osts; government perspective incl	s from reduced cancer burden. Societal perspectiv luded policy costs relevant to policy implementation ents less costly and more effective than the "no-policy of the second second second second seco	n and program monitoring and evaluation and mediolicy intervention" scenario.
 Net costs were calculated as policy costs, and policy implementation co 	lations so may not add up to tota costs minus health-related costs osts; government perspective incl	s from reduced cancer burden. Societal perspectiv luded policy costs relevant to policy implementation ents less costly and more effective than the "no-policy of the second second second second seco	n and program monitoring and evaluation and mediolicy intervention" scenario.
4. Net costs were calculated as policy costs, and policy implementation co	lations so may not add up to tota costs minus health-related costs ists; government perspective incl 150,000/QALY. Dominant represe	s from reduced cancer burden. Societal perspectiv luded policy costs relevant to policy implementation ents less costly and more effective than the "no-policy of the second second second second seco	n and program monitoring and evaluation and medi blicy intervention" scenario.



Supplementary Figure 1. Diet and Cancer Outcome Model (DiCOM)

The model consists of four general health states: (a) healthy without cancer (healthy state); (b) initial cancer diagnosis (initial state) for each cancer type *i*; (c) continuing care (continuing state) for each cancer type *i*; and (d) death state. Transitions between states are based on national cancer incidence and cancer-specific mortality rates from SEER (for individual with cancer) and lifetable-based mortality rates (for individuals without cancer). The model simulates the policy impact on the number of new cases and deaths of 13 obesity-associated cancers, health-related quality of life (HRQOL), and health-related costs among U.S. adults over a lifetime by comparing a policy scenario (menu calorie label) to a non-policy scenario (status quo).

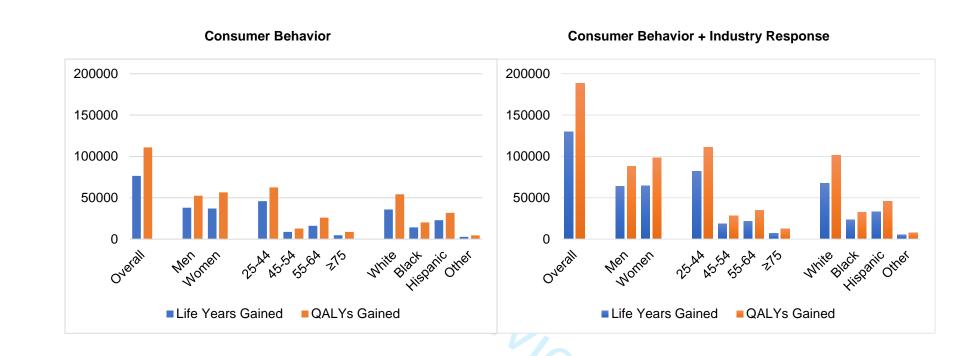


Cancer Deaths Averted

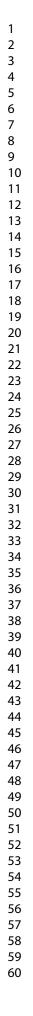
Supplementary Figure 2. Estimated reduced new cancer cases and deaths associated with the federal menu calorie labeling in the US by age, sex, race/ethnicity, and cancer type, over lifetime

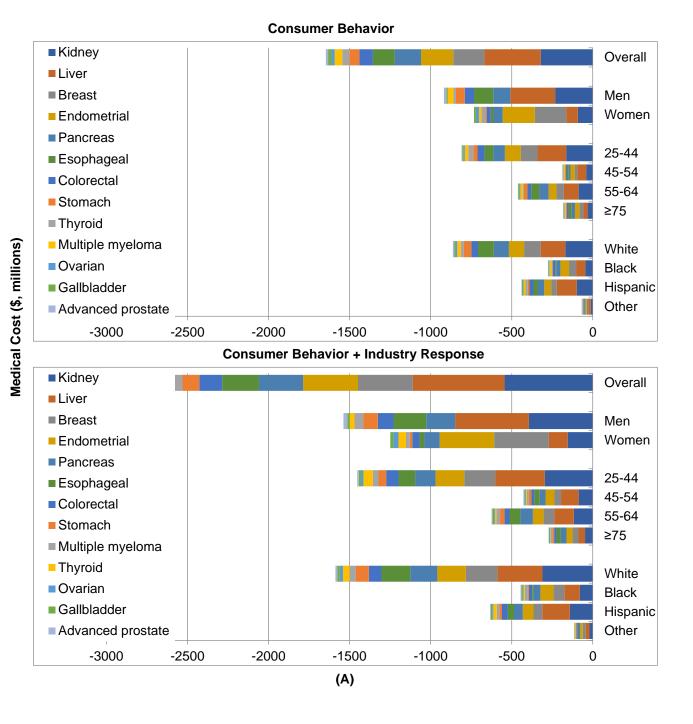
For peer review only - http://bmjopen.bmj.com/site/about/guidelines.xhtml

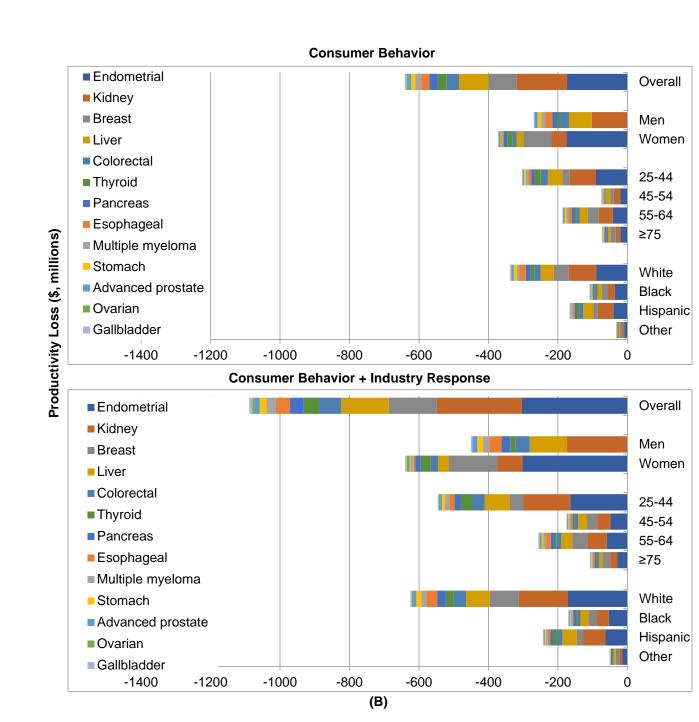
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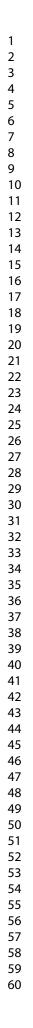


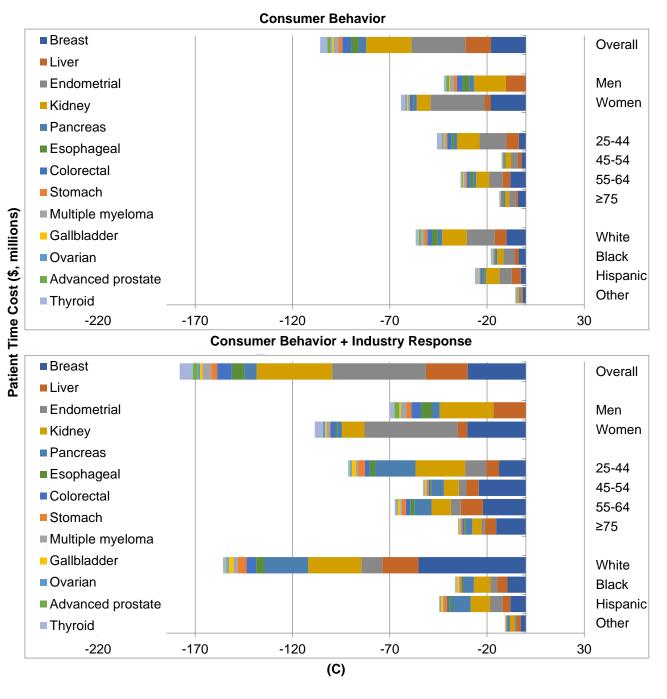
Supplementary Figure 3. Estimated life years and QALYs gained associated with the federal menu calorie labeling in the US by age, sex, and race/ethnicity, over a lifetime







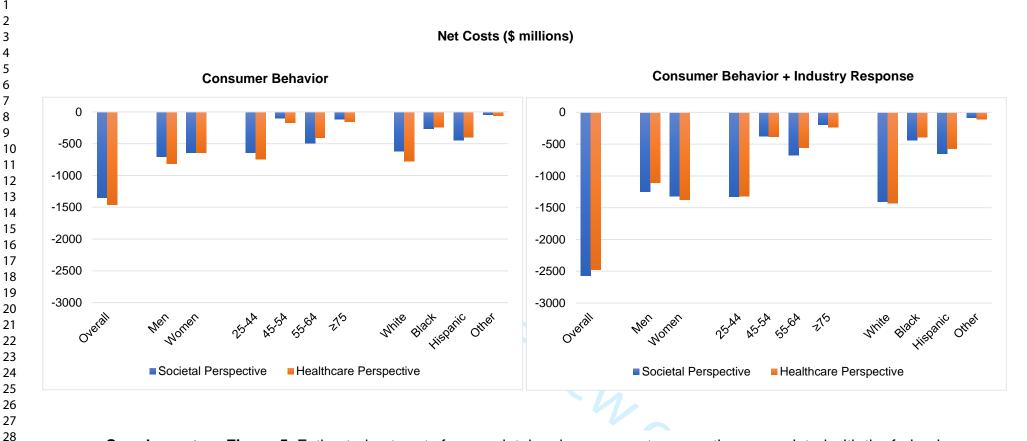




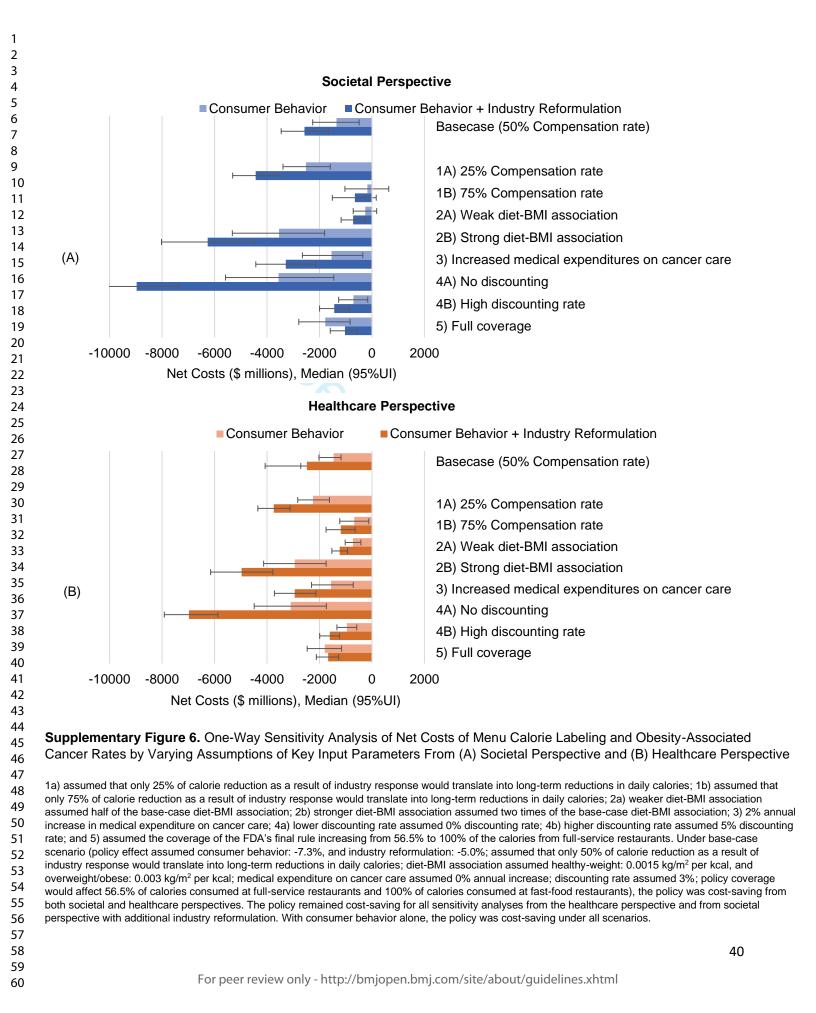
Supplementary Figure 4. Estimated changes of health-related costs associated with the federal menu calorie labeling in the US by age, sex, race/ethnicity, and cancer type, over lifetime



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Supplementary Figure 5. Estimated net costs from societal and government perspectives associated with the federal menu calorie labeling policy in the US by age, sex, and race/ethnicity, over a lifetime



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2 3	Title Cost Effectiveness Analysis of the Enderel Many Coloris Labeling and Obesity Associated Concer
1	Title Cost-Effectiveness Analysis of the Federal Menu Calorie Labeling and Obesity-Associated Cancer Burdens in the United States
5	Burdens in the United States
8	Appendix 1 . Estimate the Association Between Menu Calorie Labeling Policy and Calorie Intake from Restaurant Meals
10	Appendix Table 1 . The Policy Impact of the Federal Menu Calorie Labeling on Restaurant Industry Response
13	Appendix 2 . Baseline Cancer Incidence and Methods of Cancer Incidence Projections for 13 Types of Cancers
14 15	Appendix Table 2. Estimating "crude" incidence after applying the cohort-period method
16	Appendix 3. Cancer Survival for 13 Types of Cancers
	Appendix Table 3. Period Method for 5-Year Relative Survival for 2014
18	Appendix 4. Methods of Estimating the Health-Related Quality of Life Among 13 Types of Cancers
19 20	Appendix 5. Methods of Estimating Policy Implementation Costs
21 22	Appendix Table 4. Implementation Cost Estimates for the Federal Menu Calorie Labeling Policy (in 2015 US Dollars)
74	Appendix Table 5. The Population Size of People Who are Alive Each Year Over a Lifetime (in millions)
26	Appendix 6. Annual Health-Related Costs Among Cancer Patients and the General Population without Cancer
28 29	Cancer Appendix Table 6. Description of Data Source of Health-Related Expenditures
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Appendix 1. Estimate the association between menu calorie labeling policy and calorie intake from restaurant meals

To understand the effects of the federal menu calorie labeling policy, we performed a comprehensive literature search and reviewed the evidence on how the policy affected consumer behaviors and industry.

To estimate the policy effect on consumer behavior alone, we reviewed individual studies in both real-world and experimental settings as well as meta-analyses. A meta-analysis of natural experimental studies showed that menu calorie labeling was associated with a 7.3% (95% CI: 4.4% to 10.1%) reduction in calories per meal consumed/purchased.¹ This effect estimate is corresponding to an average reduction of 23.5 kcal per meal consumed by NHANES participants from 56.5% of full-service restaurants² and all fast-food restaurants. This estimate was consistent with evidence from a previous meta-analysis and a recent real-world study.^{3, 4} A previous meta-analysis estimated that the menu calorie labeling would lead to about an 18 kcal reduction ordered per meal.³ A recent longitudinal study used data from a large restaurant franchise in the southern U.S. and estimated that, after labeling implementation, a decrease of 60 kcal per transaction was observed in the first year, followed by an increasing trend of 0.71 kcal per transaction per week over two years.⁴ These together attenuated the calorie reduction to 23 kcal per transaction by the end of the third year of the policy implementation.⁵ Compared to other studies, the 7.3% calorie reduction per meal represents a more conservative estimate. It was reported in a cross-sectional study that customers at the labeled full-service restaurants purchased food with 151 fewer calories.⁶ One meta-analysis of studies that evaluated energy ordered in a realworld setting showed that the calorie labeling policy would lead to a mean reduction of 77.8 in calories purchased per meal.⁷ In a laboratory setting, there was a significant reduction of 115.3 kcal per meal ordered.⁸ Integrating both the real-world and experimental studies, the policy was estimated to generate

a significant reduction of 100.3 in calories purchased.⁷ Therefore, we decided to use a reduction of calorie intake per meal by 7.3% (95% CI: 4.4% to 10.1%) as the model input given it is the most updated and conservative estimate supported by existing evidence. This policy effect on consumer behavior alone was assumed to take effect during the first year of implementation and no further reduction thereafter.

Based on the published literature, we estimated that there was a 5% reduction in calories consumed per meal from chain restaurants due to industry reformulation, the introduction of new lowcalorie menu items, or the replacement of menu items high in calories with low-calorie menu options.⁹⁻ ¹³ Bleich et al. estimated the calorie changes in chain restaurants' menu items using data from the largest chain restaurants in the U.S.⁹⁻¹³ Using the estimated mean calorie per menu item from the two published studies shown in **Appendix Table 1**,^{11, 12} we calculated the mean change in calories per menu item before and after the policy implementation. Given the national law was announced in 2010, using data from the trend analysis, we treated the mean calorie per menu item measured in 2008 as the baseline and found there was an 11% reduction in calories per menu item two years after the affordable care act was enacted. The change decreased to 7% in 2015, one year after the FDA announced the final rule for the industry to comply with. In the study evaluated the calorie content in current menu items, eliminated menu items, and newly introduced menu items, we estimated that there was a 1% reduction in mean peritem calories in 2013-2014 compared to that in 2012, and the reduction increased to 5% in 2015. Based on this de novo analysis, we chose a reduction in calories per meal consumed by 5% to represent a modest industry reformulation in response to the federal menu calorie labeling by chain restaurants. We assumed no industry response in the first year, then the reformulation activities would occur in the rest of the years over the model lifetime, resulting in a net reduction of 5% in calories consumed per meal.

Appendix Table 1. The policy impact of the federal menu calorie labeling on restaurant industry response

industry response						
Study				Year		
-		2008	2012	2013	2014	2015
Bleich, 2017 ¹¹ Calorie changes in large chain restaurants from 2008 to 2015 44 of the 100 largest chain restaurants	# of menu items (n) mean per-item calories (kcal)	6,601 368.0	9,526 329.1	10,278 330.1	10,654 337.2	11,034 340.6
			2012 vs. 2008			2015 vs. 20
	diff. (%)		-38.9 (-11%)			-27 (-7%
						(. , ,
Bleich, 2018 ¹² Higher-Calorie Menu Items	# of menu items (n)		14,705	17,219 (20)13-2014)	13,920
Eliminated in Large Chain Restaurants 66 of the 100 largest chain restaurants	mean per-item calories (kcal)		374.4	370).9	357.4
				2013-20)14 vs.	
				201	12	2015 vs. 20
	diff. (%)			-3.52 ((-1%)	-17.05 (-5

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Appendix 2. Baseline cancer incidence and methods of cancer incidence projections for 13 types of cancers

We estimated the cancer incidence rate projections for the defined 32 demographic subgroups as inputs for the DiCOM model. We first obtained age-adjusted incidence rates from 2006 to 2015 from the United States Cancer Statistics combining data from the Surveillance, Epidemiology, and End Results (SEER) database and the Centers for Disease Control and Prevention's National Program of Cancer Registries (NPCR) database.¹⁴

Based on the trends from 2006 to 2015, we projected age-adjusted cancer incidence rates in the next 15 years from 2016 to2030 using the average annual percent change (AAPC) method.^{15, 16} Because longer-term projections may not be valid, we chose to hold age-adjusted cancer incidence rates constant from 2030 to 2095. Specifically, the annual percent change was calculated for each cancer site in each of the 32 subgroups by fitting a regression line to the natural logarithm of the age-adjusted rates (I) in the years 2006 through 2015 (y). The equation for AAPC: $ln(I) = \alpha + \beta y$, where α and β were coefficients to be estimated and y is the calendar year.^{15, 16} We then combined the AAPC projected cancer incidence rates with the projected US population to account for the change in population age distribution over time. The projected US population in each of the 32 subgroups from 2016 to 2060 were extracted from the National Interim Projections of the US population.¹⁷ Because projections were only available through 2060, further projections after 2060 were not considered. We further applied the cohort-period method to estimate cancer incidence in each of the 32 subgroups in the closed cohort of US adults from 2015 to 2095 as they age. Details were illustrated in **Appendix Table 2** using colon and rectum cancer incidence among non-Hispanic white females (NHWF) as an example.

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				EXAMPL	E: Colon	and Rectu	um Cance	r, Non-Hi	spanic W	hite Fem	ales			
ge	20	15		20	16			20	17			20	18	
	Baseline	Populatio	AAPC	US	Cancer	Age	AAPC	US	Cancer	Age	AAPC	US	Cancer	Age
	Incidence	n Size	Predicted	Census	Cases	Shifted	Predicted	Census	Cases	Shifted	Predicted	Census	Cases	Shifte
	Rate		Incidence	Predicted	Predicted	"crude"	Incidence	Predicted	Predicted	"crude"	Incidence	Predicted	Predicted	"crude
				Populatio		Incidence		Populatio		Incidence		Populatio		Inciden
0	8.531	30523184	8.694	n Size 1134235		10.154	8.859	n Size 1126079		11.694	9.028	n Size 1117775		13.182
21	8.531	30323 104	8.694	1156761	100565	10.104	8.859	1137549		11.034	9.028	1129379		10.104
22	8.531		8.694	1177144	102337		8.859	1159788	102748		9.028	1140620		
23	8.531		8.694	1196469	104017		8.859	1180122	104550		9.028	1162784	104976	-
24	8.531		8.694	1238910	107707		8.859	1199459	106263		9.028	1183136	106813	-
25	8.531		8.694	1283513	111585		8.859	1241739	110009		9.028	1202329	108546	
26	8.531		8.694	1294013	112497		8.859	1286229	113950		9.028	1244499	112353	-
27	8.531		8.694	1250740	108735		8.859	1296475	114858		9.028	1288797	116352	
28	8.531		8.694	1232421	107143		8.859	1253062	1110.12		9.028	1298770	117252	-
29	8.531		8.694	1216039	105719		8.859	1234519	109369		9.028	1255161	113315	
30	8.531		8.694	1228929	106839		8.859	1217844	107892		9.028	1236330	111615	
31	8.531		8.694	1244281	108174		8.859	1230337	108999		9.028	1219312	110079	
32	8.531		8.694	1205955	104842		8.859	1245249	110320		9.028	1231390	111169	
33	8.531		8.694	1226950	106667		8.859	1206736	106908		9.028	1246013	112489	
34	8.531		8.694	1226234	106605		8.859	1227540	108751		9.028	1207377	109001	
35	8.531		8.694	1217701	105863		8.859	1226721	108678		9.028	1228051	110868	
36	8.531		8.694	1228467	106799		8.859	1218141	107918		9.028	1227199	110791	
37	8.531		8.694	1160971	100931		8.859	1228796	108862		9.028	1218528	110008	
38	8.531		8.694	1139547	99069		8.859	1161267	102879	1	9.028	1229044	110958	
39	8.531		8.694	1127605	98030		8.859	1139679	100967	1	9.028	1161414	104852	
40	8.531		8.694	1088875	94663		8.859	1127530	99891		9.028	1139635	102886	
41	8.531		8.694	1130467	98279		8.859	1088644	96446	1	9.028	1127272	101770	
42	8.531		8.694	1101345	95747		8.859	1129951	100105		9.028	1088229	98245	
43	8.531		8.694	1130264	98262		8.859	1100615	97506	1	9.028	1129228	101946	
44	8.531		8.694	1210411	105229		8.859	1129268	100045		9.028	1099713	99282	
45	41269	14238423	41.919	1319769	553230	43.775	42.579	1208976	514771	45.825	43.250	1128045	487878	47.45
46	41269		41.919	1346596	564476		42.579	1317806	561110	0.010	43.250	1207332	522169	
47	41269		41.919	1292274	541705		42.579	1344191	572344		43,250	1315541	568969	
48	41269		41.919	1264917	530237		42.579	1289694	549140		43.250	1341533	580211	-
19	41269		41.919	1295410	543019		42.579	1262140	537408		43.250	1286923	556592	
iO	41269		41.919	1325816	555765		42.579	1292230	550220		43.250	1259139	544576	
51	41269		41.919	1432079	600309		42.579	1322198	562980		43.250	1288813	557410	
52	41269		41.919	1489756	624487		42.579	1427705	607904		43.250	1318321	570172	-
53	41269		41.919	1510286	633093		42.579	1484805	632216		43.250	1423107	615492	
54	41269		41.919	1532940	642589		42.579	1504858	640755		43.250	1479608	639928	
55	59.736	15111568	58.496	1575080	921363	65.864	57.283	1526976	874691	71.195	56.094	1499151	840934	75.80
56	59.736		58.496	1579128	923731		57,283	1568482	898466		56.094	1520747	853048	
57	59.736		58.496	1554236	909170		57.283	1572018	900492		56.094	1561581	875954	
58	59.736		58.496	1566074	916095		57.283	1546788	886040		56.094	1564631	877664	
59	59.736		58.496	1559941	912507		57.283	1558015	892471		56.094	1539019	863298	
60	59.736		58.496	1509257	882859		57.283	1551289	888618		56.094	1549572	869217	
61	59.736		58.496	1507776	881993		57.283	1500225	859367		56.094	1542165	865062	
62	59.736		58.496	1469467	859583		57.283	1497943	858060		56.094	1490621	836149	
63	59.736		58.496	1428612	835685		57.283	1458963	835731		56.094	1487453	834372	
64	59.736		58.496	1384020	809600		57.283	1417465	811960		56.094	1447782	812119	
65	147.246	20639658	140.189	1344027	1884181	140.189	133.471	1372210	1831501	133.471	127.075	1405568	1786119	127.07
66	147.246		140.189	1307657	1833194		133.471	1331467	1777121		127.075	1359584	1727685	
67	147.246		140.189	1291598	1810681		133.471	1294222	1727410		127.075	1318007	1674851	
8	147.246		140.189	1292613	1812104		133.471	1277026	1704458		127.075	1279794	1020292	
69	147.246		140.189	1382868	1938632		133.471	1276471	1703717		127.075	1261379	1602891	
70	147.246		140.189	987587	1384490		133.471	1363827	1820312		127.075	1259177	1600093	
71	147.246		140.189	982267	1377032		133.471	972764	1298357		127.075	1343441	1707171	
72	147.246		140.189	972611	1363496		133.471	966021	1289357		127.075	956905	1215982	
73	147.246		140.189	1012982	1420091		133.471	954967	1274603		127.075	948632	1205469	
4	147.246		140.189	874564	1226044		133.471	992594	1324824		127.075	936077	1189515	
75	147.246		140.189	796574	1116711		133.471	855200	1141443		127.075	970797	1233635	
6	147.246		140.189	747848	1048402		133.471	777087	1037185		127.075	834495	1060430	
77	147.246		140.189	706707	990727		133.471	727604	971140		127.075	756255	961007	
78	147.246		140.189	679404	952451		133.471	685495	914936		127.075	705976	897115	
79	147.246		140.189	625026	876219		133.471	656756	876578		127.075	662851	842315	
30	147.246		140.189	595777	835215		133.471	601790	803215		127.075	632555	803816	
81	147.246		140.189	572977	803252		133.471	571026	762154		127.075	577004	733225	
32	147.246		140.189	512332	718234		133.471	546330	729192		127.075	544674	692142	
33	147.246		140.189	496976	696707		133.471	485519	648027		127.075	517986	658228	
34	147.246		140.189	475655	666817		133.471	467692	624233		127.075	457134	580901	
15	147.246		140.189	452173	633898		133.471	444106	592752		127.075	436898	555186	
6	147.246		140.189	428834	601179		133.471	418526	558610		127.075	411316	522678	
7	147.246		140.189	383933	538233		133.471	393130	524714		127.075	383961	487917	
8	147.246		140.189	356801	500196		133.471	348261	464827		127.075	356875	453497	
9	147.246		140.189	320644	449508		133.471	319862	426923		127.075	312475	397076	
0	147.246		140.189	278562	390514		133.471	283710	378670		127.075	283306	360010	
91	147.246		140.189	246568	345662		133.471	242960	324281		127.075	247721	314790	
92	147.246		140.189	209022	293026		133.471	211695	282551		127.075	208839	265381	
13	147.246		140.189	169864	238131		133.471	176399	235441		127.075	178878	227308	
4	147.246		140.189	138657	194382		133.471	140691	187782		127.075	146313	185927	
15	147.246		140.189	109277	153195		133.471	112531	150196		127.075	114362	145325	
15	147.246		140.189	80177	112399		133.471	86769	115811		127.075	89499	113730	
10	147.246		140.189	80177 56739	TI2399 79542		133.471	86769 62172	82982		127.075	89499 67414	85666	
			140.189	42046	79542 58944		133.471	42907	57268		127.075	47105	59858	
_				42040	00944		00.471						03000	
98 99	147.246 147.246		140.189	27405	38419		133.471	30959	41321		127.075	31659	40231	

Appendix Table 2. Estimating "crude" incidence after applying cohort-period method

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Appendix 3. Cancer survival for 13 types of cancers

We estimated the 5-year relative survival for the defined 32 demographic subgroups. We obtained five-year relative survival rates using the period analysis method from the United States Cancer Statistics which incorporates data from the Surveillance, Epidemiology, and End Results (SEER) database.¹⁴ The five-year survival for 2014, which was the most recently available data at the time of analysis, was used. These rates were extracted for each cancer type and by the defined 32 demographic subgroups for each cancer type. The rates are on a scale of 0-1.

Relative survival is a net survival measure representing cancer survival in the absence of other causes of death. Relative survival is defined as the ratio of the proportion of observed survivors in a cohort of cancer patients to the proportion of expected survivors in a comparable set of cancer-free individuals.¹⁸ Relative survival is the preferred method to estimate survival from cancer registry data.

The period analysis is a method that enhances up-to-date monitoring of survival.^{19, 20} In contrast to traditional cohort analysis of survival, period analysis derives long-term survival estimates exclusively from the survival experience of patients within some recent calendar period.^{19, 20} Three-year intervals were chosen which results in the years 2008-2014 is used to calculate 5-year survival. Using seven years of data to calculate 5-year survival is the standard method used by SEER and used in SEER publications.²¹

The first interval contributed to the one-year survival and used cases diagnosed in 2012-2014, the second interval contributed to the two-year survival and used cases diagnosed in 2011-2013, the third interval contributed to the three-year survival and used cases diagnosed in 2010-2012, the fourth interval contributed to the four-year survival and used cases diagnosed in 2009-2011 and the fifth interval contributed to the five-year survival and used cases diagnosed in 2008-2010.

This analysis, therefore, used 2008-2014 diagnoses to calculate for 5-year relative survival for 2014. The highlighted orange boxes represent survival contributions for each year of diagnosis and year of follow-up (**Appendix Table 3**). The annual probability of death was calculated as 1-exp[ln(5-year relative survival)/5].

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						YE	ARS O	F DIAG	NOSIS						
2000	0 200	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
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3															
4 5															

Appendix 4. Methods of estimating the health-related quality of life among 13 types of cancers

Health utility values range from 0 (dead) to 1 (perfect health and were assigned for each cancer type and by phase of care (initial, continuous, end of life), if available. We first searched databases for systematic reviews pertaining to utility weights or HRQOL measures for each cancer type of interest separately. We started with PubMed and searched Google Scholar if needed. The following search string was used for each cancer type : ("health related quality of life" OR "HRQOL" OR "quality of life" OR "QOL" OR "preference weight*" OR "utility weight*" OR "health state utilit*" OR "health utility*") AND ("cancer of interest") AND ("cancer" OR "neoplasm*") AND ("review" OR "systematic review").

When an appropriate systematic review was identified, we read the articles included in the review and determined if the paper met the following data needs. Data Extraction Hierarchy: 1) cancer type specific to the type of interest; 2) consistent in the instrument used, prefer EQ-5D whenever available; 3) US samples preferred; 4) phase of care (assume same utility weights by phase if the phase of care data were not available). If no systematic reviews were available, we searched for individual studies about the utility weights of the cancer of interest. Additionally, check how often the paper is cited to see if it is a frequently used utility weight.

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Appendix 5. Methods of estimating policy implementation costs

We estimated the costs of implementing the federal menu calorie labeling for both government and industry, including government administration costs, monitoring and evaluation costs, industry compliance costs and reformulation costs, based on the FDA's budget report,²² the Nutrition Review Project report,²³ and FDA's RIA²⁴ (**Appendix Table 4**).

It was estimated by FDA that approximately 298,600 establishments, organized under 2,130 chains were covered by the menu calorie labeling policy. Among the covered establishments, 115,000 (38.5%) were full-service restaurants and drinking places organized under 530 (24.9%) chains, and 116,200 (38.9%) were limited-service restaurants organized under 540 (25.4%) chains. In total, about 231,200 (77.4%) restaurants organized under 1,070 (50.2%) chains were covered by this policy.²⁴

For industry compliance (#3) and reformulation costs (#4), the FDA estimated the costs by the type of establishments. Therefore, we only included the relevant costs incurred by restaurants as this approach generated more conservative estimates. In addition, the industry compliance costs consist of initial costs and recurring costs associated with new chains. In FDA's RIA, the initial costs were presented as a one-time cost, while the recurring costs associated with new chains were presented as annual costs and assumed to be incurred for 20 years starting from the 2nd year of policy implementation. According to FDA, 20 years is more appropriate for interventions that play out over long periods and whose effects deal with chronic conditions. Similarly, the reformulation costs (#4) estimated by FDA were presented as annual costs in FDA's RIA using the same assumption. We followed the same assumption and presented the annual compliance costs (#3) and annual reformulation costs (#4) incurred by restaurants in **Appendix Table 4**.

The cost of implementing the menu calorie labeling is fixed by the government. Uncertainty for the costs associated with government administration (#1) and government monitoring and evaluation (# 2) was not provided in the source materials.^{22, 23} We assumed that uncertainty is 20% around these costs.

For annual costs, namely the government monitoring and evaluation costs (#2) and the recurring costs in industry compliance (part of #3), and the reformulation costs (#4), we applied a 3% discounting rate recommended by the Second Panel on cost-effectiveness in health and medicine⁴ to reflect the present value of future costs of government monitoring and evaluation, industry compliance and industry reformulation. The model is a closed cohort model, so we computed the discounted present value of per-person costs and total national costs for persons alive at implementation who remained alive in each subsequent year (not for the larger total US population in each year, which also has growth from immigration and new persons reaching the threshold age). The year-specific discounting factor is estimated by $1/(1+3\%)^{(t-1)}$ (t is the number of years of policy intervention, t=1, 2, 3, ..., lifetime). As our model estimated the costs and health outcomes based on a closed cohort and the population size decline over time, we need to express the annual costs in proportion to the population at risk. The population at risk was estimated based on the proportion of death (P_{dt} , t=1, 2, 3, ...) in each year. We first obtained the proportion of people who are alive each year by calculating $1-P_{dt}$ (t=1, 2, 3, ...). Then we multiplied the baseline population size of 235 million by the proportion of people who are alive each year (Appendix Table 5).

We then estimated the per-person annual cost for cost categories #2, #3 (annual part), and #4, by dividing the annual cost estimated in the second year of implementing the policy among all US populations by the population size in the second year. Specifically, for government monitoring and evaluation, the per person annual cost is estimated \$503,648/233,719,989=\$0.00215, the per person annual cost for industry compliance recurring component is \$/233,719,989=\$, and that for reformulation

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is \$662,800,000 /233,719,989=\$2.83587. Taken together, to estimate the discounted annual cost of #2, #3 (annual part), and #4, we multiplied the population at risk, the per person annual cost estimated at year-2, and the year-specific discounting factor, using: discounted annual cost = population at risk x perperson annual cost x $1/(1+3\%)^{(t-1)}$.

Appendix Table 4. Implementation cost estimates for the federal menu calorie labeling policy (in 2015 US dollars)

Policy Effect	Cost Category	One-time Cost*	Annual Cost*	Source	Major Elements
Consumer behavior	1. Government administration#	\$9,073,620 (\$7,258,896 to \$10,888,344)	N/A	FDA FY 2012 Budget Report ²²	 Costs for outreach, education, review of regulatory issues, developing training for inspectors, etc.
	2. Government monitoring and evaluation#	N/A	\$503,648 (\$402,918 to \$604,378) (starting from 2 nd year and last for a lifetime)	Nutrition Review Project report ²³	 Monitor industry compliance Evaluate the accuracy, usefulness, and health impact of the policy intervention
	3. Industry compliance	\$276,632,470 (\$225,552,530 to \$327,205,740)	\$27,648,591 (\$16,756,003 to \$38,649,212) (starting from 2 nd year and last for a lifetime)	FDA's RIA ²⁴ Table 4-8	 Collecting and managing records of nutritional analysis for each standard menu item (initial cost + recurring cost associated with new chains) Revising or replacing existing menus, menu boards, and providing full written nutrition information (initial cost + recurring cost associated with new chains) Training employees to understand the nutrition information to help ensure compliance with the final requirements (initial cost + recurring cost associated with new chains) Legal review (initial cost + recurring cost associated with new chains)
Industry response^	4. Industry reformulation	N/A	\$15,059,100 (\$5,791,900 to \$24,124,700) (starting from 2 nd year and last for a lifetime)	FDA's RIA ²⁴ Table 4-8	 Annually recurring costs of nutrition analysis refer to the nutrition cost that will be incurred by the covered establishments due to the introduction of a new standard or reformulated standard menu items in their menus and the cost that will be incurred by new chains entering the industry Annually recurring changes to menus or menu boards will be tied to new or reformulated standard menu items. In general, these future changes to menus will be incorporated into the natural menu

		replacement cycle, so there will be no additional recurring menu update costs. However, all chain retail food establishments will need to provide additional written nutrition information for the reformulated or newly introduced menu items
		Average formula count, 6 new menu items, and 6 reformulated items per year FDA reformulation cost model

*Policy intervention costs were inflated to 2015 US (December) dollars using the Consumer Price Index.

Given no range of uncertainty was provided in source materials, we assumed 20% uncertainty around these costs.

^Some chains or establishmerits may respond to increased consumer interest in caloric content standard menu items by reformulating existing menu items or by introducing new, lower-calorie items. The change in manufacturing costs associated with reformulating these items has not been included in the cost estimation, the FDA includes the cost associated with analyzing the nutrition information of new or reformulated items.

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Appendix Table 5. The population size of people who are alive each year over	er a lifetime (in
millions)	

Year Population Size (Million) 1 235.2 2 233.7 3 232.1 4 230.4 5 228.2 : : 67 5.832 68 4.348 69 3.157 70 2.233		minoris)
$ \begin{array}{c ccccccccccccccccccccccccccccccccccc$	Year	Population Size (Million)
$ \begin{array}{c ccccccccccccccccccccccccccccccccccc$	1	235.2
4 230.4 5 228.2 : : 67 5.832 68 4.348 69 3.157 70 2.233	2	233.7
5 228.2 : : 67 5.832 68 4.348 69 3.157 70 2.233	3	232.1
: : 67 5.832 68 4.348 69 3.157 70 2.233	4	230.4
67 5.832 68 4.348 69 3.157 70 2.233	5	228.2
68 4.348 69 3.157 70 2.233		:
68 4.348 69 3.157 70 2.233	67	5.832
69 3.157 70 2.233		
70 2.233		

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Appendix 6. Annual health-related costs among cancer patients and the general population without cancer

The annual health-related costs data include: 1) medical expenditure, 2) productivity loss from missed workdays or disability, and 3) patient time cost associated with receiving care for cancer survivors by age (under 65 vs. above 65 years old) and phase of care (initial, continuing, end-year of life); 4) medical expenditure, 5) productivity loss, and 6) patient time cost for individuals without cancer by age and status of end year of life. The description of the data source and data structure were provided in **Appendix Table 6**.

We extracted the raw data for each of the costing components from the published literature.^{15, 25-} ²⁹ The overall assumptions for data extraction include: 1) health-related costs for breast cancer among postmenopausal females, advanced prostate cancer, esophageal adenocarcinoma, and stomach cardia cancer, by age, sex, and phase of cancer care, were the same as those for breast cancer, prostate cancer, esophagus cancer, and stomach cancer; 2) if no data available for a specific cancer type, we assumed the costs for that cancer type were the same as the estimates of costs for all-cancer sites, e.g., medical expenditure for all-cancer sites were used to replace the medical expenditures for multiple myeloma, gallbladder, liver, and thyroid cancers; 3) we extracted the costs for end-year of life due to cancer death and assumed that death due to other causes is not a competing outcome; 4) we assumed that the end-year life medical expenditure for individuals without cancer does not vary by the 32 subgroups.

If a specific costing component was not reported directly in the raw data, we calculated the cost for that component based on available data. For example, the annual productivity loss for colorectal cancer was reported as a percentage of total health-related costs.²⁹ We multiplied the percentage and the total health-related costs to obtain the productivity loss for colorectal cancer. We also performed data imputation for unavailable data. For instance, the annual productivity loss for all-cancer sites was

reported by time interval since cancer diagnosis (diagnosed within one year vs. diagnosed greater than one year).²⁵ To obtain this costing component by the defined phases of care, we calculated the weighted means which was used as the annual productivity loss for the continuous phase. We then assumed that the productivity loss in the initial phase and end-of-life phase of cancer care are 1.3 times and 4 times the mean estimates based on available data for other cancers.^{15, 25} For individuals without cancer, we assumed that the end-of-life productivity loss is 4 times to the mean estimate of the productivity loss. The same rules applied to data imputation for patient time costs.

We then applied the age shifting to keep the expenditures consistent within each age group. Starting from 2021, individuals in the cohort of 55-64 years old have turned into the cohort of 65 years and older. Therefore, we assumed that starting from 2021, the health-related expenditures for individuals who were in the cohort of 55-64 years old would be the same as those for individuals who were in the cohort of 65 years and older at the beginning of the DiCOM model. Based on the same assumption, starting from 2031 and 2047, the health-related expenditures for the cohort of 45-54 years old and those for the cohort of 20-44 years old were projected to be the same as those for the cohort of 65 years and older, respectively. We followed the same rule and applied the age shifting for the health-related expenditures for individuals without cancer. All estimations and projections were performed in SAS 9.4. All health-related expenditures were inflated to 2015 US dollars using the Personal Health Care (PHC) index.

	A. Cancer Survivors		B. Individuals with	out Cancer
	Data source (Excess or Total)	Category	Data source	Category
Medical expenditure	Mariotto et al. 2011, SEER-Medicare, in 2010 US dollars (Excess)	-by phase of care ¹ -by age (under 65 vs. above 65 years old) -by sex	Kim et al. 2018, MEPS 2013-2014, <i>in vivo</i> analysis, in 2014 US dollars (Total)	-Medical expenditure all US adults -by 32 subgr stratified by sex, and race/ethnicit
			Hogen et al. 2001, SEER-Medicare (65+), in 2001 US dollars (Total)	-Medical expenditure end year of among all U adults
Productivity loss	Zheng et al. 2016, MEPS 2008-2012, data available for colorectal, female breast, and prostate cancers, in 2012 US dollars (Total)	-by age		
	Guy et al. 2013, MEPS 2008-2010, all types of cancer, in 2010 US dollars (Total)	-by age -by time interval since cancer diagnosis (less than 1 year vs. greater than 1 year) ²	Guy et al. 2013, MEPS 2008-2010, in 2010 US dollars (Total)	-by age
Patient time cost	Yabroff et al. 2014, MEPS 2008-2011, all types of cancer, in 2011 US dollars (Total)	-by age	Yabroff et al. 2014, MEPS 2008-2011, in 2011 US dollars (Total)	-by age

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Consolidated Health Economic Evaluation Reporting Standards – CHEERS Checklist Page 98 of 99

CHEERS Checklist

Items to include when reporting economic evaluations of health interventions

The **ISPOR CHEERS Task Force Report**, *Consolidated Health Economic Evaluation Reporting Standards (CHEERS)—Explanation and Elaboration: A Report of the ISPOR Health Economic Evaluations Publication Guidelines Good Reporting Practices Task Force*, provides examples and further discussion of the 24-item CHEERS Checklist and the CHEERS Statement. It may be accessed via the *Value in Health* or via the ISPOR Health Economic Evaluation Publication Guidelines – CHEERS: Good Reporting Practices webpage: <u>http://www.ispor.org/TaskForces/EconomicPubGuidelines.asp</u>

Section/item	Item No	Recommendation	Reported on page No/ line No
Title and abstract			
Title	1	Identify the study as an economic evaluation or use more specific terms such as "cost-effectiveness analysis", and describe the interventions compared.	Page 1/Lines 1-2
Abstract	2	Provide a structured summary of objectives, perspective, setting, methods (including study design and inputs), results (including base case and uncertainty analyses), and conclusions.	Pages 3-4/ Lines 32-59
Introduction			
Background and objectives	3	Provide an explicit statement of the broader context for the study. Present the study question and its relevance for health policy or practice decisions.	Pages 5-6/ Lines 64-92
Methods			Page 9/
Target population and subgroups	4	Describe characteristics of the base case population and subgroups analysed, including why they were chosen.	Lines 106-113
Setting and location	5	State relevant aspects of the system(s) in which the decision(s) need(s) to be made.	Page 6/Lines 96
Study perspective	6	Describe the perspective of the study and relate this to the costs being evaluated.	Page 12/ Lines 189-197
Comparators	7	Describe the interventions or strategies being compared and state why they were chosen.	Pages 9-10/ Lines 125-140
Time horizon	8	State the time horizon(s) over which costs and consequences are being evaluated and say why appropriate.	Page 6/ Lines 98-99
Discount rate	9	Report the choice of discount rate(s) used for costs and outcomes and say why appropriate.	Page 12 /Line 198
Choice of health outcomes	10	Describe what outcomes were used as the measure(s) of benefit in the evaluation and their relevance for the type of analysis performed.	Page 11/ Lines 158-170
Measurement of effectiveness	11a	<i>Single study-based estimates:</i> Describe fully the design features of the single effectiveness study and why the single study was a sufficient source of clinical effectiveness data.	

1 2 3		11b	<i>Synthesis-based estimates:</i> Describe fully the methods used for identification of included studies and synthesis of clinical	Pages 9-11/ Lines 115-170
4		10	effectiveness data.	
5 6	Measurement and valuation of preference	12	If applicable, describe the population and methods used to elicit preferences for outcomes.	
7	based outcomes			
8 9 10 11 12	Estimating resources and costs	13a	<i>Single study-based economic evaluation:</i> Describe approaches used to estimate resource use associated with the alternative interventions. Describe primary or secondary research methods for valuing each resource item in terms of its unit cost.	
13			Describe any adjustments made to approximate to opportunity	
14			costs.	
15 16		13b	Model-based economic evaluation: Describe approaches and	
17 18			data sources used to estimate resource use associated with model health states. Describe primary or secondary research	Page 11/
19			methods for valuing each resource item in terms of its unit	Lines 168-170
20			cost. Describe any adjustments made to approximate to	
21 22	~		opportunity costs.	
23	Currency, price date,	14	Report the dates of the estimated resource quantities and unit	
24	and conversion		costs. Describe methods for adjusting estimated unit costs to	D 10/1 107 100
25			the year of reported costs if necessary. Describe methods for	Page 12/Line 197-198
26 27			converting costs into a common currency base and the exchange rate.	
28	Choice of model	15	Describe and give reasons for the specific type of decision-	
29	Choice of model	15	analytical model used. Providing a figure to show model	Supplementary Figure 1
30			structure is strongly recommended.	Pages 9-10/
31	Assumptions	16	Describe all structural or other assumptions underpinning the	Lines 118-120, 128-129,
32 33	Assumptions	10	decision-analytical model.	135-140, 145-152
34	Analytical methods	17	Describe all analytical methods supporting the evaluation. This	
35	2		could include methods for dealing with skewed, missing, or	
36 37			censored data; extrapolation methods; methods for pooling	Page 13/
38			data; approaches to validate or make adjustments (such as half	Lines 210-214
39			cycle corrections) to a model; and methods for handling	
40			population heterogeneity and uncertainty.	
41 42	Results			
42 43	Study parameters	18	Report the values, ranges, references, and, if used, probability	
44	J. T. J. F. T.	-	distributions for all parameters. Report reasons or sources for	
45			distributions used to represent uncertainty where appropriate.	
46			Providing a table to show the input values is strongly	Pages 7-8/Table 1
47			recommended.	
48 49	Incremental costs and	19	For each intervention, report mean values for the main	
49 50	outcomes		categories of estimated costs and outcomes of interest, as well	Pages 16-17/
51			as mean differences between the comparator groups. If	-
52			applicable, report incremental cost-effectiveness ratios.	Table 2
53	Characterising	20a	Single study-based economic evaluation: Describe the effects	
54 55	uncertainty		of sampling uncertainty for the estimated incremental cost and	
55 56	· J			
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	20b	incremental effectiveness parameters, together with the impact of methodological assumptions (such as discount rate, study perspective). <i>Model-based economic evaluation:</i> Describe the effects on the results of uncertainty for all input parameters, and uncertainty	Page 21/
Characterising		related to the structure of the model and assumptions.	Lines 282-29
heterogeneity	21	If applicable, report differences in costs, outcomes, or cost- effectiveness that can be explained by variations between subgroups of patients with different baseline characteristics or other observed variability in effects that are not reducible by	Pages 18-19/ Lines 267-28
Discussion		more information.	
Study findings,			
limitations, generalisability, and current knowledge	22	Summarise key study findings and describe how they support the conclusions reached. Discuss limitations and the generalisability of the findings and how the findings fit with	Pages 21-24
Other		current knowledge.	
Source of funding	23	Describe how the study was funded and the role of the funder in the identification, design, conduct, and reporting of the	D 26
Conflicts of interest	24	analysis. Describe other non-monetary sources of support. Describe any potential for conflict of interest of study contributors in accordance with journal policy. In the absence	Page 26
		of a journal policy, we recommend authors comply with International Committee of Medical Journal Editors	Pages 26-27

For consistency, the CHEERS Statement checklist format is based on the format of the CONSORT statement checklist

The **ISPOR CHEERS Task Force Report** provides examples and further discussion of the 24-item CHEERS Checklist and the CHEERS Statement. It may be accessed via the *Value in Health* link or via the ISPOR Health Economic Evaluation Publication Guidelines – CHEERS: Good Reporting Practices webpage: <u>http://www.ispor.org/TaskForces/EconomicPubGuidelines.asp</u>

The citation for the CHEERS Task Force Report is:

Husereau D, Drummond M, Petrou S, et al. Consolidated health economic evaluation reporting standards (CHEERS)—Explanation and elaboration: A report of the ISPOR health economic evaluations publication guidelines good reporting practices task force. Value Health2013;16:231-50.

BMJ Open

Cost-Effectiveness Analysis of the Federal Menu Calorie Labeling and Obesity-Associated Cancer Burdens in the United States

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1 Cost-Effectiveness Analysis of the Federal Menu Calorie Labeling and Obesity-Associated 2 **Cancer Burdens in the United States** Mengxi Du, doctoral candidate¹, Christina F. Griecci, postdoctoral fellow¹, Frederick Cudhea, 3 4 statistician¹, Heesun Eom, research assistant^{1,2}, John B. Wong, director of comparative 5 effectiveness research³, Parke Wilde, professor of food and nutrition policy¹, David D. Kim, 6 assistant professor of medicine⁴, Dominique S. Michaud, professor of public health and 7 community medicine⁵, Y. Claire Wang, associate professor, vice president of research, 8 evaluation and policy ^{2,6}, Dariush Mozaffarian, dean and Jean Mayer professor of nutrition¹, 9 Fang Fang Zhang, Neely Family professor of nutrition and cancer¹ on behalf of the Food-PRICE 10 Project 1. Friedman School of Nutrition Science & Policy, Tufts University, Boston, MA 11 12 2. New York Academy of Medicine, New York, NY 13 3. Division of Clinical Decision Making, Tufts Medical Center, Boston, MA 4. Center for the Evaluation of Value and Risk in Health, Institute for Clinical Research and 14 Health Policy Studies, Tufts Medical Center, Boston, MA 15 16 5. Department of Public Health and Community Medicine, School of Medicine, Tufts University, 17 Boston, MA 6. Department of Health Policy and Management, Mailman School of Public Health, Columbia 18 19 University, New York, NY 20 Short Running Head: Cost-Effectiveness of Menu Calorie Labeling to Prevent Cancer 21 Word Count: 3895

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- 24 (<u>fang_fang.zhang@tufts.edu</u>). Phone: 617-636-3740; Fax: 617-636-3727
- 25 Abbreviations: AMPM, Automated Multiple Pass Method; BMI, Body Mass Index; CDC,
- 26 Centers of Disease Control and Prevention; CI, Confidence Interval; DiCOM, Diet and Cancer
- 27 Outcome Model; FDA, Food and Drug Administration; FNDDS, Food and Nutrient Database for
- 28 Dietary Studies; MEC, Mobile Examination Center; NCHS, National Center for Health
- 29 Statistics; NHANES, National Health and Nutrition Examination Survey; PSA, Probabilistic
- 30 sensitivity analysis; SD, Standard Deviation; SE, Standard Error; USDA, United States
- 31 Department of Agriculture; UI, Uncertainty Interval

32	ABSTRACT
33	Objective To assess the impact of menu calorie labeling on reducing obesity-associated cancer
34	burdens in the United States (US).
35	Design Cost-effectiveness analysis using a Markov cohort state-transition model.
36	Setting Policy intervention.
37	Participants A modeled population of 235 million adults aged 20+ years in 2015-2016.
38	Interventions The impact of menu calorie labeling on reducing 13 obesity-associated cancers
39	among US adults over a lifetime was evaluated in scenarios: (1) effects on consumer behaviors;
40	and (2) additional effects on industry reformulation. The model integrated nationally
41	representative demographics, calorie intake from restaurants, cancer statistics, and estimates on
42	associations of policy with calorie intake, dietary change with BMI change, BMI with cancer
43	rates, and policy and healthcare costs from published literature.
44	Main outcome measures Averted new cancer cases and cancer deaths and net costs (in 2015 US
45	dollars) among total population and demographic subgroups. Incremental cost-effectiveness
46	ratios from societal and healthcare perspectives were assessed and compared to the threshold of
47	\$150 000 per quality-adjusted life year (QALY) gained. Probabilistic sensitivity analyses
48	incorporated uncertainty in input parameters and generated 95% uncertainty intervals (UIs).
49	Results Considering consumer behavior alone, this policy was associated with 28 000 (95% UI:
50	16 300-39 100) new cancer cases and 16 700 (9610-23 600) cancer deaths averted, 111 000 (64
51	800-158 000) QALY gained, and \$1480 (\$884-\$2080) million saved in cancer-related medical
52	costs among US adults. The policy was associated with net cost savings of \$1460 (\$864-\$2060)
53	million and \$1350 (\$486-\$2260) million from healthcare and societal perspectives, respectively.
54	Additional industry reformulation would substantially increase policy impact. Greater health

1 2		
2 3 4	55	gains and cost savings were predicted among young adults, Hispanic and non-Hispanic Black
5 6 7	56	individuals.
7 8 9	57	Conclusions Study findings suggest that menu calorie labeling is associated with lower obesity-
10 11	58	related cancer burdens and reduced healthcare costs. Policymakers may prioritize nutrition
12 13 14	59	policies for cancer prevention in the US.
15 16	60	(Word Count: 300)
17 18	61	Keywords: obesity, cost-effectiveness, menu calorie labeling, cancer incidence, cancer death,
19 20 21	62	medical cost
22 23 24	63	
25 26 27	64	Strengths and limitations of this study
28 29	65	• Our study is among the first to demonstrate that the federal menu calorie labeling policy
30 31 32	66	could be a cost-effective strategy to reduce obesity-related cancers in the US and
33 34	67	potentially narrow diet-associated cancer disparities.
35 36 37	68	• This cost-effectiveness evaluation incorporated data input parameters from established
38 39 40	69	resources and the evidence was robust to different policy scenarios.
41 42	70	• However, this modeling study does not provide a real-world evaluation of the impact of
43 44 45	71	policy implementation on health and economic outcomes.
46 47 48	72	• We only modeled the impact of menu calorie labeling on calories although the policy
48 49 50 51	73	may also result in potential changes in the nutritional quality of the restaurant meals.
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74 INTRODUCTION

Obesity affects 1 in 3 Americans and is an established risk factor for 13 types of cancers, such as endometrial, liver, breast, prostate, and colorectal cancers.¹ Obesity-associated cancer represents 40% of all newly diagnosed cancer cases and contributes to 43.5% of total direct cancer care expenditures, estimated at \$35.9 billion (US dollars) in 2015.¹⁻⁷ Rates of obesity-associated cancers are also rising disproportionally among young adults.^{5 8} Substantial health and economic burdens highlight the need to prioritize cost-effective strategies to reduce obesity-associated cancers in the US.

> Diet is one of the few modifiable factors for both obesity and obesity-associated cancers.²⁹ Restaurant meals account for 1 in 5 calories consumed by US adults, including 9% of calories from full-service restaurants and 12% from fast-food restaurants,¹⁰ and therefore, can be an important target for improving population diet. Restaurant meals can have very high calories, with a mean energy of 1362 kcal/meal and 969 kcal/meal in popular meals from randomly selected full-service and fast-food restaurants, respectively.¹¹ Consistently, individuals who cook less frequently at home consume more daily calories than those who cook more at home.¹² Thus, reducing calories consumed from restaurant meals has the potential to reduce daily calorie intake and subsequent obesity and obesity-related cancer burdens.

93 To help consumers make lower-calorie choices, the Affordable Care Act mandated that all chain 94 restaurants with 20 or more outlets post calorie information on menus and menu boards for all 95 standard menu items.¹³ The FDA published the final rules for this policy in 2016, which was 96 subsequently implemented in 2018. A meta-analysis of 14 interventional studies including 5 Page 7 of 103

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97 randomized controlled trials (RCTs) and a recent quasi-experimental longitudinal study among 98 104 restaurants demonstrated that menu calorie labeling resulted in a reduction of 7.3% in caloric 99 intake per meal and a 60 kcal (4%) reduction in calorie purchased per transaction, respectively.¹⁴ 100 ¹⁵ Such policy can also motivate restaurant reformulation to lower calorie contents or introduce 101 healthier food options.¹⁶⁻²¹ Prior cost-effectiveness analyses suggest that this policy is associated 102 with substantial health gains and is a cost-saving strategy for reducing obesity and obesityrelated diseases.^{22 23} It was estimated that the menu calorie labeling on fast foods was associated 103 104 with a 25 kJ (6 kcal) reduction in mean daily energy intake, leading to a -0.2 kg change in mean 105 body weight, a gain of 63 492 health-adjusted life years, and net savings of half billion (2010 106 Australian dollars) among Australians aged 2 years and above over their lifetime.²² Researchers 107 in the US have demonstrated that this policy would prevent a large number of incident 108 cardiovascular diseases (135 781) and type 2 diabetes (99 736) and net savings of over \$10 billion (2018 US dollars) among US adults over a lifetime.^{22 23} However, the health and 109 110 economic benefits of the policy for obesity-associated cancers have not been evaluated. This 111 study aimed to address the knowledge gap by evaluating the cost-effectiveness of the federal 112 menu calorie labeling and obesity-associated cancer burdens among US adults. 113 114 **METHODS** 115 **Study Overview** The Diet and Cancer Outcome (DiCOM), a probabilistic cohort state-transition model,^{24,25} was 116

117 used to perform an economic evaluation of the menu calorie labeling and obesity-associated

118 cancer rates among 235 million US adults aged 20 years and older (US Census), by comparing a

119 policy scenario (menu calorie label) to status quo (no policy), over a simulated lifetime starting

from 2015. The model consists of (1) four health states: healthy without cancer, initial diagnosis and treatment for 13 types of obesity-related cancers, continuous care for each of the 13 cancers, and death (from 13 cancers or other causes); (2) the annual likelihood of changes in health; and (3) the lifetime consequences of such changes on health outcomes and economic costs. (Supplementary Figure 1). The DiCOM model integrated independent parameters from different data sources, including nationally representative population demographics, dietary intake, and cancer statistics; association estimates of policy intervention with diet, diet change with body mass index (BMI), and BMI with cancer risks; and policy and health-related costs from established sources (Table 1). This study used de-identified datasets and was exempt from institutional review board review and follows the Consolidated Health Economic Evaluation Reporting Standards (CHEERS) reporting guidelines.

Table 1. Key input parameters and data sources in the Dietary Cancer Outcome M	odel (DiCOM)

Model Input	Outcome	Estimates	Distribution	Comments	Data Source	
1. Simulated population	Population	Mean consumption of calories was 332 kcal/d from full-service or fast-food restaurants (Supplementary Tables 1, 8-9)	Gamma	Stratified by age, sex, race/ethnicity; 32 subgroups	NHANES 2013-2016	
2. Policy effect ¹					Meta-analysis of labeling	
a) Consumer behavior	Policy effect	7.3% (4.4%-10.1%) (Appendix 1 and Appendix Table 1)	Beta	One-time effect	interventions on reducing calorie intake, Shangguan et al., 2019, American Journal of Preventativ Medicine	
b) Industry response	Policy effect	5% (Appendix 1 and Appendix Table 2)	Beta	Assumption: no reformulation in the 1st year of policy intervention; Restaurants will replace the high-calorie menu items with low-calorie options or reformulate the menu items in years 2 to 5 of the intervention to achieve a 5% reduction in calorie contents	Calorie changes in large chair restaurants from 2008 to 2018 Bleich et al. 2017, Prev Med; Higher-Calorie Menu Items Eliminated in Large Chain Restaurants, Bleich et al. 2018 American Journal of Preventa Medicine	
3. Effect of change in calorie intake on BMI change (kg/m²) ¹	Dietary effect	Among individuals with: BMI <25: 0.0015 per kcal BMI ≥25: 0.003 per kcal	Normal	Assumption: 55 kcal per day reduction in calorie intake would lead to 1 pound weight loss within 1 year, with no further weight loss in the future	Hall et al., 2018, JAMA; Hall e 2011, Lancet	
4. Etiologic effect of BMI on cancer outcomes ¹	Cancer outcome	RRs ranged from 1.05 to 1.50 (Supplementary Table 2)	Lognormal	BMI change and cancer incidence	Continuous Update Project (C conducted by the World Canc Research Fund (WCRF)/Ame	

					Institute for Cancer Research (AICR)
5. Cancer statistics ¹	Cancer incidence ³ and survival	Appendixes 2-3, Appendix Tables 2-3, and Supplementary Tables 3-4	Beta	Stratified by age, sex, and race/ethnicity	NCI's Surveillance, Epidemiolo and End Results Program (SE Database; CDC's National Program of Cancer Registries (NPCR) Database
6. Healthcare-related costs ^{1,2}	Medical expenditures, productivity loss, and patient time costs	Appendix 6, Appendix Table 6, and Supplementary Tables 6-7	Gamma	Stratified by age, and sex	NCI's Cancer Prevalence and Cost of Care Projections; Published literature
7. Policy costs ^{1,2}	For government and industry	Appendix 5 and Appendix Tables 4-5	Gamma	Administration and monitoring costs for government; compliance and reformulation costs for industry	FDA's budget report; Nutrition Review Project; and FDA's RIA
8. Health-related quality of life (HRQOL) ¹	For 13 types of cancers	Ranged from 0.64 to 0.86 (Appendix 4 and Supplementary Table 5) Drug Administration; NCI, National Cance	Beta	EQ-5D ⁴ data from published literature by cancer type	Published literature

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131 Simulated US Population

132 Because FDA's final rules on menu calorie labeling were published in 2016 and implemented in 133 2018, considering that some restaurants have implemented this policy prior to 2016 given the 134 law was passed in 2010, we used 2015-2016 as the baseline and assumed a closed cohort for this 135 analysis. The projected population size of US adults aged 20+ in 2015-2016 was obtained from the US Census data.²⁶ We combined the 2013-2016 National Health and Nutrition Examination 136 137 Survey (NHANES) to approximate the baseline and simulate the nationally representative US 138 adult population aged 20+ years in 32 subgroups stratified by age (20-44, 45-54, 55-64, 65+), sex 139 (men, women), and race/ethnicity (non-Hispanic White, non-Hispanic Black, Hispanic, Other) 140 (Supplementary Table 1). This closed cohort of US adults was modeled from baseline through 141 their lifetime up to 80 years or until death.

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143 Calorie Consumption from Restaurants

144 Mean calorie consumption from full-service and fast-food restaurants, demographics, and 145 prevalence of overweight or obesity were estimated using data collected from NHANES 146 participants with at least one valid 24-hour diet recall, in every 32 strata. Following FDA's estimates,¹³ we assumed that policy would affect 56.5% of calories consumed at full-service 147 148 restaurants and 100% at fast-food restaurants. The National Cancer Institute method was used to 149 estimate the usual intake distribution by statistically adjusting for within vs. between variance in dietary recalls.²⁷⁻²⁹ The complex survey design was incorporated in all statistical analyses to 150 151 ensure the representativeness of study findings to the non-institutionalized US adults.

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153 Policy Association with Calorie Consumption

Policy association with consumer behaviors was obtained from a systematic review and metaanalysis of 13 interventional studies (5 RCTs) with 19 interventions conducted in fast-food, fullservice, cafeterias, and laboratories between 2000 and 2015 that evaluated the effectiveness of menu calorie labeling on consumers' calorie consumption per meal (Appendix 1 and Appendix Table 1).¹⁵ The study results showed a 7.3% (95% CI: 4.4%-10.1%) reduction in calories consumed per meal following calorie labeling. We assumed that the policy would have a onetime effect over one year, with no further change over time.

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162 Policy intervention may stimulate industries to reformulate their products to lower the calorie 163 content. Potential policy impact on industry reformulation was derived from studies of restaurant 164 menu items following the passage and initial period of partial implementation of the final rules 165 (Appendix Table 2). Between 2012-2014, among 66 of the 100 largest US chain restaurants, 166 replacing higher-calorie menu items with lower-calorie items led to a 1-5% calorie reduction per 167 menu item.^{19 20} Among 44 chain restaurants with menu calorie information available in 2008, the calories per menu item fell by 7% between 2008 and 2015.¹⁸ Based on the evidence, we chose 168 169 5% as the mid-point for the potential policy impact on industry response, which may include 170 discontinuation of existing high-calorie menu items and/or introduction of lower-calorie menu 171 items. We assumed that no reformulation occurs in the 1st year of policy intervention, and 172 restaurants will replace the high-calorie menu items with low-calorie options or reformulate the 173 menu items in years 2 to 5 of the intervention to achieve a 5% reduction in calorie content, with 174 no change thereafter. Combining the effect on consumer behaviors with the effect on industry 175 response, the policy would lead to a 12.3% reduction in calories consumed per meal.

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In addition, we conservatively assumed that there would be some compensatory increased calorie intake outside of restaurants so that only half of all calories reduced from restaurant meals would translate into long-term reductions in daily calories (compensation rate = 50%). Therefore, the reduction in calorie consumption from fast-food or full-service restaurants among the simulated population was computed using the baseline consumption times the policy effect estimates, and then times the compensation rate.

² 184 Calorie Reduction and Obesity-Associated Cancer Risk

185 To estimate the relationships between calorie intake and obesity-associated cancers, we 186 associated the multivariate-adjusted association of change in calorie intake (kcal/day) with 187 change in BMI (kg/m²) and the estimates of BMI and cancer risks. Based on an established 188 energy-weight dynamic model that accounted for the long-term impacts of calorie reduction on 189 weight and metabolic expenditure, we assumed that each 55 kcal/day calorie reduction leads to 1 190 pound weight loss over one year among overweight or obese adults, with no further reduction 191 thereafter.^{30 31} Because long-term observational studies suggest that weight change for an 192 equivalent change in dietary intake is about twice as large in overweight or obese adults than 193 normal-weight adults, ^{32 33} we conservatively applied half of this estimate to individuals with 194 normal weight. For each of the 13 obesity-related cancers, the estimated change in risk for each 5 195 kg/m² change in BMI was derived from the systematic reviews and meta-analyses of 196 multivariable-adjusted prospective cohort studies conducted by the World Cancer Research 197 Fund/American Institute for Cancer Research Continuous Update Project and the International 198 Agency for Research on Cancer (Supplementary Table 2).²

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200 Cancer Incidence, Mortality, and Health-Related Quality of Life

201 Age-adjusted cancer incidences in 2015 were obtained from the National Program of Cancer 202 Registries and the Surveillance, Epidemiology, and End Results (SEER) program. We projected 203 the cancer incidence from 2015 to 2030 based on the 2006-2014 trend using the Average Annual 204 Percent Change method.³⁴ We then combined the projected incidence rates with the projected US 205 population from the National Interim Projections³⁵ to account for changes in population age 206 distribution over time. We further applied the cohort-period method to estimate cancer incidence 207 in the closed cohort of US adults in each of the 32 groups as they age (Appendix 2, Appendix 208 Table 2, and Supplementary Table 3). The 5-year relative survival rates for each cancer were 209 extracted and converted to an annual probability of death (Appendix 3, Appendix Table 3, and 210 Supplementary Table 4).³⁶⁻³⁸ Health-related quality of life data were obtained from publications 211 that reported EuroQol-5 Dimension utility weights for each cancer among US patient population 212 (Appendix 4 and Supplementary Table 5).

- 213
- 214 **Policy and Health-Related Costs**

215 Policy costs included government costs to administer, monitor, and evaluate the policy and 216 industry costs to comply with the policy and reformulate their products (in scenario 2). 217 Government costs were estimated from FDA's budget report and Nutrition Review Project (Appendix 5 and Appendix Tables 4-5).^{39 40} Industry compliance and reformulation costs were 218 219 based on the FDA's regulatory impact analysis that included initial and recurring nutrition 220 analysis of standard menu items and menu replacement, provision of nutrition information,

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221 employee training, and legal review and accounted for restaurant size and type, reformulation 222 type, and compliance period.¹³

224 Direct medical costs for cancer care were extracted from the SEER-Medicare linked database for 225 three phases of cancer care: initial (12 months after diagnosis), continuing, and end-of-life (the last year of life) (Appendix 6, Appendix Table 6, and Supplementary Tables 6-7).^{34 41} For 226 227 individuals without cancer, the direct medical costs were estimated based on Medical Expenditure Panel Survey (MEPS) data and insurance claims.^{25 42 43} Indirect costs including 228 229 productivity loss due to disability or missed workdays and patient time costs were derived from publications using MEPS data.44-47 230

232 **Cost-Effectiveness Analysis**

Following the guidelines on cost-effectiveness in health and medicine,⁴⁸ we evaluated the policy 233 234 impact by projecting the numbers of new cancer cases and cancer deaths averted and quality-235 adjusted life-years (QALYs) gained and cost-effectiveness from both healthcare and societal 236 perspectives. Net costs from the healthcare perspective were assessed as the difference between 237 government costs for implementing the policy and the direct medical costs of cancer care. Net 238 costs from the societal perspective were assessed as the difference between total policy costs 239 (including both government and industry costs) and health-related costs saved (including direct 240 and indirect costs of cancer care). All costs were inflated to 2015 US dollars using the Consumer 241 Price Index or Personal Health Care Index, with all costs and QALYs discounted at 3% 242 annually.⁴⁸ Incremental cost-effectiveness ratios (ICERs) were calculated as net costs divided by 243 the difference in QALYs between policy vs. no policy. ICERs falling below a willingness-to-pay

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3 4	244	threshold of \$150,000 per QALY gained were considered to be cost-effective. ^{49 50} Cost-
5 6 7	245	effectiveness analysis was further conducted among population subgroups by age, sex, and
7 8 9	246	race/ethnicity to evaluate policy associations with health disparities.
10 11 12	247	
13 14 15	248	One-way sensitivity analyses were performed by varying input parameters, including reducing
15 16 17	249	the outside-the-restaurant calorie compensation level to 25% or increasing it to 75%, altering
18 19	250	coverage of the FDA's final rule to all calories from full-service restaurants, reducing the diet-
20 21	251	BMI associations to half or doubling the estimates, incorporating an estimated 2% annual
22 23 24	252	increase in medical expenditures associated with cancer care, and altering annual discounting
24 25 26	253	rates from 3% to 0% or 5%. We also evaluated impacts at a 10-year time horizon for
27 28	254	stakeholders interested in shorter-term health gains and economic benefits. Probabilistic
29 30	255	sensitivity analyses (PSAs) were conducted to incorporate uncertainty in all input parameters
31 32 33	256	jointly (Table 1). A total of 1000 Monte Carlo simulations were performed, and 95% uncertainty
34 35	257	intervals (UIs) were estimated based on the 2.5 and 97.5 percentiles of 1,000 simulations. All
36 37	258	analyses were conducted using SAS (Version 9.4) and R (Version 3.3.1).
38 39 40	259	
41 42	260	Patient and Public Involvement
43 44 45	261	This study used de-identified datasets and did not involve patients or the public in the design,
45 46 47 48 49 50 51 52 53 54	262	conduct, reporting, or dissemination plans of our research.
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3 4	263	RESULTS
5 6	264	Population Characteristics
7 8 9	265	The simulated cohort of US adults in 2015-2016 had a mean age of 47.8 years, with 65.0% being
9 10 11	266	non-Hispanic white adults and 71.4% being overweight or obese (Supplementary Tables 8-9). A
12 13	267	mean of 332 daily calories was consumed from full-service or fast-food restaurants. Higher
14 15	268	levels were consumed among younger adults aged 20-44 years (425 kcal/day), men (388
16 17 18	269	kcal/day), non-Hispanic black (361 kcal/day), and Hispanic (367 kcal/day) adults, in comparison
19 20	270	to other corresponding subgroups.
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25 26	272	Health Gains
27 28	273	The menu calorie labeling was estimated to reduce calories consumed from restaurants by a
29 30	274	mean of 24 kcal/day among US adults, and total daily calories by 12 kcal/day. Accounting for
31 32 33	275	potential industry reformulation would reduce the mean intake by an additional 16 kcal/day, and
34 35	276	total daily calories by 8 kcal/day.
36 37	277	
38 39	278	Based on changes in consumer behavior alone, the policy was associated with a reduction of
40 41 42	279	28,000 (95% UI: 16,300-39,100) new cancer cases and 16,700 (9,610-23,600) cancer deaths, and
43 44	280	a gain of 111,000 (64,800-158,000) QALYs among 235 million US adults over a median follow-
45 46	281	up of 34.4 years (Table 2 and Figure 1). By cancer type, the greatest numbers of new cancer
47 48	282	cases averted were cancers of endometrial (N [95% UI]: 5,700 [2,380-9,190]), liver (5,180
49 50 51	283	[2,800-7,730]), kidney (5,090 [2,670-7,730]), post-menopausal breast (4,840 [2,010-8,230]), and
52 53	284	pancreas (1,400 [756-2,100]). The greatest numbers of prevented cancer deaths were estimated
54 55	285	for cancers of the liver (4,530 [2,410-6,760]), post-menopausal breast (3,080 [861-5,650]),
56 57 58		
58 59 60		16 For peer review only - http://bmjopen.bmj.com/site/about/guidelines.xhtml

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3 4	286	endometrial (2,060 [957-3,220]), kidney (1,980 [1,080-2,920]), and pancreas (1,230 [661-
5 6	287	1,830]).
7 8	288	
9 10 11	289	Based on additional industry response, the total estimated health gains approximately doubled,
12 13	290	preventing 47,300 (35,400-59,100) new cancer cases and 28,200 (21,100-35,300) cancer deaths,
14 15 16	291	and gaining 189,000 (140,000-236,000) QALYs, with similar rankings of the types of new
 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 	292	cancer cases and cancer deaths prevented.
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Table 2. Estimated health gains and costs of the federal menu calorie labeling on reducing the obesity-related cancer burdens in the US over 10 years and a lifetime (US population=235,162,844)¹

6—	Menu Calorie Labeling Policy				
/— 8	10 Years		Lifetime		
o 9		Consumer Behavior	Consumer Behavior +	Consumer Behavior	Consumer Behavior +
10		Median (2.5% to 97.5%)	Industry Response	Median (2.5% to 97.5%)	Industry Response
			Median (2.5% to 97.5%)		Median (2.5% to 97.5%)
12	New Cancer Cases Averted, N (959	% UI)			
13	Endometrial cancer	692 (276 to 1100)	1130 (716 to 1550)	5700 (2380 to 9190)	9920 (6630 to 13600)
14	Liver cancer	366 (144 to 615)	626 (386 to 887)	5180 (2800 to 7730)	8550 (5960 to 11300)
	Kidney cancer	584 (290 to 884)	980 (689 to 1280)	5090 (2670 to 7470)	8620 (6200 to 11000)
15	Breast cancer (postmenopausal)	670 (256 to 1110)	1080 (658 to 1520)	4840 (2010 to 8230)	8520 (5610 to 12200)
16	Pancreatic cancer	170 (83 to 257)	273 (183 to 367)	1400 (756 to 2100)	2380 (1690 to 3140)
17	Esophageal adenocarcinoma	179 (56 to 304)	286 (159 to 411)	1350 (485 to 2230)	2330 (1440 to 3280)
18		189 (97 to 284)	319 (225 to 418)	1050 (561 to 1600)	1780 (1230 to 2370)
19	Multiple myeloma	75 (37 to 117)	122 (81 to 169)	690 (384 to 1090)	1150 (775 to 1630)
20	Stomach cancer (cardia)	54 (6 to 109)	98 (51 to 165)	647 (261 to 1140)	1090 (644 to 1660)
21	Thyroid cancer	105 (58 to 161)	176 (123 to 243)	516 (206 to 914)	951 (576 to 1420)
22	Advanced prostate cancer	66 (17 to 118)	107 (57 to 162)	339 (138 to 561)	577 (352 to 836)
23	Gallbladder cancer	29 (16 to 42)	46 (34 to 60)	314 (213 to 438)	512 (399 to 648)
24	Ovarian cancer	33 (15 to 56)	53 (33 to 78)	147 (44 to 282)	254 (110 to 420)
25	Total	3300 (1750 to 4720)	5230 (3870 to 6790)	28000 (16300 to 39100)	47300 (35400 to 59100)
26	Cancer Deaths Prevented, N (95%	UI)			
27	Liver cancer	168 (59 to 287)	287 (174 to 410)	4530 (2410 to 6760)	7510 (5200 to 9980)
28	Breast cancer (postmenopausal)	68 (33 to 106)	111 (74 to 149)	3080 (862 to 5650)	5590 (3230 to 8310)
29	Endometrial cancer	52 (20 to 86)	87 (55 to 121)	2060 (957 to 3220)	3520 (2390 to 4700)
30	Kidney cancer	70 (29 to 110)	114 (74 to 154)	1980 (1080 to 2920)	3320 (2430 to 4300)
31	Pancreatic cancer	88 (38 to 138)	143 (93 to 195)	1230 (661 to 1830)	2080 (1480 to 2740)
	Esophageal adenocarcinoma	76 (21 to 131)	122 (69 to 178)	1150 (403 to 1930)	1990 (1210 to 2820)
32	Colorectal cancer	34 (17 to 53)	57 (40 to 77)	706 (369 to 1080)	1200 (839 to 1600)
33	Stomach cancer (cardia)	22 (2 to 48)	40 (19 to 68)	541 (230 to 947)	907 (538 to 1400)
34	Multiple myeloma	18 (8 to 30)	29 (18 to 42)	420 (239 to 662)	691 (481 to 980)
35	Gallbladder cancer	13 (7 to 20)	21 (15 to 28)	267 (181 to 369)	436 (341 to 551)
36	Advanced prostate cancer	9 (3 to 15)	13 (7 to 19)	163 (65 to 280)	273 (163 to 404)
37	Ovarian cancer	8 (3 to 15)	13 (7 to 20)	107 (39 to 191)	181 (94 to 290)
38	Thyroid cancer	1 (1 to 2)	2 (1 to 3)	23 (11 to 38)	38 (24 to 58)
39	Total	654 (320 to 970)	1080 (746 to 1400)	16700 (9610 to 23600)	28200 (21100 to 35300)
40	_ife Years Gained	678 (288 to 1040)	1120 (738 to 1490)	76400 (43400 to 109000)	130000 (96900 to 162000)
⁴¹ QALYs Gained 4280 (2170 to 6250) 7030 (4960 to 9090) 111000 (64800 to 158000) 189000 (140000 to 236000)					
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2 ³ Changes in Health-Related Co	4 (A) 111 122						
 ³ Changes in Health-Related Cos ⁴ Healthcare (medical) cost 	-192 (-277 to -100)	-319 (-403 to -227)	-1480 (-2080 to -884)	-2500 (-3090 to -1900)			
5 Patient time cost	-7.33 (-10.9 to -3.56)	-12.2 (-15.8 to -8.39)	-102 (-144 to -62.2)	-172 (-216 to -131)			
6 Productivity loss	-48.7 (-70.1 to -24.5)	-80.4 (-102 to -56.7)	-608 (-865 to -363)	-1030 (-1290 to -780)			
7 Policy Implementation Costs (-60.4 (-102 to -50.7)	-000 (-003 to -303)	-1000 (-1290 to -700)			
8 Total	518 (493 to 548)	644 (612 to 680)	839 (780 to 908)	1140 (1060 to 1220)			
9 Government cost	13.2 (11.4 to 15.9)	13.1 (11.4 to 15.7)	18.5 (14.5 to 25.1)	18.5 (14.4 to 25.5)			
10 Administration	9.08 (8.59 to 9.60)	9.07 (8.64 to 9.50)	9.07 (8.61 to 9.56)	9.09 (8.62 to 9.55)			
11 Monitoring	4.09 (2.40 to 6.74)	4.00 (2.35 to 6.63)	9.40 (5.45 to 16.1)	9.38 (5.30 to 16.3)			
12 Industry cost	505 (480 to 535)	631 (599 to 667)	820 (762 to 889)	1120 (1040 to 1210)			
13 Compliance	505 (480 to 535)	506 (480 to 533)	820 (762 to 889)	823 (757 to 889)			
14 Reformulation		124 (107 to 146)		296 (249 to 353)			
14 15 Net Costs (\$, millions) ^{2,3,4}							
16 Societal perspective	270 (156 to 389)	233 (119 to 356)	-1350 (-2260 to -486)	-2570 (-3460 to -1650)			
Healthcare perspective	-179 (-263 to -86.3)	-305 (-390 to -214)	-1460 (-2060 to -864)	-2480 (-3070 to -1880)			
18 ICER (dollars/QALY) ⁵							
19 Societal perspective	64500 (26100 to 187000)	33600 (13300 to 72400)	Dominant	Dominant			
	Dominant	Dominant	Dominant	Dominant			
ADDIEVIALIONS. ICER, INCR	emental Cost-Effectiveness Ratio; QALY, qua						
	estimates (95% uncertainty intervals) of each re inflated to 2015 US dollars using the Pers		vention costs were inflated to 2015 U.S.	dollars using the Consumer			
23 Price Index. Negative c		onal ricaliti Gale (1710) index. I olicy inter	vention costs were initiated to 2013 00				
3. Costs are medians from	3. Costs are medians from 1000 simulations so may not add up to totals.						
	4. Net oble were baldalated ab policy boote minute related bote norm related balded balde						
	aluated at \$150,000/QALY. Dominant represe	ents less costly and more effective than the	e "no-policy intervention" scenario.				
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3 4 5	293	Economic Impacts
6 7	294	Implementing the policy would cost the government \$19 (95% UI: \$15-25) million and the
8 9	295	restaurant industry, \$820 (\$762-889) million in compliance costs over a lifetime (Table 2). The
10 11 12	296	policy was associated with savings of \$1480 (\$884-2080) million in direct medical costs, \$608
13 14	297	(\$363-865) million in productivity loss costs, and \$102 (\$62-144) million in patient time costs.
15 16	298	Potential industry reformulation would cost the restaurant industry an additional \$296 (\$249-
17 18 19	299	353) million to implement but would also result in greater healthcare savings, including \$2,500
20 21	300	(\$1,900-3,090) million, \$1,030 (\$780-1,290) million and \$172 (\$131-216) million in reduced
22 23	301	direct medical, productivity loss, and patient time costs, respectively.
24 25	302	
26 27 28	303	From both the healthcare and social perspectives, implementing the menu calorie labeling policy
29 30	304	among US adults over a lifetime would be cost-saving. With changes in consumer behavior
31 32	305	alone, the net cost savings were estimated to be \$1,460 (\$864-2,060) million and \$1,350 (\$486-
33 34 35	306	2,260) million from the healthcare and societal perspective, respectively. With additional
36 37	307	industry response, estimated cost savings increased to \$2,480 (\$1,880-3,070) million from the
38 39	308	healthcare perspective and \$2,570 (\$1,650-3,460) million from the societal perspective.
40 41 42	309	
43 44	310	Policy Impacts Among Population Subgroups
45 46	311	Among population subgroups, the consumer response to the policy was estimated to result in
47 48 49	312	greater health gains per 100,000 individuals among adults aged 20-44 years (15 new cancer cases
50 51	313	averted) and 55-64 years (16 new cancer cases averted) than older age groups (aged 65+ years; 6
52 53	314	new cancer cases averted); Hispanic and non-Hispanic Black individuals than Non-Hispanic
54 55 56	315	White group (22 vs. 9 and 17 vs. 9 new cancer cases averted) (Table 3). The numbers of cancer
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316	deaths averted, life-years and QALYs gained, health-related costs saved, and net costs among
317	population subgroups followed a similar pattern (Supplementary Tables 10-11 and
318	Supplementary Figures 2-5). For instance, the policy was associated with more cancer deaths
319	prevented per 100,000 individuals among younger adults aged 20-44 years than older adults aged
320	65+ years (10 vs. 3 cancer deaths averted) and Hispanic and non-Hispanic Black adults than non-
321	Hispanic White individuals (14 vs. 5 and 11 vs. 5 cancer deaths averted). Adding potential
322	industry reformulations resulted in larger health gains among adults aged 45-54 (128% increase
323	in new cancer cases averted) and non-Hispanic White adults (84% increase in new cancer cases
324	in new cancer cases averted) and non-Hispanic White adults (84% increase in new cancer cases averted).

Table 3. Estimated new cancer cases and deaths prevented by the federal menu calorie labeling policy in the US by age, sex, and race/ethnicity, over a lifetime¹

	Consumer Behavior		Consumer Behavior + Industry Response	
	N (95% UI)	Per 100,000 individuals (95% UI)	N (95% UI)	Per 100,000 individuals (95% UI)
New Cancer Cases Averted				
Age				
20-44	15700 (6170 to 25100)	15.0 (5.89 to 24.0)	28000 (18000 to 37500)	26.7 (17.2 to 35.8)
45-54	2810 (-2110 to 8030)	6.61 (-4.97 to 18.9)	6420 (1390 to 11600)	15.1 (3.27 to 27.2)
55-64	6330 (3540 to 9400)	15.7 (8.76 to 23.3)	8640 (5790 to 11800)	21.4 (14.3 to 29.1)
≥65	2740 (795 to 4650)	5.77 (1.68 to 9.80)	4060 (2070 to 5950)	8.55 (4.36 to 12.6)
Sex				
Female	15100 (6650 to 24000)	12.5 (5.51 to 19.8)	25900 (17400 to 34900)	21.4 (14.4 to 28.9)
Male	12500 (4920 to 20100)	10.9 (4.30 to 17.6)	21100 (13500 to 29100)	18.4 (11.8 to 25.4)
Race/Ethnicity				
Non-Hispanic White	14300 (4310 to 24500)	9.16 (2.77 to 15.7)	26300 (16000 to 36700)	16.9 (10.3 to 23.6)
Non-Hispanic Black	4720 (1820 to 8100)	16.6 (6.37 to 28.4)	7630 (4750 to 11100)	26.8 (16.7 to 38.9)
Hispanic	7700 (3560 to 11500)	21.5 (9.93 to 32.2)	11200 (7060 to 15300)	31.3 (19.7 to 42.6)
Other	1150 (-240 to 2440)	7.60 (-1.59 to 16.2)	1990 (652 to 3310)	13.2 (4.33 to 22.0)
Cancer Deaths Prevented				
Age				
20-44	10200 (4170 to 16400)	9.73 (3.98 to 15.7)	18100 (11700 to 24500)	17.3 (11.2 to 23.4)
45-54	1730 (-853 to 4240)	4.07 (-2.01 to 9.97)	3650 (1040 to 6240)	8.58 (2.44 to 14.7)
55-64	3320 (1760 to 4930)	8.21 (4.36 to 12.2)	4480 (2890 to 6090)	11.1 (7.15 to 15.1)
≥65	1200 (285 to 2130)	2.53 (0.60 to 4.48)	1800 (848 to 2720)	3.79 (1.79 to 5.73)
Sex				
Female	7810 (3290 to 12600)	6.47 (2.73 to 10.5)	13400 (8850 to 18500)	11.1 (7.33 to 15.3)
Male	8510 (3500 to 13900)	7.44 (3.06 to 12.1)	14400 (9300 to 20000)	12.6 (8.13 to 17.5)
Race/Ethnicity	. ,	. ,		. , ,
Non-Hispanic White	7920 (2180 to 13900)	5.08 (1.40 to 8.94)	14700 (8770 to 20900)	9.45 (5.64 to 13.5)
Non-Hispanic Black	3010 (1000 to 5370)	10.6 (3.51 to 18.8)	4990 (2950 to 7380)	17.5 (10.4 to 25.9)
Hispanic	4960 (2360 to 7560)	13.8 (6.58 to 21.1)	7190 (4480 to 9870)	20.0 (12.5 to 27.5)
Other	565 (-246 to 1350)	3.75 (-1.63 to 8.97)	1070 (273 to 1870)	7.12 (1.81 to 12.4)

1 2		
3 4 5	325	Sensitivity Analyses
5 6 7	326	In PSA, based on consumer responses alone, the menu calorie labeling was cost-saving over a
8 9	327	lifetime in 93% of 1000 simulations and cost-effective (<\$150,000/QALY) in the remaining 7%
10 11 12	328	from the societal perspective, and was cost-saving in over 98% of 1000 simulations from the
12 13 14	329	healthcare perspective. Adding the additional industry response increased the probability of cost-
15 16	330	savings to nearly 100% of the simulations for both the societal and healthcare perspectives
17 18 19	331	(Figure 2).
20 21	332	
22 23	333	Evaluating health gains, costs, and cost-effectiveness at 10 years, the policy remained cost-
24 25 26	334	saving from the healthcare perspective and was cost-effective from the societal perspective, with
20 27 28	335	an ICER of \$64,500 (26,100-187,000) per QALY based on consumer response alone and
29 30	336	\$33,600 (13,300-72,400) per QALY with additional industry response. The cost-effectiveness of
31 32	337	this policy was most sensitive to varied assumptions of the diet-BMI estimates and annual
33 34 35	338	discounting rates (Supplementary Tables 12-13 and Supplementary Figure 6).
36 37	339	
38 39	340	DISCUSSION
40 41 42	341	This study estimated that the federal menu calorie labeling policy, based on consumer response
43 44	342	alone, was associated with a reduction of approximately 28,000 new cancer cases and 16,700
45 46	343	cancer deaths among US adults over a lifetime, and net savings of \$1,350 and \$1,460 million
47 48 49	344	from societal and healthcare perspectives, respectively. Incorporating additional modest industry
50 51	345	responses, these health and economic gains were approximately doubled. Greater health gains
52 53	346	were expected among younger, middle-aged subgroups, Hispanic, and non-Hispanic Black
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individuals compared with other subgroups. Findings were robust to a range of probabilistic andone-way sensitivity analyses.

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350 Our study findings supported that nutrition policies can have meaningful health and economic 351 impacts on cancer prevention in the US. In this case, a modest change in mean calorie 352 consumption, distributed across the population, was estimated to achieve important reductions in 353 obesity-related cancer burdens among US adults. Using the best available estimates, our study 354 further suggested that the federal menu calorie labeling policy is cost-effective in the short term 355 and cost-saving in the long term in reducing obesity-associated cancer burdens. Many preventive 356 medical screenings are cost-effective, but none of them achieve net savings. For example, among 357 a large cohort of women born in the 1960s over a lifetime, mammography screening starting at 358 age 45 years was estimated to have an ICER of \$40 135/QALY.⁵¹ Colonoscopy screening starting at age 45 years among U.S. adults achieved an ICER of \$33 900/QALY.⁵² Prostate-359 360 specific antigen screening had an ICER of \$70 831 to \$136 332/QALY among U.S. males beginning at 40 years of age over a lifetime.⁵³ In contrast, population-based nutrition 361 362 interventions could be a cost-saving strategy for cancer prevention. Cost-effectiveness analyses 363 showed that a penny-per-ounce tax on sugar-sweetened beverages would be a highly cost-364 effective strategy for cancer prevention among US adults, with an ICER of 13 220, the nutrition 365 facts added sugar labeling would prevent 30 000 incident obesity-related cancer cases and 17 100 366 cancer deaths and be associated with a net saving of 704 million, and processed meat taxes would avert 77 000 colorectal cancer cases and 12 500 stomach cancer cases save 4.5 billion, all 367 368 from the societal perspective.^{24 54 55} Thus, while we shall continue the efforts of increasing the

369 screening rates, we also need to consider population-based strategies to improve nutrition for370 cancer prevention in the US.

Our findings also indicated the importance of assessing potential industry response, which could nearly double health and economic benefits. The additional impacts of industry reformulation in response to nutrition-related policies have been reported in other studies focused on obesityassociated cancer, diabetes, and cardiovascular diseases.^{23 55-57} Our new findings build on this recent work and highlight the importance of potential strategies to encourage industry reformulation under the federal menu calorie labeling framework to further improve the health benefits and cost-effectiveness of such policies.

In addition, our results showed that population-based nutrition policies such as menu calorie labeling can potentially narrow diet-associated cancer disparities. We found greater health gains and economic impacts among racial/ethnic minorities compared to non-Hispanic whites, likely due to higher diet-associated cancer burdens among minorities.⁵⁸ However, labeling policies may have fewer effects on food purchasing behaviors among minorities or socioeconomically disadvantaged groups. Prior studies reported that individuals with higher education and income attainment were more likely to notice and use the menu calorie labels when ordering foods in fast-food or full-service restaurants compared to socioeconomically disadvantaged groups,⁵⁹⁻⁶¹ and multi-racial individuals were less likely to notice and use menu calorie labels in fast food restaurants than non-Hispanic whites.⁵⁹ Previous studies also showed that literacy or numeracy could be a barrier to label use.^{62 63} Thus, it is important for labeling policies to be paired with nutrition education to effectively reduce diet-associated health disparities.

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393	Potential limitations should be considered. First, as a modeling study, our investigation does not
394	provide the impact of real-world policy implementation on the health and economic outcomes of
395	federal menu calorie labeling. However, conducting randomized controlled trials of national
396	nutrition policy interventions is extremely difficult and often implausible while simulation
397	modeling can provide complementary evidence with the flexibility to assess different policy
398	scenarios that help inform policymaking. Second, this evaluation did not include the potential
399	benefits of menu calorie labeling on other health outcomes such as diabetes and cardiovascular
400	diseases. Considering such outcomes is likely to be associated with greater health gains and cost
401	savings. ^{23 64 65} Third, menu calorie labeling could have a greater effect among subgroups with
402	higher levels of income and education and non-Hispanic white adults ⁵⁹⁻⁶¹ and thus exacerbating
403	health disparities. Due to the lack of consistent policy effect sizes among populations with
404	different socioeconomic statuses, we were unable to integrate this into our modeling. Forth, we
405	only modeled the impact of menu calorie labeling on calories although the policy may also result
406	in potential changes in the nutritional quality of the restaurant meals. The majority of current
407	restaurant meals consumed by American adults – 70% of meals consumed from fast-food
408	restaurants and 50% consumed from full-service restaurants – are of poor nutritional quality, and
409	the remainder is only of intermediate nutritional quality, with very few being ideal. ¹⁰ If the
410	policy also improves the quality of restaurant meals, the total reduction in obesity-associated
411	cancer burdens could be greater than our current estimates.
412	

413 CONCLUSIONS

Study findings suggest that menu calorie labeling is associated with lower obesity-related cancer rates and reduced costs. Policymakers may prioritize nutrition policies for cancer prevention in the US.

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Ethics approval: This study used de-identified datasets and was exempt from institutional review board review.

Data sharing: Data described in the manuscript, codebook, and analytic code will be made available upon request.

Transparency Statement: The author affirms that this manuscript is an honest, accurate, and transparent account of the study being reported; that no important aspects of the study have been omitted; and that any discrepancies from the study as planned have been explained.

Dissemination Declaration: Dissemination to the simulated population is not applicable. **Contributors**: MD contributed to the data curation, formal analysis, visualization, original draft preparation, review and editing; CFG contributed to the data curation, review and editing; FFC, HE and DDK contributed to software; JBW, PW, DDK, DSM, YCW, and DM contributed to the review and editing; FFZ contributed the conceptualization, methodology, review and editing, supervision, and funding acquisition. All authors approved the final version. FFZ acts as the guaranter of the study.

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Figure 1. Estimated New Cancer Cases and Deaths Prevented by Federal Menu Calorie Labeling Policy in the US by Cancer Type over a Lifetime

Figure 2. Probabilistic Sensitivity Analyses (PSA) for Cost-Effectiveness of the Federal Menu Calorie Labeling Policy over 10 years and a Lifetime

Legend: Values are presented in cost-effectiveness planes of net costs (\$millions) versus incremental quality-adjusted life years (QALYs). For each policy scenario, each colored dot represents one of the 1000 simulations, with the largest dot showing the median incremental cost-effectiveness ratio (ICER, \$/QALY); and the ellipse representing the 95% UIs. Results are presented from the societal perspective and the healthcare perspective. Negative values indicate cost savings.

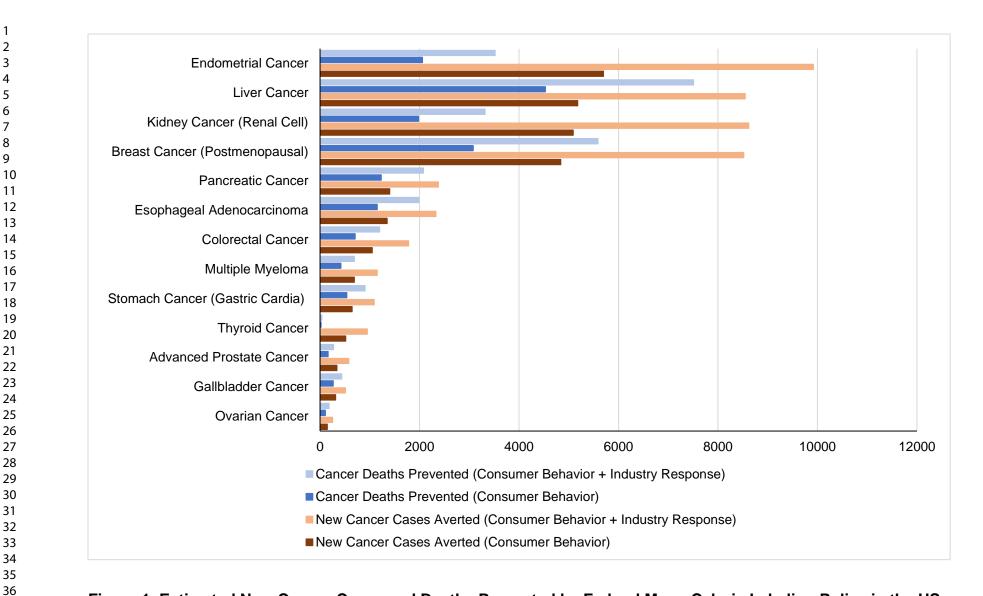
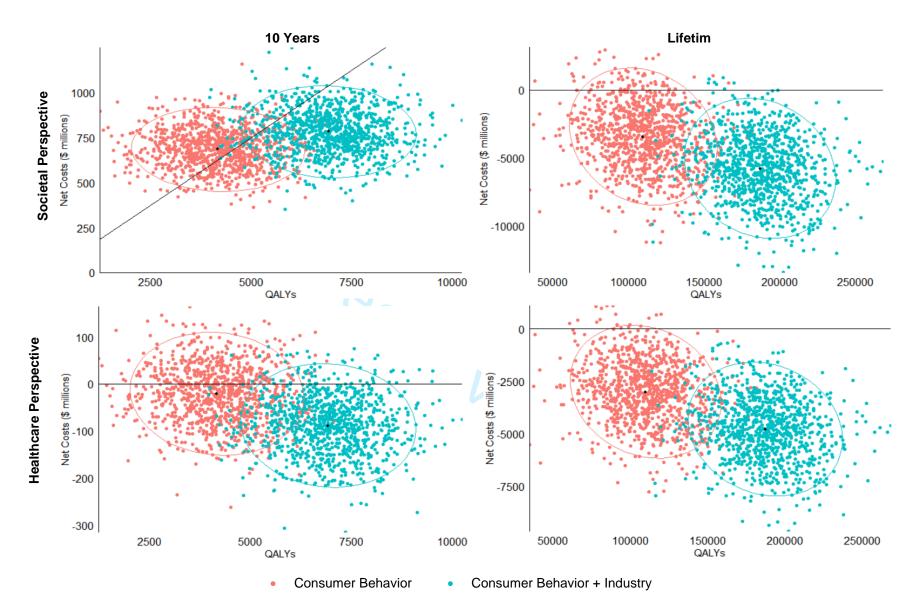


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Figure 2. Probabilistic Sensitivity Analyses (PSA) for Cost-Effectiveness of the Federal Menu Calorie Labeling Policy over 10 years and a Lifetime

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Appendix 1. Estimate the association between menu calorie labeling policy and calorie intake from restaurant meals

To understand the effects of the federal menu calorie labeling policy, we performed a comprehensive literature search and reviewed the evidence on how the policy affected consumer behaviors and industry.

To estimate the policy effect on consumer behavior alone, we reviewed individual studies in both real-world and experimental settings as well as meta-analyses (Appendix Table 1). A meta-analysis of natural experimental studies showed that menu calorie labeling was associated with a 7.3% (95% CI: 4.4% to 10.1%) reduction in calories per meal consumed/purchased.¹ This effect estimate is corresponding to an average reduction of 23.5 kcal per meal consumed by NHANES participants from 56.5% of full-service restaurants² and all fast-food restaurants. This estimate was consistent with evidence from a previous meta-analysis and a recent real-world study.^{3, 4} A previous meta-analysis estimated that the menu calorie labeling would lead to about an 18 kcal reduction ordered per meal.³ A recent longitudinal study used data from a large restaurant franchise in the southern U.S. and estimated that, after labeling implementation, a decrease of 60 kcal per transaction was observed in the first year, followed by an increasing trend of 0.71 kcal per transaction per week over two years.⁴ These together attenuated the calorie reduction to 23 kcal per transaction by the end of the third year of the policy implementation.⁵ Compared to other studies, the 7.3% calorie reduction per meal represents a more conservative estimate. It was reported in a cross-sectional study that customers at the labeled full-service restaurants purchased food with 151 fewer calories.⁶ One meta-analysis of studies that evaluated energy ordered in a real-world setting showed that the calorie labeling policy would lead to a mean reduction of 77.8 in calories purchased per meal.⁷ In a laboratory setting, there was a significant reduction of 115.3 kcal per meal ordered.⁸ Integrating both the real-world and experimental studies, the policy was

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estimated to generate a significant reduction of 100.3 in calories purchased.⁷ Therefore, we decided to use a reduction of calorie intake per meal by 7.3% (95% CI: 4.4% to 10.1%) as the model input given it is the most updated and conservative estimate supported by existing evidence. This policy effect on consumer behavior alone was assumed to take effect during the first year of implementation and no further reduction thereafter.

Based on the published literature, we estimated that there was a 5% reduction in calories consumed per meal from chain restaurants due to industry reformulation, the introduction of new lowcalorie menu items, or the replacement of menu items high in calories with low-calorie menu options.⁹⁻ ¹³ Bleich et al. estimated the calorie changes in chain restaurants' menu items using data from the largest chain restaurants in the U.S.⁹⁻¹³ Using the estimated mean calorie per menu item from the two published studies shown in **Appendix Table 2**,^{11, 12} we calculated the mean change in calories per menu item before and after the policy implementation. Given the national law was announced in 2010, using data from the trend analysis, we treated the mean calorie per menu item measured in 2008 as the baseline and found there was an 11% reduction in calories per menu item two years after the affordable care act was enacted. The change decreased to 7% in 2015, one year after the FDA announced the final rule for the industry to comply with. In the study evaluated the calorie content in current menu items, eliminated menu items, and newly introduced menu items, we estimated that there was a 1% reduction in mean peritem calories in 2013-2014 compared to that in 2012, and the reduction increased to 5% in 2015. Based on this de novo analysis, we chose a reduction in calories per meal consumed by 5% to represent a modest industry reformulation in response to the federal menu calorie labeling by chain restaurants. We assumed no industry response in the first year, then the reformulation activities would occur in the rest of the years over the model lifetime, resulting in a net reduction of 5% in calories consumed per meal.

Appendix Table 1. Policy impact of menu calorie labeling on consumer behaviors

Study	Design	Year, country	Estimate size mean (95% CI)	Comment
Shangguan et. al., 2019 ¹ A Meta-Analysis of Food Labeling Effects on Consumer Diet Behaviors and Industry Practices	Meta-analysis 13 studies (5 RCTs) with 19 interventions on changes in calorie intake per meal, among children and adults	2000 to 2015, US, Canada, UK, Sweden	-7.3% (-10.1%, -4.4%) in calorie intake per meal	Corresponds to a 23.5 kcal per meal consumed by NHANES participant from 56.5% of full- service restaurants ² and all fast-food restaurants
Petimar et. al., 2019 ⁴ Estimating the effect of calorie menu labeling on calories purchased in a large restaurant franchise in the southern United States: quasi- experimental study	Quasi-experimental longitudinal study Transaction data from 104 restaurants of a national fast food company with three different restaurant chains located in the Louisiana, Texas, and Mississippi in the US	2015 to 2018 (pre-labeling: April 2015 to April 2017; post-labeling: April 2017 to April 2018), US	-60 (-48, -72) kcal in calorie purchased per transaction, followed by a post-implementation increasing trend of 0.71 kcal per transaction per week	Because of the post implementation increase, the estimated reduction in calorie per transaction was 23 kcal lower than the counterfactual.
Cantu-Jungles et. al., 2017 ⁸ A Meta-Analysis to Determine the Impact of Restaurant Menu Labeling on Calories and Nutrients (Ordered or Consumed) in U.S. Adults	Meta-analysis 14 studies that evaluated menu calorie labeling on changes in calorie chosen in laboratory and away- from-home settings, among children and adults	1996 to 2014	-115.2 (-130.87, -99.5) kcal in calorie ordered or consumed per meal in laboratory setting	N/A
Littlewood et. al., 2016 ⁷ Menu labelling is effective in reducing energy ordered and consumed: a systematic review and meta- analysis of recent studies	Systematic review and meta-analysis 12 studies (6 RCTs) on changes in calorie consumed, ordered, or selected in both real-world and experimental settings, among children and adults	2011 to 2014, US, Canada, Australia,	 -100.3 (-146.6, -54.0) kcal in calorie consumed in both settings per meal or transaction (3 studies) -77.8 (-121.6, -34.1) kcal in calorie purchased per meal or transaction in real-world setting (5 studies) 	N/A
Long et. al., 2015 ³ Systematic Review and Meta-analysis of the Impact of Restaurant Menu Calorie Labeling	Systematic review and meta-analysis 19 studies (11 RCTs, 8 natural experiments) on changes in calorie purchased per meal or per transaction, among children and adults	2008 to 2013, US	-18.1 (-33.6, -2.70) kcal in calorie purchased per meal or per transaction When stratifying by restaurant and non- restaurant settings (RCTs), the changes were -6.7 (-20.21, 6.81) kcal and -58.2 (-102.4, - 13.9) kcal in calorie	N/A

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			purchased per meal or per transaction	
Auchincloss et. al., 2013 ⁶ Customer responses to mandatory menu labeling at full-service restaurants	Cross-sectional study 648 customer surveys and transaction receipts at 7 restaurant outlets of 1 large full-service restaurant chain (2 outlets with menu calorie labels and 5 without), among adults	2011, US	-151 kcal (-270, -33) for foods purchased from full-service restaurants (per meal)	Was included in the meta-analysis conducted by Cantu- Jungles et. al., 2017 ⁸

Appendix Table 2. Policy impact of menu calorie labeling on restaurant industry response

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19	Study				Year		
20	Study		2008	2012	2013	2014	2015
21	Bleich et. al., 2017 ¹¹	# of menu items (n)	6,601	9,526	10,278	10,654	11,034
22 23 24 25	Calorie changes in large chain restaurants from 2008 to 2015 44 of the 100 largest chain	mean per-item calories (kcal)	368.0	329.1	330.1	337.2	340.6
26	restaurants						
27				2012 vs. 2008			2015 vs. 2008
28		diff. (%)		-38.9 (-11%)			-27 (-7%)
29							
30	Bleich et. al., 2018 ¹²	# of menu items (n)		14,705	17,219 (20)13-2014)	13,920
31	Higher-Calorie Menu Items						
32	Eliminated in Large Chain	mean per-item					
33	Restaurants	calories (kcal)		374.4	370).9	357.4
34	66 of the 100 largest chain						
35	restaurants				2042.20	11.0	
36					2013-20 20 ⁷		2015 vs. 2012
37					-		
38		diff. (%)			-3.52	(-1%)	-17.05 (-5%)
39							
40							

Appendix 2. Baseline cancer incidence and methods of cancer incidence projections for 13 types of cancers

We estimated the cancer incidence rate projections for the defined 32 demographic subgroups as inputs for the DiCOM model. We first obtained age-adjusted incidence rates from 2006 to 2015 from the United States Cancer Statistics combining data from the Surveillance, Epidemiology, and End Results (SEER) database and the Centers for Disease Control and Prevention's National Program of Cancer Registries (NPCR) database.¹⁴

Based on the trends from 2006 to 2015, we projected age-adjusted cancer incidence rates in the next 15 years from 2016 to2030 using the average annual percent change (AAPC) method.^{15, 16} Because longer-term projections may not be valid, we chose to hold age-adjusted cancer incidence rates constant from 2030 to 2095. Specifically, the annual percent change was calculated for each cancer site in each of the 32 subgroups by fitting a regression line to the natural logarithm of the age-adjusted rates (I) in the years 2006 through 2015 (y). The equation for AAPC: $ln(I) = \alpha + \beta y$, where α and β were coefficients to be estimated and y is the calendar year.^{15, 16} We then combined the AAPC projected cancer incidence rates with the projected US population to account for the change in population age distribution over time. The projected US population in each of the 32 subgroups from 2016 to 2060 were extracted from the National Interim Projections of the US population.¹⁷ Because projections were only available through 2060, further projections after 2060 were not considered. We further applied the cohort-period method to estimate cancer incidence in each of the 32 subgroups in the closed cohort of US adults from 2015 to 2095 as they age. Details were illustrated in **Appendix Table 3** using colon and rectum cancer incidence among non-Hispanic white females (NHWF) as an example.

				EXAMPI	E: Colon	and Rect	um Cance	er, Non-H	ispanic W	hite Fem	ales			
Age	20	15		20	016			20)17			20)18	
	Baseline Incidence Rate	Populatio n Size	AAPC Predicted Incidence	US Census Predicted Populatio	Cancer Cases Predicted	Age Shifted "crude" Incidence	AAPC Predicted Incidence	US Census Predicted Populatio	Cancer Cases Predicted	Age Shifted "crude" Incidence	AAPC Predicted Incidence	US Census Predicted Populatio	Cancer Cases Predicted	S "(
20	8.531	30523184	8.694	n Size 1134235		10.154	8.859	n Size 1126079		11.694	9.028	n Size 1117775		
21	8.531		8.694	1156761	100565		8.859	1137549			9.028	1129379		
22	8.531		8.694	1177144	102337		8.859	1159788	102748		9.028	1140620		
23 24	8.531 8.531		8.694 8.694	1196469 1238910	104017 107707		8.859 8.859	1180122 1199459	104550 106263		9.028 9.028	1162784 1183136	104976 106813	
25	8.531		8.694	1283513	111585		8.859	1241739	110009	1	9.028	1202329	108546	
26 27	8.531		8.694	1294013	112497		8.859	1286229	113950		9.028	1244499	112353	
27	8.531 8.531		8.694 8.694	1250740 1232421	108735 107143		8.859 8.859	1296475 1253062	114858 111012		9.028 9.028	1288797 1298770	116352 117252	
29	8.531		8.694	1216039	105719		8.859	1234519	109369		9.028	1255161	113315	
30 31	8.531		8.694	1228929	106839		8.859	1217844	107892		9.028	1236330	111615	
32	8.531 8.531		8.694 8.694	1244281 1205955	108174 104842	-	8.859 8.859	1230337 1245249	108999 110320		9.028 9.028	1219312 1231390	110079 111169	
33	8.531		8.694	1226950	106667		8.859	1206736	106908		9.028	1246013	112489	
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36	8.531		8.694	1228467	106799		8.859	1218141	107918		9.028	1227199	110791	
37	8.531		8.694	1160971	100931		8.859	1228796	108862		9.028	1218528	110008	
38 39	8.531 8.531		8.694 8.694	1139547 1127605	99069 98030		8.859 8.859	1161267 1139679	102879 100967		9.028 9.028	1229044 1161414	110958 104852	
40	8.531		8.694 8.694	1088875	94663		8.859	1127530	99891		9.028	1139635	102886	
41	8.531		8.694	1130467	98279		8.859	1088644	96446		9.028	1127272	101770	
42 43	8.531 8.531		8.694 8.694	1101345 1130264	95747 98262		8.859 8.859	1129951 1100615	100105 97506		9.028 9.028	1088229 1129228	98245 101946	
44	8.531		8.694 8.694	1210411	105229		8.859	1129268	100045		9.028	1099713	99282	
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92	147.246		140.189	209022	293026		133.471	211695	282551		127.075	208839	265381	
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Appendix Table 3. Estimating "crude" incidence after applying cohort-period method

Appendix 3. Cancer survival for 13 types of cancers

We estimated the 5-year relative survival for the defined 32 demographic subgroups. We obtained five-year relative survival rates using the period analysis method from the United States Cancer Statistics which incorporates data from the Surveillance, Epidemiology, and End Results (SEER) database.¹⁴ The five-year survival for 2014, which was the most recently available data at the time of analysis, was used. These rates were extracted for each cancer type and by the defined 32 demographic subgroups for each cancer type. The rates are on a scale of 0-1.

Relative survival is a net survival measure representing cancer survival in the absence of other causes of death. Relative survival is defined as the ratio of the proportion of observed survivors in a cohort of cancer patients to the proportion of expected survivors in a comparable set of cancer-free individuals.¹⁸ Relative survival is the preferred method to estimate survival from cancer registry data.

The period analysis is a method that enhances up-to-date monitoring of survival.^{19, 20} In contrast to traditional cohort analysis of survival, period analysis derives long-term survival estimates exclusively from the survival experience of patients within some recent calendar period.^{19, 20} Three-year intervals were chosen which results in the years 2008-2014 is used to calculate 5-year survival. Using seven years of data to calculate 5-year survival is the standard method used by SEER and used in SEER publications.²¹

The first interval contributed to the one-year survival and used cases diagnosed in 2012-2014, the second interval contributed to the two-year survival and used cases diagnosed in 2011-2013, the third interval contributed to the three-year survival and used cases diagnosed in 2010-2012, the fourth interval contributed to the four-year survival and used cases diagnosed in 2009-2011 and the fifth interval contributed to the five-year survival and used cases diagnosed in 2008-2010.

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This analysis, therefore, used 2008-2014 diagnoses to calculate for 5-year relative survival for 2014. The highlighted orange boxes represent survival contributions for each year of diagnosis and year of follow-up (**Appendix Table 4**). The annual probability of death was calculated as 1-exp[ln(5-year relative survival)/5].

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						YE	ARS O	F DIAG	NOSIS						
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Appendix 4. Methods of estimating the health-related quality of life among 13 types of cancers

Health utility values range from 0 (dead) to 1 (perfect health and were assigned for each cancer type and by phase of care (initial, continuous, end of life), if available. We first searched databases for systematic reviews pertaining to utility weights or HRQOL measures for each cancer type of interest separately. We started with PubMed and searched Google Scholar if needed. The following search string was used for each cancer type : ("health related quality of life" OR "HRQOL" OR "quality of life" OR "QOL" OR "preference weight*" OR "utility weight*" OR "health state utilit*" OR "health utility*") AND ("cancer of interest") AND ("cancer" OR "neoplasm*") AND ("review" OR "systematic review").

When an appropriate systematic review was identified, we read the articles included in the review and determined if the paper met the following data needs. Data Extraction Hierarchy: 1) cancer type specific to the type of interest; 2) consistent in the instrument used, prefer EQ-5D whenever available; 3) US samples preferred; 4) phase of care (assume same utility weights by phase if the phase of care data were not available). If no systematic reviews were available, we searched for individual studies about the utility weights of the cancer of interest. Additionally, check how often the paper is cited to see if it is a frequently used utility weight.

Appendix 5. Methods of estimating policy implementation costs

We estimated the costs of implementing the federal menu calorie labeling for both government and industry, including government administration costs, monitoring and evaluation costs, industry compliance costs and reformulation costs, based on the FDA's budget report,²² the Nutrition Review Project report,²³ and FDA's RIA²⁴ (**Appendix Table 5**).

It was estimated by FDA that approximately 298,600 establishments, organized under 2,130 chains were covered by the menu calorie labeling policy. Among the covered establishments, 115,000 (38.5%) were full-service restaurants and drinking places organized under 530 (24.9%) chains, and 116,200 (38.9%) were limited-service restaurants organized under 540 (25.4%) chains. In total, about 231,200 (77.4%) restaurants organized under 1,070 (50.2%) chains were covered by this policy.²⁴

For industry compliance (#3) and reformulation costs (#4), the FDA estimated the costs by the type of establishments. Therefore, we only included the relevant costs incurred by restaurants as this approach generated more conservative estimates. In addition, the industry compliance costs consist of initial costs and recurring costs associated with new chains. In FDA's RIA, the initial costs were presented as a one-time cost, while the recurring costs associated with new chains were presented as annual costs and assumed to be incurred for 20 years starting from the 2nd year of policy implementation. According to FDA, 20 years is more appropriate for interventions that play out over long periods and whose effects deal with chronic conditions. Similarly, the reformulation costs (#4) estimated by FDA were presented as annual costs in FDA's RIA using the same assumption. We followed the same assumption and presented the annual compliance costs (#3) and annual reformulation costs (#4) incurred by restaurants in **Appendix Table 5**.

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The cost of implementing the menu calorie labeling is fixed by the government. Uncertainty for the costs associated with government administration (#1) and government monitoring and evaluation (# 2) was not provided in the source materials.^{22, 23} We assumed that uncertainty is 20% around these costs.

For annual costs, namely the government monitoring and evaluation costs (#2) and the recurring costs in industry compliance (part of #3), and the reformulation costs (#4), we applied a 3% discounting rate recommended by the Second Panel on cost-effectiveness in health and medicine⁴ to reflect the present value of future costs of government monitoring and evaluation, industry compliance and industry reformulation. The model is a closed cohort model, so we computed the discounted present value of per-person costs and total national costs for persons alive at implementation who remained alive in each subsequent year (not for the larger total US population in each year, which also has growth from immigration and new persons reaching the threshold age). The year-specific discounting factor is estimated by $1/(1+3\%)^{(t-1)}$ (t is the number of years of policy intervention, t=1, 2, 3, ..., lifetime). As our model estimated the costs and health outcomes based on a closed cohort and the population size decline over time, we need to express the annual costs in proportion to the population at risk. The population at risk was estimated based on the proportion of death (P_{dt} , t=1, 2, 3, ...) in each year. We first obtained the proportion of people who are alive each year by calculating $1-P_{dt}$ (t=1, 2, 3, ...). Then we multiplied the baseline population size of 235 million by the proportion of people who are alive each year (Appendix Table 6).

We then estimated the per-person annual cost for cost categories #2, #3 (annual part), and #4, by dividing the annual cost estimated in the second year of implementing the policy among all US populations by the population size in the second year. Specifically, for government monitoring and evaluation, the per person annual cost is estimated \$503,648/233,719,989=\$0.00215, the per person annual cost for industry compliance recurring component is \$/233,719,989=\$, and that for reformulation

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is \$662,800,000 /233,719,989=\$2.83587. Taken together, to estimate the discounted annual cost of #2, #3 (annual part), and #4, we multiplied the population at risk, the per person annual cost estimated at year-2, and the year-specific discounting factor, using: discounted annual cost = population at risk x perperson annual cost x $1/(1+3\%)^{(t-1)}$.

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Policy Effect	Cost Category	One-time Cost*	Annual Cost*	Source	Major Elements
Consumer behavior	1. Government administration [#]	\$9,073,620 (\$7,258,896 to \$10,888,344)	N/A	FDA FY 2012 Budget Report ²²	1) Costs for outreach, education, review of regulatory issues, developing training for inspectors, etc.
	2. Government monitoring and evaluation#	N/A	\$503,648 (\$402,918 to \$604,378) (starting from 2 nd year and last for a lifetime)	Nutrition Review Project report ²³	 Monitor industry compliance Evaluate the accuracy, usefulness, and health impact of the policy intervention
	3. Industry compliance	\$276,632,470 (\$225,552,530 to \$327,205,740)	\$27,648,591 (\$16,756,003 to \$38,649,212) (starting from 2 nd year and last for a lifetime)	FDA's RIA ²⁴ Table 4-8	 Collecting and managing records of nutritional analysis for each standard menu item (initial cost + recurring cost associated with new chains) Revising or replacing existing menus, menu boards, and providing full written nutrition information (initial cost + recurring cost associated with new chains) Training employees to understand the nutrition information to help ensure compliance with the final requirements (initial cost + recurring cost associated with new chains) Legal review (initial cost + recurring cost associated with new chains)
Industry response^	4. Industry reformulation	N/A	\$15,059,100 (\$5,791,900 to \$24,124,700) (starting from 2 nd year and last for a lifetime)	FDA's RIA ²⁴ Table 4-8	 Annually recurring costs of nutrition analysis refer to the nutrition cost that will be incurred by the covered establishments due to the introduction of a new standard or reformulated standard menu items in their menus and the cost that will be incurred by new chains entering the industry Annually recurring changes to menus or menu boards will be tied to new or reformulated standard menu items. In general, these future changes to menus will be incorporated into the natural menu

Appendix Table 5 Implementation cost estimates for the federal many caloria labeling policy (in 2015 US dollars)

		replacement cycle, so there will be no additional recurring menu update costs. However, all chain retail food establishments will need to provide additional written nutrition information for the reformulated or newly introduced menu items
		Average formula count, 6 new menu items, and 6 reformulated items per year FDA reformulation cost model

*Policy intervention costs were inflated to 2015 US (December) dollars using the Consumer Price Index.

 # Given no range of uncertainty was provided in source materials, we assumed 20% uncertainty around these costs.

^Some chains or establishments may respond to increased consumer interest in caloric content standard menu items by reformulating existing menu items or by introducing new, lower-calorie items. The change in manufacturing costs associated with reformulating these items has not been included in the cost estimation, the FDA includes the cost associated with analyzing the nutrition information of new or reformulated items.

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3 4 5	Appendix Table 6. The pop	oulation size of	of people who are millions)	alive each year over a lifetime
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Appendix 6. Annual health-related costs among cancer patients and the general population without cancer

The annual health-related costs data include: 1) medical expenditure, 2) productivity loss from missed workdays or disability, and 3) patient time cost associated with receiving care for cancer survivors by age (under 65 vs. above 65 years old) and phase of care (initial, continuing, end-year of life); 4) medical expenditure, 5) productivity loss, and 6) patient time cost for individuals without cancer by age and status of end year of life. The description of the data source and data structure were provided in **Appendix Table 7**.

We extracted the raw data for each of the costing components from the published literature.^{15, 25-} ²⁹ The overall assumptions for data extraction include: 1) health-related costs for breast cancer among postmenopausal females, advanced prostate cancer, esophageal adenocarcinoma, and stomach cardia cancer, by age, sex, and phase of cancer care, were the same as those for breast cancer, prostate cancer, esophagus cancer, and stomach cancer; 2) if no data available for a specific cancer type, we assumed the costs for that cancer type were the same as the estimates of costs for all-cancer sites, e.g., medical expenditure for all-cancer sites were used to replace the medical expenditures for multiple myeloma, gallbladder, liver, and thyroid cancers; 3) we extracted the costs for end-year of life due to cancer death and assumed that death due to other causes is not a competing outcome; 4) we assumed that the end-year life medical expenditure for individuals without cancer does not vary by the 32 subgroups.

If a specific costing component was not reported directly in the raw data, we calculated the cost for that component based on available data. For example, the annual productivity loss for colorectal cancer was reported as a percentage of total health-related costs.²⁹ We multiplied the percentage and the total health-related costs to obtain the productivity loss for colorectal cancer. We also performed data imputation for unavailable data. For instance, the annual productivity loss for all-cancer sites was

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reported by time interval since cancer diagnosis (diagnosed within one year vs. diagnosed greater than one year).²⁵ To obtain this costing component by the defined phases of care, we calculated the weighted means which was used as the annual productivity loss for the continuous phase. We then assumed that the productivity loss in the initial phase and end-of-life phase of cancer care are 1.3 times and 4 times the mean estimates based on available data for other cancers.^{15, 25} For individuals without cancer, we assumed that the end-of-life productivity loss is 4 times to the mean estimate of the productivity loss. The same rules applied to data imputation for patient time costs.

We then applied the age shifting to keep the expenditures consistent within each age group. Starting from 2021, individuals in the cohort of 55-64 years old have turned into the cohort of 65 years and older. Therefore, we assumed that starting from 2021, the health-related expenditures for individuals who were in the cohort of 55-64 years old would be the same as those for individuals who were in the cohort of 65 years and older at the beginning of the DiCOM model. Based on the same assumption, starting from 2031 and 2047, the health-related expenditures for the cohort of 45-54 years old and those for the cohort of 20-44 years old were projected to be the same as those for the cohort of 65 years and older, respectively. We followed the same rule and applied the age shifting for the health-related expenditures for individuals without cancer. All estimations and projections were performed in SAS 9.4. All health-related expenditures were inflated to 2015 US dollars using the Personal Health Care (PHC) index.

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Appendix Table 7. Description of the data source of health-related expenditures

	A. Cancer Survivors		B. Individuals witho	ut Cancer
	Data source (Excess or Total)	Category	Data source	Category
Medical expenditure	Mariotto et al. 2011, SEER-Medicare, in 2010 US dollars (Excess)	-by phase of care ¹ -by age (under 65 vs. above 65 years old) -by sex	Kim et al. 2018, MEPS 2013-2014, <i>in vivo</i> analysis, in 2014 US dollars (Total)	-Medical expenditure among all US adults -by 32 subgroups stratified by age, sex, and race/ethnicity
			Hogen et al. 2001, SEER-Medicare (65+), in 2001 US dollars (Total)	-Medical expenditure in the end year of life among all US adults
Productivity loss	Zheng et al. 2016, MEPS 2008-2012, data available for colorectal, female breast, and prostate cancers, in 2012 US dollars (Total)	-by age		
	Guy et al. 2013, MEPS 2008-2010, all types of cancer, in 2010 US dollars (Total)	-by age -by time interval since cancer diagnosis (less than 1 year vs. greater than 1 year) ²	Guy et al. 2013, MEPS 2008-2010, in 2010 US dollars (Total)	-by age
Patient time cost	Yabroff et al. 2014, MEPS 2008-2011, all types of cancer, in 2011 US dollars (Total)	-by age	Yabroff et al. 2014, MEPS 2008-2011, in 2011 US dollars (Total)	-by age

1. The definition of phases of care: 1) initial phase, defined as the first 12 months following diagnosis, 2) end-year of life phase, defined as the final 12 months of life, and 3) the continuing phase, defined as all the months between the initial phase and the end-year of life. The costs of end-year of life varied by cause of death, either cancer-specific death or death due to other causes. 2. Weighted means were calculated based on sample sizes and strata means. Reference

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2 3 Title Cost-Effectiveness Analysis of the Federal Menu Calorie Labeling and Obesity-Associated Cancer 4 Burdens in the United States 5 6 7 **Supplementary Table 1**. Defining Population and 32 Subgroups 8 Supplementary Table 2. Relative Risk Estimates of Etiologic Relationships Between Body Mass Index 9 (BMI) and 13 Types of Cancers 10 Supplementary Table 3. Baseline Incidence Rates of 13 Cancers among US Adults by 32 Subgroups 11 12 Supplementary Table 4. Baseline 5-year Relative Survival Rates of 13 Cancers among US Adults by 13 32 Subgroups 14 Supplementary Table 5. Health-Related Quality of Life Among US Cancer Patients Aged 20 Years or 15 Older, by Cancer Type and Phase of Care 16 17 Supplementary Table 6. Baseline Medical Costs, Productivity Loss, and Patient Time Costs Among 18 US Cancer Patients Aged 20 Years or Older, by Cancer Type and Phase of Care 19 Supplementary Table 7. Baseline Medical Costs, Productivity Loss, and Patient Time Costs Among 20 the General Population Aged 20 Years or Older in the US, by 32 Subgroups 21 Supplementary Table 8. Characteristics of US Adults Aged 20 Years or Older Participated in the 22 23 NHANES, 2013-2016 24 Supplementary Table 9. Consumption of Calories from Full-Service and Fast-Food Restaurants among 25 US Adults Participated in 2013-2016 NHANES, by 32 Subgroups 26 Supplementary Table 10. Estimated New Cancer Cases Averted by the Federal Menu Calorie Labeling 27 28 in the US by Age, Sex, Race/Ethnicity, and Cancer Type, Over a Lifetime 29 **Supplementary Table 11**. Estimated Cancer Deaths Reduced by the Federal Menu Calorie Labeling in 30 the US by Age, Sex, Race/Ethnicity, and Cancer Type, Over a Lifetime 31 Supplementary Table 12. Estimated Health Gains and Costs Associated with the Federal Menu Calorie 32 Labeling on Reducing Cancer Burdens in the US Over a Lifetime, One-Way Sensitivity Analyses at 33 34 25% and 75% Calorie Compensations Outside the Restaurant Settings 35 Supplementary Table 13. Estimated Health Gains and Costs Associated with the Federal Menu Calorie 36 Labeling on Reducing Cancer Burdens in the US Over a Lifetime, One-Way Sensitivity Analysis, 37 Assuming all Full-Service and Fast-Food Restaurants were Covered by the Policy 38 39 40 Supplementary Figure 1. Diet and Cancer Outcome Model (DiCOM) 41 Supplementary Figure 2. Estimated Reduced New Cancer Cases and Deaths Associated with the 42 Federal Menu Calorie Labeling in the US by Age, Sex, Race/Ethnicity, and Cancer Type, Over a 43 44 Lifetime 45 **Supplementary Figure 3**. Estimated life Years and OALYs Gained Associated with the Federal Menu 46 Calorie Labeling in the US by Age, Sex, and Race/Ethnicity, Over a Lifetime. 47 Supplementary Figure 4. Estimated Changes of Health-Related Costs Associated with the Federal 48 Menu Calorie Labeling in the US by Age, Sex, Race/Ethnicity, and Cancer Type, Over a Lifetime 49 50 Supplementary Figure 5. Estimated Net Costs from Societal and Healthcare Perspectives Associated 51 with the Federal Menu Calorie Labeling in the US by Age, Sex, and Race/Ethnicity, Over a Lifetime 52 Supplementary Figure 6. One-Way Sensitivity Analysis of Net Costs of the Federal Menu Calorie 53 Labeling and Obesity-Associated Cancer Rates to Varying Assumptions of Key Input Parameters From 54 (A) Societal Perspective and (B) Healthcare Perspective 55 56 57 58 1 59 For peer review only - http://bmjopen.bmj.com/site/about/guidelines.xhtml 60

Subgroups	Age	Sex	Race/Ethnicity
1	20-44y	Female	NHW
2	20-44y	Female	NHB
3	20-44y	Female	HISP
4	20-44y	Female	OTH
5	20-44y	Male	NHW
6	20-44y	Male	NHB
7	20-44y	Male	HISP
8	20-44y	Male	OTH
9	45-54y	Female	NHW
10	45-54y	Female	NHB
11	45-54y	Female	HISP
12	45-54y	Female	OTH
13	45-54y	Male	NHW
14	45-54y	Male	NHB
15	45-54y	Male	HISP
16	45-54y	Male	OTH
17	55-64y	Female	NHW
18	55-64y	Female	NHB
19	55-64y	Female	HISP
20	55-64y	Female	OTH
21	55-64y	Male	NHW
22	55-64y	Male	NHB
23	55-64y	Male	HISP
24	55-64y	Male	OTH
25	65+y	Female	NHW
26	65+y	Female	NHB
27	65+y	Female	HISP
28	65+y	Female	OTH
29	65+y	Male	NHW
30	65+y	Male	NHB
31	65+y	Male	HISP
32	65+y	Male	ОТН
	•		

Supplementary Table 1. Defining population and 32 subgroups

 Supplementary Table 2. Relative risk estimates of etiologic relationships between body mass index (BMI) and 13 types of cancers

Cancer Type	No. of Studies	No. of Events	Source	Evidence Grading	RR (95% CI) Per 5 kg/m²	Statistical Heterogeneity
Endometrial	26	18,717	CUP, 2013	Convincing ↑risk	1.50 (1.42-1.59)	I ² =86.2% P<0.0001
Esophageal (adenocarcinoma)	9	1,725	CUP, 2016	Convincing ↑risk	1.48 (1.35-1.62)	l²=36.7% P=0.13
Kidney	23	15,575	CUP, 2015	Convincing ↑risk	1.30 (1.25-1.35)	l ² =38.8% P=0.03
Liver	12	14, 311	CUP, 2015	Convincing ↑risk	1.30 (1.16-1.46)	l ² =78.3% P=0.000
Gallbladder	8	6,004	CUP, 2015	Probable ↑risk	1.25 (1.15-1.37)	l²=52.3% P=0.04
Stomach (cardia)	7	2,050	CUP, 2016	Probable ↑risk	1.23 (1.07-1.40)	l²=55.6% P=0.04
Breast (post- menopausal)	56	80,404	CUP, 2017	Convincing ↑risk	1.12 (1.09-1.15)	l ² =75% P<0.001
Pancreas	23	9,504	CUP, 2011	Convincing ↑risk	1.10 (1.07-1.14)	l ² =19% P=0.20
Multiple myeloma	20	1,388	IARC, 2016 ³⁰	Sufficient (IRAC) ↑risk	1.09 (1.03-1.16)	Not reported
Prostate (advanced)	24	11,149	CUP, 2014	Probable ↑risk	1.08 (1.04-1.12)	l ² =18.8% P=0.21
Thyroid	22	3,100	IARC, 2016 ³⁰	Sufficient (IARC) ↑risk	1.06 (1.02-1.10)	Not reported
Ovary	25	15,899	CUP, 2013	Probable ↑risk	1.06 (1.02-1.11)	l ² =55.1% P=0.001
Colorectal	38	71,089	CUP, 2017	Convincing ↑risk	1.05 (1.03-1.07)	l ² =74.2% P=0.000

Supplementary Table 3. Baseline incidence rates of 13 cancers among US adults by 32 subgroups

Subgroup	Color Can		Endor Car	netrial ncer	Esoph Ade carcin	eno-	Female (Postr	Breast meno.)	Gallbl Car	adder ncer	Kidney	Cancer	Liver C	Cancer	M ul M yei	tiple oma	Ovarian	cancer	Panc Car		Adva Pros Car	state	Cancer	nach (Gastric dia)	Thyroid	Cancer
	Rate	SE	Rate	SE	Rate	SE	Rate	SE	Rate	SE	Rate	SE	Rate	SE	Rate	SE	Rate	SE	Rate	SE	Rate	SE	Rate	SE	Rate	SE
1	8.53	0.38	6.54	3.66	0.05	4.18	0.00	0.00	0.05	2.57	3.83	3.16	0.49	4.18	0.38	4.66	4.31	0.27	1.07	3.46	0.00	0.00	0.10	3.82	28.97	0.69
2	7.78	0.74	5.04	0.59	0.03	0.20	0.00	0.00	0.07	2.46	3.57	0.50	0.56	0.20	1.02	0.27	2.98	0.45	1.03	0.26	0.00	0.00	0.09	2.25	13.12	0.95
3	6.09	0.55	7.49	3.32	0.03	3.07	0.00	0.00	0.06	2.48	3.73	3.16	0.42	3.07	0.33	3.71	3.95	0.46	0.86	0.87	0.00	0.00	0.09	2.27	20.97	1.13
4	6.36	1.10	6.56	1.13	0.02	0.15	0.00	0.00	0.07	2.58	1.87	0.40	0.32	0.15	0.38	0.23	4.49	0.70	0.74	0.25	0.00	0.00	0.09	2.36	24.88	2.21
5	9.20	0.39	0.00	0.00	0.42	5.22	0.00	0.00	0.04	0.02	5.91	4.53	0.60	5.22	0.48	5.26	0.00	0.00	1.22	2.06	0.21	0.02	0.43	4.32	6.93	0.34
6	7.94	0.78	0.00	0.00	0.29	0.30	0.00	0.00	0.04	0.02	5.47	0.65	1.17	0.30	1.48	0.34	0.00	0.00	1.00	0.28	0.56	0.09	0.34	3.42	2.36	0.42
7	6.15	0.54	0.00	0.00	0.31	3.85	0.00	0.00	0.04	0.02	4.04	3.82	0.82	3.85	0.57	0.18	0.00	0.00	0.83	0.20	0.13	0.68	0.34	3.53	3.80	0.44
8	6.21	0.85	0.00	0.00	0.31	0.47	0.00	0.00	0.05	0.02	3.68	1.04	1.59	0.47	0.70	1.40	0.00	0.00	0.82	0.29	0.41	0.09	0.36	3.52	5.70	0.84
9	41.27	0.76	38.53	0.73	1.03	0.21	124.56	1.28	0.68	5.99	14.03	0.44	3.10	0.21	3.60	0.22	17.09	0.49	7.70	0.32	0.00	0.00	0.88	6.74	37.84	0.73
10	53.14	1.92	25.73	1.34	0.59	0.60	121.73	2.88	1.54	5.87	16.08	1.06	5.17	0.60	11.29	0.89	11.75	0.90	10.91	0.87	0.00	0.00	0.94	5.38	25.80	1.34
11	33.92	1.78	33.43	1.53	0.59	0.52	77.25	3.45	2.27	1.93	16.00	1.04	3.83	0.52	4.86	0.58	14.57	1.00	6.26	0.66	0.00	0.00	0.81	5.61	37.29	1.84
12	35.77	3.15	35.84	3.07	0.65	0.66	91.82	4.82	1.70	6.05	7.78	1.92	3.27	0.66	2.55	0.70	17.07	1.51	5.17	0.81	0.00	0.00	0.85	5.53	37.73	2.90
13	53.97	0.87	0.00	0.00	5.61	0.36	0.00	0.00	0.36	7.15	29.16	0.64	9.24	0.36	5.09	0.27	0.00	0.00	10.63	0.38	10.88	0.16	3.65	0.23	13.29	0.43
14	61.29	2.20	0.00	0.00	1.50	1.02	0.00	0.00	0.47	5.07	32.82	1.61	13.29	1.02	12.34	0.99	0.00	0.00	14.12	1.05	25.31	0.58	1.90	0.33	6.41	0.71
15 16	38.05 42.81	1.94 3.85	0.00	0.00	2.75 2.88	1.06	0.00	0.00	0.43	4.83 4.93	24.48 18.63	1.27 3.06	16.38 18.71	1.06 2.28	5.23	0.60	0.00	0.00	7.95 7.62	0.74 1.05	6.02 3.70	0.38 0.50	1.96 2.51	0.34	8.56 12.57	0.76 1.36
18	59.74	0.89	90.00	1.09	2.00	2.28	0.00 305.45	2.02	1.75	4.93 0.15	26.14	0.59	9.41	0.35	3.70 8.68	0.82	26.19	0.00	21.78	0.54	0.00	0.00	1.72	0.17	34.42	0.67
17	86.11	2.62	83.71	2.60	1.30	0.35	306.22	4.92	4.08	0.57	31.53	1.58	18.22	1.21	23.28	1.37	19.79	1.25	31.37	1.58	0.00	0.00	1.92	0.6	27.72	1.48
10	58.14	2.91	69.51	3.28	1.64	1.21 1.33	218.85	7.01	4.59	0.68	29.93	1.73	17.38	1.33	9.33	0.97	21.29	1.45	17.15	1.32	0.00	0.00	1.87	0.33	39.44	1.97
20	52.83	4.48	60.22	4.45	1.49	1.33	233.48	8.33	2.44	0.50	13.91	2.72	12.58	1.97	6.13	0.96	23.98	2.79	13.44	1.43	0.00	0.00	1.57	0.13	41.74	3.08
21	88.14	1.11	0.00	0.00	15.54	0.73	0.00	0.00	0.93	0.11	53.65	0.87	37.93	0.73	13.24	0.43	0.00	0.00	29.95	0.65	47.05	0.34	9.19	0.36	16.24	0.48
22	121.39	3.41	0.00	0.00	4.30	2.72	0.00	0.00	2.06	0.41	69.05	2.57	75.50	2.72	30.69	1.71	0.00	0.00	39.72	1.95	91.41	1.22	4.87	0.68	9.12	0.92
23	84.75	3.65	0.00	0.00	8.01	2.98	0.00	0.00	1.07	0.11	51.05	2.35	61.05	2.98	13.65	1.22	0.00	0.00	23.36	1.58	32.10	1.21	5.15	0.70	11.12	1.09
24	83.77	5.72	0.00	0.00	4.97	4.85	0.00	0.00	1.22	0.11	27.95	3.81	54.13	4.85	10.32	1.39	0.00	0.00	19.14	2.87	22.70	1.31	5.16	0.96	16.04	1.75
25	147.25	1.98	86.90	1.40	4.53	0.62	429.43	3.20	5.87	0.40	42.37	1.02	15.56	0.62	20.59	0.73	38.18	0.97	55.49	1.20	0.00	0.00	4.36	0.34	24.59	0.74
26	155.86	5.74	100.81	4.21	3.10	1.98	398.07	8.74	9.68	1.43	50.03	3.07	20.61	1.98	50.31	3.20	29.78	2.45	71.93	3.94	0.00	0.00	3.41	0.52	22.57	1.98
27	117.47	5.72	66.40	4.47	3.61	3.17	285.07	11.57	11.44	1.75	45.35	3.33	38.69	3.17	24.20	2.52	32.78	2.88	51.54	3.79	0.00	0.00	3.89	0.60	29.50	2.55
28	109.32	10.15	52.12	5.29	3.51	4.72	266.14	14.52	7.02	1.70	26.14	4.17	35.77	4.72	14.41	2.43	23.90	2.89	46.15	5.64	0.00	0.00	4.11	0.28	28.15	3.08
29	181.07	2.47	0.00	0.00	29.02	1.10	0.00	0.00	3.59	0.36	88.69	1.63	40.30	1.10	34.26	1.07	0.00	0.00	72.36	1.53	80.74	0.61	19.38	0.77	17.34	0.69
30	217.23	8.36	0.00	0.00	7.29	3.98	0.00	0.00	6.24	1.14	97.13	5.16	68.31	3.98	69.18	4.66	0.00	0.00	75.66	4.94	130.67	2.34	8.81	1.55	10.03	1.60
31	182.00	9.21	0.00	0.00	15.50	5.01	0.00	0.00	6.79	1.64	87.20	5.26	78.18	5.01	33.10	3.44	0.00	0.00	61.88	4.77	66.33	2.57	11.49	1.78	15.87	2.11
32	144.37	13.43	0.00	0.00	10.56	7.52	0.00	0.00	4.75	1.02	54.45	7.24	79.16	7.52	22.48	3.35	0.00	0.00	51.45	6.82	51.84	2.78	11.34	2.12	13.86	2.28

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Supplementary Table 4. Baseline 5-year relative survival rates of 13 cancers among US adults by 32 subgroups

Subgroup	Color Can		Endon Can			nageal eno- noma	Female (Postr	Breast neno.)	Gallbl Car		Kidney	Cancer	Liver C	Cancer		tiple Ioma	Ova Car			reatic ncer	Pros	anced state ncer	Car	nach ncer stric dia)	~	roid ncer
	Rate	SE	Rate	SE	Rate	SE	Rate	SE	Rate	SE	Rate	SE	Rate	SE	Rate	SE	Rate	SE	Rate	SE	Rate	SE	Rate	SE	Rate	SE
1	0.740	0.012	0.916	0.009	0.223	0.018	0.000	0.000	0.095	0.095	0.953	0.009	0.409	0.057	0.852	0.043	0.780	0.015	0.379	0.038	0.000	0.000	0.477	0.099	1.000	0.001
2	0.652	0.024	0.775	0.027	0.223	0.018	0.000	0.000	0.286	0.064	0.856	0.029	0.144	0.113	0.837	0.048	0.736	0.036	0.530	0.064	0.000	0.000	0.502	0.205	0.993	0.004
3	0.659	0.022	0.900	0.013	0.223	0.018	0.000	0.000	0.309	0.092	0.864	0.021	0.403	0.081	0.713	0.075	0.716	0.024	0.493	0.062	0.000	0.000	0.236	0.116	0.992	0.002
4	0.694	0.027	0.910	0.016	0.223	0.018	0.000	0.000	0.286	0.064	0.819	0.043	0.321	0.077	0.787	0.122	0.737	0.029	0.371	0.076	0.000	0.000	0.667	0.193	1.000	0.002
5	0.682	0.012	0.000	0.000	0.140	0.034	0.000	0.000	0.302	0.117	0.886	0.010	0.251	0.037	0.696	0.041	0.000	0.000	0.275	0.032	0.768	0.057	0.284	0.045	0.997	0.002
6	0.601	0.027	0.000	0.000	0.160	0.031	0.000	0.000	0.357	0.096	0.779	0.027	0.157	0.045	0.606	0.057	0.000	0.000	0.151	0.046	0.780	0.086	0.672	0.274	0.949	0.025
7	0.621	0.022	0.000	0.000	0.330	0.108	0.000	0.000	0.357	0.096	0.847	0.020	0.227	0.047	0.635	0.064	0.000	0.000	0.157	0.044	0.470	0.118	0.152	0.055	0.993	0.007
8	0.635	0.029	0.000	0.000	0.287	0.172	0.000	0.000	0.357	0.096	0.840	0.033	0.152	0.032	0.649	0.108	0.000	0.000	0.230	0.066	0.805	0.180	0.545	0.133	0.992	0.008
9	0.738	0.007	0.889	0.006	0.300	0.065	0.918	0.003	0.153	0.045	0.846	0.011	0.283	0.027	0.682	0.027	0.614	0.012	0.195	0.017	0.000	0.000	0.384	0.060	0.997	0.002
10	0.666	0.015	0.751	0.022	0.290	0.174	0.810	0.009	0.155	0.059	0.834	0.025	0.145	0.035	0.626	0.034	0.497	0.034	0.177	0.029	0.000	0.000	0.457	0.144	0.990	0.008
11	0.725	0.016	0.869	0.012	0.751	0.217	0.881	0.008	0.224	0.062	0.879	0.018	0.242	0.038	0.617	0.047	0.595	0.025	0.209	0.035	0.000	0.000	0.257	0.079	0.983	0.005
12	0.731	0.018	0.893	0.012	0.308	0.060	0.926	0.007	0.210	0.082	0.810	0.037	0.287	0.051	0.686	0.071	0.640	0.027	0.307	0.055	0.000	0.000	0.357	0.152	0.991	0.005
13	0.704	0.007	0.000	0.000	0.255	0.020	0.000	0.000	0.321	0.072	0.790	0.009	0.171	0.011	0.627	0.023	0.000	0.000	0.136	0.012	0.858	0.010	0.253	0.024	0.964	0.007
14	0.612	0.015	0.000	0.000	0.186	0.085	0.000	0.000	0.371	0.127	0.793	0.020	0.117	0.019	0.616	0.037	0.000	0.000	0.138	0.022	0.814	0.020	0.148	0.059	0.970	0.027
15	0.652	0.015	0.000	0.000	0.222	0.050	0.000	0.000	0.151	0.082	0.742	0.019	0.181	0.016	0.640	0.044	0.000	0.000	0.101	0.021	0.729	0.029	0.257	0.060	0.945	0.019
16	0.721	0.017	0.000	0.000	0.308	0.110	0.000	0.000	0.751	0.153	0.799	0.027	0.239	0.023	0.594	0.066	0.000	0.000	0.162	0.039	0.865	0.040	0.298	0.080	0.960	0.018
17	0.694	0.007	0.878	0.004	0.322	0.043	0.918	0.002	0.273	0.035	0.793	0.010	0.208	0.015	0.630	0.019	0.531	0.011	0.117	0.009	0.000	0.000	0.334	0.041	0.994	0.002
18	0.621	0.014	0.667	0.015	0.298	0.039	0.830	0.007	0.151	0.043	0.805	0.022	0.219	0.028	0.609	0.027	0.371	0.028	0.112	0.018	0.000	0.000	0.440	0.113	0.971	0.012
19	0.673	0.016	0.816	0.013	0.241	0.131	0.879	0.006	0.173	0.044	0.769	0.021	0.211	0.025	0.535	0.042	0.473	0.025	0.104	0.019	0.000	0.000	0.279	0.101	0.969	0.009
20	0.714	0.017	0.847	0.013	0.298	0.039	0.911	0.006	0.151	0.061	0.785	0.032	0.288	0.033	0.631	0.051	0.555	0.031	0.164	0.027	0.000	0.000	0.281	0.140	0.987	0.008
21	0.666	0.006	0.000	0.000	0.257	0.013	0.000	0.000	0.190	0.045	0.760	0.008	0.202	0.007	0.603	0.016	0.000	0.000	0.111	0.007	0.878	0.006	0.255	0.016	0.954	0.009
22	0.579	0.013	0.000	0.000	0.178	0.072	0.000	0.000	0.261	0.105	0.758	0.019	0.140	0.012	0.545	0.028	0.000	0.000	0.080	0.014	0.786	0.014	0.148	0.046	0.945	0.039
23	0.628	0.014	0.000	0.000	0.135	0.033	0.000	0.000	0.203	0.081	0.717	0.018	0.170	0.013	0.541	0.037	0.000	0.000	0.078	0.015	0.777	0.017	0.281	0.053	0.899	0.028
24	0.654	0.015	0.000	0.000	0.237	0.082	0.000	0.000	0.148	0.069	0.698	0.025	0.268	0.017	0.485	0.050	0.000	0.000	0.122	0.023	0.885	0.019	0.257	0.061	0.967	0.022
25	0.610	0.005	0.799	0.006	0.182	0.024	0.907	0.003	0.179	0.018	0.679	0.010	0.119	0.010	0.420	0.012	0.323	0.008	0.057	0.003	0.000	0.000	0.231	0.023	0.958	0.005
26	0.551	0.012	0.552	0.016	0.170	0.143	0.806	0.008	0.217	0.043	0.709	0.024	0.097	0.020	0.407	0.022	0.210	0.021	0.059	0.009	0.000	0.000	0.264	0.068	0.894	0.023
27	0.579	0.013	0.699	0.017	0.190	0.073	0.858	0.008	0.125	0.023	0.677	0.022	0.087	0.014	0.353	0.027	0.298	0.022	0.049	0.009	0.000	0.000	0.257	0.060	0.889	0.020
28	0.599	0.013	0.735	0.020	0.180	0.022	0.900	0.007	0.115	0.030	0.614	0.032	0.187	0.017	0.440	0.040	0.356	0.029	0.043	0.008	0.000	0.000	0.187	0.067	0.858	0.023
29	0.615	0.005	0.000	0.000	0.212	0.011	0.000	0.000	0.134	0.025	0.680	0.008	0.119	0.007	0.402	0.011	0.000	0.000	0.075	0.004	0.717	0.007	0.220	0.013	0.935	0.015
30	0.498	0.014	0.000	0.000	0.164	0.069	0.000	0.000	0.209	0.076	0.705	0.024	0.134	0.019	0.459	0.027	0.000	0.000	0.049	0.011	0.569	0.017	0.174	0.052	0.810	0.068
31	0.544	0.013	0.000	0.000	0.155	0.035	0.000	0.000	0.144	0.046	0.668	0.020	0.107	0.012	0.398	0.028	0.000	0.000	0.066	0.011	0.674	0.017	0.141	0.032	0.786	0.048
32	0.625	0.013	0.000	0.000	0.126	0.049	0.000	0.000	0.263	0.071	0.653	0.026	0.182	0.014	0.431	0.037	0.000	0.000	0.080	0.013	0.733	0.020	0.255	0.042	0.800	0.039

Supplementary Table 5. Health-related quality of life among US cancer patients aged 20 years or older, by cancer type and phase of care

Cancer Type	Cancer Phase	Health Related Quality of Life mean (SE)	Source
Endometrial	Overall	0.80 (0.14)	Naik et al. ³¹
Esophageal Adenocarcinoma	Overall	0.69 (0.26)	Wildi et al. ³²
Kidney	Overall	0.78 (0.14)	Pickard et al.33
Liver	Overall	0.79 (0.19)	Naik et al. ³¹
Gallbladder	Overall	0.79 (0.19)	Naik et al. ³¹
Stomach (gastric cardia)	Initial: Continuous: End of Life:	0.84 (0.25) 0.86 (0.24) 0.65 (0.33)	Zhou et al. ³⁴
Female Breast (post-menopausal)	Initial: Continuous: End of Life:	0.78 (0.19) 0.81 (0.20) 0.64 (0.16)	Yabroff et al. ³⁵
Pancreas	Overall	0.65 (0.30)	Müller-Nordhorn et al. ³⁶
Multiple myeloma	Overall	0.79 (0.19)	Naik et al. ³¹
Advanced Prostate	Initial: Continuous: End of Life:	0.78 (0.20) 0.76 (0.19) 0.59 (0.15)	Yabroff et al. ³⁵
Thyroid	Overall	0.85 (0.13)	Naik et al. ³¹
Ovary	Overall	0.77 (0.17)	Pickard et al.33
Colorectal	Initial: Continuous: End of Life:	0.760 (0.19) 0.835 (0.20) 0.643 (0.26)	Färkkilä et al. ³⁷

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Supplementary Table 6. Baseline medical costs, productivity loss, and patient time costs among US cancer patients aged 20 years or older, by cancer type

Sex Female	Age <65	Initial	Continuous							
Female	-65			End-of-life	Initial	Continuous	End-of-life	Initial	Continuous	End-of-life
	<02	95439	6853	156417	4884	3757	15027	650	500	2001
	≥65	79532	6853	104278	6984	5372	21489	1187	913	3652
Male	<65	95787	6450	155612	4884	3757	15027	650	500	2001
	≥65	79822	6450	103742	6984	5372	21489	1187	913	3652
Female	<65	85291	3977	155636	4884	3757	15027	650	500	2001
	≥65	71076	3977	103758	6984	5372	21489	1187	913	3652
Male	<65	94144	4282	160695	4884	3757	15027	650	500	2001
	≥65	78453	4282	107130	6984	5372	21489	1187	913	3652
Female	<65	40173	5859	95782	4884	3757	15027	650	500	2001
	≥65	40173	5859	95782	6984	5372	21489	1187	913	3652
Male	<65	41161	7363	97473	4884	3757	15027	650	500	2001
	≥65	41161	7363	97473	6984	5372	21489	1187	913	3652
Female	<65	112154	8672	164911	4884	3757	15027	650	500	2001
	≥65	93462	8672	109941	6984	5372	21489	1187	913	3652
Male	<65	112911	11697	169673	4884	3757	15027	650	500	2001
	≥65	94092	11697	113115	6984	5372	21489	1187	913	3652
Male	<65	23652	3201	93363	3715	2858	11432	650	500	2001
	≥65	19710	3201	62242	6549	5038	20152	1187	913	3652
Female	<65	61593	3159	126778	10330	7946	31784	650	500	2001
	≥65	51327	3159	84519	7479	5753	23012	1187	913	3652 7
	Female Male Male Female Male Male	≥65Female<65 ≥65Male<65 ≥65Male<65 ≥65Male<65 ≥65Male<65 ≥65Male<65 ≥65Male<65 ≥65Male<65 ≥65Male<65 ≥65Male<65 ≥65Male<65 ≥65Male<65 ≥65	≥ 65 79822 Female < 65 85291 ≥ 65 71076 Male < 65 94144 ≥ 65 78453 Female < 65 40173 ≥ 65 40173 ≥ 65 Male < 65 40173 ≥ 65 40173 ≥ 65 Male < 65 41161 ≥ 65 93462 $= 65$ Male < 65 112911 ≥ 65 94092 $= 65$ Male < 65 23652 ≥ 65 19710 $= 65$ Female < 65 23652 ≥ 65 19710 $= 65$ Female < 65 19710	≥ 65 798226450Female < 65 85291 3977 ≥ 65 71076 3977 $Male$ < 65 941444282 ≥ 65 784534282Female < 65 401735859 ≥ 65 401735859 $Male$ < 65 411617363 $Pemale$ < 65 411617363 $Male$ < 65 411617363 $Pemale$ < 65 112154 8672 $Male$ < 65 11291111697 ≥ 65 9409211697 $Male$ < 65 236523201 $Male$ < 65 197103201Female < 65 615933159	≥ 65 798226450103742Female < 65 85291 3977 155636 ≥ 65 71076 3977 103758 Male < 65 94144 4282 160695 ≥ 65 78453 4282 107130 Female < 65 40173 5859 95782 ≥ 65 40173 5859 95782 Male < 65 41161 7363 97473 ≥ 65 41161 7363 97473 ≥ 65 112154 8672 164911 ≥ 65 93462 8672 109941 Male < 65 112911 11697 169673 ≥ 65 94092 11697 113115 Male < 65 23652 3201 93363 ≥ 65 19710 3201 62242 Female < 65 61593 3159 126778	≥ 65 7982264501037426984Female<65	$\begin{array}{c c c c c c c c c c c c c c c c c c c $	≥65 79822 6450 103742 6984 5372 21489 Female <65	≥65 79822 6450 103742 6984 5372 21489 1187 Female <65	265 79822 6450 103742 6984 5372 21489 1187 913 Female .65 .85291 .3977 155636 .4884 .3757 15027 .650 .500 Male .65 .94144 .4282 .100695 .4884 .3757 .15027 .650 .500 .265 .78453 .4282 .100130 .6984 .5372 .21489 .1187 .913 Female .465 .40173 .5859 .95782 .4884 .3757 .15027 .650 .500 .265 .40173 .5859 .95782 .6984 .3757 .15027 .650 .500 .265 .40173 .5859 .95782 .6984 .3757 .15027 .650 .500 .265 .41161 .7363 .97473 .4884 .3757 .15027 .650 .500 .265 .3162 .8672 .164911 .4884 .3757 .15027

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1												
2		Male	<65	62174	4595	128507	10330	7946	31784	650	500	2001
3			≥65	51812	4595	85671	7479	5753	23012	1187	913	3652
4 5												
6	Endometrial	Female	<65	32129	1535	105262	4884	3757	15027	650	500	2001
7			≥65	26775	1535	70175	6984	5372	21489	1187	913	3652
8 9												
9 10	Ovarian	Female	<65	98788	8296	149573	4884	3757	15027	650	500	2001
11			≥65	82324	8296	99715	6984	5372	21489	1187	913	3652
12 13			203	02024	0230	33713	0304	5572	21403	1107	313	5052
13	0			O_{h}								
15	Gallbladder	Female	<65	40173	5859	95782	4884	3757	15027	650	500	2001
16			≥65	40173	5859	95782	6984	5372	21489	1187	913	3652
17 18		Male	<65	41161	7363	97473	4884	3757	15027	650	500	2001
18			≥65	41161	7363	97473	6984	5372	21489	1187	913	3652
20												
21 22	Kidney (Renal Cell)	Female	<65	46077	6255	110765	4884	3757	15027	650	500	2001
22			≥65	38397	6255	73843	6984	5372	21489	1187	913	3652
24		Male	<65	46048	6018	117123	4884	3757	15027	650	500	2001
25 26			≥65	38374	6018	78082	6984	5372	21489	1187	913	3652
26 27												
28	Breast (Postmenopausal)	Female	<65	27693	2207	94284	5985	4604	18416	650	500	2001
29 30	х г ,		≥65	23078	2207	62856	4752	3655	14620	1187	913	3652
31				20010		0_000					0.0	0002
32	The modul		05	40470	5050	05700	400.4	0757	45007	050	500	0004
33	Thyroid	Female	<65	40173	5859	95782	4884	3757	15027	650	500	2001
34 35			≥65	40173	5859	95782	6984	5372	21489	1187	913	3652
36		Male	<65	41161	7363	97473	4884	3757	15027	650	500	2001
37			≥65	41161	7363	97473	6984	5372	21489	1187	913	3652
38												
39 40	Multiple Myeloma	Female	<65	40173	5859	95782	4884	3757	15027	650	500	2001
40 41			≥65	40173	5859	95782	6984	5372	21489	1187	913	3652
42			-	-		-				-	-	
43												8

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1 2	Male	<65	41161	7363	97473	4884	3757	15027	650	500	2001
3		≥65				6984					
3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33		≥65	41161	7363	97473	6984	5372	21489	1187	913	3652
34 35 36 37 38 39 40 41 42 43 44 45 46 47					//bmjopen.bm						9

Supplementary Table 7. Baseline medical costs, productivity loss, and patient time cost among general population aged 20 years or older in the US, by 32 subgroups

Age group,		Race/ethnici	Medical of	costs	Product	ivity loss	Patient tin	ne cost
years	Sex	ty	Annual general	End-of-life	Annual general	End-of-life costs	Annual general	End-of-lif
years		-	costs	costs	costs		costs	costs
		NHW	4020	40000	2040	8160	226	904
	Female	NHB	3100	40000	2040	8160	226	904
	i emale	Hispanic	2355	40000	2040	8160	226	904
20-44		Other	2617	40000	2040	8160	226	904
20-44		NHW	2022	40000	2040	8160	226	904
	Male	NHB	2279	40000	2040	8160	226	904
	Male	Hispanic	1145	40000	2040	8160	226	904
		Other	1803	40000	2040	8160	226	904
							226	904
		NHW	5371	40000	2040	8160	226	904
	Fomala	NHB	5712	40000	2040	8160	226	904
	Female	Hispanic	3196	40000	2040	8160	226	904
		Other	4082	40000	2040	8160	226	904
45-54		NHW	3812	40000	2040	8160	226	904
	Mala	NHB	3639	40000	2040	8160	226	904
	Male	Hispanic	3612	40000	2040	8160	226	904
		Other	2560	40000	2040	8160	226	904
							226	904
		NHW	7300	40000	2040	8160	226	904
		NHB	5479	40000	2040	8160	226	904
	Female	Hispanic	4607	40000	2040	8160	226	904
55.04		Other	3951	40000	2040	8160	226	904
55-64		NHW	6519	40000	2040	8160	226	904
	Mala	NHB	6455	40000	2040	8160	226	904
	Male	Hispanic	5077	40000	2040	8160	226	904
		Other	6320	40000	2040	8160	226	904
		NHW	8997	40000	4409	8160	607	904
	E a secolo	NHB	9585	40000	4409	8160	607	904
	Female	Hispanic	8847	40000	4409	8160	607	904
205		Other	8625	40000	4409	8160	607	904
≥65		NHW	9334	40000	4409	8160	607	904
		NHB	7367	40000	4409	8160	607	904
	Male	Hispanic	5640	40000	4409	8160	607	904
		Other	7461	40000	4409	8160	607	904

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Supplementary Table 8. Characteristics of US adults aged 20 years or older participated in the NHANES, 2013-2016

47.8 ± 0.41 4319 (44.5) 1704 (18.3) 1725 (17.3) 2316 (19.9) 4829 (48.3) 5235 (51.7) 3944 (65.0) 2069 (11.2)	$425 \pm 4.38 \\ 315 \pm 5.39 \\ 271 \pm 4.90 \\ 192 \pm 3.83 \\ 388 \pm 4.53 \\ 279 \pm 4.04 $
4319 (44.5) 1704 (18.3) 1725 (17.3) 2316 (19.9) 4829 (48.3) 5235 (51.7) 3944 (65.0)	315 ± 5.39 271 ± 4.90 192 ± 3.83 388 ± 4.53 279 ± 4.04
1704 (18.3) 1725 (17.3) 2316 (19.9) 4829 (48.3) 5235 (51.7) 3944 (65.0)	315 ± 5.39 271 ± 4.90 192 ± 3.83 388 ± 4.53 279 ± 4.04
1704 (18.3) 1725 (17.3) 2316 (19.9) 4829 (48.3) 5235 (51.7) 3944 (65.0)	315 ± 5.39 271 ± 4.90 192 ± 3.83 388 ± 4.53 279 ± 4.04
1725 (17.3) 2316 (19.9) 4829 (48.3) 5235 (51.7) 3944 (65.0)	271 ± 4.90 192 ± 3.83 388 ± 4.53 279 ± 4.04
2316 (19.9) 4829 (48.3) 5235 (51.7) 3944 (65.0)	192 ± 3.83 388 ± 4.53 279 ± 4.04
4829 (48.3) 5235 (51.7) 3944 (65.0)	388 ± 4.53 279 ± 4.04
5235 (51.7) 3944 (65.0)	279 ± 4.04
5235 (51.7) 3944 (65.0)	279 ± 4.04
3944 (65.0)	
2069 (11-2)	320 ± 4.76
	361 ± 6.55
2668 (14.9)	367 ± 4.44
1383 (8.90)	325 ± 8.12
	311 ± 5.14
()	332 ± 5.72
	341 ± 4.92
2562 (31.0)	332 ± 7.10
	325 ± 4.87
	333 ± 4.55
	344 ± 6.73
	328 ± 7.01
29.3 ± 0.16	
145 (1.36)	341 ± 17.5
2671 (27.2)	327 ± 4.81
7163 (71.4)	334 ± 4.01
	2671 (27.2)



Supplementary Table 9. Consumption of calories from full-service and fast-food restaurants among US adults participated in 2013-2016 NHANES by 32 subgroups

Age group, years	group, years Sex Race/ethnicity		Baseline consumption kcal/day (mean ± SE)
20-44	Female	NHW	357 ± 6.47
2011	i omalo	NHB	397 ± 8.98
		Hispanic	364 ± 6.77
		Other	334 ± 11.3
	Male	NHW	485 ± 9.00
	indio	NHB	508 ± 12.3
		Hispanic	500 ± 13.7
		Other	466 ± 14.1
45-54	Female	NHW	270 ± 9.38
		NHB	266 ± 7.85
		Hispanic	265 ± 9.11
		Other	228 ± 14.6
	Male	NHW	374 ± 11.3
		NHB	388 ± 17.4
		Hispanic	355 ± 15.0
		Other	338 ± 20.2
55-64	Female	NHW	231 ± 5.25
		NHB	249 ± 9.58
		Hispanic	234 ± 7.99
		Other	216 ± 10.2
	Male	NHW	315 ± 9.55
		NHB	314 ± 18.3
		Hispanic	307 ± 9.90
		Other	298 ± 11.1
≥65	Female	NHW	164 ± 4.71
		NHB	156 ± 6.07
		Hispanic	158 ± 5.27
		Other	137 ± 5.43
	Male	NHW	235 ± 7.43
		NHB	220 ± 7.07
		Hispanic	218 ± 8.07

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1		Other	198 ± 20.0	
3 4				
5 6				
7 8 9				
10 11				
12 13				
14 15 16				
17 18				
19 20				
21 22				
23 24 25				
26 27				
28 29				
30 31 32				
33 34				
35 36 37				
37 38 39				
40 41				
42 43				13
44 45 46	For peer review only	- http://bmjopen.bmj.com/site/abc	out/guidelines.xhtml	
40 47				

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Supplementary Table 10. Estimated new cancer cases averted by the federal menu calorie labeling in the US by age, sex, race/ethnicity, and cancer type, over lifetime (U.S. population=235,162,844)¹

Concer Turns	Policy	20-44	/	45-54	у	55-64	У	65 + <u>y</u>	/
Cancer Type	Scenario	Female	Male	Female	Male	Female	Male	Female	Male
Endometrial									
Age	consumer	0000 (000)		504 (000)	0100	1110 (100)	40.40)	050 (407)	4400)
0	behavior	3300 (696 to	6090)	591 (-990 to	2160)	1140 (433 to	9 1940)	656 (107 to	1190)
	+industry response	5960 (3360 to	5 889 <u>0</u>)	1340 (-208 to	n 2980)	1600 (928 to	2430)	926 (396 to	1460)
Race/Ethnicity	100001100	0000 (0000 1	0000)	1040 (200 (0 2000)	1000 (020 10	, 2400)	320 (000 10	1400)
Non-		4000		400		757		570	
Hispanic	consumer behavior	1630 (-711 to 4080)	0	-136 (-1590 to 1430)	0	757 (140 to 1500)	0	572 (38 to 1070)	0
Vhite				, , , , , , , , , , , , , , , , , , ,		, , ,			
	+industry	3080	0	369	0	1110	0	780	0
Non	response	(829 to 5780)		(-1100 to 1950)	-	(463 to 1830)	-	(245 to 1290)	-
Non- Hispanic Black	consumer behavior	763 (-157 to 1710)	0	258 (-23 to 543)	0	283 (73 to 528)	0	47 (-43 to 150)	0
	+industry	1240		372		355		(-43 to 130) 77	
	response	(316 to 2200)	0	(93 to 668)	0	(146 to 604)	0	(-13 to 176)	0
Llienenie	consumer	910	0	290	0	42	0	43	0
Hispanic	behavior	(74 to 1790)	0	(-48 to 596)	0	(-83 to 185)	0	(-16 to 102)	0
	+industry	1460	0	399	0	89	0	64	0
	response	(580 to 2340)	0	(66 to 703)	Ŭ	(-35 to 233)	Ũ	(5 to 122)	Ũ
Other	consumer	19 (212 to 102)	0	165 (41 to 210)	0	54	0	-6	0
	behavior +industry	(-312 to 402) 150		(41 to 319) 191		(3 to 109) 68		(-26 to 14) 0	
	response	(-174 to 546)	0	(68 to 344)	0	(18 to 124)	0	(-21 to 21)	0
	100001100	(11110010)						(21 10 21)	
Breast									
Postmenopa									
usal)									
Age	consumer	0500 (000 to	5040)	272 / 4070 4	- 4050)	1010 (100 1	0400)	740 /407 40	1200)
0	behavior Lindustry	2530 (263 to	5040)	373 (-1070 te	5 1950)	1210 (480 to) 2130)	742 (137 to	1380)
	+industry response	4670 (2330 to	7350)	1040 (-390 to	a 2680)	1710 (1010 t	n 2640)	1040 (433 to	1700)
Race/Ethnicity	.0000100	1010 (2000 10		10-00 / 0-01				1001) 0101	
Non-	consumer	1370		-224		832		660	
Hispanic	behavior	(-659 to 3750)	0	(-1570 to 1210)	0	(170 to 1670)	0	(57 to 1280)	0
Vhite		, ,		234		, , , , , , , , , , , , , , , , , , ,		902	
	+industry response	2660 (490 to 5220)	0	234 (-1130 to 1770)	0	1200 (535 to 2040)	0	902 (291 to 1570)	0
Non-	consumer	(490 to 5220) 567	-	182	-	(555 10 2040) 267		(291101570) 43	_
lispanic Black	behavior	(-110 to 1300)	0	(-34 to 431)	0	(89 to 487)	0	(-40 to 136)	0
•		(, , , , , , , , , , , , , , , , , , ,				()			
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1		+industry	912 (240 to 1680)	0	271 (55 to 536)	0	329 (149 to 554)	0	71 (-13 to 166)	0
2	Hispanic	response consumer	(240 to 1680) 581	0	<u>231</u>	0	32.9	0	42	0
3 4		behavior +industry	(44 to 1200) 934		(-14 to 474) 312		(-72 to 154) 76	-	(-12 to 100) 61	-
5 6		response consumer	(368 to 1600) 1	0	(71 to 563) 182	0	(-34 to 198) 74	0	(6 to 123) -7	0
7	Other	behavior	(-310 to 384)	0	(40 to 353)	0	(9 to 148)	0	(-35 to 22)	0
8 9		+industry response	128 (-187 to 541)	0	210 (71 to 386)	0	94 (29 to 170)	0	1 (-27 to 31)	0
10 11	Kidney									
12	(Renal Cell)	consumor								
14	Age	consumer behavior +industry	2930 (864	to 5040)	581 (-364	to 1540)	1180 (526	i to 1810)	428 (28	to 805)
15 16	-	response	5240 (3110) to 7390)	1230 (244	to 2210)	1590 (941	to 2250)	651 (248	to 1030)
17	Race/Ethnicity Non-									
18 19	Hispanic	consumer behavior	338	1040	-42	53	172	677	147	192
20	White	+industry	(-137 to 844) 646	(-536 to 2790) 2020	(-332 to 273) 58	(-791 to 884) 379	(34 to 339) 251	(88 to 1240) 898	(18 to 280) 199	(-170 to 536) 320
21		response	(173 to 1180)	(410 to 3750)	(-236 to 383)	(-452 to 1250)	(109 to 420)	(326 to 1470)	(72 to 335)	(-35 to 661)
22		consumer	170	88	60	136	79	85	13	44
23 24	Hispanic Black	behavior +industry	(-35 to 384) 280	(-454 to 620) 343	(-5 to 128) 87	(-96 to 410) 203	(26 to 139) 97	(-81 to 258) 119	(-12 to 40) 21	(9 to 79) 56
25		response	(69 to 502)	(-202 to 898)	(22 to 157)	(-30 to 475)	(43 to 157)	(-45 to 295)	(-4 to 48)	(22 to 90)
26	Hispanic	consumer	267	895	92	230	14	94	15	9
27 28	Inopanio	behavior	(21 to 527) 425	(-21 to 1920) 1290	(-4 to 184) 123	(-25 to 503) 305	(-27 to 60) 29	(8 to 196) 127	(-6 to 36) 22	(-29 to 50) 21
20 29		+industry response	(166 to 697)	(371 to 2320)	(27 to 218)	(49 to 570)	(-12 to 76)	(41 to 232)	(2 to 44)	(-17 to 63)
30	Other	consumer	5	75	34	3	13	33	-1	8
31	Other	behavior	(-47 to 66)	(-103 to 274)	(12 to 59)	(-64 to 77)	(2 to 25)	/10 to 58)	(-6 to 4)	(-18 to 37)
32		+industry	27	147	38	17 (52 to 01)	16 (5 to 28)	41 (10 to 67)	1	11 (15 to 10)
33 34		response	(-26 to 89)	(-29 to 347)	(17 to 64)	(-52 to 91)	(5 to 28)	(19 to 67)	(-4 to 6)	(-15 to 40)
34 35	Liver									
	Age	consumer behavior	3210 (1000) to 5540)	701 (-200	to 1760)	1000 (477	′ to 1580)	275 (17	to 551)
38		+industry response	5560 (3130) to 8130)	1340 (397	to 2480)	1340 (804	to 1950)	432 (174	4 to 719)
40	Race/Ethnicity									
41 42										
43										15
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45				For peer review only	y - http://pmjopen.l	omj.com/site/about/	guiaeiines.xntml			
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Non- 1 Hispanic 2 White 3	consumer behavior +industry	170 (-125 to 597) 367	1150 (-258 to 3130) 2120	18 (-168 to 236) 78	-82 (-844 to 807) 215	113 (36 to 227) 159	520 (108 to 1020) 668	75 (6 to 155) 100	116 (-110 to 365) 198
4	response	(53 to 855)	(498 to 4300)	(-105 to 319)	(-537 to 1150)	(77 to 280)	(287 to 1220)	(35 to 189)	(-26 to 454)
5 Non-	consumer	143	85	53	213	51	118	7	37
6 Hispanic Black	behavior	(-27 to 346)	(-678 to 1050)	(2 to 120)	(-146 to 705)	(14 to 100)	(-112 to 393)	(-7 to 26)	(-4 to 88)
7	+industry	231	429	74	306	63	163	12	52
8	response	(53 to 458)	(-312 to 1460)	(24 to 147)	(-41 to 823)	(28 to 115)	(-58 to 447)	(-2 to 32)	(11 to 107)
⁹ Hispanic	consumer	239	1150	99	321	14	113	17	8
10	behavior	(19 to 570)	(93 to 2490)	(3 to 215)	(15 to 703)	(-30 to 72)	(19 to 233)	(-5 to 41)	(-33 to 54)
11	+industry	384	1600	132	409	31	150	25	20
12	response	(132 to 756)	(529 to 3050)	(36 to 257)	(106 to 820)	(-13 to 90)	(55 to 276)	(3 to 50)	(-19 to 70)
13 Other	consumer behavior	2 (-56 to 82)	99 (-125 to 379)	38 (9 to 77)	-1 (-101 to 125)	15 (0 to 34)	38 (5 to 76)	0 (-8 to 7)	9 (-28 to 53)
14	+industry	(-56 10 82) 26	183	(91077) 43	18	(0 10 34)	(5 10 7 8) 48	(-8 t0 7)	(-28 10 53)
15	response	(-32 to 108)	(-31 to 483)	(15 to 85)	(-80 to 152)	(5 to 40)	(17 to 91)	(-5 to 10)	(-23 to 59)
16	response	(-52 10 100)	(-31 10 403)	(13 10 03)	(-00 10 132)	(0 10 40)	(17 10 91)	(-5 10 10)	(-23 (0 33)
¹⁷ Pancreatic									
	consumer								
19 Age	behavior	764 (262	to 1340)	81.6 (-18	6 to 388)	404 (193	s to 651)	148 (21	to 286)
20	+industry								
21	response	1350 (820) to 1990)	269 (4	to 595)	540 (327	′ to 793)	227 (96	to 370)
²² Race/Ethnicity									
23 Non-	consumer	404	0.47	10	10	07	04.0	<u></u>	50
²⁴ Hispanic 25 White	behavior	121 (-44 to 367)	247 (-120 to 768)	-48 (-159 to 87)	-16 (-246 to 245)	87 (26 to 175)	218 (48 to 432)	63 (3 to 131)	58 (-54 to 189)
26 VIII.e	+industry	(-44 (0 367) 229	(-120 t0 708) 490	-11	(-240 10 245) 73	122	(48 10 432) 283	(310131) 87	(-54 to 189) 98
27	response	(50 to 493)	(99 to 1060)	(-124 to 134)	(-154 to 363)	(56 to 218)	(115 to 507)	(27 to 163)	(-12 to 238)
28 Non-	consumer	()	()				```	· · /	· /
		60	18	24	30	32	19	5	10
		60 (-10 to 158)	18 (-80 to 128)	24 (-1 to 54)	30 (-20 to 87)	32 (9 to 63)	19 (-16 to 62)	5 (-6 to 19)	10 (2 to 19)
29 Hispanic Black	behavior +industry	60 (-10 to 158) 98	18 (-80 to 128) 64	24 (-1 to 54) 34	30 (-20 to 87) 44	32 (9 to 63) 39	19 (-16 to 62) 27	5 (-6 to 19) 9	10 (2 to 19) 13
29 Hispanic Black	behavior	(-10 to 158)	(-80 to 128)	(-1 to 54)	(-20 to 87)	(9 to 63)	(-16 to 62)	(-6 to 19)	(2 to 19)
29 Hispanic Black 30 31	behavior +industry	(-10 to 158) 98	(-80 to 128) 64	(-1 to 54) 34	(-20 to 87) 44	(9 to 63) 39	(-16 to 62) 27	(-6 to 19) 9	(2 to 19) 13
29 Hispanic Black 30	behavior +industry response	(-10 to 158) 98 (21 to 207)	(-80 to 128) 64 (-36 to 184)	(-1 to 54) 34 (9 to 67) 26 (-4 to 60)	(-20 to 87) 44 (-4 to 102)	(9 to 63) 39 (17 to 72)	(-16 to 62) 27 (-9 to 70) 18 (-3 to 44)	(-6 to 19) 9 (-2 to 23)	(2 to 19) 13 (5 to 23)
29 Hispanic Black 30 31 ³² Hispanic	behavior +industry response consumer behavior +industry	(-10 to 158) 98 (21 to 207) 68 (5 to 150) 108	(-80 to 128) 64 (-36 to 184) 194 (13 to 422) 273	(-1 to 54) 34 (9 to 67) 26 (-4 to 60) 36	(-20 to 87) 44 (-4 to 102) 46 (-5 to 105) 63	(9 to 63) 39 (17 to 72) 4 (-11 to 22) 10	(-16 to 62) 27 (-9 to 70) 18 (-3 to 44) 26	(-6 to 19) 9 (-2 to 23) 6 (-2 to 14) 8	(2 to 19) 13 (5 to 23) 2 (-8 to 12) 5
29 Hispanic Black 30 31 32 Hispanic 33	behavior +industry response consumer behavior +industry response	(-10 to 158) 98 (21 to 207) 68 (5 to 150) 108 (40 to 201)	(-80 to 128) 64 (-36 to 184) 194 (13 to 422) 273 (92 to 518)	(-1 to 54) 34 (9 to 67) 26 (-4 to 60) 36 (7 to 70)	(-20 to 87) 44 (-4 to 102) 46 (-5 to 105) 63 (11 to 124)	(9 to 63) 39 (17 to 72) 4 (-11 to 22) 10 (-5 to 28)	(-16 to 62) 27 (-9 to 70) 18 (-3 to 44) 26 (6 to 53)	(-6 to 19) 9 (-2 to 23) 6 (-2 to 14) 8 (0 to 18)	(2 to 19) 13 (5 to 23) 2 (-8 to 12) 5 (-5 to 15)
29 Hispanic Black 30 31 32 Hispanic 33 34 35	behavior +industry response consumer behavior +industry response consumer	(-10 to 158) 98 (21 to 207) 68 (5 to 150) 108 (40 to 201) -2	(-80 to 128) 64 (-36 to 184) 194 (13 to 422) 273 (92 to 518) 18	(-1 to 54) 34 (9 to 67) 26 (-4 to 60) 36 (7 to 70) 17	(-20 to 87) 44 (-4 to 102) 46 (-5 to 105) 63 (11 to 124) 0	(9 to 63) 39 (17 to 72) 4 (-11 to 22) 10 (-5 to 28) 8	(-16 to 62) 27 (-9 to 70) 18 (-3 to 44) 26 (6 to 53) 10	(-6 to 19) 9 (-2 to 23) 6 (-2 to 14) 8 (0 to 18) 0	(2 to 19) 13 (5 to 23) 2 (-8 to 12) 5 (-5 to 15) 2
29 Hispanic Black 30 31 32 Hispanic 33 34 35	behavior +industry response consumer behavior +industry response consumer behavior	(-10 to 158) 98 (21 to 207) 68 (5 to 150) 108 (40 to 201) -2 (-27 to 30)	(-80 to 128) 64 (-36 to 184) 194 (13 to 422) 273 (92 to 518) 18 (-29 to 72)	$(-1 to 54) \\ 34 \\ (9 to 67) \\ 26 \\ (-4 to 60) \\ 36 \\ (7 to 70) \\ 17 \\ (4 to 33)$	(-20 to 87) 44 (-4 to 102) 46 (-5 to 105) 63 (11 to 124) 0 (-20 to 23)	(9 to 63) 39 (17 to 72) 4 (-11 to 22) 10 (-5 to 28) 8 (1 to 16)	(-16 to 62) 27 (-9 to 70) 18 (-3 to 44) 26 (6 to 53) 10 (3 to 19)	(-6 to 19) 9 (-2 to 23) 6 (-2 to 14) 8 (0 to 18) 0 (-4 to 3)	(2 to 19) 13 (5 to 23) 2 (-8 to 12) 5 (-5 to 15) 2 (-6 to 13)
29 Hispanic Black 30 31 32 Hispanic 33 34 35 36 Other	behavior +industry response consumer behavior +industry response consumer behavior +industry	(-10 to 158) 98 (21 to 207) 68 (5 to 150) 108 (40 to 201) -2 (-27 to 30) 9	(-80 to 128) 64 (-36 to 184) 194 (13 to 422) 273 (92 to 518) 18 (-29 to 72) 36	$(-1 to 54) \\ 34 \\ (9 to 67) \\ 26 \\ (-4 to 60) \\ 36 \\ (7 to 70) \\ 17 \\ (4 to 33) \\ 19 \\ (9 to 51) \\ (10 to 5$	(-20 to 87) 44 (-4 to 102) 46 (-5 to 105) 63 (11 to 124) 0 (-20 to 23) 4	(9 to 63) 39 (17 to 72) 4 (-11 to 22) 10 (-5 to 28) 8 (1 to 16) 10	(-16 to 62) 27 (-9 to 70) 18 (-3 to 44) 26 (6 to 53) 10 (3 to 19) 13	(-6 to 19) 9 (-2 to 23) 6 (-2 to 14) 8 (0 to 18) 0 (-4 to 3) 1	(2 to 19) 13 (5 to 23) 2 (-8 to 12) 5 (-5 to 15) 2 (-6 to 13) 4
29 Hispanic Black 30 31 32 Hispanic 33 34 35 36 Other 37	behavior +industry response consumer behavior +industry response consumer behavior	(-10 to 158) 98 (21 to 207) 68 (5 to 150) 108 (40 to 201) -2 (-27 to 30)	(-80 to 128) 64 (-36 to 184) 194 (13 to 422) 273 (92 to 518) 18 (-29 to 72)	$(-1 to 54) \\ 34 \\ (9 to 67) \\ 26 \\ (-4 to 60) \\ 36 \\ (7 to 70) \\ 17 \\ (4 to 33)$	(-20 to 87) 44 (-4 to 102) 46 (-5 to 105) 63 (11 to 124) 0 (-20 to 23)	(9 to 63) 39 (17 to 72) 4 (-11 to 22) 10 (-5 to 28) 8 (1 to 16)	(-16 to 62) 27 (-9 to 70) 18 (-3 to 44) 26 (6 to 53) 10 (3 to 19)	(-6 to 19) 9 (-2 to 23) 6 (-2 to 14) 8 (0 to 18) 0 (-4 to 3)	(2 to 19) 13 (5 to 23) 2 (-8 to 12) 5 (-5 to 15) 2 (-6 to 13)

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Esophageal ¹ Adenocarcin ² oma									
³ ₄ Age	consumer behavior			92 (-296 to 501)		419 (136 to 719)		128 (-60 to 309)	
5	+industry response	1300 (602	2 to 2100)	293 (-10	2 to 708)	556 (270) to 858)	206 (20 to 390)	
 7 Race/Ethnicity 8 Non- 9 Hispanic 10 White 11 12 13 Non- 14 Hispanic Black 15 16 17 Hispanic 18 19 20 21 Other 22 	consumer behavior +industry response consumer behavior +industry response consumer behavior +industry response consumer behavior	45 (-25 to 125) 91 (17 to 179) 10 (-2 to 22) 16 (4 to 29) 28 (2 to 57) 44 (17 to 76) -1 (-10 to 11)	$\begin{array}{c} 406\\(-228\ to\ 1100)\\815\\(174\ to\ 1560)\\10\\(-28\ to\ 50)\\28\\(-11\ to\ 69)\\196\\(-2\ to\ 414)\\280\\(80\ to\ 504)\\10\\(-16\ to\ 41)\end{array}$	$\begin{array}{c} -9 \\ (-55 \text{ to } 41) \\ 7 \\ (-40 \text{ to } 60) \\ 3 \\ (-1 \text{ to } 8) \\ 5 \\ (1 \text{ to } 9) \\ 9 \\ (-1 \text{ to } 20) \\ 13 \\ (2 \text{ to } 24) \\ 6 \\ (1 \text{ to } 11) \end{array}$	26 (-368 to 419) 179 (-210 to 578) 11 (-7 to 32) 16 (-2 to 37) 46 (-7 to 112) 63 (7 to 130) 0 (-12 to 13)	30(7 to 58)43(20 to 73)5(2 to 9)6(3 to 11)2(-3 to 8)3(-1 to 10)2(0 to 5)	345(64 to 630)449(174 to 739)67(-7 to 22)9(-4 to 25)24(3 to 47)32(11 to 56)7(2 to 12)	27 (5 to 50) 35 (14 to 59) 1 (-1 to 3) 1 (0 to 3) 2 (-1 to 4) 3 (0 to 5) 0 (-1 to 1)	92 (-88 to 263) 155 (-17 to 330) 4 (0 to 7) 5 (2 to 8) 2 (-7 to 12) 4 (-4 to 15) 2 (-4 to 8)
22 23 24	+industry response	3 (-6 to 15)	21 (-6 to 52)	75 (2 to 12)	2 (-10 to 15)	3 (1 to 6)	8 (4 to 13)	0 (-1 to 1)	2 (-3 to 9)
25 Colorectal									
²⁶ Age 27 Age 28	consumer behavior +industry	584 (183	to 1090)	79 (-90	to 289)	251 (126	S to 412)	117 (19	to 224)
29 30 Race/Ethnicity	response	1050 (605	5 to 1610)	201 (23	to 426)	341 (209	9 to 514)	175 (81	to 289)
 31 Non- 32 Hispanic 33 White 34 35 36 Non- 37 Hispanic Black 38 39 40 Hispanic 41 42 43 	consumer behavior +industry response consumer behavior +industry response consumer behavior	$\begin{array}{c} 67\\ (-51 \text{ to } 261)\\ 144\\ (-2 \text{ to } 382)\\ 31\\ (-9 \text{ to } 88)\\ 53\\ (9 \text{ to } 119)\\ 45\\ (2 \text{ to } 113)\end{array}$	169 (-107 to 569) 358 (40 to 790) 38 (-48 to 144) 78 (-8 to 203) 185 (25 to 409)	-35 (-106 to 64) -12 (-80 to 97) 11 (-1 to 29) 17 (4 to 36) 20 (1 to 43)	$\begin{array}{r} -17 \\ (-151 \text{ to } 163) \\ 38 \\ (-99 \text{ to } 233) \\ 26 \\ (-13 \text{ to } 79) \\ 36 \\ (-2 \text{ to } 91) \\ 57 \\ (9 \text{ to } 114) \end{array}$	52 (11 to 111) 75 (30 to 146) 19 (7 to 36) 23 (11 to 41) 3 (-7 to 16)	$126 \\ (21 \text{ to } 262) \\ 168 \\ (62 \text{ to } 313) \\ 14 \\ (-17 \text{ to } 49) \\ 20 \\ (-9 \text{ to } 56) \\ 21 \\ (2 \text{ to } 44) \\ \end{cases}$	55 (11 to 115) 73 (28 to 138) 3 (-4 to 12) 6 (-1 to 12) 4 (-1 to 15) 4 (-1 to 11)	44 (-36 to 129) 70 (-7 to 162) 8 (1 to 17) 11 (3 to 21) 1 (-8 to 11) 17
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	+industry	73	256	26	70	6	28	6	4
1	response	(18 to 155)	(84 to 504)	(8 to 51)	(23 to 129)	(-3 to 20)	(10 to 53)	(1 to 13)	(-5 to 14)
² Other	consumer	-2	20	7	1	4	8	-1	3
3 Other	behavior	(-21 to 26)	(-31 to 89)	(-1 to 19)	(-20 to 26)	(0 to 11)	(1 to 16)	(-3 to 2)	(-6 to 13)
4	+industry	6	41	9	5	6	10	0	4
5	response	(-13 to 36)	(-9 to 115)	(1 to 21)	(-15 to 31)	(1 to 12)	(4 to 19)	(-2 to 3)	(-5 to 14)
6									
7 Thyroid									
0	consumer								
⁸ Age 9	behavior	374 (114	to 751)	10 (-69	to 125)	84 (44	to 144)	34 (7	to 68)
10	+industry								
11	response	683 (349	to 1130)	67 (-17	to 200)	117 (70	to 187)	52 (22	to 91)
12 Race/Ethnicity									
13 Non-	oonoumor								
A Hispanic	consumer	96	52	-28	-15	21	28	20	8
15 White	behavior	(-59 to 382)	(-59 to 273)	(-85 to 56)	(-64 to 58)	(1 to 62)	(1 to 73)	(2 to 47)	(-9 to 31)
16	+industry	205	131	-8	3	33	40	28	14
17 No.	response	(-15 to 563)	(-26 to 395)	(-63 to 92)	(-43 to 85)	(5 to 80)	(12 to 90)	(9 to 58)	(-3 to 40)
NOD-	consumer	29	7	8	3	12	2	1	1
¹⁸ Hispanic Black	behavior	(-10 to 113)	(-10 to 36)	(-1 to 24)	(-3 to 12)	(6 to 22)	(-2 to 8)	(-2 to 5)	(0 to 2)
19	+industry	52	16	12	5	14	3	2	2
20	response	(-1 to 153)	(-4 to 50)	(2 to 30)	(-1 to 15)	(8 to 26)	(-1 to 10)	(0 to 7)	(1 to 3)
21 ₂₂ Hispanic	consumer	68	59	15	13	2	4	2	0
	behavior	(1 to 201)	(6 to 151)	(-5 to 39)	(2 to 30)	(-4 to 12)	(0 to 9)	(-1 to 6)	(-1 to 3)
23	+industry	113	84	21	16	4	5	3	1
24	response	(22 to 276)	(26 to 189)	(2 to 48)	(6 to 35)	(-2 to 15)	(2 to 12)	(0 to 8)	(-1 to 3)
25 26 Other	consumer	-4	13	6	1	5	5	-1	0
20	behavior	(-38 to 59)	(-13 to 56)	(-4 to 20)	(-7 to 12)	(2 to 10)	(3 to 8)	(-2 to 1)	(-2 to 3)
27	+industry	12	23	8	3	6	6	0	1
28	response	(-25 to 82)	(-2 to 70)	(-1 to 23)	(-5 to 14)	(3 to 11)	(4 to 9)	(-2 to 2)	(-1 to 4)
29									
30 Multiple									
31 Myeloma									
³² Age	consumer								
33	behavior	370 (113	to 743)	78 (-46	to 242)	181 (85	to 308)	63 (7 t	o 128)
34	+industry								
35	response	653 (327	to 1120)	164 (29	to 357)	243 (142	2 to 385)	97 (41	to 169)
36 Race/Ethnicity									
an Non-	consumer								
Hispanic	behavior	27	102	-14	-4	24	96	20	23
38 White		(-34 to 138)	(-61 to 375)	(-50 to 50)	(-96 to 139)	(3 to 67)	(25 to 204)	(1 to 52)	(-23 to 83)
40	+industry	64	207	-1	29	36	125	28	39
41	response	(-22 to 204)	(0 to 544)	(-38 to 74)	(-60 to 199)	(9 to 87)	(52 to 246)	(8 to 65)	(-5 to 111)
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Non-	consumer	39	22	14	27	19	11	4	10
¹ Hispanic Black	behavior	(-9 to 135)	(-63 to 178)	(-1 to 43)	(-15 to 95)	(4 to 45)	(-22 to 60)	(-4 to 17)	(2 to 22)
2	+industry	`	`	`22 ´	`	`24 ´	` 18 ´	`6 ´	`13 ´
3	response	(1 to 183)	(-30 to 242)	(4 to 55)	(-3 to 113)	(9 to 54)	(-13 to 71)	(-1 to 20)	(5 to 26)
4 Hispapia	consumer	26	111	7	25	2	15	2	0
5 Hispanic	behavior	(0 to 79)	(12 to 277)	(-5 to 24)	(-3 to 68)	(-4 to 11)	(3 to 32)	(-1 to 7)	(-5 to 7)
6	+industry	43	154	10	33	4	19	3	1
7	response	(6 to 110)	(50 to 340)	(0 to 30)	(6 to 82)	(-2 to 15)	(8 to 39)	(0 to 9)	(-3 to 9)
⁸ Other	consumer	0	8	7	0	1	4	-0	1
9	behavior	(-7 to 11)	(-11 to 41)	(3 to 12)	(-10 to 12)	(1 to 4)	(1 to 9)	(-1 to 1)	(-3 to 6)
10	+industry	2	16	8	1	2	5	0	1
11	response	(-4 to 16)	(-3 to 53)	(4 to 13)	(-8 to 15)	(0 to 5)	(2 to 11)	(-1 to 1)	(-2 to 6)
¹²									
13 Stomach									
14 (Gastric									
14 Cardia)	oonoumor								
16 Age	consumer behavior	338 (49	to 803)	58 (-90) to 264)	182 (70	to 3/17)	54 (-10	to 149)
17	+industry	550 (43		00 (-93	10 204)	102 (70	10 047)	54 (-13	10 143)
18	response	607 (241	to 1140)	141 (-2)	0 to 378)	240 (129	(10, 420)	86 (15	to 190)
¹⁹ Race/Ethnicity	response	007 (241	(0 1 1 + 0)		0 10 07 0)	240 (120	10 420)	00(10	10 100)
²⁰ Non-									
²¹ Hispanic	consumer	18	208	-9	24	15	145	14	34
²² White	behavior	(-19 to 77)	(-55 to 648)	(-31 to 25)	(-128 to 233)	(4 to 37)	(35 to 304)	(3 to 28)	(-36 to 124)
23	+industry	43	380	-1	86	22	187	18	58
24	response	(-6 to 117)	(51 to 886)	(-24 to 38)	(-67 to 322)	(9 to 47)	(77 to 364)	(8 to 35)	(-9 to 160)
25 Non-	consumer	7	6	2	7	3	3	0	3
26 Hispanic Black	behavior	(-2 to 21)	(-19 to 44)	(0 to 6)	(-5 to 24)	(1 to 7)	(-6 to 15)	(0 to 2)	(1 to 5)
27	+industry	`12 ´	` 19 ´	` 3 ´	` 10 <i>´</i>	<u> </u>	`5	` 1 <i>´</i>	`3 ´
28	response	(2 to 28)	(-8 to 62)	(1 to 7)	(-2 to 29)	(2 to 8)	(-4 to 17)	(0 to 2)	(2 to 6)
29 Hispanic	consumer	15	63	5	16		7	1	1
²⁹ Hispanic 30	behavior	(1 to 39)	(-7 to 170)	(0 to 13)	(-4 to 45)	(-2 to 5)	(0 to 18)	(0 to 3)	(-3 to 5)
31	+industry	24	95	7	22	2	/ 10	<u>1</u>	2
32	response	(6 to 52)	(21 to 214)	(2 to 16)	(3 to 54)	(-1 to 6)	(3 to 23)	(0 to 3)	(-2 to 7)
³³ Other	consumer	-1	5	5	0	1	4	0	1
34	behavior	(-7 to 10)	(-14 to 34)	(2 to 9)	(-8 to 12)	(0 to 3)	(1 to 9)	(-1 to 1)	(-3 to 6)
35	+industry	2	12	6	2	2	5	0	2
36	response	(-5 to 14)	(-7 to 46)	(3 to 10)	(-6 to 15)	(0 to 4)	(2 to 10)	(-1 to 1)	(-2 to 7)
27									
37 38 Gallbladder									
39 Age	consumer								
40	behavior	161 (67	to 263)	51 (8	to 100)	76 (47	to 109)	29 (11	to 51)
41	+industry	/		/ / -					
42	response	282 (181	to 396)	86 (43	to 138)	101 (73	to 137)	44 (25	5 to 66)
43									19
44									10
45			For peer review only	/ - http://bmjopen	.bmj.com/site/about	/guidelines.xhtml			
					-	-			

Race/Ethnicity									
¹ Non-	consumer								
2 Hispanic	behavior	24	19	0	1.97	19	23	16	6
3 White	Denavior	(-10 to 71)	(-13 to 61)	(-25 to 30)	(-17 to 24)	(5 to 38)	(6 to 42)	(3 to 31)	(-5 to 17)
4	+industry	47	39	9	9	27	29	21	9
5	response	(10 to 99)	(5 to 88)	(-16 to 42)	(-10 to 34)	(12 to 48)	(13 to 50)	(8 to 37)	(-1 to 21)
6 Non-	consumer	27	2	11	6	14	4	2	2
7 Hispanic Black	behavior	(-6 to 70)	(-17 to 26)	(0 to 24)	(-4 to 18)	(4 to 26)	(-4 to 12)	(-2 to 7)	(0 to 4)
8	+industry	45	11	15	9	17	5	4	3
9	response	(11 to 93)	(-8 to 38)	(4 to 29)	(-1 to 21)	(8 to 30)	(-2 to 14)	(-1 to 9)	(1 to 5)
	consumer	32	42	10	14	3	7	3	0
¹⁰ Hispanic 11	behavior	(2 to 73)	(-10 to 106)	(-4 to 26)	(-2 to 34)	(-5 to 11)	(1 to 15)	(-1 to 7)	(-3 to 4)
12	+industry	53	65	15	19	5	9	4	1
13	response	(19 to 96) 🗸	(11 to 130)	(1 to 31)	(3 to 39)	(-2 to 14)	(3 to 18)	(1 to 9)	(-2 to 5)
	consumer	0	3	6	0	3	3	0	` 1 <i>´</i>
•	behavior	(-11 to 18)	(-6 to 15)	(1 to 13)	(-4 to 5)	(0 to 7)	(1 to 5)	(-1 to 1)	(-1 to 3)
15	+industry	`5´´	7	`7 [′]	`1 ´	4	`3 ´	Ò Ó	` 1 <i>´</i>
16	response	(-7 to 24)	(-2 to 19)	(2 to 14)	(-3 to 6)	(1 to 8)	(1 to 5)	(-1 to 2)	(-1 to 3)
17	,				()	()	(<i>'</i>	()	· · · · ·
¹⁸ Advanced									
¹⁹ Prostate									
20	consumer								
₂₁ Age	behavior	163 (9	to 360)	37 (-54	to 146)	106 (33	to 194)	35 (-14	4 to 91)
22	+industry	(-	····/			((,
23	response	300 (130) to 507)	85 (-6	to 203)	142 (67	to 240)	56 (91	to 119)
²⁴ Race/Ethnicity			,	(-		(-	/	(-	/
25 Non-									
26 Hispanic	consumer		86		-1		75		24
27 White	behavior	0	(-24 to 267)	0	(-80 to 98)	0	(9 to 162)	0	(-23 to 80)
28	+industry	0	162	0	30	0	100	0	40
29	response		(32 to 350)		(-48 to 144)		(36 to 199)		(-5 to 102)
30 Non-	consumer	0	3	0	21	0	16	0	8
31 Hispanic Black	behavior	-	(-61 to 97)	-	(-17 to 69)		(-13 to 51)	-	(2 to 17)
32	+industry	0	34	0	31	0	22	0	11
33	response	-	(-33 to 145)	-	(-5 to 83)		(-7 to 57)	-	(4 to 20)
~ /	consumer	0	59	0	13	0	9	0	1
³⁴ Hispanic 35	behavior	-	(8 to 133)	-	(-3 to 37)	-	(2 to 20)	-	(-3 to 5)
	+industry	0	82	0	18	0	12	0	2
36	response	ů,	(28 to 163)	Ū	(1 to 44)	Ŭ	(5 to 23)	Ũ	(-2 to 7)
37	consumer	0	3	0	0	0	4	0	1
38 Other	behavior	ů,	(-10 to 21)	Ū	(-7 to 8)	Ŭ	(2 to 8)	Ũ	(-3 to 5)
39	+industry	0	8	0	1	0	5	0	2
40	response	5	(-5 to 28)	5	(-5 to 9)	0	(3 to 9)	5	(-2 to 6)
41	.0000100		(0.020)						(2 10 0)
42									
43									20
44									
			Ear poor raviow only	L. L. L. //L	L / / . L	(7) to 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1,			

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Ovarian

Ovarian									
1 2 Age 3	consumer behavior +industry	66 (-10 to	180)	16 (-20 to	75)	31 (11 to	69)	28 (11 to	961)
4	response	129 (16 to	277)	33 (-6 to	33 (-6 to 102)		87)	37 (19 to 75)	
5 Race/Ethnicit 6 Non- 7 Hispanic 8 White	y consumer behavior	34 (-25 to 147)	0	-4 (-38 to 54)	0	20 (2 to 55)	0	25 (8 to 57)	0
9 10	+industry response	71 (-23 to 220)	0	7 (-30 to 72)	0	30 (6 to 71)	0	32 (15 to 70)	0
₁₁ Non- ₁₂ Hispanic Blac	consumer ck behavior	11 (-5 to 41)	0	4 (0 to 13)	0	6 (3 to 13)	0	1 (-1 to 5)	0
13 14	+industry response	19 (-3 to 56)	0	6 (0 to 17)	0	8 (4 to 16)	0	2 (0 to 6)	0
15 Hispanic 16	consumer behavior	21 (-2 to 67)	0	8 (-1 to 21)	0	1 (-3 to 8)	0	1 (-1 to 5)	0
17 18	+industry response	34 (1 to 91)	0	11 (3 to 26)	0	3 (-1 to 10)	0	2 (0 to 6)	0
19 Other	consumer behavior	-8 (-19 to 13)	0	6 (2 to 13)	0	2 (1 to 5)	0	0 (-1 to 1)	0
20 21	+industry response	-3 (-15 to 21)	0	7 (3 to 14)	0	3 (1 to 6)	0	0 (-1 to 2)	0
23	e the median estimate	es (95% uncertainty interva	als) of each distril	bution of 1000 simulations.					
24 25									
26 27									
28 29									
30 31									
32 33									
34 35									
36									
37 38									
39 40									
41 42									
43 44									21
45 46		Fc	or peer review o	only - http://bmjopen.bm	nj.com/site/ab	out/guidelines.xhtml			
47									

Supplementary Table 11. Estimated cancer deaths reduced by the federal menu calorie labeling in the US by age, sex, race/ethnicity, and cancer type, over a lifetime (U.S. population=235,162,844)¹

Cancer Type	Policy	20-4			-54 y	55-6		65 + y	
	Scenario	Female	Male	Female	Male	Female	Male	Female	Male
Breast Postmenopa usal)									
Age	consumer behavior	2490 (260) to 4980)	151 (-20	04 to 521)	285 (129	to 479)	126 (3	0 to 227)
_ /	+industry response	4610 (229	0 to 7240)	336 (-2	26 to 725)	396 (237	to 598)	178 (8	2 to 284)
Race/Ethnicity Non- Hispanic White	consumer behavior	1350 (-652 to 3690)	0	-55 (-373 to 278)	0	165 (33 to 327)	0	103 (10 to 204)	0
	+industry response	2620 (480 to 5150)	0	54 (-264 to 419)	0	238 (105 to 401)	0	139 (47 to 244)	0
Non- Hispanic Black	consumer behavior	560 (-109 to 1280)	0	85 (-11 to 200)	0	95 (32 to 173)	0	13 (-12 to 40)	0
	+industry response	901 (238 to 1660)	0	126 (26 to 247)	0	117 (53 to 196)	0	21 (-4 to 49)	0
Hispanic	consumer behavior	572 (45 to 1180)	0	76 (-7 to 163)	0	9 (-21 to 44)	0	10 (-3 to 24)	0
	+industry response	922 (364 to 1570)	0	104 (21 to 193)	0	21 (-9 to 57)	0	15 (2 to 30)	0
Other	consumer behavior +industry	0 (-306 to 378) 125	0	39 (9 to 76) 45	0	15 (2 to 31) 19	0	-1 (-6 to 3) 0	0
	response	(-185 to 532)	0	(16 to 84)	0	(6 to 35)	0	(-5 to 5)	0
Liver	00000000								
Age	consumer behavior	2840 (897	' to 4890)	628 (-18	31 to 1570)	852 (411	to 1340)	227 (1	8 to 455)
Race/Ethnicity	+industry response	4900 (276	0 to 7190)	1200 (34	45 to 2210)	1140 (689	to 1650)	357 (14	6 to 587)
Non- Hispanic White	consumer behavior	139 (-108 to 504)	1040 (-237 to 2780)	15 (-147 to 207)	-70 (-749 to 722)	98 (31 to 196)	440 (93 to 858)	63 (6 to 130)	97 (-88 to 2
WINE .	+industry response	310 (42 to 719)	1900 (449 to 3830)	67 (-93 to 276)	199 (-478 to 1040)	137 (67 to 240)	565 (241 to 1020)	85 (30 to 159)	161 (-18 to :
							1020)		

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47

1	Non-	consumer	134	72	49	193	43	100	6	29
2	Hispanic Black	behavior +industry	(-25 to 317) 214	(-601 to 932) 382	(3 to 110) 68	(-133 to 632) 276	(12 to 85) 54	(-95 to 336) 139	(-6 to 22) 10	(-4 to 69) 41
3 4		response consumer	(51 to 425) 199	(-273 to 1280) 1020	(23 to 133) 87	(-37 to 729) 285	(24 to 97) 12	(-49 to 377) 99	(-2 to 27) 15	(8 to 83) 6
5	Hispanic	behavior	(17 to 473)	(88 to 2210) 1430	(2 to 189) 116	(13 to 630) 365	(-26 to 62) 26	(18 to 201)	(-4 to 35)	(-28 to 46) 17
6 7		+industry response	316 (111 to 623)	(482 to 2690)	(31 to 223)	(94 to 729)	(-11 to 78)	131 (48 to 242)	21 (3 to 43)	(-15 to 59)
8 9	Other	consumer behavior	2 (-47 to 68)	90 (-110 to 339)	32 (7 to 65)	-2 (-88 to 108)	12 (0 to 28)	30 (4 to 61)	0 (-6 to 6)	7 (-22 to 42)
10		+industry	22	168	36	<u> </u>	` 16 ´́	39	1	11
11 12		response	(-28 to 93)	(-26 to 434)	(13 to 71)	(-70 to 130)	(4 to 32)	(14 to 74)	(-4 to 8)	(-18 to 46)
13	Endometrial	consumer								
14 15	Age	behavior	1190 (309	9 to 2140)	251 (-24	l8 to 785)	394 (177	to 659)	213 (51	to 378)
16		+industry response	2100 (120	0 to 3110)	512 (26	to 1060)	548 (325	to 817)	302 (13	9 to 472)
17 18	Race/Ethnicity									
19	Non- Hispanic	consumer behavior	440 (-210 to 1170)	0	-42 (-511 to 440)	0	206 (36 to 399)	0	173 (13 to 319)	0
20 21	White	+industry	(-210101170) 858		(-511 (0 440)		(30 10 399) 298		234	
22		response	(218 to 1620)	0	(-351 to 606)	0	(127 to 491)	0	(76 to 388)	0
23 24	Non- Hispanic Black	consumer behavior	412 (-90 to 937)	0	139 (-9 to 293)	0	157 (42 to 295)	0	26 (-24 to 83)	0
25 26	•	+industry response	666 (177 to 1210)	0	`201 (51 to 361)	0	` 195 ∕ (81 to 338)	0	42 (-8 to 97)	0
27	Hispanic	consumer	<u>`</u> 315	0	105	0	16	0	` 19 ´	0
28 29	inopanio	behavior +industry	(22 to 645) 505		(-22 to 222) 144		(-33 to 70) 34		(-7 to 44) 28	
30		response	(197 to 854)	0	(21 to 261)	0	(-14 to 89)	0	(3 to 54)	0
31 32	Other	consumer behavior	8 (-99 to 139)	0	51 (13 to 99)	0	17 (1 to 36)	0	-3 (-10 to 5)	0
33		+industry response	50 (-56 to 187)	0	58 (21 to 107)	0	22 (6 to 41)	0	0 (-8 to 7)	0
34 35	Kidaaa		(000000)		(,		(0.10.1.)		(• •• •)	
36 37	Kidney (Renal Cell)									
38	Age	consumer behavior	1050 (284	4 to 1830)	263 (-15	53 to 695)	506 (225	to 778)	182 (20) to 338)
39 40		+industry	1880 (110	0 to 2680)	539 (10	6 to 977)	679 (402	to 954)	276 (11)	2 to 429)
41	Race/Ethnicity	response				,			(,
42 43										23
44			F	or peer review only	/ - http://hmionen	.bmj.com/site/abou	ıt/auidelines xhtml			-
45 46				- peer erren om						
47										

1	Non- Hispanic	consumer	57 (22 to 150)	332	-16 (128 to 100)	26 (251 to 200)	72	287	66 (0 to 121)	81 (68 to 210)
2	White	behavior	(-23 to 159)	(-183 to 922)	(-128 to 106)	(-351 to 396)	(14 to 138)	(42 to 525)	(9 to 124)	(-68 to 219)
3		+industry	111	663	22	168	105	378	89	133
4		response	(27 to 224)	(123 to 1280)	(-90 to 146)	(-199 to 552)	(46 to 171)	(138 to 623)	(33 to 148)	(-12 to 272)
5	Non-	consumer	67	48	24	59	30	35	5	16
6	Hispanic Black	behavior	(-16 to 162)	(-225 to 326)	(-2 to 53)	(-40 to 171)	(10 to 56)	(-32 to 106)	(-5 to 16)	(3 to 28)
7		+industry	113	174	34	87	37	49	8	20
8		response	(25 to 218)	(-96 to 461)	(9 to 64)	(-14 to 199)	(17 to 63)	(-17 to 121)	(-2 to 20)	(7 to 33)
9	Hispanic	consumer behavior	111 (9 to 229)	367 (0 to 792)	30 (-3 to 62)	118 (-15 to 261)	6 (-13 to 29)	47 (5 to 98)	7 (-2 to 17)	4 (-12 to 23)
10		+industry	(9 10 229)	(0 t0 792) 522	(-3 to 62) 40	(-13 to 201) 157	13	(3 10 98) 64	(-2 10 17)	(-12 (0 23) 9
11		response	(67 to 305)	(168 to 968)	(8 to 74)	(23 to 303)	(-5 to 36)	(22 to 116)	(1 to 21)	(-7 to 28)
12	_	consumer	3	33	15	0	(0 10 00)	16	-1	4
13	Other	behavior	(-23 to 34)	(-40 to 122)	(5 to 28)	(-28 to 33)	(1 to 11)	(5 to 29)	(-3 to 2)	(-8 to 17)
14		+industry	13	63	17	6	6	20	0	5
15 16		response	(-12 to 45)	(-10 to 156)	(7 to 30)	(-22 to 39)	(2 to 12)	(9 to 33)	(-2 to 3)	(-6 to 18)
10		·	, , , , , , , , , , , , , , , , , , ,		, ,	· · · · ·	х <i>,</i>	× ,	, ,	· · · ·
17	Pancreatic									
19	Age	consumer	656 (220) to 1160)	74 (-16	6 to 350)	362 (175	to 581)	131 (2)	0 to 250)
20	, igo	behavior	000 (220			0.0000	002 (110		101 (2)	0 10 200)
		+industry	1160 (70	7 to 1730)	243 (1	to 535)	483 (293	to 708)	199 (8	7 to 321)
21	Paco/Ethnicity	response	1160 (70	7 to 1730)	243 (1	to 535)	483 (293	to 708)	199 (8	7 to 321)
21 22	Race/Ethnicity	•	,	·	243 (1		, ,	,	· ·	,
21 22 23	Non-	response	101	213	-44	-13	79	193	56	50
21 22 23 24	Non- Hispanic	response	,	·	Č Č		, ,	,	· ·	,
21 22 23	Non-	response consumer behavior	101	213	-44	-13	79	193	56	50
21 22 23 24 25	Non- Hispanic	response consumer behavior +industry	101 (-40 to 310)	213 (-100 to 659)	-44 (-143 to 78)	-13 (-216 to 221)	79 (24 to 158)	193 (44 to 384)	56 (3 to 117) 78	50 (-45 to 162) 84
21 22 23 24 25 26	Non- Hispanic	response consumer behavior	101 (-40 to 310) 196	213 (-100 to 659) 420	-44 (-143 to 78) -10	-13 (-216 to 221) 67	79 (24 to 158) 111	193 (44 to 384) 250	56 (3 to 117)	50 (-45 to 162) 84 (-10 to 203) 9
21 22 23 24 25 26 27	Non- Hispanic White	response consumer behavior +industry response	101 (-40 to 310) 196 (42 to 425)	213 (-100 to 659) 420 (85 to 911) 16 (-72 to 117)	-44 (-143 to 78) -10 (-111 to 120) 22 (-1 to 49)	-13 (-216 to 221) 67 (-140 to 326) 27 (-18 to 78)	79 (24 to 158) 111 (51 to 198) 29 (8 to 57)	193 (44 to 384) 250 (102 to 448)	56 (3 to 117) 78 (25 to 146)	50 (-45 to 162) 84 (-10 to 203) 9 (1 to 17)
21 22 23 24 25 26 27 28 29 30	Non- Hispanic White Non-	response consumer behavior +industry response consumer behavior +industry	101 (-40 to 310) 196 (42 to 425) 48 (-7 to 125) 78	213 (-100 to 659) 420 (85 to 911) 16 (-72 to 117) 57	-44 (-143 to 78) -10 (-111 to 120) 22 (-1 to 49) 31	-13 (-216 to 221) 67 (-140 to 326) 27 (-18 to 78) 39	79 (24 to 158) 111 (51 to 198) 29 (8 to 57) 36	193 (44 to 384) 250 (102 to 448) 18 (-15 to 56) 24	56 (3 to 117) 78 (25 to 146) 5 (-5 to 17) 8	50 (-45 to 162) 84 (-10 to 203) 9 (1 to 17) 12
21 22 23 24 25 26 27 28 29 30 31	Non- Hispanic White Non-	response consumer behavior +industry response consumer behavior +industry response	101 (-40 to 310) 196 (42 to 425) 48 (-7 to 125) 78 (18 to 162)	213 (-100 to 659) 420 (85 to 911) 16 (-72 to 117) 57 (-33 to 164)	-44 (-143 to 78) -10 (-111 to 120) 22 (-1 to 49) 31 (9 to 62)	-13 (-216 to 221) 67 (-140 to 326) 27 (-18 to 78) 39 (-3 to 91)	79 (24 to 158) 111 (51 to 198) 29 (8 to 57) 36 (15 to 65)	193 (44 to 384) 250 (102 to 448) 18 (-15 to 56) 24 (-8 to 63)	56 (3 to 117) 78 (25 to 146) 5 (-5 to 17) 8 (-1 to 20)	50 (-45 to 162) 84 (-10 to 203) 9 (1 to 17) 12 (4 to 19)
21 22 23 24 25 26 27 28 29 30 31 32	Non- Hispanic White Non- Hispanic Black	response consumer behavior +industry response consumer behavior +industry response consumer	101 (-40 to 310) 196 (42 to 425) 48 (-7 to 125) 78 (18 to 162) 55	213 (-100 to 659) 420 (85 to 911) 16 (-72 to 117) 57 (-33 to 164) 175	-44 (-143 to 78) -10 (-111 to 120) 22 (-1 to 49) 31 (9 to 62) 24	-13 (-216 to 221) 67 (-140 to 326) 27 (-18 to 78) 39 (-3 to 91) 42	79 (24 to 158) 111 (51 to 198) 29 (8 to 57) 36 (15 to 65) 4	193 (44 to 384) 250 (102 to 448) 18 (-15 to 56) 24 (-8 to 63) 16	56 (3 to 117) 78 (25 to 146) 5 (-5 to 17) 8 (-1 to 20) 5	50 (-45 to 162) 84 (-10 to 203) 9 (1 to 17) 12 (4 to 19) 1
21 22 23 24 25 26 27 28 29 30 31 32 33	Non- Hispanic White Non-	response consumer behavior +industry response consumer behavior +industry response consumer behavior	101 (-40 to 310) 196 (42 to 425) 48 (-7 to 125) 78 (18 to 162) 55 (5 to 118)	213 (-100 to 659) 420 (85 to 911) 16 (-72 to 117) 57 (-33 to 164) 175 (13 to 374)	-44 (-143 to 78) -10 (-111 to 120) 22 (-1 to 49) 31 (9 to 62) 24 (-4 to 53)	-13 (-216 to 221) 67 (-140 to 326) 27 (-18 to 78) 39 (-3 to 91) 42 (-5 to 97)	79 (24 to 158) 111 (51 to 198) 29 (8 to 57) 36 (15 to 65) 4 (-10 to 20)	193 (44 to 384) 250 (102 to 448) 18 (-15 to 56) 24 (-8 to 63) 16 (-2 to 40)	56 (3 to 117) 78 (25 to 146) 5 (-5 to 17) 8 (-1 to 20) 5 (-2 to 13)	50 (-45 to 162) 84 (-10 to 203) 9 (1 to 17) 12 (4 to 19) 1 (-7 to 10)
21 22 23 24 25 26 27 28 29 30 31 32 33 34	Non- Hispanic White Non- Hispanic Black	response consumer behavior +industry response consumer behavior +industry response consumer behavior +industry	101 (-40 to 310) 196 (42 to 425) 48 (-7 to 125) 78 (18 to 162) 55 (5 to 118) 88	213 (-100 to 659) 420 (85 to 911) 16 (-72 to 117) 57 (-33 to 164) 175 (13 to 374) 245	$\begin{array}{c} -44 \\ (-143 \text{ to } 78) \\ -10 \\ (-111 \text{ to } 120) \\ 22 \\ (-1 \text{ to } 49) \\ 31 \\ (9 \text{ to } 62) \\ 24 \\ (-4 \text{ to } 53) \\ 32 \end{array}$	$\begin{array}{c} -13 \\ (-216 \text{ to } 221) \\ 67 \\ (-140 \text{ to } 326) \\ 27 \\ (-18 \text{ to } 78) \\ 39 \\ (-3 \text{ to } 91) \\ 42 \\ (-5 \text{ to } 97) \\ 57 \end{array}$	79 (24 to 158) 111 (51 to 198) 29 (8 to 57) 36 (15 to 65) 4 (-10 to 20) 9	193 (44 to 384) 250 (102 to 448) 18 (-15 to 56) 24 (-8 to 63) 16 (-2 to 40) 23	56 (3 to 117) 78 (25 to 146) 5 (-5 to 17) 8 (-1 to 20) 5 (-2 to 13) 8	50 (-45 to 162) 84 (-10 to 203) 9 (1 to 17) 12 (4 to 19) 1 (-7 to 10) 4
21 22 23 24 25 26 27 28 29 30 31 32 33 34 35	Non- Hispanic White Non- Hispanic Black Hispanic	response consumer behavior +industry response consumer behavior +industry response consumer behavior +industry response	101 (-40 to 310) 196 (42 to 425) 48 (-7 to 125) 78 (18 to 162) 55 (5 to 118) 88 (33 to 158)	213 (-100 to 659) 420 (85 to 911) 16 (-72 to 117) 57 (-33 to 164) 175 (13 to 374) 245 (83 to 462)	-44 (-143 to 78) -10 (-111 to 120) 22 (-1 to 49) 31 (9 to 62) 24 (-4 to 53) 32 (6 to 63)	$\begin{array}{c} -13 \\ (-216 \text{ to } 221) \\ 67 \\ (-140 \text{ to } 326) \\ 27 \\ (-18 \text{ to } 78) \\ 39 \\ (-3 \text{ to } 91) \\ 42 \\ (-5 \text{ to } 97) \\ 57 \\ (10 \text{ to } 113) \end{array}$	79 (24 to 158) 111 (51 to 198) 29 (8 to 57) 36 (15 to 65) 4 (-10 to 20) 9 (-5 to 25)	193 (44 to 384) 250 (102 to 448) 18 (-15 to 56) 24 (-8 to 63) 16 (-2 to 40) 23 (5 to 48)	$56 \\ (3 \text{ to } 117) \\ 78 \\ (25 \text{ to } 146) \\ 5 \\ (-5 \text{ to } 17) \\ 8 \\ (-1 \text{ to } 20) \\ 5 \\ (-2 \text{ to } 13) \\ 8 \\ (1 \text{ to } 16) \\ \end{cases}$	50 (-45 to 162) 84 (-10 to 203) 9 (1 to 17) 12 (4 to 19) 1 (-7 to 10) 4 (-4 to 13)
21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36	Non- Hispanic White Non- Hispanic Black	response consumer behavior +industry response consumer behavior +industry response consumer behavior +industry response consumer	101 (-40 to 310) 196 (42 to 425) 48 (-7 to 125) 78 (18 to 162) 55 (5 to 118) 88 (33 to 158) -2	$\begin{array}{c} 213\\ (-100 \text{ to } 659)\\ 420\\ (85 \text{ to } 911)\\ 16\\ (-72 \text{ to } 117)\\ 57\\ (-33 \text{ to } 164)\\ 175\\ (13 \text{ to } 374)\\ 245\\ (83 \text{ to } 462)\\ 16\end{array}$	$\begin{array}{r} -44 \\ (-143 \text{ to } 78) \\ -10 \\ (-111 \text{ to } 120) \\ 22 \\ (-1 \text{ to } 49) \\ 31 \\ (9 \text{ to } 62) \\ 24 \\ (-4 \text{ to } 53) \\ 32 \\ (6 \text{ to } 63) \\ 14 \end{array}$	$\begin{array}{c} -13 \\ (-216 \text{ to } 221) \\ 67 \\ (-140 \text{ to } 326) \\ 27 \\ (-18 \text{ to } 78) \\ 39 \\ (-3 \text{ to } 91) \\ 42 \\ (-5 \text{ to } 97) \\ 57 \\ (10 \text{ to } 113) \\ 0 \end{array}$	79 (24 to 158) 111 (51 to 198) 29 (8 to 57) 36 (15 to 65) 4 (-10 to 20) 9 (-5 to 25) 7	$ \begin{array}{r} 193 \\ (44 \text{ to } 384) \\ 250 \\ (102 \text{ to } 448) \\ 18 \\ (-15 \text{ to } 56) \\ 24 \\ (-8 \text{ to } 63) \\ 16 \\ (-2 \text{ to } 40) \\ 23 \\ (5 \text{ to } 48) \\ 9 \\ \end{array} $	$56 \\ (3 \text{ to } 117) \\ 78 \\ (25 \text{ to } 146) \\ 5 \\ (-5 \text{ to } 17) \\ 8 \\ (-1 \text{ to } 20) \\ 5 \\ (-2 \text{ to } 13) \\ 8 \\ (1 \text{ to } 16) \\ 0 \\ \end{bmatrix}$	50 (-45 to 162) 84 (-10 to 203) 9 (1 to 17) 12 (4 to 19) 1 (-7 to 10) 4 (-4 to 13) 2
21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37	Non- Hispanic White Non- Hispanic Black Hispanic	response consumer behavior +industry response consumer behavior +industry response consumer behavior +industry response consumer behavior	101 (-40 to 310) 196 (42 to 425) 48 (-7 to 125) 78 (18 to 162) 55 (5 to 118) 88 (33 to 158)	213 (-100 to 659) 420 (85 to 911) 16 (-72 to 117) 57 (-33 to 164) 175 (13 to 374) 245 (83 to 462) 16 (-23 to 63)	$\begin{array}{r} -44 \\ (-143 \text{ to } 78) \\ -10 \\ (-111 \text{ to } 120) \\ 22 \\ (-1 \text{ to } 49) \\ 31 \\ (9 \text{ to } 62) \\ 24 \\ (-4 \text{ to } 53) \\ 32 \\ (6 \text{ to } 63) \\ 14 \\ (3 \text{ to } 27) \end{array}$	$\begin{array}{c} -13 \\ (-216 \text{ to } 221) \\ 67 \\ (-140 \text{ to } 326) \\ 27 \\ (-18 \text{ to } 78) \\ 39 \\ (-3 \text{ to } 91) \\ 42 \\ (-5 \text{ to } 97) \\ 57 \\ (10 \text{ to } 113) \end{array}$	79 (24 to 158) 111 (51 to 198) 29 (8 to 57) 36 (15 to 65) 4 (-10 to 20) 9 (-5 to 25)	193 (44 to 384) 250 (102 to 448) 18 (-15 to 56) 24 (-8 to 63) 16 (-2 to 40) 23 (5 to 48)	$56 \\ (3 \text{ to } 117) \\ 78 \\ (25 \text{ to } 146) \\ 5 \\ (-5 \text{ to } 17) \\ 8 \\ (-1 \text{ to } 20) \\ 5 \\ (-2 \text{ to } 13) \\ 8 \\ (1 \text{ to } 16) \\ \end{cases}$	50 (-45 to 162) 84 (-10 to 203) 9 (1 to 17) 12 (4 to 19) 1 (-7 to 10) 4 (-4 to 13)
21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38	Non- Hispanic White Non- Hispanic Black Hispanic	response consumer behavior +industry response consumer behavior +industry response consumer behavior +industry response consumer behavior +industry response consumer behavior +industry	$ \begin{array}{c} 101 \\ (-40 \text{ to } 310) \\ 196 \\ (42 \text{ to } 425) \\ 48 \\ (-7 \text{ to } 125) \\ 78 \\ (18 \text{ to } 162) \\ 55 \\ (5 \text{ to } 118) \\ 88 \\ (33 \text{ to } 158) \\ -2 \\ (-23 \text{ to } 25) \\ 7 \end{array} $	$\begin{array}{c} 213\\ (-100 \text{ to } 659)\\ 420\\ (85 \text{ to } 911)\\ 16\\ (-72 \text{ to } 117)\\ 57\\ (-33 \text{ to } 164)\\ 175\\ (13 \text{ to } 374)\\ 245\\ (83 \text{ to } 462)\\ 16\\ (-23 \text{ to } 63)\\ 32\end{array}$	$\begin{array}{r} -44 \\ (-143 \text{ to } 78) \\ -10 \\ (-111 \text{ to } 120) \\ 22 \\ (-1 \text{ to } 49) \\ 31 \\ (9 \text{ to } 62) \\ 24 \\ (-4 \text{ to } 53) \\ 32 \\ (6 \text{ to } 63) \\ 14 \\ (3 \text{ to } 27) \\ 16 \end{array}$	$\begin{array}{c} -13 \\ (-216 \text{ to } 221) \\ 67 \\ (-140 \text{ to } 326) \\ 27 \\ (-18 \text{ to } 78) \\ 39 \\ (-3 \text{ to } 91) \\ 42 \\ (-5 \text{ to } 97) \\ 57 \\ (10 \text{ to } 113) \\ 0 \\ (-18 \text{ to } 20) \\ 3 \end{array}$	79 (24 to 158) 111 (51 to 198) 29 (8 to 57) 36 (15 to 65) 4 (-10 to 20) 9 (-5 to 25) 7 (1 to 14) 9	$ \begin{array}{r} 193 \\ (44 \text{ to } 384) \\ 250 \\ (102 \text{ to } 448) \\ 18 \\ (-15 \text{ to } 56) \\ 24 \\ (-8 \text{ to } 63) \\ 16 \\ (-2 \text{ to } 40) \\ 23 \\ (5 \text{ to } 48) \\ 9 \\ (3 \text{ to } 17) \\ 11 \end{array} $	$56 \\ (3 \text{ to } 117) \\ 78 \\ (25 \text{ to } 146) \\ 5 \\ (-5 \text{ to } 17) \\ 8 \\ (-1 \text{ to } 20) \\ 5 \\ (-2 \text{ to } 13) \\ 8 \\ (1 \text{ to } 16) \\ 0 \\ (-3 \text{ to } 3) \\ 1 \end{bmatrix}$	$50 \\ (-45 \text{ to } 162) \\ 84 \\ (-10 \text{ to } 203) \\ 9 \\ (1 \text{ to } 17) \\ 12 \\ (4 \text{ to } 19) \\ 1 \\ (-7 \text{ to } 10) \\ 4 \\ (-4 \text{ to } 13) \\ 2 \\ (-5 \text{ to } 11) \\ 3 \end{bmatrix}$
21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37	Non- Hispanic White Non- Hispanic Black Hispanic	response consumer behavior +industry response consumer behavior +industry response consumer behavior +industry response consumer behavior	$\begin{array}{c} 101 \\ (-40 \text{ to } 310) \\ 196 \\ (42 \text{ to } 425) \\ 48 \\ (-7 \text{ to } 125) \\ 78 \\ (18 \text{ to } 162) \\ 55 \\ (5 \text{ to } 118) \\ 88 \\ (33 \text{ to } 158) \\ -2 \\ (-23 \text{ to } 25) \end{array}$	213 (-100 to 659) 420 (85 to 911) 16 (-72 to 117) 57 (-33 to 164) 175 (13 to 374) 245 (83 to 462) 16 (-23 to 63)	$\begin{array}{r} -44 \\ (-143 \text{ to } 78) \\ -10 \\ (-111 \text{ to } 120) \\ 22 \\ (-1 \text{ to } 49) \\ 31 \\ (9 \text{ to } 62) \\ 24 \\ (-4 \text{ to } 53) \\ 32 \\ (6 \text{ to } 63) \\ 14 \\ (3 \text{ to } 27) \end{array}$	$\begin{array}{c} -13 \\ (-216 \text{ to } 221) \\ 67 \\ (-140 \text{ to } 326) \\ 27 \\ (-18 \text{ to } 78) \\ 39 \\ (-3 \text{ to } 91) \\ 42 \\ (-5 \text{ to } 97) \\ 57 \\ (10 \text{ to } 113) \\ 0 \\ (-18 \text{ to } 20) \end{array}$	79 (24 to 158) 111 (51 to 198) 29 (8 to 57) 36 (15 to 65) 4 (-10 to 20) 9 (-5 to 25) 7 (1 to 14)	$ \begin{array}{r} 193 \\ (44 \text{ to } 384) \\ 250 \\ (102 \text{ to } 448) \\ 18 \\ (-15 \text{ to } 56) \\ 24 \\ (-8 \text{ to } 63) \\ 16 \\ (-2 \text{ to } 40) \\ 23 \\ (5 \text{ to } 48) \\ 9 \\ (3 \text{ to } 17) \end{array} $	$56 \\ (3 \text{ to } 117) \\ 78 \\ (25 \text{ to } 146) \\ 5 \\ (-5 \text{ to } 17) \\ 8 \\ (-1 \text{ to } 20) \\ 5 \\ (-2 \text{ to } 13) \\ 8 \\ (1 \text{ to } 16) \\ 0 \\ (-3 \text{ to } 3) \\ \end{cases}$	50 (-45 to 162) 84 (-10 to 203) 9 (1 to 17) 12 (4 to 19) 1 (-7 to 10) 4 (-4 to 13) 2 (-5 to 11)

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1 2	Esophageal Adenocarcin oma									
3 4	Age	consumer behavior	631 (33	3 to 1320)	78 (-25	5 to 423)	348 (113	to 584)	101 (-4	2 to 239)
5 6		+industry response	1150 (52	20 to 1870)	246 (-9	6 to 601)	457 (225	to 699)	161 (1	9 to 302)
7 8	Race/Ethnicity Non- Hispanic	consumer	40	366	-8	24	24	283	22	71
9 10	White	behavior	(-23 to 112)	(-206 to 1000)	(-47 to 36)	(-314 to 359)	(6 to 47)	(55 to 516)	(4 to 41)	(-65 to 202)
11 12	Non-	+industry response consumer	81 (15 to 160) 9	732 (157 to 1400) 9	5 (-34 to 51) 3	152 (-176 to 495) 10	35 (16 to 59) 4	366 (142 to 602) 6	28 (11 to 48) 1	119 (-13 to 253) 3
13 14 15	Hispanic Black	behavior +industry	(-1 to 20) 14	(-25 to 45) 25	(0 to 7) 4	(-6 to 28) 14	(1 to 8) 5	(-6 to 18) 8	(-1 to 2) 1	(0 to 5) 4
16 17	Hispanic	response consumer behavior	(3 to 26) 25 (2 to 52)	(-10 to 62) 164 (2 to 354)	(1 to 8) 3 (-1 to 13)	(-2 to 33) 40 (-7 to 99)	(2 to 9) 1 (-3 to 7)	(-3 to 21) 21 (3 to 42)	(0 to 3) 1 (-1 to 4)	(1 to 6) 1 (-6 to 10)
18 19 20		+industry response	40 (15 to 68)	235 (70 to 425)	5 (0 to 16)	55 (6 to 114)	(0 to 7) 3 (-1 to 8)	28 (10 to 50)	2 (0 to 4)	(0 to 10) 4 (-4 to 12)
20 21 22	Other	consumer behavior +industry	-1 (-9 to 10) 3	9 (-14 to 35) 18	5 (1 to 9) 6	-1 (-10 to 10) 1	2 (0 to 4) 2	6 (2 to 10) 7	0 (-1 to 1) 0	1 (-3 to 7) 2
23 24		response	(-6 to 14)	(-5 to 46)	(2 to 10)	(-8 to 12)	(1 to 5)	(3 to 11)	(-1 to 1)	(-3 to 7)
25 26	Colorectal									
27	Age	consumer behavior	430 (13	39 to 779)	56 (-48	3 to 184)	150 (77	to 241)	63 (13	3 to 119)
28 29 30	Race/Ethnicity	+industry response	764 (45	0 to 1160)	133 (2	3 to 268)	203 (126	to 304)	95 (46	6 to 153)
31	Non-	consumer	49	119	-21	-10	32	72	31	22
32 33	Hispanic White	behavior	(-36 to 181)	(-75 to 391)	(-65 to 40)	(-89 to 97)	(7 to 67)	(11 to 150)	(6 to 63)	(-17 to 64)
34 35	Non-	+industry response consumer	106 (4 to 261) 26	248 (28 to 545) 27	-6 (-49 to 59) 8	24 (-60 to 140) 18	46 (20 to 85) 13	96 (36 to 176) 9	41 (16 to 76) 2	35 (-3 to 81) 5
36 37 38	Hispanic Black	behavior +industry	(-7 to 70) 44	(-36 to 104) 58	(0 to 21) 12	(-9 to 53) 25.1	(4 to 24) 15	(-10 to 31) 13	(-2 to 7) 3	(0 to 10) 6
39 40	Hispanic	response consumer behavior	(9 to 94) 36 (2 to 88)	(-7 to 145) 136 (21 to 300)	(4 to 26) 13 (0 to 27)	(-1 to 61) 37 (5 to 74)	(7 to 27) 2 (-4 to 10)	(-6 to 36) 13 (2 to 28)	(-1 to 9) 2 (-1 to 7)	(2 to 12) 1 (-5 to 6)
41 42		Sonavior	(2 10 00)		(0 (0 21)		(11010)	(2 10 20)	(107)	(0.00)
43 44										25
45 46			I	or peer review only	- http://bmjoper	.bmj.com/site/abou	t/guidelines.xhtm			
40 47										

1 2 3 4 5 6	Other	+industry response consumer behavior +industry response	58 (17 to 120) -1 (-15 to 20) 5 (-9 to 27)	188 (65 to 366) 16 (-21 to 65) 30 (-5 to 83)	16 (5 to 32) 5 (-1 to 11) 6 (1 to 13)	45 (14 to 84) 0 (-12 to 15) 2 (-9 to 17)	4 (-2 to 13) 2 (0 to 6) 3 (1 to 7)	18 (6 to 33) 5 (1 to 9) 6 (2 to 11)	4 (0 to 8) 0 (-2 to 1) 0 (-1 to 2)	2 (-3 to 8) 1 (-3 to 6) 2 (-2 to 7)
7 8 9	Stomach (Gastric Cardia)									
10	Age	consumer behavior	286 (45	to 672)	50 (-84	4 to 224)	149 (58	to 282)	42 (-14	4 to 113)
11 12		+industry	513 (19	6 to 965)	120 (-1	4 to 321)	196 (105	to 342)	67 (13	3 to 145)
13	Race/Ethnicity	response						,		,
14 15	Non-	consumer	14	178	-7	21	13	118	11	27
16	Hispanic White	behavior	(-16 to 63)	(-46 to 545)	(-26 to 20)	(-109 to 194)	(4 to 30)	(29 to 248)	(3 to 22)	(-26 to 95)
17 18		+industry	34	322	-1	74	18	152	14	45
19	Non-	response consumer	(-5 to 95) 5	(43 to 766) 2	(-19 to 30) 2	(-58 to 270) 6	(7 to 38) 2	(63 to 296) 3	(6 to 27) 0	(-6 to 121) 2
20	Hispanic Black	behavior	(-1 to 17)	(-11 to 29)	(0 to 5)	(-5 to 22)	(1 to 5)	(-5 to 13)	(0 to 1)	(1 to 4)
21 22		+industry	9	7	2	9	3	4	1	3
23		response consumer	(2 to 22) 13	(-5 to 43) 57	(1 to 6) 5	(-2 to 26) 14	(2 to 6) 1	(-3 to 15) 6	(0 to 2) 1	(1 to 5) 0
24	Hispanic	behavior	(1 to 35)	(-6 to 154)	(0 to 12)	(-3 to 38)	(-1 to 4)	(0 to 15)	(0 to 2)	(-2 to 4)
25		+industry	22	86	6	19	1	8	1	1
26 27		response consumer	(5 to 47) -1	(20 to 194) 4	(2 to 14) 4	(3 to 46) 0	(-1 to 5)	(2 to 19) 3	(0 to 3) 0	(-1 to 6) 1
28	Other	behavior	(-5 to 7)	(-9 to 25)	(2 to 8)	(-7 to 10)	(0 to 3)	(1 to 7)	(-1 to 1)	(-2 to 5)
29		+industry	1	9	4	2	1	4	0	1
30		response	(-3 to 9)	(-4 to 34)	(2 to 8)	(-5 to 12)	(0 to 3)	(2 to 8)	(0 to 1)	(-2 to 5)
31 32 33	Multiple Myeloma									
34	Age	consumer	220 (65	to 441)	51 (-29	9 to 150)	112 (54	to 186)	42 (6	δ to 84)
35	C C	behavior +industry		,		,		·		·
36 37		response	380 (202	2 to 657)	105 (2	0 to 215)	151 (89	to 232)	63 (27	7 to 111)
38	Race/Ethnicity									
39	Non- Hispanic	consumer	11	59	-8	-3	15	58	14	15
40 41	White	behavior	(-13 to 52)	(-34 to 221)	(-32 to 31)	(-59 to 83)	(2 to 41)	(15 to 123)	(1 to 35)	(-14 to 54)
42										
43										26
44 45			F	or peer review only	/ - http://bmioper	n.bmj.com/site/abou	t/auidelines xhtm	I		
45 46				or peer review only			s guidennes.Antin	•		
47										

	+industry	26 (7 to 91)	122	-1	19 (27 to 122)	22 (C to 52)	75	19	26
Non-	response consumer	(-7 to 81) 17	(1 to 321) 14	(-23 to 45) 10	(-37 to 123) 17	(6 to 53) 12	(32 to 147) 7	(6 to 44) 2	(-3 to 71) 6
Hispanic Black	behavior	(-4 to 63)	(-40 to 115)	(0 to 29)	(-10 to 59)	(3 to 28)	(-14 to 38)	(-3 to 11)	(1 to 12)
Парапіс Біаск	+industry	29	44	15	24	(3 10 20)	11	(-5 to 11) 4	7
	response	(1 to 83)	(-20 to 159)	(3 to 37)	(-1 to 70)	(6 to 34)	(-8 to 45)	(-1 to 13)	(3 to 15
	consumer	16	72	(3 (8 37)	15	(0 10 04)	10	2	0
Hispanic	behavior	(0 to 51)	(9 to 193)	(-3 to 17)	(-2 to 42)	(-3 to 8)	(2 to 22)	(-1 to 5)	(-3 to 5)
	+industry	28	100	7	21	3	13	3	1
	response	(5 to 71)	(31 to 244)	(0 to 21)	(4 to 51)	(-1 to 10)	(5 to 26)	(0 to 6)	(-2 to 6)
	consumer	0	5	4	0	1	3	0	(2 10 0
Other	behavior	(-3 to 6)	(-7 to 27)	(2 to 7)	(-6 to 7)	(0 to 2)	(1 to 6)	(-1 to 1)	(-2 to 4
	+industry	1	10	4	1	(0.02)	4	0	1
	response	(-2 to 8)	(-2 to 36)	(2 to 8)	(-5 to 9)	(0 to 3)	(2 to 7)	(-1 to 1)	(-1 to 4
	response	(2100)	(21000)	(2 10 0)	(0100)	(0 10 0)	(2 (0 7)	(101)	(104
Gallbladder									
Age	consumer behavior	136 (58	3 to 229)	44 (7	to 86)	65 (40	to 93)	24 (9	to 41)
	+industry				1. (10)	00/01		00 (0)	
	response	239 (15	3 to 341)	74 (36	to 119)	86 (61 t	:0 117)	36 (20	0 to 53)
Race/Ethnicity									
Non-		00	4 5		0	40	40	40	-
Hispanic	consumer	22	15 (10 to 52)		$\frac{2}{(11+2,10)}$	16 (4 to 22)	19 (C to 2C)	13	5
White	behavior	(-10 to 64)	(-10 to 52)	(-23 to 27)	(-14 to 19)	(4 to 32)	(6 to 36)	(2 to 25)	(-4 to 14
	+industry	43	32	8	8	23	24	17	8
	response	(9 to 90)	(4 to 72)	(-15 to 37)	(-8 to 27)	(10 to 40)	(11 to 42)	(6 to 30)	(-1 to 18
Non-	consumer	24	2	10	4	12	3	2	2
Hispanic Black	behavior	(-5 to 61)	(-14 to 21)	(0 to 21)	(-3 to 14)	(4 to 23)	(-3 to 10)	(-2 to 6)	(0 to 3)
	+industry	40	9	14	6	15	4	3	2
	response	(10 to 80)	(-7 to 31)	(4 to 27)	(-1 to 17)	(7 to 26)	(-2 to 12)	(0 to 7)	(1 to 4)
Hispanic	consumer	28	33	9	12	2	6	2	0
riispariic	behavior	(2 to 63)	(-8 to 85)	(-4 to 23)	(-2 to 30)	(-4 to 10)	(1 to 13)	(-1 to 6)	(-2 to 3
	+industry	45	51	13	16	4	8	4	1
	response	(16 to 83)	(9 to 106)	(1 to 28)	(3 to 35)	(-2 to 13)	(3 to 16)	(0 to 8)	(-1 to 4
Other	consumer	0	2	5	0	3	2	0	0
Other	behavior	(-10 to 16)	(-5 to 12)	(1 to 11)	(-2 to 2)	(0 to 6)	(1 to 4)	(-1 to 1)	(-1 to 2
	+industry	4	5	6	0	4	3	0	1
	response	(-6 to 21)	(-2 to 15)	(2 to 12)	(-1 to 3)	(1 to 7)	(1 to 5)	(-1 to 2)	(-1 to 2)
Advanced									
Prostate									
Age	consumer behavior	101 (13	8 to 214)	18 (-17	′ to 58)	33 (11	to 58)	15 (-4	4 to 38)
		F	or peer review only	y - http://bmjopen.l	bmj.com/site/abou	t/quidelines.xhtm	I		
				,					

1 2	Race/Ethnicity	+industry response	174 (80	to 304)	37 (1	to 83)	43 (22 te	o 71)	24 (6	to 48)
3 4 5	Non- Hispanic White	consumer behavior	0	43 (-13 to 140)	0	0 (-29 to 35)	0	20 (3 to 42)	0	10 (-9 to 32)
6 7		+industry response	0	82 (16 to 192)	0	11 (-17 to 50)	0	27 (10 to 51)	0	16 (-2 to 40)
8 9	Non- Hispanic Black	consumer behavior	0	2 (-31 to 51)	0	9 (-7 to 30)	0	7 (-5 to 20)	0	4 (1 to 9)
10 11		+industry response	0	17 (-16 to 75)	0	13 (-2 to 36)	0	9 (-3 to 23)	0	6 (2 to 11)
12 13	Hispanic	consumer behavior	0	47 (7 to 103)	0	7 (-2 to 20)	0	4 (1 to 9)	0	0 (-1 to 3)
14 15		+industry response	0	64 (23 to 127)	0	10 (1 to 25)	0	6 (2 to 11)	0	1 (-1 to 3)
16 17	Other	consumer behavior	0	1 (-4 to 12)	0	0 (-2 to 3)	0	1 (0 to 2)	0	0 (-1 to 2)
18 19		+industry response	0	2 (-1 to 16)	0	0 (-2 to 3)	0	1 (1 to 2)	0	1 (-1 to 2)
20	Ovarian									
21 22	Age	consumer behavior	45 (-3	o 114)	13 (-1	4 to 54)	24 (9 to	51)	21 (8	to 46)
23 24		+industry response	87 (19	to 175)	25 (-4	4 to 75)	34 (14 te	o 64)	28 (15	5 to 56)
25 26	Race/Ethnicity									
26 27 28	Non- Hispanic White	consumer behavior	21 (-15 to 89)	0	-3 (-29 to 38)	0	15 (2 to 41)	0	19 (6 to 43)	0
29 30		+industry response	45 (-10 to 131)	0	5 (-21 to 52)	0	22 (5 to 51)	0	25 (11 to 52)	0
31 32	Non- Hispanic Black	consumer behavior	7 (-3 to 27)	0	3 (0 to 11)	0	5 (2 to 11)	0	1 (-1 to 4)	0
33 34		+industry response	13 (-1 to 38)	0	5 (1 to 13)	0	7 (3 to 13)	0	1 (0 to 5)	0
35 36	Hispanic	consumer behavior	15 (0 to 48)	0	6 (-1 to 16)	0	1 (-2 to 6)	0	1 (-1 to 4)	0
37 38		+industry response	25 (2 to 64)	0	8 (2 to 20)	0	2 (-1 to 8)	0	2 (0 to 5)	0
39 40	Other	consumer behavior	-5 (-13 to 9)	0	5 (1 to 10)	0	2 (0 to 4)	0	0 (-1 to 1)	0
40 41 42		+industry response	-1 (-9 to 15)	0	5 (2 to 11)	0	2 (1 to 4)	0	0 (0 to 1)	0
43 44 45 46			Fo	or peer review only	/ - http://bmjopen	.bmj.com/site/abou	t/guidelines.xhtml			28

1 2 3 4	Thyroid Age	consumer behavior +industry		to 22)	3 (-4 1	,	6 (3 to			to 7)
5		response	16 (7	to 33)	6 (0 t	0 16)	9 (5 to	15)	5 (3	to 9)
6 7 8 9	Race/Ethnicity Non- Hispanic White	consumer behavior	0 (0 to 2)	0 (-1 to 5)	0 (-1 to 1)	-2 (-7 to 5)	0 (0 to 1)	3 (0 to 8)	1 (0 to 4)	1 (-1 to 3)
10		+industry response	0 (0 to 3)	1 (0 to 9)	0 (-1 to 2)	0 (-5 to 9)	1 (0 to 2)	4 (1 to 10)	2 (1 to 4)	1 (0 to 4)
11 12	Non-	consumer	1	1	0	0	1	0	0	0
13 14	Hispanic Black	behavior +industry	(0 to 5) 2	(-2 to 7) 2	(0 to 1) 0	(0 to 2) 0	(0 to 2) 1	(0 to 1) 0	(0 to 1) 0	(0 to 1) 0
14		response	(0 to 7)	(-1 to 10)	(0 to 2)	(0 to 2)	(0 to 2)	(0 to 1)	(0 to 1)	(0 to 1)
16 17	Hispanic	consumer behavior	3 (0 to 10)	1 (0 to 9)	1 (0 to 3)	2 (0 to 5)	0 (0 to 1)	1 (0 to 2)	0 (0 to 1)	0 (0 to 1)
18 19		+industry response	5 (1 to 14)	(0 to 12)	1 (0 to 4)	2 (1 to 7)	0 (0 to 1)	1 (0 to 3)	1 (0 to 2)	0 (0 to 1)
20	Other	consumer behavior	0	0 (-1 to 3)	0 (0 to 1)	0 (-1 to 1)	0 (0 to 1)	0 (0 to 1)	0	0 (0 to 1)
21 22		+industry response	0	0 (0 to 4)	0 (0 to 1)	0 (-1 to 2)	0 (0 to 1)	0 (0 to 1)	0	0 (0 to 1)
23 24	1. Values are the me	edian estimates (95	5% uncertainty inter	vals) of each distribution	on of 1000 simulations					
24 25										
26										
27										

Supplementary Table 12. Estimated health gains and costs associated with the federal menu calorie labeling on reducing cancer burdens in the US over a lifetime, one-way sensitivity analyses at 25% and 75% calorie compensation outside restaurant settings (US population=235,162,844)¹

	ettings (US population=235,		Labeling Policy	
7	75% Com			mpensation
3 9 10	Consumer Behavior Median (2.5% to 97.5%)	Consumer Behavior + Industry Response Median (2.5% to 97.5%)	Consumer Behavior Median (2.5% to 97.5%)	Consumer Behavior + Industry Response Median (2.5% to 97.5%)
¹ New Cancer Cases Averted, N (95	% UI)			
² Liver cancer	2550 (265 to 5030)	4280 (2000 to 6770)	7760 (5160 to 10500)	12800 (9790 to 16000)
² Endometrial cancer	2490 (-633 to 5890)	4640 (1570 to 8070)	8890 (5500 to 12700)	15100 (11800 to 19100)
⁴ Kidnov concor	2360 (65 to 4510)	4160 (1900 to 6410)	7810 (5230 to 10000)	13000 (10400 to 15300)
⁵ Breast cancer (postmenopausal)	2060 (-616 to 5280)	3930 (1260 to 7200)	7640 (4560 to 11400)	13000 (9700 to 17200)
⁶ Pancreatic cancer	638 (51 to 1280)	1140 (536 to 1800)	2140 (1490 to 2890)	3590 (2840 to 4460)
⁷ Esophageal adenocarcinoma	598 (-239 to 1400)	1100 (262 to 1930)	2130 (1200 to 3000)	3560 (2600 to 4520)
⁸ Colorectal cancer	480 (56 to 940)	851 (423 to 1330)	1600 (1060 to 2140)	2660 (2030 to 3310)
⁹ Multiple myeloma	343 (61 to 674)	576 (281 to 950)	1050 (677 to 1480)	1730 (1240 to 2340)
⁰ Stomach cancer (cardia)	312 (-42 to 736)	533 (192 to 998)	994 (555 to 1530)	1640 (1060 to 2300)
¹ Thyroid cancer	185 (-70 to 498)	406 (128 to 749)	851 (473 to 1310)	1470 (963 to 2100)
² Gallbladder cancer	165 (70 to 274)	266 (167 to 378)	468 (348 to 602)	758 (626 to 912)
³ Advanced prostate cancer	162 (-28 to 360)	282 (87 to 493)	519 (304 to 768)	868 (603 to 1160)
4 Ovarian cancer	65 (-17 to 179)	119 (26 to 245)	228 (96 to 398)	384 (196 to 617)
5 Total	12700 (2430 to 24200)	22600 (12400 to 34100)	42800 (30400 to 53900)	71500 (59100 to 82800)
6Cancer Deaths Prevented, N (95%		(, , , , , , , , , , , , , , , , , , ,	, ,	,
7 Liver cancer	2200 (199 to 4450)	3750 (1720 to 5970)	6790 (4490 to 9270)	11200 (8570 to 14100)
8 Breast cancer (postmenopausal)	1140 (-958 to 3640)	2420 (281 to 4990)	4980 (2540 to 7860)	8670 (6030 to 12000)
9 Endometrial cancer	980 (-69 to 2030)	1710 (675 to 2770)	3160 (2020 to 4450)	5270 (4120 to 6630)
0 Kidney cancer	939 (94 to 1820)	1630 (795 to 2520)	3020 (2080 to 3930)	4990 (4020 to 6020)
Pancreatic cancer	561 (54 to 1120)	996 (473 to 1590)	1870 (1300 to 2510)	3130 (2480 to 3890)
2 Esophageal adenocarcinoma	503 (-224 to 1190)	932 (203 to 1640)	1820 (1010 to 2580)	3050 (2220 to 3890)
3 Colorectal cancer	323 (41 to 640)	571 (280 to 910)	1080 (724 to 1440)	1800 (1390 to 2240)
Stomach cancer (cardia)	264 (-32 to 623)	446 (159 to 838)	824 (454 to 1280)	1360 (887 to 1910)
5 Multiple myeloma	213 (45 to 411)	350 (178 to 576)	635 (419 to 897)	1040 (757 to 1370)
Collbladdor concor	141 (60 to 234)	226 (142 to 320)	398 (300 to 512)	644 (531 to 777)
^D Advanced prestate concer	80 (-12 to 179)	135 (44 to 239)	246 (144 to 373)	410 (278 to 563)
/ Ovarian cancer	49 (-7 to 123)	87 (26 to 170)	162 (76 to 270)	272 (155 to 415)
⁸ Thyroid cancer	11 (1 to 24)	19 (8 to 33)	34 (21 to 53)	56 (39.9 to 81.8)
⁹ Total	7760 (1280 to 13900)	13600 (7160 to 20100)	25600 (17900 to 32300)	42500 (34600 to 49600)
Life Years Gained	34700 (5070 to 66300)	62200 (32500 to 93500)	118000 (82400 to 151000)	197000 (161000 to 232000)

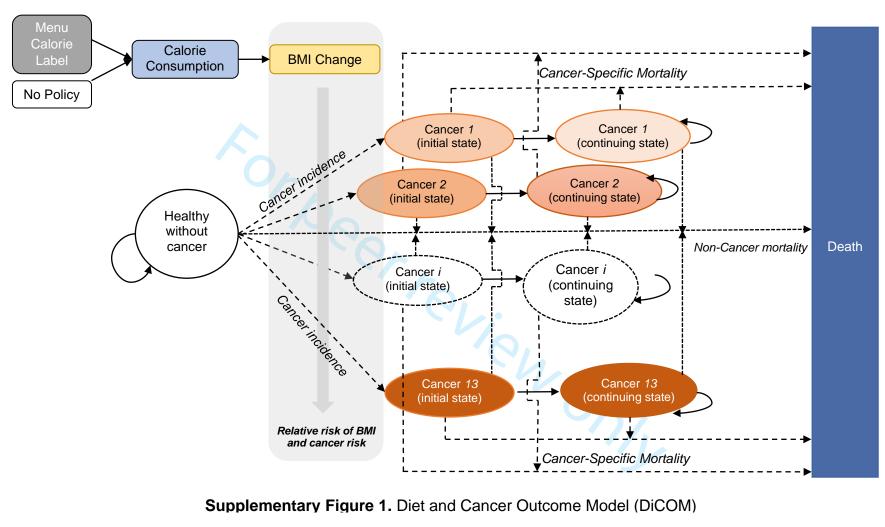
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⁻ ³ QALYs Gained	51400 (9690 to 95700)	90500 (49300 to 135000)	171000 (119000 to 218000)	284000 (234000 to 334000)
⁴ Changes in Health-Related Cos				201000 (201000 10 00 1000)
⁵ Healthcare (medical) cost	-693 (-1250 to -138)	-1210 (-1770 to -660)	-2270 (-2850 to -1640)	-3760 (-4360 to -3140)
6 Patient time cost	-47.9 (-90.0 to -11.9)	-83.6 (-126 to -47.3)	-155 (-198 to -113)	-258 (-302 to -215)
7 Productivity loss	-279 (-527 to -56.6)	-490 (-743 to -271)	-929 (-1170 to -673)	-1550 (-1800 to -1290)
8 Policy Implementation Costs (\$		· · · · · ·	, , , , , , , , , , , , , , , , , , ,	, ,
9 Government cost	18.5 (14.5 to 25.1)	18.5 (14.4 to 25.5)	18.5 (14.5 to 25.1)	18.5 (14.4 to 25.5)
10 Administration	9.07 (8.61 to 9.56)	9.09 (8.62 to 9.55)	9.07 (8.61 to 9.56)	9.09 (8.62 to 9.55)
11 Monitoring	9.40 (5.45 to 16.1)	9.38 (5.30 to 16.3)	9.40 (5.45 to 16.1)	9.38 (5.30 to 16.3)
12 Industry cost	820 (762 to 889)	1120 (1040 to 1210)	820 (762 to 889)	1120 (1040 to 1210)
13 Compliance	820 (762 to 889)	823 (757 to 889)	820 (762 to 889)	823 (757 to 889)
14 Reformulation	Uk	296 (249 to 353)		296 (249 to 353)
15 Net Costs, Cancer Only (\$, milli				
16 Societal perspective	-174 (-1032 to 639)	-653 (-1510 to 164)	-2520 (-3390 to -1590)	-4430 (-5310 to -3510)
17 Healthcare perspective	-674 (-1229 to -120)	-1190 (-1750 to -639)	-2250 (-2830 to -1620)	-3740 (-4350 to -3120)
¹⁷ / ₁₈ ICER (dollars/QALY) ⁵				
10 Societal perspective	Dominant	Dominant	Dominant	Dominant
20 Healthcare perspective	Dominant	Dominant	Dominant	Dominant
Abbreviations: ICER, Incre	mental Cost-Effectiveness Ratio; QALY, questimates (95% uncertainty intervals) of eac			
		sonal Health Care (PHC) index. Policy interv	vention costs were inflated to 2015 US dolla	ars using the Consumer
23 Price Index. Negative co	osts represent savings.			C C
3. Costs are medians from	1000 simulations so may not add up to tot		repeative includes healthcare east patient t	me ecoto productivity
		ts from reduced cancer burden. Societal per- cluded policy costs relevant to policy implem		
		sents less costly and more effective than the		
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43 44	For peer review on	ly - http://bmjopen.bmj.com/site/abo	out/guidelines.xhtml	31

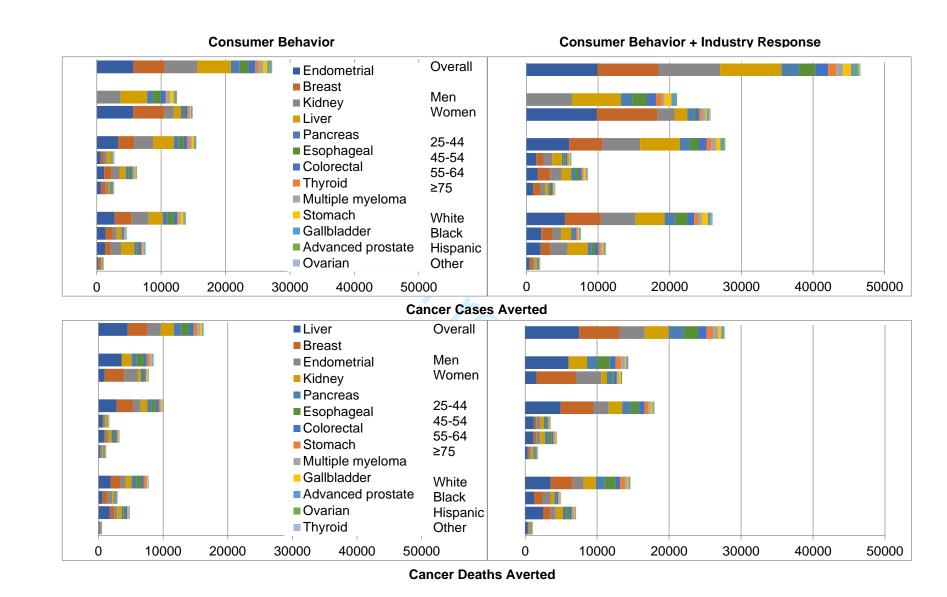
Supplementary Table 13. Estimated health gains and costs associated with the federal menu calorie labeling on reducing cancer burdens in the US over a lifetime, one-way sensitivity analysis, assuming all full-service and fast-food restaurants were covered by the policy (US population=235,162,844)¹

		Calorie Labeling Policy	
	Consumer Behavior	Consumer Behavior + Industry Res	spons
	Median (2.5% to 97.5%)	Median (2.5% to 97.5%)	
New Cancer Cases Averted, N (95% UI)	7000 (1000 (+ 10100)	44400 (0400 1: 44400)	
Liver cancer	7280 (4690 to 10100)	11400 (8480 to 14400)	
Kidney cancer	6820 (4180 to 9460)	11100 (8470 to 13700)	
Endometrial cancer	5340 (1540 to 9220)	10400 (6690 to 14300)	
Breast cancer (postmenopausal)	4920 (1580 to 8420)	9380 (5960 to 13100)	
Esophageal adenocarcinoma	2060 (1170 to 3060)	3260 (2310 to 4330)	
Pancreatic cancer	1810 (1150 to 2600)	3000 (2290 to 3870)	
Colorectal cancer	1320 (772 to 1910)	2200 (1600 to 2880)	
Stomach cancer (cardia)	938 (531 to 1510)	1480 (985 to 2140)	
Thyroid cancer	746 (430 to 1180)	1270 (850 to 1820)	
Multiple myeloma	710 (377 to 1150)	1270 (879 to 1820)	
Advanced prostate cancer	430 (208 to 681)	715 (461 to 1010)	
Gallbladder cancer	329 (201 to 457)	568 (435 to 708)	
Ovarian cancer	133 (20.9 to 292)	263 (109 to 468)	
Total	32900 (20300 to 46000)	56400 (43700 to 69300)	
Cancer Deaths Prevented, N (95% UI)			
Liver cancer	6460 (4170 to 8980)	10000 (7480 to 12800)	
Breast cancer (postmenopausal)	3410 (701 to 6280)	6440 (3560 to 9750)	
Kidney cancer	2620 (1610 to 3620)	4250 (3210 to 5300)	
Endometrial cancer	1890 (654 to 3140)	3610 (2390 to 4900)	
Esophageal adenocarcinoma	1800 (1030 to 2670)	2840 (2010 to 3750)	
Pancreatic cancer	1580 (976 to 2250)	2620 (1990 to 3380)	
Colorectal cancer	923 (560 to 1310)	1520 (1110 to 1970)	
Stomach cancer (cardia)	785 (437 to 1270)	1240 (812 to 1790)	
Multiple myeloma	431 (234 to 709)	762 (524 to 1100)	
Gallbladder cancer	275 (170 to 385)	479 (366 to 601)	
Advanced prostate cancer	219 (117 to 353)	353 (233 to 506)	
Ovarian cancer	94 (18 to 197)	185 (91 to 317)	
Thyroid cancer			
	27 (13 to 45)	45 (28 to 68)	
Total	7760 (1280 to 13900)	34400 (26800 to 42400)	
Life Years Gained	97300 (62300 to 135000)	162000 (126000 to 201000)	
QALYs Gained	20500 (13100 to 28500)	230000 (178000 to 287000)	
Changes in Health-Related Costs, Cancer Only (\$, millions) ^{2,0}		
			32
			52

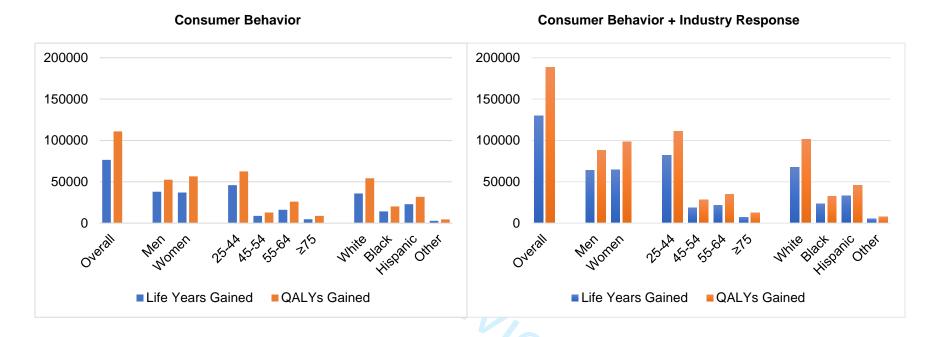
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3	Healthcare (medical) cost	-1820 (-2500 to -1180)	-3060 (-3740 to -2400)
4	Patient time cost	-112 (-160 to -62.7)	-197 (-245 to -148)
5	Productivity loss	-692 (-976 to -401)	-1210 (-1490 to -916)
6	Policy Implementation Costs (\$, millions) ^{2,3}		
7	Government cost	18.4 (14.7 to 25.7)	18.4 (14.7 to 25.7)
8	Administration	9.06 (8.56 to 9.52)	9.07 (8.60 to 9.56)
9	Monitoring	9.32 (5.61 to 16.5)	9.37 (5.64 to 16.6)
10	Industry cost	821 (764 to 888)	1120 (1040 to 1200)
11	Compliance	821 (764 to 888)	821 (763 to 886)
12	Reformulation		297 (248 to 350)
13	Net Costs, Cancer Only (\$, millions) ^{2,3,4}		
14	Societal perspective	-1780 (-2790 to -831)	-1030 (-1590 to -549)
15	Healthcare perspective	-1800 (-2470 to -1160)	-1670 (-2120 to -1270)
16	ICER (dollars/QALY) ⁵		
17	Societal perspective	Dominant	Dominant
18	Healthcare perspective	Dominant	Dominant
19	Abbreviations: ICER, Incremental Cost-Effectiveness Ratio; QALY 1. Values are the median estimates (95% uncertainty intervals) of		
20	2. Health-related costs were inflated to 2015 US dollars using the		osts were inflated to 2015 US dollars using the Consumer
21	Price Index. Negative costs represent savings.		Ŭ
22	3. Costs are medians from 1000 simulations so may not add up to		
23	 Net costs were calculated as policy costs minus health-related of costs, and policy implementation costs; government perspective 		
24	5. ICER threshold was evaluated at \$150,000/QALY. Dominant re		
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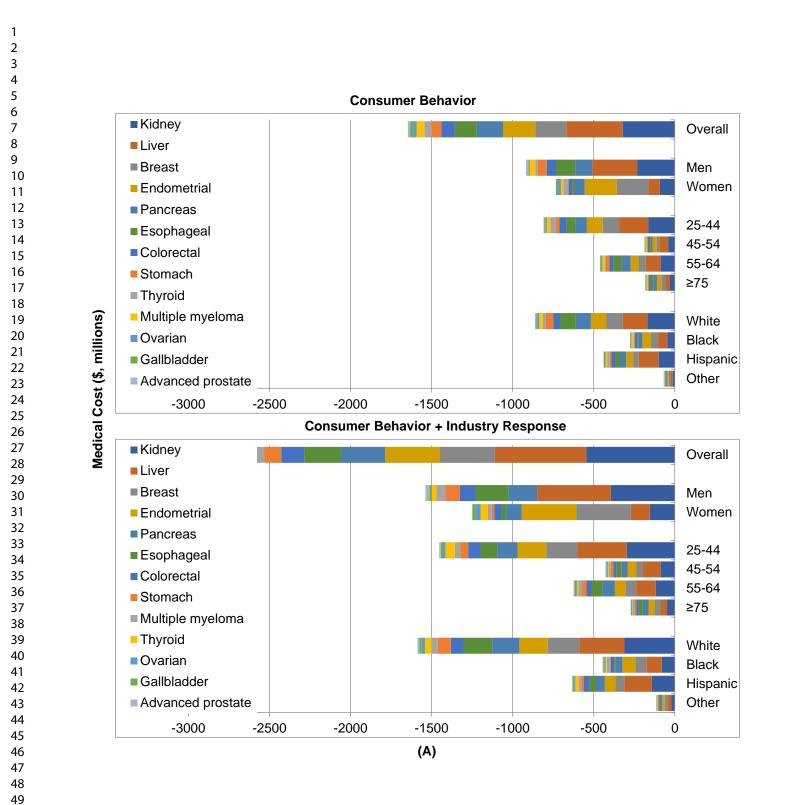
The model consists of four general health states: (a) healthy without cancer (healthy state); (b) initial cancer diagnosis (initial state) for each cancer type *i*; (c) continuing care (continuing state) for each cancer type *i*; and (d) death state. Transitions between states are based on national cancer incidence and cancer-specific mortality rates from SEER (for individual with cancer) and lifetable-based mortality rates (for individuals without cancer). The model simulates the policy impact on the number of new cases and deaths of 13 obesity-associated cancers, health-related quality of life (HRQOL), and health-related costs among U.S. adults over a lifetime by comparing a policy scenario (menu calorie label) to a non-policy scenario (status quo).

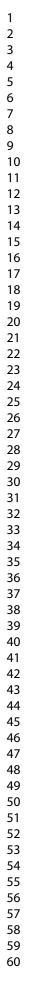


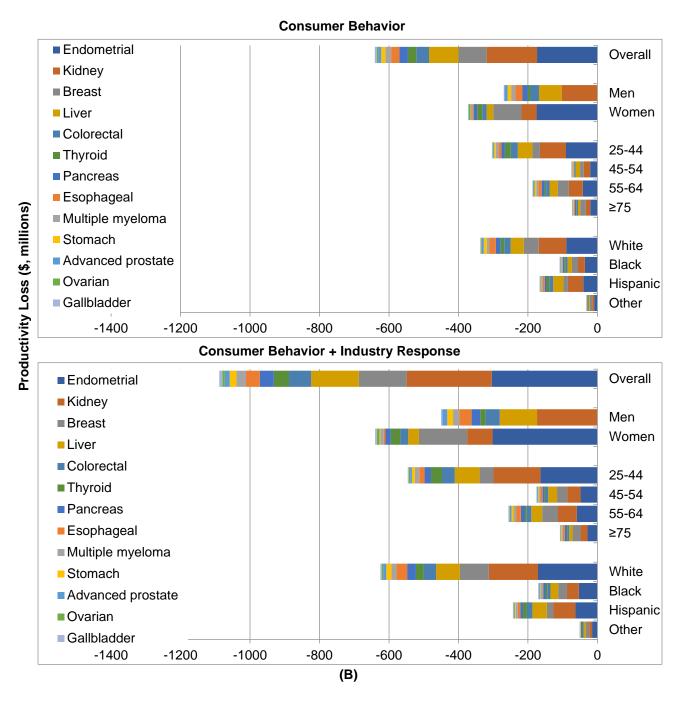
Supplementary Figure 2. Estimated reduced new cancer cases and deaths associated with the federal menu calorie labeling in the US by age, sex, race/ethnicity, and cancer type, over lifetime

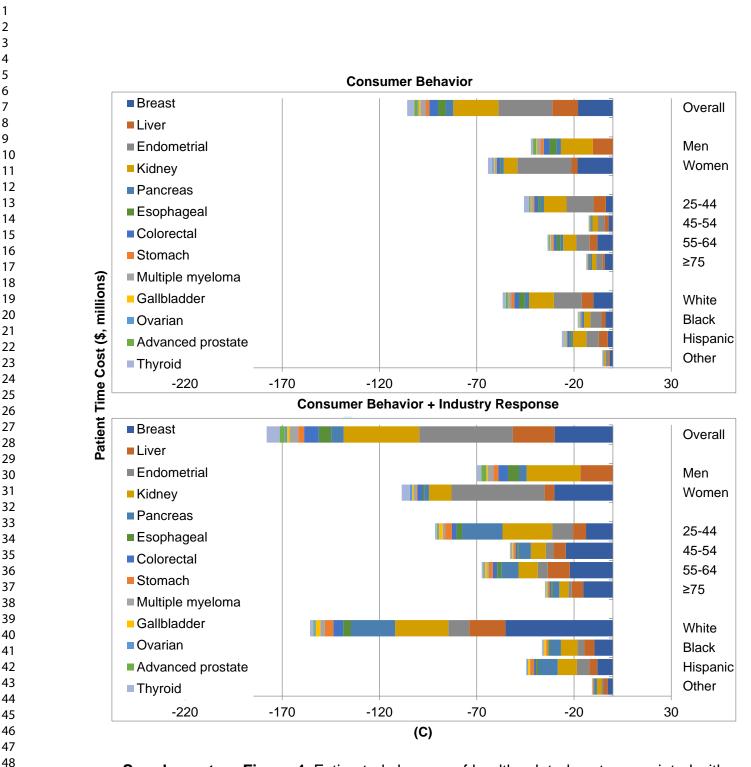


Supplementary Figure 3. Estimated life years and QALYs gained associated with the federal menu calorie labeling in the US by age, sex, and race/ethnicity, over a lifetime









Supplementary Figure 4. Estimated changes of health-related costs associated with the federal menu calorie labeling in the US by age, sex, race/ethnicity, and cancer type, over lifetime

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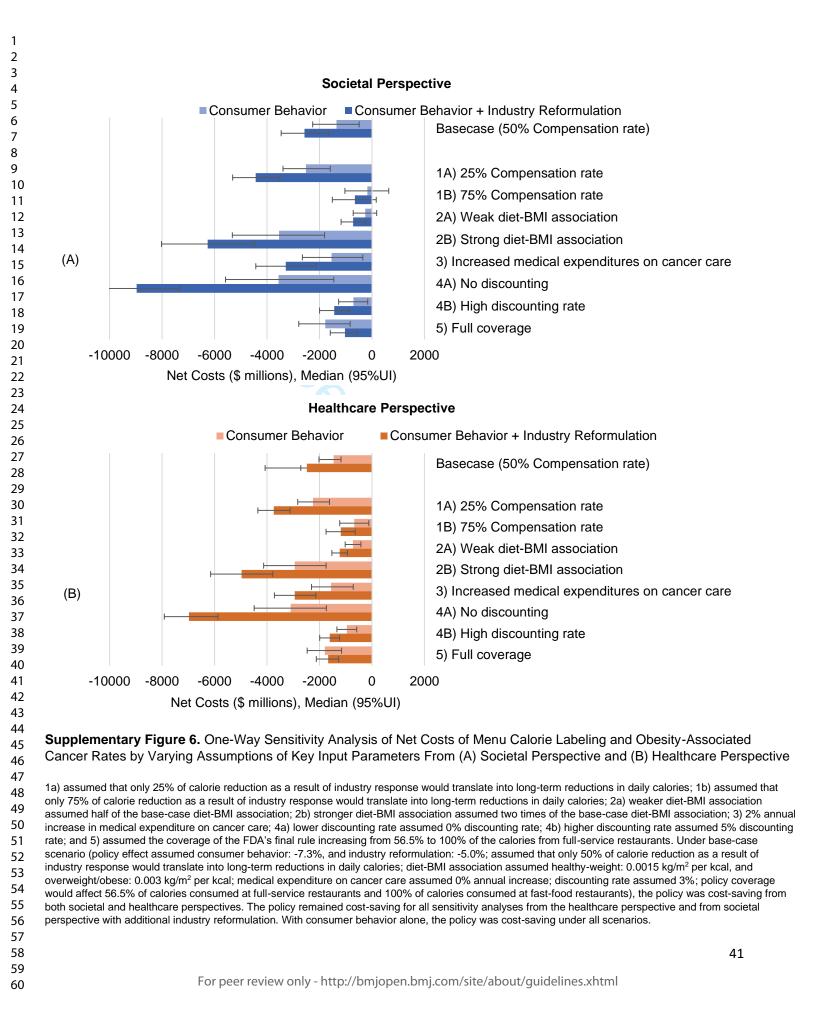
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Net Costs (\$ millions) **Consumer Behavior Consumer Behavior + Industry Response** 0 0 -500 -500 -1000 -1000 -1500 -1500 -2000 -2000 -2500 -2500 -3000 -3000 Overall Hispanic White women Women 275 BIRCH Overall Mer Mer 25.44 215 white other 25-44 15:54 55.64 4554 Black Hispanic Other Societal Perspective Healthcare Perspective Societal Perspective Healthcare Perspective

Supplementary Figure 5. Estimated net costs from societal and government perspectives associated with the federal menu calorie labeling policy in the US by age, sex, and race/ethnicity, over a lifetime



Consolidated Health Economic Evaluation Reporting Standards – CHEERS Checklist Page 102 of 103

CHEERS Checklist

Items to include when reporting economic evaluations of health interventions

The **ISPOR CHEERS Task Force Report**, *Consolidated Health Economic Evaluation Reporting Standards (CHEERS)—Explanation and Elaboration: A Report of the ISPOR Health Economic Evaluations Publication Guidelines Good Reporting Practices Task Force*, provides examples and further discussion of the 24-item CHEERS Checklist and the CHEERS Statement. It may be accessed via the *Value in Health* or via the ISPOR Health Economic Evaluation Publication Guidelines – CHEERS: Good Reporting Practices webpage: <u>http://www.ispor.org/TaskForces/EconomicPubGuidelines.asp</u>

Section/item	Item No	Recommendation	Reported on page No/ line No
Title and abstract			
Title	1	Identify the study as an economic evaluation or use more specific terms such as "cost-effectiveness analysis", and describe the interventions compared.	Page 1/Lines 1-2
Abstract	2	Provide a structured summary of objectives, perspective, setting, methods (including study design and inputs), results (including base case and uncertainty analyses), and conclusions.	Pages 3-4/ Lines 32-59
Introduction			
Background and objectives	3	Provide an explicit statement of the broader context for the study. Present the study question and its relevance for health policy or practice decisions.	Pages 5-6/ Lines 64-92
Methods			Daga 0/
Target population and subgroups	4	Describe characteristics of the base case population and subgroups analysed, including why they were chosen.	Page 9/ Lines 106-113
Setting and location	5	State relevant aspects of the system(s) in which the decision(s) need(s) to be made.	Page 6/Lines 96-
Study perspective	6	Describe the perspective of the study and relate this to the costs being evaluated.	Page 12/ Lines 189-197
Comparators	7	Describe the interventions or strategies being compared and state why they were chosen.	Pages 9-10/ Lines 125-140
Time horizon	8	State the time horizon(s) over which costs and consequences are being evaluated and say why appropriate.	Page 6/ Lines 98-99
Discount rate	9	Report the choice of discount rate(s) used for costs and outcomes and say why appropriate.	Page 12 /Line 198
Choice of health outcomes	10	Describe what outcomes were used as the measure(s) of benefit in the evaluation and their relevance for the type of analysis performed.	Page 11/ Lines 158-170
Measurement of effectiveness	11a	<i>Single study-based estimates:</i> Describe fully the design features of the single effectiveness study and why the single study was a sufficient source of clinical effectiveness data.	

1 2 3		11b	<i>Synthesis-based estimates:</i> Describe fully the methods used for identification of included studies and synthesis of clinical effectiveness data.	Pages 9-11/ Lines 115-170
4 5 6 7	Measurement and valuation of preference based outcomes	12	If applicable, describe the population and methods used to elicit preferences for outcomes.	
8 9 10 11 12 13 14	Estimating resources and costs	13a	Single study-based economic evaluation: Describe approaches used to estimate resource use associated with the alternative interventions. Describe primary or secondary research methods for valuing each resource item in terms of its unit cost. Describe any adjustments made to approximate to opportunity costs.	
15 16 17 18 19 20 21		13b	<i>Model-based economic evaluation:</i> Describe approaches and data sources used to estimate resource use associated with model health states. Describe primary or secondary research methods for valuing each resource item in terms of its unit cost. Describe any adjustments made to approximate to opportunity costs.	Page 11/ Lines 168-170
22 23 24 25 26 27	Currency, price date, and conversion	14	Report the dates of the estimated resource quantities and unit costs. Describe methods for adjusting estimated unit costs to the year of reported costs if necessary. Describe methods for converting costs into a common currency base and the exchange rate.	Page 12/Line 197-198
28 29 30 31	Choice of model	15	Describe and give reasons for the specific type of decision- analytical model used. Providing a figure to show model structure is strongly recommended.	Supplementary Figure 1 Pages 9-10/
32 33	Assumptions	16	Describe all structural or other assumptions underpinning the decision-analytical model.	Lines 118-120, 128-129, 135-140, 145-152
34 35 36 37 38 39 40	Analytical methods	17	Describe all analytical methods supporting the evaluation. This could include methods for dealing with skewed, missing, or censored data; extrapolation methods; methods for pooling data; approaches to validate or make adjustments (such as half cycle corrections) to a model; and methods for handling population heterogeneity and uncertainty.	Page 13/ Lines 210-214
41 42	Results			
43 44 45 46 47	Study parameters	18	Report the values, ranges, references, and, if used, probability distributions for all parameters. Report reasons or sources for distributions used to represent uncertainty where appropriate. Providing a table to show the input values is strongly	Pages 7-8/Table 1
48 49 50 51 52 53	Incremental costs and outcomes	19	recommended. For each intervention, report mean values for the main categories of estimated costs and outcomes of interest, as well as mean differences between the comparator groups. If applicable, report incremental cost-effectiveness ratios.	Pages 16-17/ Table 2
55 54 55 56 57	Characterising uncertainty	20a	<i>Single study-based economic evaluation:</i> Describe the effects of sampling uncertainty for the estimated incremental cost and	

Consolidated Health Economic Evaluation Reporting Standards – CHEERS Checklist Page 104 of 103

		incremental effectiveness parameters, together with the impact of methodological assumptions (such as discount rate, study	
Characterising	20b	perspective). <i>Model-based economic evaluation:</i> Describe the effects on the results of uncertainty for all input parameters, and uncertainty related to the structure of the model and assumptions.	Page 21/ Lines 282-2
heterogeneity	21	If applicable, report differences in costs, outcomes, or cost- effectiveness that can be explained by variations between subgroups of patients with different baseline characteristics or other observed variability in effects that are not reducible by	Pages 18-1 Lines 267-2
Discussion Study findings,		more information.	
limitations, generalisability, and current knowledge	22	Summarise key study findings and describe how they support the conclusions reached. Discuss limitations and the generalisability of the findings and how the findings fit with	Pages 21-2
Other		current knowledge.	
Source of funding	23	Describe how the study was funded and the role of the funder in the identification, design, conduct, and reporting of the analysis. Describe other non-monetary sources of support.	Page 26
Conflicts of interest	24	Describe any potential for conflict of interest of study contributors in accordance with journal policy. In the absence of a journal policy, we recommend authors comply with	Pages 26-2'
		International Committee of Medical Journal Editors recommendations.	

For consistency, the CHEERS Statement checklist format is based on the format of the CONSORT statement checklist

The **ISPOR CHEERS Task Force Report** provides examples and further discussion of the 24-item CHEERS Checklist and the CHEERS Statement. It may be accessed via the *Value in Health* link or via the ISPOR Health Economic Evaluation Publication Guidelines – CHEERS: Good Reporting Practices webpage: <u>http://www.ispor.org/TaskForces/EconomicPubGuidelines.asp</u>

The citation for the CHEERS Task Force Report is:

Husereau D, Drummond M, Petrou S, et al. Consolidated health economic evaluation reporting standards (CHEERS)—Explanation and elaboration: A report of the ISPOR health economic evaluations publication guidelines good reporting practices task force. Value Health2013;16:231-50.

BMJ Open

What is the cost-effectiveness of menu calorie labeling on reducing obesity-associated cancer burdens: an economic evaluation of a federal policy intervention among 235 million adults in the United States

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Manuscript ID	bmjopen-2022-063614.R2
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Word Count: 3895

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1	What is the cost-effectiveness of menu calorie labeling on reducing obesity-associated
2	cancer burdens: an economic evaluation of a federal policy intervention among 235 million
3	adults in the United States
4	Mengxi Du, doctoral candidate ¹ , Christina F. Griecci, postdoctoral fellow ¹ , Frederick Cudhea,
5	statistician ¹ , Heesun Eom, research assistant ^{1,2} , John B. Wong, director of comparative
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8	community medicine ⁵ , Y. Claire Wang, associate professor, vice president of research,
9	evaluation and policy ^{2,6} , Dariush Mozaffarian, dean and Jean Mayer professor of nutrition ¹ ,
10	Fang Fang Zhang, Neely Family professor of nutrition and cancer ¹ on behalf of the Food-PRICE
11	Project
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20	University, New York, NY
21	Short Running Head: Cost-Effectiveness of Menu Calorie Labeling to Prevent Cancer

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- 25 (<u>fang_fang.zhang@tufts.edu</u>). Phone: 617-636-3740; Fax: 617-636-3727
- 26 Abbreviations: AMPM, Automated Multiple Pass Method; BMI, Body Mass Index; CDC,
- 27 Centers of Disease Control and Prevention; CI, Confidence Interval; DiCOM, Diet and Cancer
- 28 Outcome Model; FDA, Food and Drug Administration; FNDDS, Food and Nutrient Database for
- 29 Dietary Studies; MEC, Mobile Examination Center; NCHS, National Center for Health
- 30 Statistics; NHANES, National Health and Nutrition Examination Survey; PSA, Probabilistic
- 31 sensitivity analysis; SD, Standard Deviation; SE, Standard Error; USDA, United States
 - 32 Department of Agriculture; UI, Uncertainty Interval

33	ABSTRACT
34	Objective To assess the impact of menu calorie labeling on reducing obesity-associated cancer
35	burdens in the United States (US).
36	Design Cost-effectiveness analysis using a Markov cohort state-transition model.
37	Setting Policy intervention.
38	Participants A modeled population of 235 million adults aged 20+ years in 2015-2016.
39	Interventions The impact of menu calorie labeling on reducing 13 obesity-associated cancers
40	among US adults over a lifetime was evaluated in scenarios: (1) effects on consumer behaviors
41	and (2) additional effects on industry reformulation. The model integrated nationally
42	representative demographics, calorie intake from restaurants, cancer statistics, and estimates or
43	associations of policy with calorie intake, dietary change with BMI change, BMI with cancer
44	rates, and policy and healthcare costs from published literature.
45	Main outcome measures Averted new cancer cases and cancer deaths and net costs (in 2015 U
46	dollars) among total population and demographic subgroups. Incremental cost-effectiveness
47	ratios from societal and healthcare perspectives were assessed and compared to the threshold o
48	\$150 000 per quality-adjusted life year (QALY) gained. Probabilistic sensitivity analyses
49	incorporated uncertainty in input parameters and generated 95% uncertainty intervals (UIs).
50	Results Considering consumer behavior alone, this policy was associated with 28 000 (95% U
51	16 300-39 100) new cancer cases and 16 700 (9610-23 600) cancer deaths averted, 111 000 (64
52	800-158 000) QALY gained, and \$1480 (\$884-\$2080) million saved in cancer-related medical
53	costs among US adults. The policy was associated with net cost savings of \$1460 (\$864-\$2060
54	million and \$1350 (\$486-\$2260) million from healthcare and societal perspectives, respectivel
55	Additional industry reformulation would substantially increase policy impact. Greater health

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2 3 4	56	gains and cost savings were predicted among young adults, Hispanic and non-Hispanic Black
5 6 7	57	individuals.
7 8 9	58	Conclusions Study findings suggest that menu calorie labeling is associated with lower obesity-
10 11	59	related cancer burdens and reduced healthcare costs. Policymakers may prioritize nutrition
12 13	60	policies for cancer prevention in the US.
14 15 16	61	(Word Count: 300)
17 18	62	Keywords: obesity, cost-effectiveness, menu calorie labeling, cancer incidence, cancer death,
19 20 21	63	medical cost
22 23 24	64	
25 26 27	65	Strengths and limitations of this study
28 29	66	• Our study populated a Markov cohort state-transition model among 32 subgroups based
30 31 32	67	on the nationally representative distributions of age, sex, and race/ethnicity and
33 34	68	demonstrated that the federal menu calorie labeling could be a cost-effective strategy to
35 36	69	reduce obesity-related cancers in the US and potentially narrow diet-associated cancer
37 38 39	70	disparities.
40 41 42	71	• This cost-effectiveness evaluation incorporated data input parameters from established
42 43 44	72	resources and the evidence was robust to different policy scenarios.
45 46 47	73	• However, given the nature of modeling research, this study does not provide a real-world
48 49	74	evaluation of the impact of policy implementation on health and economic outcomes.
50 51 52	75	• We only modeled the impact of menu calorie labeling on calories although the policy
53 54 55 56 57	76	may also result in potential changes in the nutritional quality of the restaurant meals.
58 59 60		4 For peer review only - http://bmjopen.bmj.com/site/about/guidelines.xhtml

77 INTRODUCTION

Obesity affects 1 in 3 Americans and is an established risk factor for 13 types of cancers, such as endometrial, liver, breast, prostate, and colorectal cancers.¹ Obesity-associated cancer represents 40% of all newly diagnosed cancer cases and contributes to 43.5% of total direct cancer care expenditures, estimated at \$35.9 billion (US dollars) in 2015.¹⁻⁷ Rates of obesity-associated cancers are also rising disproportionally among young adults.^{5 8} Substantial health and economic burdens highlight the need to prioritize cost-effective strategies to reduce obesity-associated cancers in the US.

> Diet is one of the few modifiable factors for both obesity and obesity-associated cancers.²⁹ Restaurant meals account for 1 in 5 calories consumed by US adults, including 9% of calories from full-service restaurants and 12% from fast-food restaurants,¹⁰ and therefore, can be an important target for improving population diet. Restaurant meals can have very high calories, with a mean energy of 1362 kcal/meal and 969 kcal/meal in popular meals from randomly selected full-service and fast-food restaurants, respectively.¹¹ Consistently, individuals who cook less frequently at home consume more daily calories than those who cook more at home.¹² Thus, reducing calories consumed from restaurant meals has the potential to reduce daily calorie intake and subsequent obesity and obesity-related cancer burdens.

96 To help consumers make lower-calorie choices, the Affordable Care Act mandated that all chain 97 restaurants with 20 or more outlets post calorie information on menus and menu boards for all 98 standard menu items.¹³ The FDA published the final rules for this policy in 2016, which was 99 subsequently implemented in 2018. A meta-analysis of 14 interventional studies including 5 Page 7 of 103

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randomized controlled trials (RCTs) and a recent quasi-experimental longitudinal study among 104 restaurants demonstrated that menu calorie labeling resulted in a reduction of 7.3% in caloric intake per meal and a 60 kcal (4%) reduction in calorie purchased per transaction, respectively.¹⁴ ¹⁵ Such policy can also motivate restaurant reformulation to lower calorie contents or introduce healthier food options.¹⁶⁻²¹ Prior cost-effectiveness analyses suggest that this policy is associated with substantial health gains and is a cost-saving strategy for reducing obesity and obesityrelated diseases.^{22 23} It was estimated that the menu calorie labeling on fast foods was associated with a 25 kJ (6 kcal) reduction in mean daily energy intake, leading to a -0.2 kg change in mean body weight, a gain of 63 492 health-adjusted life years, and net savings of half billion (2010 Australian dollars) among Australians aged 2 years and above over their lifetime.²² Researchers in the US have demonstrated that this policy would prevent a large number of incident cardiovascular diseases (135 781) and type 2 diabetes (99 736) and net savings of over \$10 billion (2018 US dollars) among US adults over a lifetime.^{22 23} However, the health and economic benefits of the policy for obesity-associated cancers have not been evaluated. This study aimed to address the knowledge gap by evaluating the cost-effectiveness of the federal menu calorie labeling and obesity-associated cancer burdens among US adults. **METHODS Study Overview** The Diet and Cancer Outcome (DiCOM), a probabilistic cohort state-transition model,^{24,25} was

120 used to perform an economic evaluation of the menu calorie labeling and obesity-associated

121 cancer rates among 235 million US adults aged 20 years and older (US Census), by comparing a

122 policy scenario (menu calorie label) to status quo (no policy), over a simulated lifetime starting

from 2015. The model consists of (1) four health states: healthy without cancer, initial diagnosis and treatment for 13 types of obesity-related cancers, continuous care for each of the 13 cancers, and death (from 13 cancers or other causes); (2) the annual likelihood of changes in health; and (3) the lifetime consequences of such changes on health outcomes and economic costs. (Supplementary Figure 1). The DiCOM model integrated independent parameters from different data sources, including nationally representative population demographics, dietary intake, and cancer statistics; association estimates of policy intervention with diet, diet change with body mass index (BMI), and BMI with cancer risks; and policy and health-related costs from established sources (Table 1). This study used de-identified datasets and was exempt from institutional review board review and follows the Consolidated Health Economic Evaluation Reporting Standards (CHEERS) reporting guidelines.

Table 1. Key input parameters and data sources in the Dietary Cancer Outcome Model (DiCOM)
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Model Input	Outcome	Estimates	Distribution	Comments	Data Source
1. Simulated population	Population	Mean consumption of calories was 332 kcal/d from full-service or fast-food restaurants (Supplementary Tables 1, 8-9)	Gamma	Stratified by age, sex, race/ethnicity; 32 subgroups	NHANES 2013-2016
2. Policy effect ¹					
a) Consumer behavior	Policy effect	7.3% (4.4%-10.1%) (Appendix 1 and Appendix Table 1)	Beta	One-time effect	Meta-analysis of labeling interventions on reducing calorie intake, Shangguan et al., 2019, American Journal of Preventative Medicine
b) Industry response	Policy effect	5% (Appendix 1 and Appendix Table 2)	Beta	Assumption: no reformulation in the 1st year of policy intervention; Restaurants will replace the high-calorie menu items with low-calorie options or reformulate the menu items in years 2 to 5 of the intervention to achieve a 5% reduction in calorie contents	Calorie changes in large chain restaurants from 2008 to 2015, Bleich et al. 2017, Prev Med; Higher-Calorie Menu Items Eliminated in Large Chain Restaurants, Bleich et al. 2018, American Journal of Preventative Medicine
3. Effect of change in calorie intake on BMI change (kg/m ²) ¹	Dietary effect	Among individuals with: BMI <25: 0.0015 per kcal BMI ≥25: 0.003 per kcal	Normal	Assumption: 55 kcal per day reduction in calorie intake would lead to 1 pound weight loss within 1 year, with no further weight loss in the future	Hall et al., 2018, JAMA; Hall et al. 2011, Lancet

4. Etiologic effect of BMI on cancer outcomes ¹	Cancer outcome	RRs ranged from 1.05 to 1.50 (Supplementary Table 2)	Lognormal	BMI change and cancer incidence	Continuous Update Project (CUP) conducted by the World Cancer Research Fund (WCRF)/American Institute for Cancer Research (AICR)
5. Cancer statistics ¹	Cancer incidence ³ and survival	Appendixes 2-3, Appendix Tables 2-3, and Supplementary Tables 3-4	Beta	Stratified by age, sex, and race/ethnicity	NCI's Surveillance, Epidemiology, and End Results Program (SEER) Database; CDC's National Program of Cancer Registries (NPCR) Database
6. Healthcare-related costs ^{1,2}	Medical expenditures, productivity loss, and patient time costs	Appendix 6, Appendix Table 6, and Supplementary Tables 6-7	Gamma	Stratified by age, and sex	NCI's Cancer Prevalence and Cost of Care Projections; Published literature
7. Policy costs ^{1,2}	For government and industry	Appendix 5 and Appendix Tables 4-5	Gamma	Administration and monitoring costs for government; compliance and reformulation costs for industry	FDA's budget report; Nutrition Review Project; and FDA's RIA
8. Health-related quality of life (HRQOL) ¹	For 13 types of cancers	Ranged from 0.64 to 0.86 (Appendix 4 and Supplementary Table 5) Drug Administration; NCI, National Canc	Beta	EQ-5D ⁴ data from published literature by cancer type	Published literature

Abbreviations: BMI, Body Mass Index; FDA, Food and Drug Administration; NCI, National Cancer Institute; NHANES, National Health, and Nutrition Examination Survey; UK, United Kingdom. 1. Uncertainty distributions were incorporated in the probabilistic sensitivity analyses. Uncertainties in each parameter were presented in supplemental materials (Table TS3 and Tables S3-9). 2. If the source did not provide uncertainty estimates, we assumed the standard errors were 20% of the mean estimate to generate gamma distribution.

3. Time-varying input parameter, for which the model accounted the secular trends. Details were provided in the Supplements.

4. EQ-5D is a standardized instrument developed by the EuroQol Group as a measure of health-related quality of life that can be used in a wide range of health conditions and treatments.

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134 Simulated US Population

135 Because FDA's final rules on menu calorie labeling were published in 2016 and implemented in 136 2018, considering that some restaurants have implemented this policy prior to 2016 given the 137 law was passed in 2010, we used 2015-2016 as the baseline and assumed a closed cohort for this 138 analysis. The projected population size of US adults aged 20+ in 2015-2016 was obtained from 139 the US Census data.²⁶ We combined the 2013-2016 National Health and Nutrition Examination 140 Survey (NHANES) to approximate the baseline and simulate the nationally representative US 141 adult population aged 20+ years in 32 subgroups stratified by age (20-44, 45-54, 55-64, 65+), sex 142 (men, women), and race/ethnicity (non-Hispanic White, non-Hispanic Black, Hispanic, Other) 143 (Supplementary Table 1). This closed cohort of US adults was modeled from baseline through 144 their lifetime up to 80 years or until death.

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146 Calorie Consumption from Restaurants

147 Mean calorie consumption from full-service and fast-food restaurants, demographics, and 148 prevalence of overweight or obesity were estimated using data collected from NHANES 149 participants with at least one valid 24-hour diet recall, in every 32 strata. Following FDA's 150 estimates,¹³ we assumed that policy would affect 56.5% of calories consumed at full-service 151 restaurants and 100% at fast-food restaurants. The National Cancer Institute method was used to 152 estimate the usual intake distribution by statistically adjusting for within vs. between variance in dietary recalls.²⁷⁻²⁹ The complex survey design was incorporated in all statistical analyses to 153 154 ensure the representativeness of study findings to the non-institutionalized US adults.

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156 Policy Association with Calorie Consumption

Policy association with consumer behaviors was obtained from a systematic review and metaanalysis of 13 interventional studies (5 RCTs) with 19 interventions conducted in fast-food, fullservice, cafeterias, and laboratories between 2000 and 2015 that evaluated the effectiveness of menu calorie labeling on consumers' calorie consumption per meal (Appendix 1 and Appendix Table 1).¹⁵ The study results showed a 7.3% (95% CI: 4.4%-10.1%) reduction in calories consumed per meal following calorie labeling. We assumed that the policy would have a onetime effect over one year, with no further change over time.

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Policy intervention may stimulate industries to reformulate their products to lower the calorie 165 166 content. Potential policy impact on industry reformulation was derived from studies of restaurant 167 menu items following the passage and initial period of partial implementation of the final rules 168 (Appendix Table 2). Between 2012-2014, among 66 of the 100 largest US chain restaurants, 169 replacing higher-calorie menu items with lower-calorie items led to a 1-5% calorie reduction per 170 menu item.^{19 20} Among 44 chain restaurants with menu calorie information available in 2008, the calories per menu item fell by 7% between 2008 and 2015.¹⁸ Based on the evidence, we chose 171 172 5% as the mid-point for the potential policy impact on industry response, which may include 173 discontinuation of existing high-calorie menu items and/or introduction of lower-calorie menu 174 items. We assumed that no reformulation occurs in the 1st year of policy intervention, and 175 restaurants will replace the high-calorie menu items with low-calorie options or reformulate the 176 menu items in years 2 to 5 of the intervention to achieve a 5% reduction in calorie content, with 177 no change thereafter. Combining the effect on consumer behaviors with the effect on industry 178 response, the policy would lead to a 12.3% reduction in calories consumed per meal.

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In addition, we conservatively assumed that there would be some compensatory increased calorie

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181 intake outside of restaurants so that only half of all calories reduced from restaurant meals would 182 translate into long-term reductions in daily calories (compensation rate = 50%). Therefore, the 183 reduction in calorie consumption from fast-food or full-service restaurants among the simulated 184 population was computed using the baseline consumption times the policy effect estimates, and 185 then times the compensation rate. 186 **Calorie Reduction and Obesity-Associated Cancer Risk** 187 188 To estimate the relationships between calorie intake and obesity-associated cancers, we 189 associated the multivariate-adjusted association of change in calorie intake (kcal/day) with 190 change in BMI (kg/m²) and the estimates of BMI and cancer risks. Based on an established 191 energy-weight dynamic model that accounted for the long-term impacts of calorie reduction on 192 weight and metabolic expenditure, we assumed that each 55 kcal/day calorie reduction leads to 1 193 pound weight loss over one year among overweight or obese adults, with no further reduction thereafter.^{30 31} Because long-term observational studies suggest that weight change for an 194 195 equivalent change in dietary intake is about twice as large in overweight or obese adults than 196 normal-weight adults, ^{32 33} we conservatively applied half of this estimate to individuals with 197 normal weight. For each of the 13 obesity-related cancers, the estimated change in risk for each 5 kg/m² change in BMI was derived from the systematic reviews and meta-analyses of 198 199 multivariable-adjusted prospective cohort studies conducted by the World Cancer Research 200 Fund/American Institute for Cancer Research Continuous Update Project and the International 201 Agency for Research on Cancer (Supplementary Table 2).²

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203 Cancer Incidence, Mortality, and Health-Related Quality of Life

Age-adjusted cancer incidences in 2015 were obtained from the National Program of Cancer Registries and the Surveillance, Epidemiology, and End Results (SEER) program. We projected the cancer incidence from 2015 to 2030 based on the 2006-2014 trend using the Average Annual Percent Change method.³⁴ We then combined the projected incidence rates with the projected US population from the National Interim Projections³⁵ to account for changes in population age distribution over time. We further applied the cohort-period method to estimate cancer incidence in the closed cohort of US adults in each of the 32 groups as they age (Appendix 2, Appendix Table 2, and Supplementary Table 3). The 5-year relative survival rates for each cancer were extracted and converted to an annual probability of death (Appendix 3, Appendix Table 3, and Supplementary Table 4).³⁶⁻³⁸ Health-related quality of life data were obtained from publications that reported EuroQol-5 Dimension utility weights for each cancer among US patient population (Appendix 4 and Supplementary Table 5).

9 217 Policy and Health-Related Costs

Policy costs included government costs to administer, monitor, and evaluate the policy and
industry costs to comply with the policy and reformulate their products (in scenario 2).
Government costs were estimated from FDA's budget report and Nutrition Review Project
(Appendix 5 and Appendix Tables 4-5).^{39 40} Industry compliance and reformulation costs were
based on the FDA's regulatory impact analysis that included initial and recurring nutrition
analysis of standard menu items and menu replacement, provision of nutrition information,

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employee training, and legal review and accounted for restaurant size and type, reformulation
 type, and compliance period.¹³

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Direct medical costs for cancer care were extracted from the SEER-Medicare linked database for
three phases of cancer care: initial (12 months after diagnosis), continuing, and end-of-life (the
last year of life) (Appendix 6, Appendix Table 6, and Supplementary Tables 6-7).^{34 41} For
individuals without cancer, the direct medical costs were estimated based on Medical
Expenditure Panel Survey (MEPS) data and insurance claims.^{25 42 43} Indirect costs including
productivity loss due to disability or missed workdays and patient time costs were derived from
publications using MEPS data.⁴⁴⁻⁴⁷

235 Cost-Effectiveness Analysis

Following the guidelines on cost-effectiveness in health and medicine,⁴⁸ we evaluated the policy 236 237 impact by projecting the numbers of new cancer cases and cancer deaths averted and quality-238 adjusted life-years (QALYs) gained and cost-effectiveness from both healthcare and societal 239 perspectives. Net costs from the healthcare perspective were assessed as the difference between 240 government costs for implementing the policy and the direct medical costs of cancer care. Net 241 costs from the societal perspective were assessed as the difference between total policy costs 242 (including both government and industry costs) and health-related costs saved (including direct 243 and indirect costs of cancer care). All costs were inflated to 2015 US dollars using the Consumer 244 Price Index or Personal Health Care Index, with all costs and QALYs discounted at 3% 245 annually.⁴⁸ Incremental cost-effectiveness ratios (ICERs) were calculated as net costs divided by 246 the difference in QALYs between policy vs. no policy. ICERs falling below a willingness-to-pay

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3 4	247	threshold of \$150,000 per QALY gained were considered to be cost-effective. ^{49 50} Cost-
5 6 7	248	effectiveness analysis was further conducted among population subgroups by age, sex, and
7 8 9	249	race/ethnicity to evaluate policy associations with health disparities.
10 11 12	250	
13 14 15	251	One-way sensitivity analyses were performed by varying input parameters, including reducing
15 16 17	252	the outside-the-restaurant calorie compensation level to 25% or increasing it to 75%, altering
18 19	253	coverage of the FDA's final rule to all calories from full-service restaurants, reducing the diet-
20 21	254	BMI associations to half or doubling the estimates, incorporating an estimated 2% annual
22 23 24	255	increase in medical expenditures associated with cancer care, and altering annual discounting
25 26	256	rates from 3% to 0% or 5%. We also evaluated impacts at a 10-year time horizon for
27 28	257	stakeholders interested in shorter-term health gains and economic benefits. Probabilistic
29 30	258	sensitivity analyses (PSAs) were conducted to incorporate uncertainty in all input parameters
31 32 33	259	jointly (Table 1). A total of 1000 Monte Carlo simulations were performed, and 95% uncertainty
34 35	260	intervals (UIs) were estimated based on the 2.5 and 97.5 percentiles of 1,000 simulations. All
36 37	261	analyses were conducted using SAS (Version 9.4) and R (Version 3.3.1).
38 39 40	262	
41 42	263	Patient and Public Involvement
43 44 45	264	This study used de-identified datasets and did not involve patients or the public in the design,
45 46 47 48 49 50 51 52 53	265	conduct, reporting, or dissemination plans of our research.
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3 4	266	RESULTS
5 6	267	Population Characteristics
7 8 9	268	The simulated cohort of US adults in 2015-2016 had a mean age of 47.8 years, with 65.0% being
9 10 11	269	non-Hispanic white adults and 71.4% being overweight or obese (Supplementary Tables 8-9). A
12 13	270	mean of 332 daily calories was consumed from full-service or fast-food restaurants. Higher
14 15	271	levels were consumed among younger adults aged 20-44 years (425 kcal/day), men (388
16 17 18	272	kcal/day), non-Hispanic black (361 kcal/day), and Hispanic (367 kcal/day) adults, in comparison
19 20	273	to other corresponding subgroups.
21 22	274	
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25 26	275	Health Gains
27 28	276	The menu calorie labeling was estimated to reduce calories consumed from restaurants by a
29 30	277	mean of 24 kcal/day among US adults, and total daily calories by 12 kcal/day. Accounting for
31 32 33	278	potential industry reformulation would reduce the mean intake by an additional 16 kcal/day, and
34 35	279	total daily calories by 8 kcal/day.
36 37	280	
38 39	281	Based on changes in consumer behavior alone, the policy was associated with a reduction of
40 41 42	282	28,000 (95% UI: 16,300-39,100) new cancer cases and 16,700 (9,610-23,600) cancer deaths, and
43 44	283	a gain of 111,000 (64,800-158,000) QALYs among 235 million US adults over a median follow-
45 46	284	up of 34.4 years (Table 2 and Figure 1). By cancer type, the greatest numbers of new cancer
47 48	285	cases averted were cancers of endometrial (N [95% UI]: 5,700 [2,380-9,190]), liver (5,180
49 50 51	286	[2,800-7,730]), kidney (5,090 [2,670-7,730]), post-menopausal breast (4,840 [2,010-8,230]), and
52 53	287	pancreas (1,400 [756-2,100]). The greatest numbers of prevented cancer deaths were estimated
54 55	288	for cancers of the liver (4,530 [2,410-6,760]), post-menopausal breast (3,080 [861-5,650]),
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58 59 60		16 For peer review only - http://bmjopen.bmj.com/site/about/guidelines.xhtml

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3 4	289	endometrial (2,060 [957-3,220]), kidney (1,980 [1,080-2,920]), and pancreas (1,230 [661-
5 6	290	1,830]).
7 8	291	
9 10 11	292	Based on additional industry response, the total estimated health gains approximately doubled,
12 13	293	preventing 47,300 (35,400-59,100) new cancer cases and 28,200 (21,100-35,300) cancer deaths,
14 15 16	294	and gaining 189,000 (140,000-236,000) QALYs, with similar rankings of the types of new
16 17 18	295	cancer cases and cancer deaths prevented.
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Table 2. Estimated health gains and costs of the federal menu calorie labeling on reducing the obesity-related cancer burdens in the US over 10 years and a lifetime (US population=235,162,844)¹

	Menu Calorie Labeling Policy				
	10 Y		Lifetime		
0	Consumer Behavior Median (2.5% to 97.5%)	Consumer Behavior + Industry Response Median (2.5% to 97.5%)	Consumer Behavior Median (2.5% to 97.5%)	Consumer Behavior + Industry Response Median (2.5% to 97.5%)	
New Cancer Cases Averted, N (95%	% UI)	, , , , , , , , , , , , , , , , , , ,			
Endometrial cancer	692 (276 to 1100)	1130 (716 to 1550)	5700 (2380 to 9190)	9920 (6630 to 13600)	
Liver cancer	366 (144 to 615)	626 (386 to 887)	5180 (2800 to 7730)	8550 (5960 to 11300)	
Kidney cancer	584 (290 to 884)	980 (689 to 1280)	5090 (2670 to 7470)	8620 (6200 to 11000)	
Breast cancer (postmenopausal)	670 (256 to 1110)	1080 (658 to 1520)	4840 (2010 to 8230)	8520 (5610 to 12200)	
Pancreatic cancer	170 (83 to 257)	273 (183 to 367)	1400 (756 to 2100)	2380 (1690 to 3140)	
Esophageal adenocarcinoma	179 (56 to 304)	286 (159 to 411)	1350 (485 to 2230)	2330 (1440 to 3280)	
Colorectal cancer	189 (97 to 284)	319 (225 to 418)	1050 (561 to 1600)	1780 (1230 to 2370)	
Multiple myeloma	75 (37 to 117)	122 (81 to 169)	690 (384 to 1090)	1150 (775 to 1630)	
Stomach cancer (cardia)	54 (6 to 109)	98 (51 to 165)	647 (261 to 1140)	1090 (644 to 1660)	
Thyroid cancer	105 (58 to 161)	176 (123 to 243)	516 (206 to 914)	951 (576 to 1420)	
Advanced prostate cancer	66 (17 to 118)	107 (57 to 162)	339 (138 to 561)	577 (352 to 836)	
Gallbladder cancer	29 (16 to 42)	46 (34 to 60)	314 (213 to 438)	512 (399 to 648)	
Ovarian cancer	33 (15 to 56)	53 (33 to 78)	147 (44 to 282)	254 (110 to 420)	
Total	3300 (1750 to 4720)	5230 (3870 to 6790)	28000 (16300 to 39100)	47300 (35400 to 59100)	
Cancer Deaths Prevented, N (95%	ÚI)				
Liver cancer	168 (59 to 287)	287 (174 to 410)	4530 (2410 to 6760)	7510 (5200 to 9980)	
Breast cancer (postmenopausal)	68 (33 to 106)	111 (74 to 149)	3080 (862 to 5650)	5590 (3230 to 8310)	
Endometrial cancer	52 (20 to 86)	87 (55 to 121)	2060 (957 to 3220)	3520 (2390 to 4700)	
Kidney cancer	70 (29 to 110)	114 (74 to 154)	1980 (1080 to 2920)	3320 (2430 to 4300)	
Pancreatic cancer	88 (38 to 138)	143 (93 to 195)	1230 (661 to 1830)	2080 (1480 to 2740)	
Esophageal adenocarcinoma	76 (21 to 131)	122 (69 to 178)	1150 (403 to 1930)	1990 (1210 to 2820)	
Colorectal cancer	34 (17 to 53)	57 (40 to 77)	706 (369 to 1080)	1200 (839 to 1600)	
Stomach cancer (cardia)	22 (2 to 48)	40 (19 to 68)	541 (230 to 947)	907 (538 to 1400)	
Multiple myeloma	18 (8 to 30)	29 (18 to 42)	420 (239 to 662)	691 (481 to 980)	
Gallbladder cancer	13 (7 to 20)	21 (15 to 28)	267 (181 to 369)	436 (341 to 551)	
Advanced prostate cancer	9 (3 to 15)	13 (7 to 19)	163 (65 to 280)	273 (163 to 404)	
Ovarian cancer	8 (3 to 15)	13 (7 to 20)	107 (39 to 191)	181 (94 to 290)	
Thyroid cancer	1 (1 to 2)	2 (1 to 3)	23 (11 to 38)	38 (24 to 58)	
Total	654 (320 to 970)	1080 (746 to 1400)	16700 (9610 to 23600)	28200 (21100 to 35300)	

1 2				
² ³ Life Years Gained	678 (288 to 1040)	1120 (738 to 1490)	76400 (43400 to 109000)	130000 (96900 to 162000)
⁴ QALYs Gained	678 (288 to 1040) 4280 (2170 to 6250)	7030 (4960 to 9090)	111000 (64800 to 158000)	189000 (140000 to 236000)
⁵ Changes in Health-Related Cost	· · · · · · · · · · · · · · · · · · ·	7030 (4900 10 9090)	111000 (04800 to 138000)	189000 (140000 to 230000)
 6 Healthcare (medical) cost 	-192 (-277 to -100)	-319 (-403 to -227)	-1480 (-2080 to -884)	-2500 (-3090 to -1900)
7 Patient time cost	-7.33 (-10.9 to -3.56)	-12.2 (-15.8 to -8.39)	-102 (-144 to -62.2)	-172 (-216 to -131)
⁸ Productivity loss	-48.7 (-70.1 to -24.5)	-80.4 (-102 to -56.7)	-608 (-865 to -363)	-1030 (-1290 to -780)
⁹ Policy Implementation Costs (\$,		-00.4 (-102 to -30.7)	-000 (-003 to -503)	-1030 (-1230 t0 -760)
¹⁰ Total	518 (493 to 548)	644 (612 to 680)	839 (780 to 908)	1140 (1060 to 1220)
¹ Government cost	13.2 (11.4 to 15.9)	13.1 (11.4 to 15.7)	18.5 (14.5 to 25.1)	18.5 (14.4 to 25.5)
¹² Administration	9.08 (8.59 to 9.60)	9.07 (8.64 to 9.50)	9.07 (8.61 to 9.56)	9.09 (8.62 to 9.55)
¹ ³ Monitoring	4.09 (2.40 to 6.74)	4.00 (2.35 to 6.63)	9.40 (5.45 to 16.1)	9.38 (5.30 to 16.3)
¹⁴ Industry cost	505 (480 to 535)	631 (599 to 667)	820 (762 to 889)	1120 (1040 to 1210)
15 Compliance	505 (480 to 535)	506 (480 to 533)	820 (762 to 889)	823 (757 to 889)
¹⁶ Reformulation		124 (107 to 146)		296 (249 to 353)
¹ /Net Costs (\$, millions) ^{2,3,4}				
¹⁸ Societal perspective	270 (156 to 389)	233 (119 to 356)	-1350 (-2260 to -486)	-2570 (-3460 to -1650)
¹⁹ Healthcare perspective	-179 (-263 to -86.3)	-305 (-390 to -214)	-1460 (-2060 to -864)	-2480 (-3070 to -1880)
²⁰ ICER (dollars/QALY) ⁵				
² ¹ Societal perspective	64500 (26100 to 187000)	33600 (13300 to 72400)	Dominant	Dominant
22 Healthcare perspective 23 Abbreviations: ICER. Increm	Dominant	Dominant	Dominant	Dominant
 1. Values are the median estimates (65% uncertainty intervals) of each distribution of 1000 simulations. 2. Heath-related costs were inflated to 2015 US dollars using the Personal Heath Care (PHC) index. Policy intervention costs were inflated to 2015 US dollars using the Consumer Price Index. Negative costs represent savings. 3. Costs are medians from 1000 simulations so may not add up to totals. 4. Net costs were calculated as policy costs minus health-related costs from reduced cancer burden. The societal perspective includes healthcare costs, patient time costs, productivity costs, and policy implementation costs; the government perspective included policy costs relevant to policy implementation and program monitoring and evaluation, and medical costs. 5. ICER threshold was evaluated at \$150,000/QALY. Dominant represents less costly and more effective than the "no-policy intervention" scenario. 				
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4 5 6 7	296	Economic Impacts
	297	Implementing the policy would cost the government \$19 (95% UI: \$15-25) million and the
8 9 10	298	restaurant industry, \$820 (\$762-889) million in compliance costs over a lifetime (Table 2). The
11 12 13 14 15 16	299	policy was associated with savings of \$1480 (\$884-2080) million in direct medical costs, \$608
	300	(\$363-865) million in productivity loss costs, and \$102 (\$62-144) million in patient time costs.
	301	Potential industry reformulation would cost the restaurant industry an additional \$296 (\$249-
17 18 19	302	353) million to implement but would also result in greater healthcare savings, including \$2,500
20 21	303	(\$1,900-3,090) million, \$1,030 (\$780-1,290) million and \$172 (\$131-216) million in reduced
22 23	304	direct medical, productivity loss, and patient time costs, respectively.
24 25	305	
26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42	306	From both the healthcare and social perspectives, implementing the menu calorie labeling policy
	307	among US adults over a lifetime would be cost-saving. With changes in consumer behavior
	308	alone, the net cost savings were estimated to be \$1,460 (\$864-2,060) million and \$1,350 (\$486-
	309	2,260) million from the healthcare and societal perspective, respectively. With additional
	310	industry response, estimated cost savings increased to \$2,480 (\$1,880-3,070) million from the
	311	healthcare perspective and \$2,570 (\$1,650-3,460) million from the societal perspective.
	312	
43 44	313	Policy Impacts Among Population Subgroups
45 46 47 48 49 50 51 52 53 54	314	Among population subgroups, the consumer response to the policy was estimated to result in
	315	greater health gains per 100,000 individuals among adults aged 20-44 years (15 new cancer cases
	316	averted) and 55-64 years (16 new cancer cases averted) than older age groups (aged 65+ years; 6
	317	new cancer cases averted); Hispanic and non-Hispanic Black individuals than Non-Hispanic
55 56 57	318	White group (22 vs. 9 and 17 vs. 9 new cancer cases averted) (Table 3). The numbers of cancer
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319	deaths averted, life-years and QALYs gained, health-related costs saved, and net costs among
320	population subgroups followed a similar pattern (Supplementary Tables 10-11 and
321	Supplementary Figures 2-5). For instance, the policy was associated with more cancer deaths
322	prevented per 100,000 individuals among younger adults aged 20-44 years than older adults aged
323	65+ years (10 vs. 3 cancer deaths averted) and Hispanic and non-Hispanic Black adults than non-
324	Hispanic White individuals (14 vs. 5 and 11 vs. 5 cancer deaths averted). Adding potential
325	industry reformulations resulted in larger health gains among adults aged 45-54 (128% increase
326	in new cancer cases averted) and non-Hispanic White adults (84% increase in new cancer cases
327	in new cancer cases averted) and non-Hispanic White adults (84% increase in new cancer cases averted).

Table 3. Estimated new cancer cases and deaths prevented by the federal menu calorie labeling policy in the US by age, sex, and race/ethnicity, over a lifetime¹

	Consume	r Behavior	Consumer Behavior	Consumer Behavior + Industry Response	
	N (95% UI)	Per 100,000 individuals (95% UI)	N (95% UI)	Per 100,000 individuals (95% UI)	
New Cancer Cases Averted					
Age					
20-44	15700 (6170 to 25100)	15.0 (5.89 to 24.0)	28000 (18000 to 37500)	26.7 (17.2 to 35.8)	
45-54	2810 (-2110 to 8030)	6.61 (-4.97 to 18.9)	6420 (1390 to 11600)	15.1 (3.27 to 27.2)	
55-64	6330 (3540 to 9400)	15.7 (8.76 to 23.3)	8640 (5790 to 11800)	21.4 (14.3 to 29.1)	
≥65	2740 (795 to 4650)	5.77 (1.68 to 9.80)	4060 (2070 to 5950)	8.55 (4.36 to 12.6)	
Sex					
Female	15100 (6650 to 24000)	12.5 (5.51 to 19.8)	25900 (17400 to 34900)	21.4 (14.4 to 28.9)	
Male	12500 (4920 to 20100)	10.9 (4.30 to 17.6)	21100 (13500 to 29100)	18.4 (11.8 to 25.4)	
Race/Ethnicity					
Non-Hispanic White	14300 (4310 to 24500)	9.16 (2.77 to 15.7)	26300 (16000 to 36700)	16.9 (10.3 to 23.6)	
Non-Hispanic Black	4720 (1820 to 8100)	16.6 (6.37 to 28.4)	7630 (4750 to 11100)	26.8 (16.7 to 38.9)	
Hispanic	7700 (3560 to 11500)	21.5 (9.93 to 32.2)	11200 (7060 to 15300)	31.3 (19.7 to 42.6)	
Other	1150 (-240 to 2440)	7.60 (-1.59 to 16.2)	1990 (652 to 3310)	13.2 (4.33 to 22.0)	
Cancer Deaths Prevented					
Age					
20-44	10200 (4170 to 16400)	9.73 (3.98 to 15.7)	18100 (11700 to 24500)	17.3 (11.2 to 23.4)	
45-54	1730 (-853 to 4240)	4.07 (-2.01 to 9.97)	3650 (1040 to 6240)	8.58 (2.44 to 14.7)	
55-64	3320 (1760 to 4930)	8.21 (4.36 to 12.2)	4480 (2890 to 6090)	11.1 (7.15 to 15.1)	
≥65	1200 (285 to 2130)	2.53 (0.60 to 4.48)	1800 (848 to 2720)	3.79 (1.79 to 5.73)	
Sex					
Female	7810 (3290 to 12600)	6.47 (2.73 to 10.5)	13400 (8850 to 18500)	11.1 (7.33 to 15.3)	
Male	8510 (3500 to 13900)	7.44 (3.06 to 12.1)	14400 (9300 to 20000)	12.6 (8.13 to 17.5)	
Race/Ethnicity					
Non-Hispanic White	7920 (2180 to 13900)	5.08 (1.40 to 8.94)	14700 (8770 to 20900)	9.45 (5.64 to 13.5)	
Non-Hispanic Black	3010 (1000 to 5370)	10.6 (3.51 to 18.8)	4990 (2950 to 7380)	17.5 (10.4 to 25.9)	
Hispanic	4960 (2360 to 7560)	13.8 (6.58 to 21.1)	7190 (4480 to 9870)	20.0 (12.5 to 27.5)	
Other	565 (-246 to 1350)	3.75 (-1.63 to 8.97)	1070 (273 to 1870)	7.12 (1.81 to 12.4)	

1. Values are the median estimates (95% uncertainty intervals) of each distribution of 1000 simulations.

1 2		
3 4 5	328	Sensitivity Analyses
5 6 7	329	In PSA, based on consumer responses alone, the menu calorie labeling was cost-saving over a
8 9	330	lifetime in 93% of 1000 simulations and cost-effective (<\$150,000/QALY) in the remaining 7%
10 11 12	331	from the societal perspective, and was cost-saving in over 98% of 1000 simulations from the
12 13 14	332	healthcare perspective. Adding the additional industry response increased the probability of cost-
15 16	333	savings to nearly 100% of the simulations for both the societal and healthcare perspectives
17 18 19	334	(Figure 2).
20 21	335	
22 23	336	Evaluating health gains, costs, and cost-effectiveness at 10 years, the policy remained cost-
24 25 26	337	saving from the healthcare perspective and was cost-effective from the societal perspective, with
20 27 28	338	an ICER of \$64,500 (26,100-187,000) per QALY based on consumer response alone and
29 30	339	\$33,600 (13,300-72,400) per QALY with additional industry response. The cost-effectiveness of
31 32 33	340	this policy was most sensitive to varied assumptions of the diet-BMI estimates and annual
33 34 35	341	discounting rates (Supplementary Tables 12-13 and Supplementary Figure 6).
36 37	342	
38 39	343	DISCUSSION
40 41 42	344	This study estimated that the federal menu calorie labeling policy, based on consumer response
43 44	345	alone, was associated with a reduction of approximately 28,000 new cancer cases and 16,700
45 46	346	cancer deaths among US adults over a lifetime, and net savings of \$1,350 and \$1,460 million
47 48 49	347	from societal and healthcare perspectives, respectively. Incorporating additional modest industry
50 51	348	responses, these health and economic gains were approximately doubled. Greater health gains
52 53	349	were expected among younger, middle-aged subgroups, Hispanic, and non-Hispanic Black
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individuals compared with other subgroups. Findings were robust to a range of probabilistic andone-way sensitivity analyses.

Our study findings supported that nutrition policies can have meaningful health and economic impacts on cancer prevention in the US. In this case, a modest change in mean calorie consumption, distributed across the population, was estimated to achieve important reductions in obesity-related cancer burdens among US adults. Using the best available estimates, our study further suggested that the federal menu calorie labeling policy is cost-effective in the short term and cost-saving in the long term in reducing obesity-associated cancer burdens. Many preventive medical screenings are cost-effective, but none of them achieve net savings. For example, among a large cohort of women born in the 1960s over a lifetime, mammography screening starting at age 45 years was estimated to have an ICER of \$40 135/QALY.⁵¹ Colonoscopy screening starting at age 45 years among U.S. adults achieved an ICER of \$33 900/QALY.⁵² Prostate-specific antigen screening had an ICER of \$70 831 to \$136 332/QALY among U.S. males beginning at 40 years of age over a lifetime.⁵³ In contrast, population-based nutrition interventions could be a cost-saving strategy for cancer prevention. Cost-effectiveness analyses showed that a penny-per-ounce tax on sugar-sweetened beverages would be a highly cost-effective strategy for cancer prevention among US adults, with an ICER of 13 220, the nutrition facts added sugar labeling would prevent 30 000 incident obesity-related cancer cases and 17 100 cancer deaths and be associated with a net saving of 704 million, and processed meat taxes would avert 77 000 colorectal cancer cases and 12 500 stomach cancer cases save 4.5 billion, all from the societal perspective.^{24 54 55} Thus, while we shall continue the efforts of increasing the

372 screening rates, we also need to consider population-based strategies to improve nutrition for373 cancer prevention in the US.

Our findings also indicated the importance of assessing potential industry response, which could nearly double health and economic benefits. The additional impacts of industry reformulation in response to nutrition-related policies have been reported in other studies focused on obesityassociated cancer, diabetes, and cardiovascular diseases.^{23 55-57} Our new findings build on this recent work and highlight the importance of potential strategies to encourage industry reformulation under the federal menu calorie labeling framework to further improve the health benefits and cost-effectiveness of such policies.

In addition, our results showed that population-based nutrition policies such as menu calorie labeling can potentially narrow diet-associated cancer disparities. We found greater health gains and economic impacts among racial/ethnic minorities compared to non-Hispanic whites, likely due to higher diet-associated cancer burdens among minorities.⁵⁸ However, labeling policies may have fewer effects on food purchasing behaviors among minorities or socioeconomically disadvantaged groups. Prior studies reported that individuals with higher education and income attainment were more likely to notice and use the menu calorie labels when ordering foods in fast-food or full-service restaurants compared to socioeconomically disadvantaged groups,⁵⁹⁻⁶¹ and multi-racial individuals were less likely to notice and use menu calorie labels in fast food restaurants than non-Hispanic whites.⁵⁹ Previous studies also showed that literacy or numeracy could be a barrier to label use.^{62 63} Thus, it is important for labeling policies to be paired with nutrition education to effectively reduce diet-associated health disparities.

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	396	Potential limitations should be considered. First, as a modeling study, our investigation does not
	397	provide the impact of real-world policy implementation on the health and economic outcomes of
)	398	federal menu calorie labeling. However, conducting randomized controlled trials of national
2 3	399	nutrition policy interventions is extremely difficult and often implausible while simulation
1 5	400	modeling can provide complementary evidence with the flexibility to assess different policy
5 7	401	scenarios that help inform policymaking. Second, this evaluation did not include the potential
))	402	benefits of menu calorie labeling on other health outcomes such as diabetes and cardiovascular
 <u>2</u>	403	diseases. Considering such outcomes is likely to be associated with greater health gains and cost
3 1 -	404	savings. ^{23 64 65} Third, menu calorie labeling could have a greater effect among subgroups with
5 7	405	higher levels of income and education and non-Hispanic white adults ⁵⁹⁻⁶¹ and thus exacerbating
3	406	health disparities. Due to the lack of consistent policy effect sizes among populations with
) I	407	different socioeconomic statuses, we were unable to integrate this into our modeling. Forth, we
2 3	408	only modeled the impact of menu calorie labeling on calories although the policy may also result
+ 5 5	409	in potential changes in the nutritional quality of the restaurant meals. The majority of current
7 3	410	restaurant meals consumed by American adults – 70% of meals consumed from fast-food
))	411	restaurants and 50% consumed from full-service restaurants – are of poor nutritional quality, and
 2 2	412	the remainder is only of intermediate nutritional quality, with very few being ideal. ¹⁰ If the
, 1 5	413	policy also improves the quality of restaurant meals, the total reduction in obesity-associated
5 7	414	cancer burdens could be greater than our current estimates.
3 9	415	
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416 **CONCLUSIONS**

Study findings suggest that menu calorie labeling is associated with lower obesity-related cancer rates and reduced costs. Policymakers may prioritize nutrition policies for cancer prevention in the US.

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Ethics approval: This study used de-identified datasets and was exempt from institutional review board review.

Data sharing: Data described in the manuscript, codebook, and analytic code will be made available upon request.

Transparency Statement: The author affirms that this manuscript is an honest, accurate, and transparent account of the study being reported; that no important aspects of the study have been omitted; and that any discrepancies from the study as planned have been explained.

Dissemination Declaration: Dissemination to the simulated population is not applicable. **Contributors**: MD contributed to the data curation, formal analysis, visualization, original draft preparation, review and editing; CFG contributed to the data curation, review and editing; FFC, HE and DDK contributed to software; JBW, PW, DDK, DSM, YCW, and DM contributed to the review and editing; FFZ contributed the conceptualization, methodology, review and editing, supervision, and funding acquisition. All authors approved the final version. FFZ acts as the guarantor of the study.

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Figure 1. Estimated New Cancer Cases and Deaths Prevented by Federal Menu Calorie Labeling Policy in the US by Cancer Type over a Lifetime

Figure 2. Probabilistic Sensitivity Analyses (PSA) for Cost-Effectiveness of the Federal Menu Calorie Labeling Policy over 10 years and a Lifetime

Legend: Values are presented in cost-effectiveness planes of net costs (\$millions) versus incremental quality-adjusted life years (QALYs). For each policy scenario, each colored dot represents one of the 1000 simulations, with the largest dot showing the median incremental cost-effectiveness ratio (ICER, \$/QALY); and the ellipse representing the 95% UIs. Results are presented from the societal perspective and the healthcare perspective. Negative values indicate cost savings.

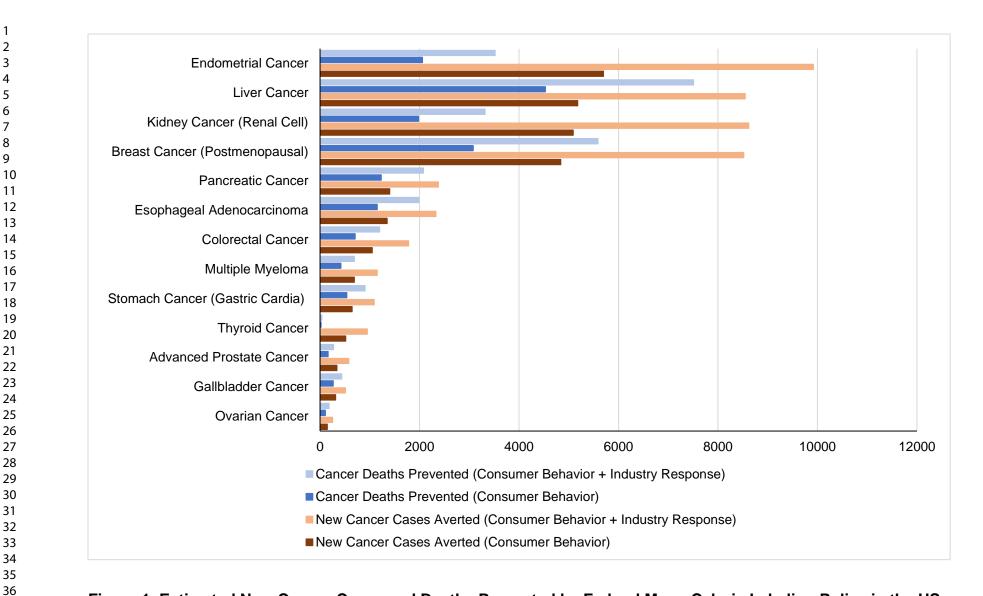
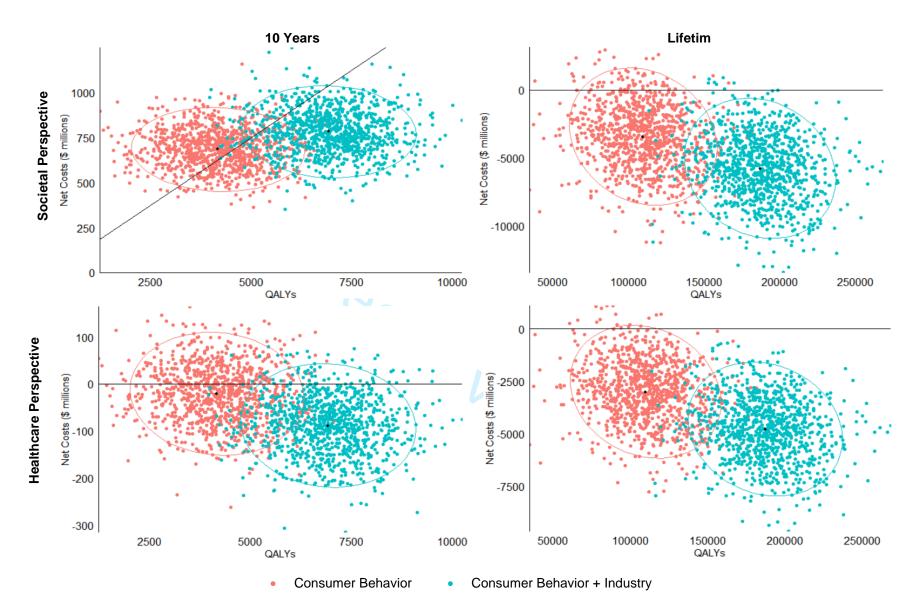


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Figure 2. Probabilistic Sensitivity Analyses (PSA) for Cost-Effectiveness of the Federal Menu Calorie Labeling Policy over 10 years and a Lifetime

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Appendix 1. Estimate the association between menu calorie labeling policy and calorie intake from restaurant meals

To understand the effects of the federal menu calorie labeling policy, we performed a comprehensive literature search and reviewed the evidence on how the policy affected consumer behaviors and industry.

To estimate the policy effect on consumer behavior alone, we reviewed individual studies in both real-world and experimental settings as well as meta-analyses (Appendix Table 1). A meta-analysis of natural experimental studies showed that menu calorie labeling was associated with a 7.3% (95% CI: 4.4% to 10.1%) reduction in calories per meal consumed/purchased.¹ This effect estimate is corresponding to an average reduction of 23.5 kcal per meal consumed by NHANES participants from 56.5% of full-service restaurants² and all fast-food restaurants. This estimate was consistent with evidence from a previous meta-analysis and a recent real-world study.^{3, 4} A previous meta-analysis estimated that the menu calorie labeling would lead to about an 18 kcal reduction ordered per meal.³ A recent longitudinal study used data from a large restaurant franchise in the southern U.S. and estimated that, after labeling implementation, a decrease of 60 kcal per transaction was observed in the first year, followed by an increasing trend of 0.71 kcal per transaction per week over two years.⁴ These together attenuated the calorie reduction to 23 kcal per transaction by the end of the third year of the policy implementation.⁵ Compared to other studies, the 7.3% calorie reduction per meal represents a more conservative estimate. It was reported in a cross-sectional study that customers at the labeled full-service restaurants purchased food with 151 fewer calories.⁶ One meta-analysis of studies that evaluated energy ordered in a real-world setting showed that the calorie labeling policy would lead to a mean reduction of 77.8 in calories purchased per meal.⁷ In a laboratory setting, there was a significant reduction of 115.3 kcal per meal ordered.⁸ Integrating both the real-world and experimental studies, the policy was

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estimated to generate a significant reduction of 100.3 in calories purchased.⁷ Therefore, we decided to use a reduction of calorie intake per meal by 7.3% (95% CI: 4.4% to 10.1%) as the model input given it is the most updated and conservative estimate supported by existing evidence. This policy effect on consumer behavior alone was assumed to take effect during the first year of implementation and no further reduction thereafter.

Based on the published literature, we estimated that there was a 5% reduction in calories consumed per meal from chain restaurants due to industry reformulation, the introduction of new lowcalorie menu items, or the replacement of menu items high in calories with low-calorie menu options.⁹⁻ ¹³ Bleich et al. estimated the calorie changes in chain restaurants' menu items using data from the largest chain restaurants in the U.S.⁹⁻¹³ Using the estimated mean calorie per menu item from the two published studies shown in **Appendix Table 2**,^{11, 12} we calculated the mean change in calories per menu item before and after the policy implementation. Given the national law was announced in 2010, using data from the trend analysis, we treated the mean calorie per menu item measured in 2008 as the baseline and found there was an 11% reduction in calories per menu item two years after the affordable care act was enacted. The change decreased to 7% in 2015, one year after the FDA announced the final rule for the industry to comply with. In the study evaluated the calorie content in current menu items, eliminated menu items, and newly introduced menu items, we estimated that there was a 1% reduction in mean peritem calories in 2013-2014 compared to that in 2012, and the reduction increased to 5% in 2015. Based on this de novo analysis, we chose a reduction in calories per meal consumed by 5% to represent a modest industry reformulation in response to the federal menu calorie labeling by chain restaurants. We assumed no industry response in the first year, then the reformulation activities would occur in the rest of the years over the model lifetime, resulting in a net reduction of 5% in calories consumed per meal.

Appendix Table 1. Policy impact of menu calorie labeling on consumer behaviors

Study	Design	Year, country	Estimate size mean (95% CI)	CommentCorresponds to a23.5 kcal per mealconsumed byNHANES participantsfrom 56.5% of full-service restaurants2and all fast-foodrestaurantsBecause of the post-implementationincrease, theestimated reductionin calorie pertransaction was 23kcal lower than thecounterfactual.	
Shangguan et. al., 2019 ¹ A Meta-Analysis of Food Labeling Effects on Consumer Diet Behaviors and Industry Practices	Meta-analysis 13 studies (5 RCTs) with 19 interventions on changes in calorie intake per meal, among children and adults	2000 to 2015, US, Canada, UK, Sweden	-7.3% (-10.1%, -4.4%) in calorie intake per meal		
Petimar et. al., 2019 ⁴ Estimating the effect of calorie menu labeling on calories purchased in a large restaurant franchise in the southern United States: quasi- experimental study	Quasi-experimental longitudinal study Transaction data from 104 restaurants of a national fast food company with three different restaurant chains located in the Louisiana, Texas, and Mississippi in the US	2015 to 2018 (pre-labeling: April 2015 to April 2017; post-labeling: April 2017 to April 2018), US	-60 (-48, -72) kcal in calorie purchased per transaction, followed by a post-implementation increasing trend of 0.71 kcal per transaction per week		
Cantu-Jungles et. al., 2017 ⁸ A Meta-Analysis to Determine the Impact of Restaurant Menu Labeling on Calories and Nutrients (Ordered or Consumed) in U.S. Adults	Meta-analysis 14 studies that evaluated menu calorie labeling on changes in calorie chosen in laboratory and away- from-home settings, among children and adults	1996 to 2014	-115.2 (-130.87, -99.5) kcal in calorie ordered or consumed per meal in laboratory setting	N/A	
Littlewood et. al., 2016 ⁷ Menu labelling is effective in reducing energy ordered and consumed: a systematic review and meta- analysis of recent studies	et. al., 20167Systematic review and meta-analysiselling is n reducing12 studies (6 RCTs) on changes in caloriedered and t: a systematic d meta-2011 to 2014, US, Canada, Australia,		-100.3 (-146.6, -54.0) kcal in calorie consumed in both settings per meal or transaction (3 studies) -77.8 (-121.6, -34.1) kcal in calorie purchased per meal or transaction in real-world setting (5 studies)	N/A	
Long et. al., 20153Systematic review and meta-analysisSystematic Review and Meta-analysis of the Impact of Restaurant Menu Calorie Labeling19 studies (11 RCTs, 8 natural experiments) on changes in calorie purchased per meal or per transaction, among children and adults2		2008 to 2013, US	 -18.1 (-33.6, -2.70) kcal in calorie purchased per meal or per transaction When stratifying by restaurant and non- restaurant settings (RCTs), the changes were -6.7 (-20.21, 6.81) kcal and -58.2 (-102.4, - 13.9) kcal in calorie 		

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			purchased per meal or per transaction	
Auchincloss et. al., 2013 ⁶ Customer responses to mandatory menu labeling at full-service restaurants	Cross-sectional study 648 customer surveys and transaction receipts at 7 restaurant outlets of 1 large full-service restaurant chain (2 outlets with menu calorie labels and 5 without), among adults	2011, US	-151 kcal (-270, -33) for foods purchased from full-service restaurants (per meal)	Was included in the meta-analysis conducted by Cantu- Jungles et. al., 2017 ⁸

Appendix Table 2. Policy impact of menu calorie labeling on restaurant industry response

18							
19	Study		Year				
20	Study		2008	2012	2013	2014	2015
21	Bleich et. al., 2017 ¹¹	# of menu items (n)	6,601	9,526	10,278	10,654	11,034
22 23 24 25	Calorie changes in large chain restaurants from 2008 to 2015 44 of the 100 largest chain	mean per-item calories (kcal)	368.0	329.1	330.1	337.2	340.6
26	restaurants						
27				2012 vs. 2008			2015 vs. 2008
28		diff. (%)		-38.9 (-11%)			-27 (-7%)
29							
30	Bleich et. al., 2018 ¹²	# of menu items (n)	14,705 17,219 (2013-2014)		13,920		
31	Higher-Calorie Menu Items						
32	Eliminated in Large Chain	mean per-item					
33	Restaurants	calories (kcal)		374.4	370.9		357.4
34	66 of the 100 largest chain						
35	restaurants				2042.20	11.0	
36			2013-2014 vs. 2012			2015 vs. 2012	
37					-		
38		diff. (%)			-3.52	(-1%)	-17.05 (-5%)
39							
40							

Appendix 2. Baseline cancer incidence and methods of cancer incidence projections for 13 types of cancers

We estimated the cancer incidence rate projections for the defined 32 demographic subgroups as inputs for the DiCOM model. We first obtained age-adjusted incidence rates from 2006 to 2015 from the United States Cancer Statistics combining data from the Surveillance, Epidemiology, and End Results (SEER) database and the Centers for Disease Control and Prevention's National Program of Cancer Registries (NPCR) database.¹⁴

Based on the trends from 2006 to 2015, we projected age-adjusted cancer incidence rates in the next 15 years from 2016 to2030 using the average annual percent change (AAPC) method.^{15, 16} Because longer-term projections may not be valid, we chose to hold age-adjusted cancer incidence rates constant from 2030 to 2095. Specifically, the annual percent change was calculated for each cancer site in each of the 32 subgroups by fitting a regression line to the natural logarithm of the age-adjusted rates (I) in the years 2006 through 2015 (y). The equation for AAPC: $ln(I) = \alpha + \beta y$, where α and β were coefficients to be estimated and y is the calendar year.^{15, 16} We then combined the AAPC projected cancer incidence rates with the projected US population to account for the change in population age distribution over time. The projected US population in each of the 32 subgroups from 2016 to 2060 were extracted from the National Interim Projections of the US population.¹⁷ Because projections were only available through 2060, further projections after 2060 were not considered. We further applied the cohort-period method to estimate cancer incidence in each of the 32 subgroups in the closed cohort of US adults from 2015 to 2095 as they age. Details were illustrated in **Appendix Table 3** using colon and rectum cancer incidence among non-Hispanic white females (NHWF) as an example.

				EXAMPI	E: Colon	and Rect	um Cance	er, Non-H	ispanic W	hite Fem	ales			
Age	20	15		20	016			20)17			20)18	
	Baseline Incidence Rate	Populatio n Size	AAPC Predicted Incidence	US Census Predicted Populatio	Cancer Cases Predicted	Age Shifted "crude" Incidence	AAPC Predicted Incidence	US Census Predicted Populatio	Cancer Cases Predicted	Age Shifted "crude" Incidence	AAPC Predicted Incidence	US Census Predicted Populatio	Cancer Cases Predicted	S "(
20	8.531	30523184	8.694	n Size 1134235		10.154	8.859	n Size 1126079		11.694	9.028	n Size 1117775		
21	8.531		8.694	1156761	100565		8.859	1137549			9.028	1129379		
22	8.531		8.694	1177144	102337		8.859	1159788	102748		9.028	1140620		
23 24	8.531 8.531		8.694 8.694	1196469 1238910	104017 107707		8.859 8.859	1180122 1199459	104550 106263		9.028 9.028	1162784 1183136	104976 106813	
25	8.531		8.694	1283513	111585		8.859	1241739	110009	1	9.028	1202329	108546	
26 27	8.531		8.694	1294013	112497		8.859	1286229	113950		9.028	1244499	112353	
27	8.531 8.531		8.694 8.694	1250740 1232421	108735 107143		8.859 8.859	1296475 1253062	114858 111012		9.028 9.028	1288797 1298770	116352 117252	
29	8.531		8.694	1216039	105719		8.859	1234519	109369		9.028	1255161	113315	
30 31	8.531		8.694	1228929	106839		8.859	1217844	107892		9.028	1236330	111615	
32	8.531 8.531		8.694 8.694	1244281 1205955	108174 104842	-	8.859 8.859	1230337 1245249	108999 110320		9.028 9.028	1219312 1231390	110079 111169	
33	8.531		8.694	1226950	106667		8.859	1206736	106908		9.028	1246013	112489	
34 35	8.531 8.531		8.694 8.694	1226234 1217701	106605 105863		8.859 8.859	1227540 1226721	108751 108678		9.028 9.028	1207377 1228051	109001 110868	
36	8.531		8.694	1228467	106799		8.859	1218141	107918		9.028	1227199	110791	
37	8.531		8.694	1160971	100931		8.859	1228796	108862		9.028	1218528	110008	
38 39	8.531 8.531		8.694 8.694	1139547 1127605	99069 98030		8.859 8.859	1161267 1139679	102879 100967		9.028 9.028	1229044 1161414	110958 104852	
40	8.531		8.694 8.694	1088875	94663		8.859	1127530	99891		9.028	1139635	102886	
41	8.531		8.694	1130467	98279		8.859	1088644	96446		9.028	1127272	101770	
42 43	8.531 8.531		8.694 8.694	1101345 1130264	95747 98262		8.859 8.859	1129951 1100615	100105 97506		9.028 9.028	1088229 1129228	98245 101946	
44	8.531		8.694 8.694	1210411	105229		8.859	1129268	100045		9.028	1099713	99282	
45	41269	14238423	41.919	1319769	553230	43.775	42.579	1208976	514771	45.825	43.250	1128045	487878	
46 47	41269 41269		41.919 41.919	1346596 1292274	564476 541705		42.579 42.579	1317806 1344191	561110 572344		43.250 43.250	1207332 1315541	522169 568969	▐
48	41269		41.919	1264917	530237		42.579	1289694	549140		43.250	1341533	580211	1
49 50	41269		41.919	1295410	543019		42.579	1262140	537408		43.250	1286923	556592	
50	41269 41269		41.919 41.919	1325816 1432079	555765 600309		42.579 42.579	1292230 1322198	550220 562980		43.250 43.250	1259139 1288813	544576 557410	╟
52	41269		41.919	1489756	624487		42.579	1427705	607904		43.250	1318321	570172	
53 54	41269 41269		41.919 41.919	1510286 1532940	633093 642589		42.579 42.579	1484805 1504858	632216 640755		43.250 43.250	1423107 1479608	615492 639928	
55	59.736	15111568	58.496	1575080	921363	65.864	57.283	1526976	874691	71.195	56.094	1499151	840934	r
56	59.736		58.496	1579128	923731		57,283	1568482	898466		56.094	1520747	853048	
57 58	59.736 59.736		58.496 58.496	1554236 1566074	909170 916095		57.283 57.283	1572018 1546788	900492 886040		56.094 56.094	1561581 1564631	875954 877664	
59	59.736		58.496	1559941	912507		57.283	1558015	892471		56.094	1539019	863298	
60	59.736		58.496	1509257	882859		57.283	1551289	888618		56.094	1549572	869217	
61 62	59.736 59.736		58.496 58.496	1507776 1469467	881993 859583		57.283 57.283	1500225 1497943	859367 858060		56.094 56.094	1542165 1490621	865062 836149	╟
63	59.736		58.496	1428612	835685		57.283	1458963	835731		56.094	1487453	834372	
64 65	59.736 147.246	20639658	58.496 140.189	1384020 1344027	809600 1884181	140.189	57.283 133.471	1417465 1372210	811960 1831501	133.471	56.094 127.075	1447782 1405568	812119 1786119	ŀ
66	147.246	20039038	140.189	1307657	1833194	40.169	133.471	1331467	1777121	65.471	127.075	1359584	1727685	┢
67	147.246		140.189	1291598	1810681		133.471	1294222	1727410		127.075	1318007	1674851	
68 69	147.246 147.246		140.189 140.189	1292613 1382868	1812104 1938632		133.471 133.471	1277026 1276471	1704458 1703717		127.075	1279794 1261379	1602891	┣
70	147.246		140.189	987587	1384490		133.471	1363827	1820312		127.075	1259177	1600093	
71 72	147.246		140.189	982267	1377032		133.471	972764	1298357		127.075	1343441	1707171	
72	147.246 147.246		140.189 140.189	972611 1012982	1363496 1420091		133.471 133.471	966021 954967	1289357 1274603		127.075 127.075	956905 948632	1215982 1205469	
74	147.246		140.189	874564	1226044		133.471	992594	1324824		127.075	936077	1189515	
75 76	147.246 147.246		140.189 140.189	796574 747848	1116711 1048402		133.471 133.471	855200 777087	1141443 1037185		127.075 127.075	970797 834495	1233635 1060430	
77	147.246		140.189	706707	990727		133.471	727604	971140		127.075	756255	961007	
78 70	147.246		140.189	679404	952451		133.471	685495	914936		127.075	705976	897115	ſ
79 80	147.246 147.246		140.189 140.189	625026 595777	876219 835215		133.471 133.471	656756 601790	876578 803215		127.075 127.075	662851 632555	842315 803816	
81	147.246		140.189	572977	803252		133.471	571026	762154		127.075	577004	733225	ſ
82 83	147.246 147.246		140.189 140.189	512332 496976	718234 696707		133.471 133.471	546330 485519	729192 648027		127.075 127.075	544674 517986	692142 658228	
84	147.246		140.189	475655	666817		133.471	467692	624233		127.075	457134	580901	
85	147.246		140.189	452173	633898		133.471	444106	592752		127.075	436898	555186	
86 87	147.246 147.246		140.189 140.189	428834 383933	601179 538233		133.471 133.471	418526 393130	558610 524714		127.075 127.075	411316 383961	522678 487917	ŀ
88	147.246		140.189	356801	500196		133.471	348261	464827		127.075	356875	453497	
89 90	147.246		140.189	320644	449508		133.471	319862	426923		127.075	312475	397076	
90 91	147.246 147.246		140.189 140.189	278562 246568	390514 345662		133.471 133.471	283710 242960	378670 324281		127.075 127.075	283306 247721	360010 314790	
92	147.246		140.189	209022	293026		133.471	211695	282551		127.075	208839	265381	
93 94	147.246		140.189	169864	238131		133.471	176399	235441		127.075	178878	227308	
94 95	147.246 147.246		140.189 140.189	138657 109277	194382 153195		133.471 133.471	140691 112531	187782 150196		127.075 127.075	146313 114362	185927 145325	
96	147.246		140.189	80177	112399		133.471	86769	115811		127.075	89499	113730	ſ
97 98	147.246 147.246		140.189 140.189	56739 42046	79542 58944		133.471 133.471	62172 42907	82982 57268		127.075 127.075	67414 47105	85666 59858	
98	147.246		140.189	42046 27405	58944 38419		133.471 133.471	42907 30959	41321		127.075	4/105 31659	40231	F
		-	140.189	49314	69133		133.471	50716	67691		127.075	52719	66992	

Appendix Table 3. Estimating "crude" incidence after applying cohort-period method

Appendix 3. Cancer survival for 13 types of cancers

We estimated the 5-year relative survival for the defined 32 demographic subgroups. We obtained five-year relative survival rates using the period analysis method from the United States Cancer Statistics which incorporates data from the Surveillance, Epidemiology, and End Results (SEER) database.¹⁴ The five-year survival for 2014, which was the most recently available data at the time of analysis, was used. These rates were extracted for each cancer type and by the defined 32 demographic subgroups for each cancer type. The rates are on a scale of 0-1.

Relative survival is a net survival measure representing cancer survival in the absence of other causes of death. Relative survival is defined as the ratio of the proportion of observed survivors in a cohort of cancer patients to the proportion of expected survivors in a comparable set of cancer-free individuals.¹⁸ Relative survival is the preferred method to estimate survival from cancer registry data.

The period analysis is a method that enhances up-to-date monitoring of survival.^{19, 20} In contrast to traditional cohort analysis of survival, period analysis derives long-term survival estimates exclusively from the survival experience of patients within some recent calendar period.^{19, 20} Three-year intervals were chosen which results in the years 2008-2014 is used to calculate 5-year survival. Using seven years of data to calculate 5-year survival is the standard method used by SEER and used in SEER publications.²¹

The first interval contributed to the one-year survival and used cases diagnosed in 2012-2014, the second interval contributed to the two-year survival and used cases diagnosed in 2011-2013, the third interval contributed to the three-year survival and used cases diagnosed in 2010-2012, the fourth interval contributed to the four-year survival and used cases diagnosed in 2009-2011 and the fifth interval contributed to the five-year survival and used cases diagnosed in 2008-2010.

This analysis, therefore, used 2008-2014 diagnoses to calculate for 5-year relative survival for 2014. The highlighted orange boxes represent survival contributions for each year of diagnosis and year of follow-up (**Appendix Table 4**). The annual probability of death was calculated as 1-exp[ln(5-year relative survival)/5].

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						YE	ARS O	F DIAG	NOSIS						
	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
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Appendix 4. Methods of estimating the health-related quality of life among 13 types of cancers

Health utility values range from 0 (dead) to 1 (perfect health and were assigned for each cancer type and by phase of care (initial, continuous, end of life), if available. We first searched databases for systematic reviews pertaining to utility weights or HRQOL measures for each cancer type of interest separately. We started with PubMed and searched Google Scholar if needed. The following search string was used for each cancer type : ("health related quality of life" OR "HRQOL" OR "quality of life" OR "QOL" OR "preference weight*" OR "utility weight*" OR "health state utilit*" OR "health utility*") AND ("cancer of interest") AND ("cancer" OR "neoplasm*") AND ("review" OR "systematic review").

When an appropriate systematic review was identified, we read the articles included in the review and determined if the paper met the following data needs. Data Extraction Hierarchy: 1) cancer type specific to the type of interest; 2) consistent in the instrument used, prefer EQ-5D whenever available; 3) US samples preferred; 4) phase of care (assume same utility weights by phase if the phase of care data were not available). If no systematic reviews were available, we searched for individual studies about the utility weights of the cancer of interest. Additionally, check how often the paper is cited to see if it is a frequently used utility weight.

Appendix 5. Methods of estimating policy implementation costs

We estimated the costs of implementing the federal menu calorie labeling for both government and industry, including government administration costs, monitoring and evaluation costs, industry compliance costs and reformulation costs, based on the FDA's budget report,²² the Nutrition Review Project report,²³ and FDA's RIA²⁴ (**Appendix Table 5**).

It was estimated by FDA that approximately 298,600 establishments, organized under 2,130 chains were covered by the menu calorie labeling policy. Among the covered establishments, 115,000 (38.5%) were full-service restaurants and drinking places organized under 530 (24.9%) chains, and 116,200 (38.9%) were limited-service restaurants organized under 540 (25.4%) chains. In total, about 231,200 (77.4%) restaurants organized under 1,070 (50.2%) chains were covered by this policy.²⁴

For industry compliance (#3) and reformulation costs (#4), the FDA estimated the costs by the type of establishments. Therefore, we only included the relevant costs incurred by restaurants as this approach generated more conservative estimates. In addition, the industry compliance costs consist of initial costs and recurring costs associated with new chains. In FDA's RIA, the initial costs were presented as a one-time cost, while the recurring costs associated with new chains were presented as annual costs and assumed to be incurred for 20 years starting from the 2nd year of policy implementation. According to FDA, 20 years is more appropriate for interventions that play out over long periods and whose effects deal with chronic conditions. Similarly, the reformulation costs (#4) estimated by FDA were presented as annual costs in FDA's RIA using the same assumption. We followed the same assumption and presented the annual compliance costs (#3) and annual reformulation costs (#4) incurred by restaurants in **Appendix Table 5**.

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The cost of implementing the menu calorie labeling is fixed by the government. Uncertainty for the costs associated with government administration (#1) and government monitoring and evaluation (# 2) was not provided in the source materials.^{22, 23} We assumed that uncertainty is 20% around these costs.

For annual costs, namely the government monitoring and evaluation costs (#2) and the recurring costs in industry compliance (part of #3), and the reformulation costs (#4), we applied a 3% discounting rate recommended by the Second Panel on cost-effectiveness in health and medicine⁴ to reflect the present value of future costs of government monitoring and evaluation, industry compliance and industry reformulation. The model is a closed cohort model, so we computed the discounted present value of per-person costs and total national costs for persons alive at implementation who remained alive in each subsequent year (not for the larger total US population in each year, which also has growth from immigration and new persons reaching the threshold age). The year-specific discounting factor is estimated by $1/(1+3\%)^{(t-1)}$ (t is the number of years of policy intervention, t=1, 2, 3, ..., lifetime). As our model estimated the costs and health outcomes based on a closed cohort and the population size decline over time, we need to express the annual costs in proportion to the population at risk. The population at risk was estimated based on the proportion of death (P_{dt} , t=1, 2, 3, ...) in each year. We first obtained the proportion of people who are alive each year by calculating $1-P_{dt}$ (t=1, 2, 3, ...). Then we multiplied the baseline population size of 235 million by the proportion of people who are alive each year (Appendix Table 6).

We then estimated the per-person annual cost for cost categories #2, #3 (annual part), and #4, by dividing the annual cost estimated in the second year of implementing the policy among all US populations by the population size in the second year. Specifically, for government monitoring and evaluation, the per person annual cost is estimated \$503,648/233,719,989=\$0.00215, the per person annual cost for industry compliance recurring component is \$/233,719,989=\$, and that for reformulation

is \$662,800,000 /233,719,989=\$2.83587. Taken together, to estimate the discounted annual cost of #2, #3 (annual part), and #4, we multiplied the population at risk, the per person annual cost estimated at year-2, and the year-specific discounting factor, using: discounted annual cost = population at risk x perperson annual cost x $1/(1+3\%)^{(t-1)}$.

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Policy Effect	Cost Category	One-time Cost*	Annual Cost*	Source	Major Elements
Consumer behavior	1. Government administration [#]	\$9,073,620 (\$7,258,896 to \$10,888,344)	N/A	FDA FY 2012 Budget Report ²²	1) Costs for outreach, education, review of regulatory issues, developing training for inspectors, etc.
	2. Government monitoring and evaluation#	N/A	\$503,648 (\$402,918 to \$604,378) (starting from 2 nd year and last for a lifetime)	Nutrition Review Project report ²³	 Monitor industry compliance Evaluate the accuracy, usefulness, and health impact of the policy intervention
	3. Industry compliance	\$276,632,470 (\$225,552,530 to \$327,205,740)	\$27,648,591 (\$16,756,003 to \$38,649,212) (starting from 2 nd year and last for a lifetime)	FDA's RIA ²⁴ Table 4-8	 Collecting and managing records of nutritional analysis for each standard menu item (initial cost + recurring cost associated with new chains) Revising or replacing existing menus, menu boards, and providing full written nutrition information (initial cost + recurring cost associated with new chains) Training employees to understand the nutrition information to help ensure compliance with the final requirements (initial cost + recurring cost associated with new chains) Legal review (initial cost + recurring cost associated with new chains)
Industry response^	4. Industry reformulation	N/A	\$15,059,100 (\$5,791,900 to \$24,124,700) (starting from 2 nd year and last for a lifetime)	FDA's RIA ²⁴ Table 4-8	 Annually recurring costs of nutrition analysis refer to the nutrition cost that will be incurred by the covered establishments due to the introduction of a new standard or reformulated standard menu items in their menus and the cost that will be incurred by new chains entering the industry Annually recurring changes to menus or menu boards will be tied to new or reformulated standard menu items. In general, these future changes to menus will be incorporated into the natural menu

Appendix Table 5 Implementation cost estimates for the federal many caloria labeling policy (in 2015 US dollars)

		replacement cycle, so there will be no additional recurring menu update costs. However, all chain retail food establishments will need to provide additional written nutrition information for the reformulated or newly introduced menu items
		Average formula count, 6 new menu items, and 6 reformulated items per year FDA reformulation cost model

*Policy intervention costs were inflated to 2015 US (December) dollars using the Consumer Price Index.

 # Given no range of uncertainty was provided in source materials, we assumed 20% uncertainty around these costs.

^Some chains or establishments may respond to increased consumer interest in caloric content standard menu items by reformulating existing menu items or by introducing new, lower-calorie items. The change in manufacturing costs associated with reformulating these items has not been included in the cost estimation, the FDA includes the cost associated with analyzing the nutrition information of new or reformulated items.

1 2				
3 4 5	Appendix Table 6. The pop	oulation size of	of people who are millions)	alive each year over a lifetime
5 6 7		Year	Population Size (Million)]
8		1	235.2	-
9 10		2	233.7	-
10		3	232.1	-
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20		67	5.832	_
21		68	4.348	
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23		70	2.233	
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Appendix 6. Annual health-related costs among cancer patients and the general population without cancer

The annual health-related costs data include: 1) medical expenditure, 2) productivity loss from missed workdays or disability, and 3) patient time cost associated with receiving care for cancer survivors by age (under 65 vs. above 65 years old) and phase of care (initial, continuing, end-year of life); 4) medical expenditure, 5) productivity loss, and 6) patient time cost for individuals without cancer by age and status of end year of life. The description of the data source and data structure were provided in **Appendix Table 7**.

We extracted the raw data for each of the costing components from the published literature.^{15, 25-} ²⁹ The overall assumptions for data extraction include: 1) health-related costs for breast cancer among postmenopausal females, advanced prostate cancer, esophageal adenocarcinoma, and stomach cardia cancer, by age, sex, and phase of cancer care, were the same as those for breast cancer, prostate cancer, esophagus cancer, and stomach cancer; 2) if no data available for a specific cancer type, we assumed the costs for that cancer type were the same as the estimates of costs for all-cancer sites, e.g., medical expenditure for all-cancer sites were used to replace the medical expenditures for multiple myeloma, gallbladder, liver, and thyroid cancers; 3) we extracted the costs for end-year of life due to cancer death and assumed that death due to other causes is not a competing outcome; 4) we assumed that the end-year life medical expenditure for individuals without cancer does not vary by the 32 subgroups.

If a specific costing component was not reported directly in the raw data, we calculated the cost for that component based on available data. For example, the annual productivity loss for colorectal cancer was reported as a percentage of total health-related costs.²⁹ We multiplied the percentage and the total health-related costs to obtain the productivity loss for colorectal cancer. We also performed data imputation for unavailable data. For instance, the annual productivity loss for all-cancer sites was

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reported by time interval since cancer diagnosis (diagnosed within one year vs. diagnosed greater than one year).²⁵ To obtain this costing component by the defined phases of care, we calculated the weighted means which was used as the annual productivity loss for the continuous phase. We then assumed that the productivity loss in the initial phase and end-of-life phase of cancer care are 1.3 times and 4 times the mean estimates based on available data for other cancers.^{15, 25} For individuals without cancer, we assumed that the end-of-life productivity loss is 4 times to the mean estimate of the productivity loss. The same rules applied to data imputation for patient time costs.

We then applied the age shifting to keep the expenditures consistent within each age group. Starting from 2021, individuals in the cohort of 55-64 years old have turned into the cohort of 65 years and older. Therefore, we assumed that starting from 2021, the health-related expenditures for individuals who were in the cohort of 55-64 years old would be the same as those for individuals who were in the cohort of 65 years and older at the beginning of the DiCOM model. Based on the same assumption, starting from 2031 and 2047, the health-related expenditures for the cohort of 45-54 years old and those for the cohort of 20-44 years old were projected to be the same as those for the cohort of 65 years and older, respectively. We followed the same rule and applied the age shifting for the health-related expenditures for individuals without cancer. All estimations and projections were performed in SAS 9.4. All health-related expenditures were inflated to 2015 US dollars using the Personal Health Care (PHC) index.

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Appendix Table 7. Description of the data source of health-related expenditures

	A. Cancer Survivors		B. Individuals witho	ut Cancer
	Data source (Excess or Total)	Category	Data source	Category
Medical expenditure	Mariotto et al. 2011, SEER-Medicare, in 2010 US dollars (Excess)	-by phase of care ¹ -by age (under 65 vs. above 65 years old) -by sex	Kim et al. 2018, MEPS 2013-2014, <i>in vivo</i> analysis, in 2014 US dollars (Total)	-Medical expenditure among all US adults -by 32 subgroups stratified by age, sex, and race/ethnicity
			Hogen et al. 2001, SEER-Medicare (65+), in 2001 US dollars (Total)	-Medical expenditure in the end year of life among all US adults
Productivity loss	Zheng et al. 2016, MEPS 2008-2012, data available for colorectal, female breast, and prostate cancers, in 2012 US dollars (Total)	-by age		
	Guy et al. 2013, MEPS 2008-2010, all types of cancer, in 2010 US dollars (Total)	-by age -by time interval since cancer diagnosis (less than 1 year vs. greater than 1 year) ²	Guy et al. 2013, MEPS 2008-2010, in 2010 US dollars (Total)	-by age
Patient time cost	Yabroff et al. 2014, MEPS 2008-2011, all types of cancer, in 2011 US dollars (Total)	-by age	Yabroff et al. 2014, MEPS 2008-2011, in 2011 US dollars (Total)	-by age

1. The definition of phases of care: 1) initial phase, defined as the first 12 months following diagnosis, 2) end-year of life phase, defined as the final 12 months of life, and 3) the continuing phase, defined as all the months between the initial phase and the end-year of life. The costs of end-year of life varied by cause of death, either cancer-specific death or death due to other causes. 2. Weighted means were calculated based on sample sizes and strata means. Reference

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2 3 Title Cost-Effectiveness Analysis of the Federal Menu Calorie Labeling and Obesity-Associated Cancer 4 Burdens in the United States 5 6 7 **Supplementary Table 1**. Defining Population and 32 Subgroups 8 Supplementary Table 2. Relative Risk Estimates of Etiologic Relationships Between Body Mass Index 9 (BMI) and 13 Types of Cancers 10 Supplementary Table 3. Baseline Incidence Rates of 13 Cancers among US Adults by 32 Subgroups 11 12 Supplementary Table 4. Baseline 5-year Relative Survival Rates of 13 Cancers among US Adults by 13 32 Subgroups 14 Supplementary Table 5. Health-Related Quality of Life Among US Cancer Patients Aged 20 Years or 15 Older, by Cancer Type and Phase of Care 16 17 Supplementary Table 6. Baseline Medical Costs, Productivity Loss, and Patient Time Costs Among 18 US Cancer Patients Aged 20 Years or Older, by Cancer Type and Phase of Care 19 Supplementary Table 7. Baseline Medical Costs, Productivity Loss, and Patient Time Costs Among 20 the General Population Aged 20 Years or Older in the US, by 32 Subgroups 21 Supplementary Table 8. Characteristics of US Adults Aged 20 Years or Older Participated in the 22 23 NHANES, 2013-2016 24 Supplementary Table 9. Consumption of Calories from Full-Service and Fast-Food Restaurants among 25 US Adults Participated in 2013-2016 NHANES, by 32 Subgroups 26 Supplementary Table 10. Estimated New Cancer Cases Averted by the Federal Menu Calorie Labeling 27 28 in the US by Age, Sex, Race/Ethnicity, and Cancer Type, Over a Lifetime 29 **Supplementary Table 11**. Estimated Cancer Deaths Reduced by the Federal Menu Calorie Labeling in 30 the US by Age, Sex, Race/Ethnicity, and Cancer Type, Over a Lifetime 31 Supplementary Table 12. Estimated Health Gains and Costs Associated with the Federal Menu Calorie 32 Labeling on Reducing Cancer Burdens in the US Over a Lifetime, One-Way Sensitivity Analyses at 33 34 25% and 75% Calorie Compensations Outside the Restaurant Settings 35 Supplementary Table 13. Estimated Health Gains and Costs Associated with the Federal Menu Calorie 36 Labeling on Reducing Cancer Burdens in the US Over a Lifetime, One-Way Sensitivity Analysis, 37 Assuming all Full-Service and Fast-Food Restaurants were Covered by the Policy 38 39 40 Supplementary Figure 1. Diet and Cancer Outcome Model (DiCOM) 41 Supplementary Figure 2. Estimated Reduced New Cancer Cases and Deaths Associated with the 42 Federal Menu Calorie Labeling in the US by Age, Sex, Race/Ethnicity, and Cancer Type, Over a 43 44 Lifetime 45 **Supplementary Figure 3**. Estimated life Years and OALYs Gained Associated with the Federal Menu 46 Calorie Labeling in the US by Age, Sex, and Race/Ethnicity, Over a Lifetime. 47 Supplementary Figure 4. Estimated Changes of Health-Related Costs Associated with the Federal 48 Menu Calorie Labeling in the US by Age, Sex, Race/Ethnicity, and Cancer Type, Over a Lifetime 49 50 Supplementary Figure 5. Estimated Net Costs from Societal and Healthcare Perspectives Associated 51 with the Federal Menu Calorie Labeling in the US by Age, Sex, and Race/Ethnicity, Over a Lifetime 52 Supplementary Figure 6. One-Way Sensitivity Analysis of Net Costs of the Federal Menu Calorie 53 Labeling and Obesity-Associated Cancer Rates to Varying Assumptions of Key Input Parameters From 54 (A) Societal Perspective and (B) Healthcare Perspective 55 56 57 58 1 59 For peer review only - http://bmjopen.bmj.com/site/about/guidelines.xhtml 60

Subgroups	Age	Sex	Race/Ethnicity
1	20-44y	Female	NHW
2	20-44y	Female	NHB
3	20-44y	Female	HISP
4	20-44y	Female	OTH
5	20-44y	Male	NHW
6	20-44y	Male	NHB
7	20-44y	Male	HISP
8	20-44y	Male	OTH
9	45-54y	Female	NHW
10	45-54y	Female	NHB
11	45-54y	Female	HISP
12	45-54y	Female	OTH
13	45-54y	Male	NHW
14	45-54y	Male	NHB
15	45-54y	Male	HISP
16	45-54y	Male	OTH
17	55-64y	Female	NHW
18	55-64y	Female	NHB
19	55-64y	Female	HISP
20	55-64y	Female	OTH
21	55-64y	Male	NHW
22	55-64y	Male	NHB
23	55-64y	Male	HISP
24	55-64y	Male	OTH
25	65+y	Female	NHW
26	65+y	Female	NHB
27	65+y	Female	HISP
28	65+y	Female	OTH
29	65+y	Male	NHW
30	65+y	Male	NHB
31	65+y	Male	HISP
32	65+y	Male	ОТН
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Supplementary Table 1. Defining population and 32 subgroups

 Supplementary Table 2. Relative risk estimates of etiologic relationships between body mass index (BMI) and 13 types of cancers

Cancer Type	No. of Studies	No. of Events	Source	Evidence Grading	RR (95% CI) Per 5 kg/m²	Statistical Heterogeneity		
Endometrial	26	18,717	CUP, 2013	Convincing ↑risk	1.50 (1.42-1.59)	I ² =86.2% P<0.0001		
Esophageal (adenocarcinoma)	9	1,725	CUP, 2016	Convincing ↑risk	1.48 (1.35-1.62)	l ² =36.7% P=0.13		
Kidney	/ 23		CUP, 2015	Convincing ↑risk	1.30 (1.25-1.35)	l ² =38.8% P=0.03		
Liver			Convincing ↑risk	1.30 (1.16-1.46)	l ² =78.3% P=0.000			
Gallbladder	8	6,004	CUP, 2015	Probable ↑risk	1.25 (1.15-1.37)	l ² =52.3% P=0.04		
Stomach (cardia)	7	2,050	CUP, 2016	Probable ↑risk	1.23 (1.07-1.40)	l²=55.6% P=0.04		
Breast (post- menopausal)	56	80,404	CUP, 2017	Convincing ↑risk	1.12 (1.09-1.15)	l ² =75% P<0.001		
Pancreas	23	9,504	CUP, 2011	Convincing ↑risk	1.10 (1.07-1.14)	l ² =19% P=0.20		
Multiple myeloma	20	1,388	IARC, 2016 ³⁰	Sufficient (IRAC) ↑risk	1.09 (1.03-1.16)	Not reported		
Prostate (advanced)	24	11,149	CUP, 2014	Probable ↑risk	1.08 (1.04-1.12)	l ² =18.8% P=0.21		
Thyroid	22	3,100	IARC, 2016 ³⁰	Sufficient (IARC) ↑risk	1.06 (1.02-1.10)	Not reported		
Ovary	25	15,899	CUP, 2013	Probable ↑risk	1.06 (1.02-1.11)	l ² =55.1% P=0.001		
Colorectal	38	71,089	CUP, 2017	Convincing ↑risk	1.05 (1.03-1.07)	l ² =74.2% P=0.000		

Supplementary Table 3. Baseline incidence rates of 13 cancers among US adults by 32 subgroups

Subgroup	Color Can		Endor Car	netrial ncer	Esoph Ade carcin	eno-	Female (Postr	Breast meno.)	Gallbl Car	adder ncer	Kidney	Cancer	Liver C	Cancer	M ul M yei	tiple oma	Ovarian	cancer	Panc Car		Adva Pros Car	state	Cancer	nach (Gastric dia)	Thyroid	Cancer
	Rate	SE	Rate	SE	Rate	SE	Rate	SE	Rate	SE	Rate	SE	Rate	SE	Rate	SE	Rate	SE	Rate	SE	Rate	SE	Rate	SE	Rate	SE
1	8.53	0.38	6.54	3.66	0.05	4.18	0.00	0.00	0.05	2.57	3.83	3.16	0.49	4.18	0.38	4.66	4.31	0.27	1.07	3.46	0.00	0.00	0.10	3.82	28.97	0.69
2	7.78	0.74	5.04	0.59	0.03	0.20	0.00	0.00	0.07	2.46	3.57	0.50	0.56	0.20	1.02	0.27	2.98	0.45	1.03	0.26	0.00	0.00	0.09	2.25	13.12	0.95
3	6.09	0.55	7.49	3.32	0.03	3.07	0.00	0.00	0.06	2.48	3.73	3.16	0.42	3.07	0.33	3.71	3.95	0.46	0.86	0.87	0.00	0.00	0.09	2.27	20.97	1.13
4	6.36	1.10	6.56	1.13	0.02	0.15	0.00	0.00	0.07	2.58	1.87	0.40	0.32	0.15	0.38	0.23	4.49	0.70	0.74	0.25	0.00	0.00	0.09	2.36	24.88	2.21
5	9.20	0.39	0.00	0.00	0.42	5.22	0.00	0.00	0.04	0.02	5.91	4.53	0.60	5.22	0.48	5.26	0.00	0.00	1.22	2.06	0.21	0.02	0.43	4.32	6.93	0.34
6	7.94	0.78	0.00	0.00	0.29	0.30	0.00	0.00	0.04	0.02	5.47	0.65	1.17	0.30	1.48	0.34	0.00	0.00	1.00	0.28	0.56	0.09	0.34	3.42	2.36	0.42
7	6.15	0.54	0.00	0.00	0.31	3.85	0.00	0.00	0.04	0.02	4.04	3.82	0.82	3.85	0.57	0.18	0.00	0.00	0.83	0.20	0.13	0.68	0.34	3.53	3.80	0.44
8	6.21	0.85	0.00	0.00	0.31	0.47	0.00	0.00	0.05	0.02	3.68	1.04	1.59	0.47	0.70	1.40	0.00	0.00	0.82	0.29	0.41	0.09	0.36	3.52	5.70	0.84
9	41.27	0.76	38.53	0.73	1.03	0.21	124.56	1.28	0.68	5.99	14.03	0.44	3.10	0.21	3.60	0.22	17.09	0.49	7.70	0.32	0.00	0.00	0.88	6.74	37.84	0.73
10	53.14	1.92	25.73	1.34	0.59	0.60	121.73	2.88	1.54	5.87	16.08	1.06	5.17	0.60	11.29	0.89	11.75	0.90	10.91	0.87	0.00	0.00	0.94	5.38	25.80	1.34
11	33.92	1.78	33.43	1.53	0.59	0.52	77.25	3.45	2.27	1.93	16.00	1.04	3.83	0.52	4.86	0.58	14.57	1.00	6.26	0.66	0.00	0.00	0.81	5.61	37.29	1.84
12	35.77	3.15	35.84	3.07	0.65	0.66	91.82	4.82	1.70	6.05	7.78	1.92	3.27	0.66	2.55	0.70	17.07	1.51	5.17	0.81	0.00	0.00	0.85	5.53	37.73	2.90
13	53.97	0.87	0.00	0.00	5.61	0.36	0.00	0.00	0.36	7.15	29.16	0.64	9.24	0.36	5.09	0.27	0.00	0.00	10.63	0.38	10.88	0.16	3.65	0.23	13.29	0.43
14	61.29	2.20	0.00	0.00	1.50	1.02	0.00	0.00	0.47	5.07	32.82	1.61	13.29	1.02	12.34	0.99	0.00	0.00	14.12	1.05	25.31	0.58	1.90	0.33	6.41	0.71
15 16	38.05 42.81	1.94 3.85	0.00	0.00	2.75 2.88	1.06	0.00	0.00	0.43	4.83 4.93	24.48 18.63	1.27 3.06	16.38 18.71	1.06 2.28	5.23	0.60	0.00	0.00	7.95 7.62	0.74 1.05	6.02 3.70	0.38 0.50	1.96 2.51	0.34	8.56 12.57	0.76 1.36
18	59.74	0.89	90.00	1.09	2.00	2.28	0.00 305.45	2.02	1.75	4.93 0.15	26.14	0.59	9.41	0.35	3.70 8.68	0.82	26.19	0.00	21.78	0.54	0.00	0.00	1.72	0.17	34.42	0.67
17	86.11	2.62	83.71	2.60	1.30	0.35	306.22	4.92	4.08	0.57	31.53	1.58	18.22	1.21	23.28	1.37	19.79	1.25	31.37	1.58	0.00	0.00	1.92	0.6	27.72	1.48
10	58.14	2.91	69.51	3.28	1.64	1.21 1.33	218.85	7.01	4.59	0.68	29.93	1.73	17.38	1.33	9.33	0.97	21.29	1.45	17.15	1.32	0.00	0.00	1.87	0.33	39.44	1.97
20	52.83	4.48	60.22	4.45	1.49	1.33	233.48	8.33	2.44	0.50	13.91	2.72	12.58	1.97	6.13	0.96	23.98	2.79	13.44	1.43	0.00	0.00	1.57	0.13	41.74	3.08
21	88.14	1.11	0.00	0.00	15.54	0.73	0.00	0.00	0.93	0.11	53.65	0.87	37.93	0.73	13.24	0.43	0.00	0.00	29.95	0.65	47.05	0.34	9.19	0.36	16.24	0.48
22	121.39	3.41	0.00	0.00	4.30	2.72	0.00	0.00	2.06	0.41	69.05	2.57	75.50	2.72	30.69	1.71	0.00	0.00	39.72	1.95	91.41	1.22	4.87	0.68	9.12	0.92
23	84.75	3.65	0.00	0.00	8.01	2.98	0.00	0.00	1.07	0.11	51.05	2.35	61.05	2.98	13.65	1.22	0.00	0.00	23.36	1.58	32.10	1.21	5.15	0.70	11.12	1.09
24	83.77	5.72	0.00	0.00	4.97	4.85	0.00	0.00	1.22	0.11	27.95	3.81	54.13	4.85	10.32	1.39	0.00	0.00	19.14	2.87	22.70	1.31	5.16	0.96	16.04	1.75
25	147.25	1.98	86.90	1.40	4.53	0.62	429.43	3.20	5.87	0.40	42.37	1.02	15.56	0.62	20.59	0.73	38.18	0.97	55.49	1.20	0.00	0.00	4.36	0.34	24.59	0.74
26	155.86	5.74	100.81	4.21	3.10	1.98	398.07	8.74	9.68	1.43	50.03	3.07	20.61	1.98	50.31	3.20	29.78	2.45	71.93	3.94	0.00	0.00	3.41	0.52	22.57	1.98
27	117.47	5.72	66.40	4.47	3.61	3.17	285.07	11.57	11.44	1.75	45.35	3.33	38.69	3.17	24.20	2.52	32.78	2.88	51.54	3.79	0.00	0.00	3.89	0.60	29.50	2.55
28	109.32	10.15	52.12	5.29	3.51	4.72	266.14	14.52	7.02	1.70	26.14	4.17	35.77	4.72	14.41	2.43	23.90	2.89	46.15	5.64	0.00	0.00	4.11	0.28	28.15	3.08
29	181.07	2.47	0.00	0.00	29.02	1.10	0.00	0.00	3.59	0.36	88.69	1.63	40.30	1.10	34.26	1.07	0.00	0.00	72.36	1.53	80.74	0.61	19.38	0.77	17.34	0.69
30	217.23	8.36	0.00	0.00	7.29	3.98	0.00	0.00	6.24	1.14	97.13	5.16	68.31	3.98	69.18	4.66	0.00	0.00	75.66	4.94	130.67	2.34	8.81	1.55	10.03	1.60
31	182.00	9.21	0.00	0.00	15.50	5.01	0.00	0.00	6.79	1.64	87.20	5.26	78.18	5.01	33.10	3.44	0.00	0.00	61.88	4.77	66.33	2.57	11.49	1.78	15.87	2.11
32	144.37	13.43	0.00	0.00	10.56	7.52	0.00	0.00	4.75	1.02	54.45	7.24	79.16	7.52	22.48	3.35	0.00	0.00	51.45	6.82	51.84	2.78	11.34	2.12	13.86	2.28

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Supplementary Table 4. Baseline 5-year relative survival rates of 13 cancers among US adults by 32 subgroups

Subgroup	Color Can		Endon Can			nageal eno- noma	Female (Postr	Breast neno.)	Gallbl Car		Kidney	Cancer	Liver C	Cancer		tiple Ioma	Ova Car			reatic ncer	Pros	anced state ncer	Car	nach ncer stric dia)	~	roid ncer
	Rate	SE	Rate	SE	Rate	SE	Rate	SE	Rate	SE	Rate	SE	Rate	SE	Rate	SE	Rate	SE	Rate	SE	Rate	SE	Rate	SE	Rate	SE
1	0.740	0.012	0.916	0.009	0.223	0.018	0.000	0.000	0.095	0.095	0.953	0.009	0.409	0.057	0.852	0.043	0.780	0.015	0.379	0.038	0.000	0.000	0.477	0.099	1.000	0.001
2	0.652	0.024	0.775	0.027	0.223	0.018	0.000	0.000	0.286	0.064	0.856	0.029	0.144	0.113	0.837	0.048	0.736	0.036	0.530	0.064	0.000	0.000	0.502	0.205	0.993	0.004
3	0.659	0.022	0.900	0.013	0.223	0.018	0.000	0.000	0.309	0.092	0.864	0.021	0.403	0.081	0.713	0.075	0.716	0.024	0.493	0.062	0.000	0.000	0.236	0.116	0.992	0.002
4	0.694	0.027	0.910	0.016	0.223	0.018	0.000	0.000	0.286	0.064	0.819	0.043	0.321	0.077	0.787	0.122	0.737	0.029	0.371	0.076	0.000	0.000	0.667	0.193	1.000	0.002
5	0.682	0.012	0.000	0.000	0.140	0.034	0.000	0.000	0.302	0.117	0.886	0.010	0.251	0.037	0.696	0.041	0.000	0.000	0.275	0.032	0.768	0.057	0.284	0.045	0.997	0.002
6	0.601	0.027	0.000	0.000	0.160	0.031	0.000	0.000	0.357	0.096	0.779	0.027	0.157	0.045	0.606	0.057	0.000	0.000	0.151	0.046	0.780	0.086	0.672	0.274	0.949	0.025
7	0.621	0.022	0.000	0.000	0.330	0.108	0.000	0.000	0.357	0.096	0.847	0.020	0.227	0.047	0.635	0.064	0.000	0.000	0.157	0.044	0.470	0.118	0.152	0.055	0.993	0.007
8	0.635	0.029	0.000	0.000	0.287	0.172	0.000	0.000	0.357	0.096	0.840	0.033	0.152	0.032	0.649	0.108	0.000	0.000	0.230	0.066	0.805	0.180	0.545	0.133	0.992	0.008
9	0.738	0.007	0.889	0.006	0.300	0.065	0.918	0.003	0.153	0.045	0.846	0.011	0.283	0.027	0.682	0.027	0.614	0.012	0.195	0.017	0.000	0.000	0.384	0.060	0.997	0.002
10	0.666	0.015	0.751	0.022	0.290	0.174	0.810	0.009	0.155	0.059	0.834	0.025	0.145	0.035	0.626	0.034	0.497	0.034	0.177	0.029	0.000	0.000	0.457	0.144	0.990	0.008
11	0.725	0.016	0.869	0.012	0.751	0.217	0.881	0.008	0.224	0.062	0.879	0.018	0.242	0.038	0.617	0.047	0.595	0.025	0.209	0.035	0.000	0.000	0.257	0.079	0.983	0.005
12	0.731	0.018	0.893	0.012	0.308	0.060	0.926	0.007	0.210	0.082	0.810	0.037	0.287	0.051	0.686	0.071	0.640	0.027	0.307	0.055	0.000	0.000	0.357	0.152	0.991	0.005
13	0.704	0.007	0.000	0.000	0.255	0.020	0.000	0.000	0.321	0.072	0.790	0.009	0.171	0.011	0.627	0.023	0.000	0.000	0.136	0.012	0.858	0.010	0.253	0.024	0.964	0.007
14	0.612	0.015	0.000	0.000	0.186	0.085	0.000	0.000	0.371	0.127	0.793	0.020	0.117	0.019	0.616	0.037	0.000	0.000	0.138	0.022	0.814	0.020	0.148	0.059	0.970	0.027
15	0.652	0.015	0.000	0.000	0.222	0.050	0.000	0.000	0.151	0.082	0.742	0.019	0.181	0.016	0.640	0.044	0.000	0.000	0.101	0.021	0.729	0.029	0.257	0.060	0.945	0.019
16	0.721	0.017	0.000	0.000	0.308	0.110	0.000	0.000	0.751	0.153	0.799	0.027	0.239	0.023	0.594	0.066	0.000	0.000	0.162	0.039	0.865	0.040	0.298	0.080	0.960	0.018
17	0.694	0.007	0.878	0.004	0.322	0.043	0.918	0.002	0.273	0.035	0.793	0.010	0.208	0.015	0.630	0.019	0.531	0.011	0.117	0.009	0.000	0.000	0.334	0.041	0.994	0.002
18	0.621	0.014	0.667	0.015	0.298	0.039	0.830	0.007	0.151	0.043	0.805	0.022	0.219	0.028	0.609	0.027	0.371	0.028	0.112	0.018	0.000	0.000	0.440	0.113	0.971	0.012
19	0.673	0.016	0.816	0.013	0.241	0.131	0.879	0.006	0.173	0.044	0.769	0.021	0.211	0.025	0.535	0.042	0.473	0.025	0.104	0.019	0.000	0.000	0.279	0.101	0.969	0.009
20	0.714	0.017	0.847	0.013	0.298	0.039	0.911	0.006	0.151	0.061	0.785	0.032	0.288	0.033	0.631	0.051	0.555	0.031	0.164	0.027	0.000	0.000	0.281	0.140	0.987	0.008
21	0.666	0.006	0.000	0.000	0.257	0.013	0.000	0.000	0.190	0.045	0.760	0.008	0.202	0.007	0.603	0.016	0.000	0.000	0.111	0.007	0.878	0.006	0.255	0.016	0.954	0.009
22	0.579	0.013	0.000	0.000	0.178	0.072	0.000	0.000	0.261	0.105	0.758	0.019	0.140	0.012	0.545	0.028	0.000	0.000	0.080	0.014	0.786	0.014	0.148	0.046	0.945	0.039
23	0.628	0.014	0.000	0.000	0.135	0.033	0.000	0.000	0.203	0.081	0.717	0.018	0.170	0.013	0.541	0.037	0.000	0.000	0.078	0.015	0.777	0.017	0.281	0.053	0.899	0.028
24	0.654	0.015	0.000	0.000	0.237	0.082	0.000	0.000	0.148	0.069	0.698	0.025	0.268	0.017	0.485	0.050	0.000	0.000	0.122	0.023	0.885	0.019	0.257	0.061	0.967	0.022
25	0.610	0.005	0.799	0.006	0.182	0.024	0.907	0.003	0.179	0.018	0.679	0.010	0.119	0.010	0.420	0.012	0.323	0.008	0.057	0.003	0.000	0.000	0.231	0.023	0.958	0.005
26	0.551	0.012	0.552	0.016	0.170	0.143	0.806	0.008	0.217	0.043	0.709	0.024	0.097	0.020	0.407	0.022	0.210	0.021	0.059	0.009	0.000	0.000	0.264	0.068	0.894	0.023
27	0.579	0.013	0.699	0.017	0.190	0.073	0.858	0.008	0.125	0.023	0.677	0.022	0.087	0.014	0.353	0.027	0.298	0.022	0.049	0.009	0.000	0.000	0.257	0.060	0.889	0.020
28	0.599	0.013	0.735	0.020	0.180	0.022	0.900	0.007	0.115	0.030	0.614	0.032	0.187	0.017	0.440	0.040	0.356	0.029	0.043	0.008	0.000	0.000	0.187	0.067	0.858	0.023
29	0.615	0.005	0.000	0.000	0.212	0.011	0.000	0.000	0.134	0.025	0.680	0.008	0.119	0.007	0.402	0.011	0.000	0.000	0.075	0.004	0.717	0.007	0.220	0.013	0.935	0.015
30	0.498	0.014	0.000	0.000	0.164	0.069	0.000	0.000	0.209	0.076	0.705	0.024	0.134	0.019	0.459	0.027	0.000	0.000	0.049	0.011	0.569	0.017	0.174	0.052	0.810	0.068
31	0.544	0.013	0.000	0.000	0.155	0.035	0.000	0.000	0.144	0.046	0.668	0.020	0.107	0.012	0.398	0.028	0.000	0.000	0.066	0.011	0.674	0.017	0.141	0.032	0.786	0.048
32	0.625	0.013	0.000	0.000	0.126	0.049	0.000	0.000	0.263	0.071	0.653	0.026	0.182	0.014	0.431	0.037	0.000	0.000	0.080	0.013	0.733	0.020	0.255	0.042	0.800	0.039

Supplementary Table 5. Health-related quality of life among US cancer patients aged 20 years or older, by cancer type and phase of care

Cancer Type	Cancer Phase	Health Related Quality of Life mean (SE)	Source
Endometrial	Overall	0.80 (0.14)	Naik et al. ³¹
Esophageal Adenocarcinoma	Overall	0.69 (0.26)	Wildi et al. ³²
Kidney	Overall	0.78 (0.14)	Pickard et al.33
Liver	Overall	0.79 (0.19)	Naik et al. ³¹
Gallbladder	Overall	0.79 (0.19)	Naik et al. ³¹
Stomach (gastric cardia)	Initial: Continuous: End of Life:	0.84 (0.25) 0.86 (0.24) 0.65 (0.33)	Zhou et al. ³⁴
Female Breast (post-menopausal)	Initial: Continuous: End of Life:	0.78 (0.19) 0.81 (0.20) 0.64 (0.16)	Yabroff et al. ³⁵
Pancreas	Overall	0.65 (0.30)	Müller-Nordhorn et al. ³⁶
Multiple myeloma	Overall	0.79 (0.19)	Naik et al. ³¹
Advanced Prostate	Initial: Continuous: End of Life:	0.78 (0.20) 0.76 (0.19) 0.59 (0.15)	Yabroff et al. ³⁵
Thyroid	Overall	0.85 (0.13)	Naik et al. ³¹
Ovary	Overall	0.77 (0.17)	Pickard et al.33
Colorectal	Initial: Continuous: End of Life:	0.760 (0.19) 0.835 (0.20) 0.643 (0.26)	Färkkilä et al. ³⁷

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Supplementary Table 6. Baseline medical costs, productivity loss, and patient time costs among US cancer patients aged 20 years or older, by cancer type

Sex Female	Age <65	Initial	Continuous							
Female	-65	95439		End-of-life	Initial	Continuous	End-of-life	Initial	Continuous	End-of-life
	<02	95439	6853	156417	4884	3757	15027	650	500	2001
	≥65	79532	6853	104278	6984	5372	21489	1187	913	3652
Male	<65	95787	6450	155612	4884	3757	15027	650	500	2001
	≥65	79822	6450	103742	6984	5372	21489	1187	913	3652
Female	<65	85291	3977	155636	4884	3757	15027	650	500	2001
	≥65	71076	3977	103758	6984	5372	21489	1187	913	3652
Male	<65	94144	4282	160695	4884	3757	15027	650	500	2001
	≥65	78453	4282	107130	6984	5372	21489	1187	913	3652
Female	<65	40173	5859	95782	4884	3757	15027	650	500	2001
	≥65	40173	5859	95782	6984	5372	21489	1187	913	3652
Male	<65	41161	7363	97473	4884	3757	15027	650	500	2001
	≥65	41161	7363	97473	6984	5372	21489	1187	913	3652
Female	<65	112154	8672	164911	4884	3757	15027	650	500	2001
	≥65	93462	8672	109941	6984	5372	21489	1187	913	3652
Male	<65	112911	11697	169673	4884	3757	15027	650	500	2001
	≥65	94092	11697	113115	6984	5372	21489	1187	913	3652
Male	<65	23652	3201	93363	3715	2858	11432	650	500	2001
	≥65	19710	3201	62242	6549	5038	20152	1187	913	3652
Female	<65	61593	3159	126778	10330	7946	31784	650	500	2001
	≥65	51327	3159	84519	7479	5753	23012	1187	913	3652 7
	Female Male Male Female Male Male	≥65Female<65 ≥65Male<65 ≥65Male<65 ≥65Male<65 ≥65Male<65 ≥65Male<65 ≥65Male<65 ≥65Male<65 ≥65Male<65 ≥65Male<65 ≥65Male<65 ≥65Male<65 ≥65	≥ 65 79822 Female < 65 85291 ≥ 65 71076 Male < 65 94144 ≥ 65 78453 Female < 65 40173 ≥ 65 40173 ≥ 65 Male < 65 40173 ≥ 65 40173 ≥ 65 Male < 65 41161 ≥ 65 93462 $= 65$ Male < 65 112911 ≥ 65 94092 $= 65$ Male < 65 23652 ≥ 65 19710 $= 65$ Female < 65 23652 ≥ 65 19710 $= 65$ Female < 65 19710	≥ 65 798226450Female < 65 85291 3977 ≥ 65 71076 3977 $Male$ < 65 941444282 ≥ 65 784534282Female < 65 401735859 ≥ 65 401735859 $Male$ < 65 411617363 $Pemale$ < 65 411617363 $Male$ < 65 411617363 $Pemale$ < 65 112154 8672 $Male$ < 65 11291111697 ≥ 65 9409211697 $Male$ < 65 236523201 $Male$ < 65 197103201Female < 65 615933159	≥ 65 798226450103742Female < 65 85291 3977 155636 ≥ 65 71076 3977 103758 Male < 65 94144 4282 160695 ≥ 65 78453 4282 107130 Female < 65 40173 5859 95782 ≥ 65 40173 5859 95782 Male < 65 41161 7363 97473 ≥ 65 41161 7363 97473 ≥ 65 112154 8672 164911 ≥ 65 93462 8672 109941 Male < 65 112911 11697 169673 ≥ 65 94092 11697 113115 Male < 65 23652 3201 93363 ≥ 65 19710 3201 62242 Female < 65 61593 3159 126778	≥ 65 7982264501037426984Female<65	$\begin{array}{c c c c c c c c c c c c c c c c c c c $	≥65 79822 6450 103742 6984 5372 21489 Female <65	≥65 79822 6450 103742 6984 5372 21489 1187 Female <65	265 79822 6450 103742 6984 5372 21489 1187 913 Female .65 .85291 .3977 155636 .4884 .3757 15027 .650 .500 Male .65 .94144 .4282 .100695 .4884 .3757 .15027 .650 .500 .265 .78453 .4282 .100130 .6984 .5372 .21489 .1187 .913 Female .465 .40173 .5859 .95782 .4884 .3757 .15027 .650 .500 .265 .40173 .5859 .95782 .6984 .5372 .21489 .1187 .913 Male .465 .40173 .5859 .95782 .6984 .5372 .21489 .1187 .913 Male .465 .41161 .7363 .97473 .6984 .5372 .21489 .1187 .913 Male .465 .112154 .8672 .164911

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1												
2		Male	<65	62174	4595	128507	10330	7946	31784	650	500	2001
3			≥65	51812	4595	85671	7479	5753	23012	1187	913	3652
4 5												
6	Endometrial	Female	<65	32129	1535	105262	4884	3757	15027	650	500	2001
7			≥65	26775	1535	70175	6984	5372	21489	1187	913	3652
8 9												
9 10	Ovarian	Female	<65	98788	8296	149573	4884	3757	15027	650	500	2001
11			≥65	82324	8296	99715	6984	5372	21489	1187	913	3652
12 13			203	02024	0230	33713	0304	5572	21403	1107	313	5052
13	0			O_{h}								
15	Gallbladder	Female	<65	40173	5859	95782	4884	3757	15027	650	500	2001
16			≥65	40173	5859	95782	6984	5372	21489	1187	913	3652
17 18		Male	<65	41161	7363	97473	4884	3757	15027	650	500	2001
18			≥65	41161	7363	97473	6984	5372	21489	1187	913	3652
20												
21 22	Kidney (Renal Cell)	Female	<65	46077	6255	110765	4884	3757	15027	650	500	2001
22			≥65	38397	6255	73843	6984	5372	21489	1187	913	3652
24		Male	<65	46048	6018	117123	4884	3757	15027	650	500	2001
25 26			≥65	38374	6018	78082	6984	5372	21489	1187	913	3652
26 27												
28	Breast (Postmenopausal)	Female	<65	27693	2207	94284	5985	4604	18416	650	500	2001
29 30	х г ,		≥65	23078	2207	62856	4752	3655	14620	1187	913	3652
31				20010		0_000					0.0	0002
32	The modul		05	40470	5050	05700	400.4	0757	45007	050	500	0004
33	Thyroid	Female	<65	40173	5859	95782	4884	3757	15027	650	500	2001
34 35			≥65	40173	5859	95782	6984	5372	21489	1187	913	3652
36		Male	<65	41161	7363	97473	4884	3757	15027	650	500	2001
37			≥65	41161	7363	97473	6984	5372	21489	1187	913	3652
38												
39 40	Multiple Myeloma	Female	<65	40173	5859	95782	4884	3757	15027	650	500	2001
40 41			≥65	40173	5859	95782	6984	5372	21489	1187	913	3652
42			-	-		-				-	-	
43												8

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1 2	Male	<65	41161	7363	97473	4884	3757	15027	650	500	2001
3		≥65				6984					
3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33		≥65	41161	7363	97473	6984	5372	21489	1187	913	3652
34 35 36 37 38 39 40 41 42 43 44 45 46 47					//bmjopen.bm						9

Supplementary Table 7. Baseline medical costs, productivity loss, and patient time cost among general population aged 20 years or older in the US, by 32 subgroups

Age group,		Race/ethnici	Medical of	costs	Product	ivity loss	Patient tin	ne cost
years	Sex	ty	Annual general	End-of-life	Annual general	End-of-life costs	Annual general	End-of-lif
years		-	costs	costs	costs		costs	costs
		NHW	4020	40000	2040	8160	226	904
	Female	NHB	3100	40000	2040	8160	226	904
	i emale	Hispanic	2355	40000	2040	8160	226	904
20-44		Other	2617	40000	2040	8160	226	904
20-44		NHW	2022	40000	2040	8160	226	904
	Male	NHB	2279	40000	2040	8160	226	904
	Male	Hispanic	1145	40000	2040	8160	226	904
		Other	1803	40000	2040	8160	226	904
							226	904
		NHW	5371	40000	2040	8160	226	904
	Fomala	NHB	5712	40000	2040	8160	226	904
	Female	Hispanic	3196	40000	2040	8160	226	904
		Other	4082	40000	2040	8160	226	904
45-54		NHW	3812	40000	2040	8160	226	904
	Mala	NHB	3639	40000	2040	8160	226	904
	Male	Hispanic	3612	40000	2040	8160	226	904
		Other	2560	40000	2040	8160	226	904
							226	904
	Female	NHW	7300	40000	2040	8160	226	904
		NHB	5479	40000	2040	8160	226	904
		Hispanic	4607	40000	2040	8160	226	904
55.04		Other	3951	40000	2040	8160	226	904
55-64		NHW	6519	40000	2040	8160	226	904
	Mala	NHB	6455	40000	2040	8160	226	904
	Male	Hispanic	5077	40000	2040	8160	226	904
		Other	6320	40000	2040	8160	226	904
		NHW	8997	40000	4409	8160	607	904
	E a secolo	NHB	9585	40000	4409	8160	607	904
	Female	Hispanic	8847	40000	4409	8160	607	904
205		Other	8625	40000	4409	8160	607	904
≥65		NHW	9334	40000	4409	8160	607	904
		NHB	7367	40000	4409	8160	607	904
	Male	Hispanic	5640	40000	4409	8160	607	904
		Other	7461	40000	4409	8160	607	904

Supplementary Table 8. Characteristics of US adults aged 20 years or older participated in the NHANES, 2013-2016

47.8 ± 0.41 4319 (44.5) 1704 (18.3) 1725 (17.3) 2316 (19.9) 4829 (48.3) 5235 (51.7) 3944 (65.0) 2069 (11.2)	$425 \pm 4.38 \\ 315 \pm 5.39 \\ 271 \pm 4.90 \\ 192 \pm 3.83 \\ 388 \pm 4.53 \\ 279 \pm 4.04 $
4319 (44.5) 1704 (18.3) 1725 (17.3) 2316 (19.9) 4829 (48.3) 5235 (51.7) 3944 (65.0)	315 ± 5.39 271 ± 4.90 192 ± 3.83 388 ± 4.53 279 ± 4.04
1704 (18.3) 1725 (17.3) 2316 (19.9) 4829 (48.3) 5235 (51.7) 3944 (65.0)	315 ± 5.39 271 ± 4.90 192 ± 3.83 388 ± 4.53 279 ± 4.04
1704 (18.3) 1725 (17.3) 2316 (19.9) 4829 (48.3) 5235 (51.7) 3944 (65.0)	315 ± 5.39 271 ± 4.90 192 ± 3.83 388 ± 4.53 279 ± 4.04
1725 (17.3) 2316 (19.9) 4829 (48.3) 5235 (51.7) 3944 (65.0)	271 ± 4.90 192 ± 3.83 388 ± 4.53 279 ± 4.04
2316 (19.9) 4829 (48.3) 5235 (51.7) 3944 (65.0)	192 ± 3.83 388 ± 4.53 279 ± 4.04
4829 (48.3) 5235 (51.7) 3944 (65.0)	388 ± 4.53 279 ± 4.04
5235 (51.7) 3944 (65.0)	279 ± 4.04
5235 (51.7) 3944 (65.0)	279 ± 4.04
3944 (65.0)	
2069 (11-2)	320 ± 4.76
	361 ± 6.55
2668 (14.9)	367 ± 4.44
1383 (8.90)	325 ± 8.12
	311 ± 5.14
()	332 ± 5.72
	341 ± 4.92
2562 (31.0)	332 ± 7.10
	325 ± 4.87
	333 ± 4.55
	344 ± 6.73
	328 ± 7.01
29.3 ± 0.16	
145 (1.36)	341 ± 17.5
2671 (27.2)	327 ± 4.81
7163 (71.4)	334 ± 4.01
	2671 (27.2)



Supplementary Table 9. Consumption of calories from full-service and fast-food restaurants among US adults participated in 2013-2016 NHANES by 32 subgroups

Age group, years	Sex	Race/ethnicity	Baseline consumption kcal/day (mean ± SE)
20-44	Female	NHW	357 ± 6.47
2011	i omalo	NHB	397 ± 8.98
		Hispanic	364 ± 6.77
		Other	334 ± 11.3
	Male	NHW	485 ± 9.00
	indio	NHB	508 ± 12.3
		Hispanic	500 ± 13.7
		Other	466 ± 14.1
45-54	Female	NHW	270 ± 9.38
		NHB	266 ± 7.85
		Hispanic	265 ± 9.11
		Other	228 ± 14.6
	Male	NHW	374 ± 11.3
		NHB	388 ± 17.4
		Hispanic	355 ± 15.0
		Other	338 ± 20.2
55-64	Female	NHW	231 ± 5.25
		NHB	249 ± 9.58
		Hispanic	234 ± 7.99
		Other	216 ± 10.2
	Male	NHW	315 ± 9.55
		NHB	314 ± 18.3
		Hispanic	307 ± 9.90
		Other	298 ± 11.1
≥65	Female	NHW	164 ± 4.71
		NHB	156 ± 6.07
		Hispanic	158 ± 5.27
		Other	137 ± 5.43
	Male	NHW	235 ± 7.43
		NHB	220 ± 7.07
		Hispanic	218 ± 8.07

1 2		Other	198 ± 20.0	_
3 4				
5 6				
7 8 9				
10 11				
12 13				
14 15 16				
17 18				
19 20				
21 22				
23 24 25				
26 27				
28 29				
30 31 32				
33 34				
35 36 37				
37 38 39				
40 41				
42 43				13
44 45 46	For peer review only	- http://bmjopen.bmj.com/site/abo	out/guidelines.xhtml	
40 47				

Supplementary Table 10. Estimated new cancer cases averted by the federal menu calorie labeling in the US by age, sex, race/ethnicity, and cancer type, over lifetime (U.S. population=235,162,844)¹

Concer Turns	Policy	20-44	/	45-54	у	55-64	У	65 + <u>y</u>	/
Cancer Type	Scenario	Female	Male	Female	Male	Female	Male	Female	Male
Endometrial									
Age	consumer	0000 (000 (504 (000)	0100	1110 (100)	40.40)	050 (407)	4400
0	behavior	3300 (696 to	6090)	591 (-990 to	2160)	1140 (433 to	9 1940)	656 (107 to	1190)
	+industry response	5960 (3360 to	8890)	1340 (-208 to 2980)		1600 (928 to	2430)	926 (396 to 1460	
Race/Ethnicity	response	0000 (0000 1	0000)	1040 (200 (0 2000)	1000 (520 10	, 2400)	520 (550 10	1400)
Non-		4000		400		757		570	
Hispanic	consumer behavior	1630 (-711 to 4080)	0	-136 (-1590 to 1430)	0	757 (140 to 1500)	0	572 (38 to 1070)	0
Vhite				, , , , , , , , , , , , , , , , , , ,		, , ,			
	+industry	3080	0	369	0	1110	0	780	0
Non	response	(829 to 5780)		(-1100 to 1950)	-	(463 to 1830)	-	(245 to 1290)	-
Non- Hispanic Black	consumer behavior	763 (-157 to 1710)	0	258 (-23 to 543)	0	283 (73 to 528)	0	47 (-43 to 150)	0
	+industry	1240		372		355		(-43 to 130) 77	
	response	(316 to 2200)	0	(93 to 668)	0	(146 to 604)	0	(-13 to 176)	0
Llienenie	consumer	910	0	290	0	42	0	43	0
Hispanic	behavior	(74 to 1790)	0	(-48 to 596)	0	(-83 to 185)	0	(-16 to 102)	0
	+industry	1460	0	399	0	89	0	64	0
	response	(580 to 2340)	0	(66 to 703)	Ŭ	(-35 to 233)	Ũ	(5 to 122)	Ũ
Other	consumer	19 (212 to 102)	0	165 (41 to 210)	0	54	0	-6	0
	behavior +industry	(-312 to 402) 150		(41 to 319) 191		(3 to 109) 68		(-26 to 14) 0	
	response	(-174 to 546)	0	(68 to 344)	0	(18 to 124)	0	(-21 to 21)	0
		(((_ · · · · _ ·)	
Breast									
Postmenopa									
usal)									
∖ge	consumer	2520 (262 to	5040)	272 / 4070 +	- 1050)	1010 (400 to	2120)	740 (407 to	1200)
-	behavior +industry	2530 (263 to	5040)	373 (-1070 te	5 1950)	1210 (480 to) 2130)	742 (137 to	1360)
	response	4670 (2330 to	0 7350)	1040 (-390 te	0 2680)	1710 (1010 t	0 2640)	1040 (433 to	1700)
Race/Ethnicity		.570 (2000 1	,						
Non-	consumer	1370		-224		832		660	
Hispanic	behavior	(-659 to 3750)	0	(-1570 to 1210)	0	(170 to 1670)	0	(57 to 1280)	0
Vhite	+industry	2660		234		1200		902	
	+industry response	(490 to 5220)	0	234 (-1130 to 1770)	0	(535 to 2040)	0	902 (291 to 1570)	0
Non-	consumer	(490 to 5220) 567	-	182		267	c	43	-
Hispanic Black	behavior	(-110 to 1300)	0	(-34 to 431)	0	(89 to 487)	0	(-40 to 136)	0
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1		+industry	912 (240 to 1680)	0	271 (55 to 536)	0	329 (149 to 554)	0	71 (-13 to 166)	0
2	Hispanic	response consumer	(240 to 1680) 581	0	<u>231</u>	0	32.9	0	42	0
3 4		behavior +industry	(44 to 1200) 934		(-14 to 474) 312		(-72 to 154) 76	-	(-12 to 100) 61	-
5 6		response consumer	(368 to 1600) 1	0	(71 to 563) 182	0	(-34 to 198) 74	0	(6 to 123) -7	0
7	Other	behavior	(-310 to 384)	0	(40 to 353)	0	(9 to 148)	0	(-35 to 22)	0
8 9		+industry response	128 (-187 to 541)	0	210 (71 to 386)	0	94 (29 to 170)	0	1 (-27 to 31)	0
10 11	Kidney									
12	(Renal Cell)	consumor								
14	Age	consumer behavior +industry	2930 (864	to 5040)	581 (-364	to 1540)	1180 (526	i to 1810)	428 (28	to 805)
15 16	-	response	5240 (3110) to 7390)	1230 (244	to 2210)	1590 (941	to 2250)	651 (248	to 1030)
17	Race/Ethnicity Non-									
18 19	Hispanic	consumer behavior	338	1040	-42	53	172	677	147	192
20	White	+industry	(-137 to 844) 646	(-536 to 2790) 2020	(-332 to 273) 58	(-791 to 884) 379	(34 to 339) 251	(88 to 1240) 898	(18 to 280) 199	(-170 to 536) 320
21		response	(173 to 1180)	(410 to 3750)	(-236 to 383)	(-452 to 1250)	(109 to 420)	(326 to 1470)	(72 to 335)	(-35 to 661)
22		consumer	170	88	60	136	79	85	13	44
25 24	Hispanic Black	behavior +industry	(-35 to 384) 280	(-454 to 620) 343	(-5 to 128) 87	(-96 to 410) 203	(26 to 139) 97	(-81 to 258) 119	(-12 to 40) 21	(9 to 79) 56
25		response	(69 to 502)	(-202 to 898)	(22 to 157)	(-30 to 475)	(43 to 157)	(-45 to 295)	(-4 to 48)	(22 to 90)
26	Hispanic	consumer	267	895	92	230	14	94	15	9
27 28	Inopanio	behavior	(21 to 527) 425	(-21 to 1920) 1290	(-4 to 184) 123	(-25 to 503) 305	(-27 to 60) 29	(8 to 196) 127	(-6 to 36) 22	(-29 to 50) 21
20 29		+industry response	(166 to 697)	(371 to 2320)	(27 to 218)	(49 to 570)	(-12 to 76)	(41 to 232)	(2 to 44)	(-17 to 63)
30	Other	consumer	5	75	34	3	13	33	-1	8
31	Other	behavior	(-47 to 66)	(-103 to 274)	(12 to 59)	(-64 to 77)	(2 to 25)	/10 to 58)	(-6 to 4)	(-18 to 37)
32		+industry	27	147	38	17 (52 to 01)	16 (5 to 28)	41 (10 to 67)	1	11 (15 to 10)
33 34		response	(-26 to 89)	(-29 to 347)	(17 to 64)	(-52 to 91)	(5 to 28)	(19 to 67)	(-4 to 6)	(-15 to 40)
34 35	Liver									
	Age	consumer behavior	3210 (1000) to 5540)	701 (-200	to 1760)	1000 (477	′ to 1580)	275 (17	to 551)
38		+industry response	5560 (3130) to 8130)	1340 (397	to 2480)	1340 (804	to 1950)	432 (174	4 to 719)
	Race/Ethnicity									
41 42										
43										15
44				For poor review and	, bttp://brains.r.	ami com /site /abaut	/auidalinaa yktor			
45				For peer review only	y - nitp://pmjopen.i	omj.com/site/about/	guidelines.xntml			
46										

Non- 1 Hispanic 2 White 3	consumer behavior +industry	170 (-125 to 597) 367	1150 (-258 to 3130) 2120	18 (-168 to 236) 78	-82 (-844 to 807) 215	113 (36 to 227) 159	520 (108 to 1020) 668	75 (6 to 155) 100	116 (-110 to 365) 198	
4	response	(53 to 855)	(498 to 4300)	(-105 to 319)	(-537 to 1150)	(77 to 280)	(287 to 1220)	(35 to 189)	(-26 to 454)	
5 Non-	consumer	143	85	53	213	51	118	7	37	
6 Hispanic Black	behavior	(-27 to 346)	(-678 to 1050)	(2 to 120)	(-146 to 705)	(14 to 100)	(-112 to 393)	(-7 to 26)	(-4 to 88)	
7	+industry	231	429	74	306	63	163	12	52	
8	response	(53 to 458)	(-312 to 1460)	(24 to 147)	(-41 to 823)	(28 to 115)	(-58 to 447)	(-2 to 32)	(11 to 107)	
⁹ Hispanic	consumer	239	1150	99	321	14	113	17	8	
10	behavior	(19 to 570)	(93 to 2490)	(3 to 215)	(15 to 703)	(-30 to 72)	(19 to 233)	(-5 to 41)	(-33 to 54)	
11	+industry	384	1600	132	409	31	150	25	20	
12	response	(132 to 756)	(529 to 3050)	(36 to 257)	(106 to 820)	(-13 to 90)	(55 to 276)	(3 to 50)	(-19 to 70)	
13 Other	consumer behavior	2 (-56 to 82)	99 (-125 to 379)	38 (9 to 77)	-1 (-101 to 125)	15 (0 to 34)	38 (5 to 76)	0 (-8 to 7)	9 (-28 to 53)	
14	+industry	(-56 10 82) 26	183	(91077) 43	18	(0 10 34)	(5 10 7 8) 48	(-8 t0 7)	(-28 10 53)	
15	response	(-32 to 108)	(-31 to 483)	(15 to 85)	(-80 to 152)	(5 to 40)	(17 to 91)	(-5 to 10)	(-23 to 59)	
16	response	(-52 10 100)	(-31 10 403)	(13 10 03)	(-00 10 132)	(0 10 40)	(17 10 91)	(-5 10 10)	(-23 (0 33)	
¹⁷ Pancreatic										
	consumer									
19 Age	behavior	764 (262	to 1340)	81.6 (-18	6 to 388)	404 (193	s to 651)	148 (21	to 286)	
20	+industry									
21	response	1350 (820) to 1990)	269 (4	269 (4 to 595)		540 (327 to 793)		227 (96 to 370)	
²² Race/Ethnicity										
23 Non-	consumer	404	0.47	10	10	07	04.0	<u></u>	50	
²⁴ Hispanic 25 White	behavior	121 (-44 to 367)	247 (-120 to 768)	-48 (-159 to 87)	-16 (-246 to 245)	87 (26 to 175)	218 (48 to 432)	63 (3 to 131)	58 (-54 to 189)	
26 VIII.e	+industry	(-44 (0 367) 229	(-120 t0 708) 490	-11	(-240 10 245) 73	122	(48 (0 432) 283	(310131) 87	(-54 to 189) 98	
27	response	(50 to 493)	(99 to 1060)	(-124 to 134)	(-154 to 363)	(56 to 218)	(115 to 507)	(27 to 163)	(-12 to 238)	
28 Non-	consumer	()	()				```	· · ·	· /	
		60	18	24	30	32	19	5	10	
		60 (-10 to 158)	18 (-80 to 128)	24 (-1 to 54)	30 (-20 to 87)	32 (9 to 63)	19 (-16 to 62)	5 (-6 to 19)	10 (2 to 19)	
29 Hispanic Black	behavior +industry	60 (-10 to 158) 98	18 (-80 to 128) 64	24 (-1 to 54) 34	30 (-20 to 87) 44	32 (9 to 63) 39	19 (-16 to 62) 27	5 (-6 to 19) 9	10 (2 to 19) 13	
29 Hispanic Black	behavior	(-10 to 158)	(-80 to 128)	(-1 to 54)	(-20 to 87)	(9 to 63)	(-16 to 62)	(-6 to 19)	(2 to 19)	
29 Hispanic Black 30 31	behavior +industry	(-10 to 158) 98	(-80 to 128) 64	(-1 to 54) 34	(-20 to 87) 44	(9 to 63) 39	(-16 to 62) 27	(-6 to 19) 9	(2 to 19) 13	
29 Hispanic Black 30	behavior +industry response	(-10 to 158) 98 (21 to 207)	(-80 to 128) 64 (-36 to 184)	(-1 to 54) 34 (9 to 67) 26 (-4 to 60)	(-20 to 87) 44 (-4 to 102)	(9 to 63) 39 (17 to 72)	(-16 to 62) 27 (-9 to 70) 18 (-3 to 44)	(-6 to 19) 9 (-2 to 23)	(2 to 19) 13 (5 to 23)	
29 Hispanic Black 30 31 ³² Hispanic	behavior +industry response consumer behavior +industry	(-10 to 158) 98 (21 to 207) 68 (5 to 150) 108	(-80 to 128) 64 (-36 to 184) 194 (13 to 422) 273	(-1 to 54) 34 (9 to 67) 26 (-4 to 60) 36	(-20 to 87) 44 (-4 to 102) 46 (-5 to 105) 63	(9 to 63) 39 (17 to 72) 4 (-11 to 22) 10	(-16 to 62) 27 (-9 to 70) 18 (-3 to 44) 26	(-6 to 19) 9 (-2 to 23) 6 (-2 to 14) 8	(2 to 19) 13 (5 to 23) 2 (-8 to 12) 5	
29 Hispanic Black 30 31 32 Hispanic 33	behavior +industry response consumer behavior +industry response	(-10 to 158) 98 (21 to 207) 68 (5 to 150) 108 (40 to 201)	(-80 to 128) 64 (-36 to 184) 194 (13 to 422) 273 (92 to 518)	(-1 to 54) 34 (9 to 67) 26 (-4 to 60) 36 (7 to 70)	(-20 to 87) 44 (-4 to 102) 46 (-5 to 105) 63 (11 to 124)	(9 to 63) 39 (17 to 72) 4 (-11 to 22) 10 (-5 to 28)	(-16 to 62) 27 (-9 to 70) 18 (-3 to 44) 26 (6 to 53)	(-6 to 19) 9 (-2 to 23) 6 (-2 to 14) 8 (0 to 18)	(2 to 19) 13 (5 to 23) 2 (-8 to 12) 5 (-5 to 15)	
29 Hispanic Black 30 31 32 Hispanic 33 34 35	behavior +industry response consumer behavior +industry response consumer	(-10 to 158) 98 (21 to 207) 68 (5 to 150) 108 (40 to 201) -2	(-80 to 128) 64 (-36 to 184) 194 (13 to 422) 273 (92 to 518) 18	(-1 to 54) 34 (9 to 67) 26 (-4 to 60) 36 (7 to 70) 17	(-20 to 87) 44 (-4 to 102) 46 (-5 to 105) 63 (11 to 124) 0	(9 to 63) 39 (17 to 72) 4 (-11 to 22) 10 (-5 to 28) 8	(-16 to 62) 27 (-9 to 70) 18 (-3 to 44) 26 (6 to 53) 10	(-6 to 19) 9 (-2 to 23) 6 (-2 to 14) 8 (0 to 18) 0	(2 to 19) 13 (5 to 23) 2 (-8 to 12) 5 (-5 to 15) 2	
29 Hispanic Black 30 31 32 Hispanic 33 34 35	behavior +industry response consumer behavior +industry response consumer behavior	(-10 to 158) 98 (21 to 207) 68 (5 to 150) 108 (40 to 201) -2 (-27 to 30)	(-80 to 128) 64 (-36 to 184) 194 (13 to 422) 273 (92 to 518) 18 (-29 to 72)	$(-1 to 54) \\ 34 \\ (9 to 67) \\ 26 \\ (-4 to 60) \\ 36 \\ (7 to 70) \\ 17 \\ (4 to 33)$	(-20 to 87) 44 (-4 to 102) 46 (-5 to 105) 63 (11 to 124) 0 (-20 to 23)	(9 to 63) 39 (17 to 72) 4 (-11 to 22) 10 (-5 to 28) 8 (1 to 16)	(-16 to 62) 27 (-9 to 70) 18 (-3 to 44) 26 (6 to 53) 10 (3 to 19)	(-6 to 19) 9 (-2 to 23) 6 (-2 to 14) 8 (0 to 18) 0 (-4 to 3)	(2 to 19) 13 (5 to 23) 2 (-8 to 12) 5 (-5 to 15) 2 (-6 to 13)	
29 Hispanic Black 30 31 32 Hispanic 33 34 35 36 Other	behavior +industry response consumer behavior +industry response consumer behavior +industry	(-10 to 158) 98 (21 to 207) 68 (5 to 150) 108 (40 to 201) -2 (-27 to 30) 9	(-80 to 128) 64 (-36 to 184) 194 (13 to 422) 273 (92 to 518) 18 (-29 to 72) 36	$(-1 to 54) \\ 34 \\ (9 to 67) \\ 26 \\ (-4 to 60) \\ 36 \\ (7 to 70) \\ 17 \\ (4 to 33) \\ 19 \\ (9 to 51) \\ (10 to 5$	(-20 to 87) 44 (-4 to 102) 46 (-5 to 105) 63 (11 to 124) 0 (-20 to 23) 4	(9 to 63) 39 (17 to 72) 4 (-11 to 22) 10 (-5 to 28) 8 (1 to 16) 10	(-16 to 62) 27 (-9 to 70) 18 (-3 to 44) 26 (6 to 53) 10 (3 to 19) 13	(-6 to 19) 9 (-2 to 23) 6 (-2 to 14) 8 (0 to 18) 0 (-4 to 3) 1	(2 to 19) 13 (5 to 23) 2 (-8 to 12) 5 (-5 to 15) 2 (-6 to 13) 4	
29 Hispanic Black 30 31 32 33 34 35 36 Other 37	behavior +industry response consumer behavior +industry response consumer behavior	(-10 to 158) 98 (21 to 207) 68 (5 to 150) 108 (40 to 201) -2 (-27 to 30)	(-80 to 128) 64 (-36 to 184) 194 (13 to 422) 273 (92 to 518) 18 (-29 to 72)	$(-1 to 54) \\ 34 \\ (9 to 67) \\ 26 \\ (-4 to 60) \\ 36 \\ (7 to 70) \\ 17 \\ (4 to 33)$	(-20 to 87) 44 (-4 to 102) 46 (-5 to 105) 63 (11 to 124) 0 (-20 to 23)	(9 to 63) 39 (17 to 72) 4 (-11 to 22) 10 (-5 to 28) 8 (1 to 16)	(-16 to 62) 27 (-9 to 70) 18 (-3 to 44) 26 (6 to 53) 10 (3 to 19)	(-6 to 19) 9 (-2 to 23) 6 (-2 to 14) 8 (0 to 18) 0 (-4 to 3)	(2 to 19) 13 (5 to 23) 2 (-8 to 12) 5 (-5 to 15) 2 (-6 to 13)	

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Esophageal ¹ Adenocarcin ² oma									
³ ₄ Age	consumer behavior	715 (43	to 1480)	92 (-296	6 to 501)	419 (136	6 to 719)	128 (-60) to 309)
5	+industry response	1300 (602	2 to 2100)	293 (-10	2 to 708)	556 (270) to 858)	206 (20 to 390)	
 7 Race/Ethnicity 8 Non- 9 Hispanic 10 White 11 12 13 Non- 14 Hispanic Black 15 16 17 Hispanic 18 19 20 21 Other 22 	consumer behavior +industry response consumer behavior +industry response consumer behavior +industry response consumer behavior	45 (-25 to 125) 91 (17 to 179) 10 (-2 to 22) 16 (4 to 29) 28 (2 to 57) 44 (17 to 76) -1 (-10 to 11)	$\begin{array}{c} 406\\(-228\ to\ 1100)\\815\\(174\ to\ 1560)\\10\\(-28\ to\ 50)\\28\\(-11\ to\ 69)\\196\\(-2\ to\ 414)\\280\\(80\ to\ 504)\\10\\(-16\ to\ 41)\end{array}$	$\begin{array}{c} -9 \\ (-55 \text{ to } 41) \\ 7 \\ (-40 \text{ to } 60) \\ 3 \\ (-1 \text{ to } 8) \\ 5 \\ (1 \text{ to } 9) \\ 9 \\ (-1 \text{ to } 20) \\ 13 \\ (2 \text{ to } 24) \\ 6 \\ (1 \text{ to } 11) \end{array}$	26 (-368 to 419) 179 (-210 to 578) 11 (-7 to 32) 16 (-2 to 37) 46 (-7 to 112) 63 (7 to 130) 0 (-12 to 13)	30(7 to 58)43(20 to 73)5(2 to 9)6(3 to 11)2(-3 to 8)3(-1 to 10)2(0 to 5)	345(64 to 630)449(174 to 739)67(-7 to 22)9(-4 to 25)24(3 to 47)32(11 to 56)7(2 to 12)	27 (5 to 50) 35 (14 to 59) 1 (-1 to 3) 1 (0 to 3) 2 (-1 to 4) 3 (0 to 5) 0 (-1 to 1)	92 (-88 to 263) 155 (-17 to 330) 4 (0 to 7) 5 (2 to 8) 2 (-7 to 12) 4 (-4 to 15) 2 (-4 to 8)
22 23 24	+industry response	3 (-6 to 15)	21 (-6 to 52)	75 (2 to 12)	2 (-10 to 15)	3 (1 to 6)	8 (4 to 13)	0 (-1 to 1)	2 (-3 to 9)
25 Colorectal									
²⁶ Age 27 Age 28	consumer behavior +industry	584 (183	to 1090)	79 (-90	to 289)	251 (126	S to 412)	117 (19	to 224)
29 30 Race/Ethnicity	response	1050 (605	5 to 1610)	201 (23	to 426)	341 (209	9 to 514)	175 (81	to 289)
 31 Non- 32 Hispanic 33 White 34 35 36 Non- 37 Hispanic Black 38 39 40 Hispanic 41 42 43 	consumer behavior +industry response consumer behavior +industry response consumer behavior	$\begin{array}{c} 67\\ (-51 \text{ to } 261)\\ 144\\ (-2 \text{ to } 382)\\ 31\\ (-9 \text{ to } 88)\\ 53\\ (9 \text{ to } 119)\\ 45\\ (2 \text{ to } 113)\end{array}$	169 (-107 to 569) 358 (40 to 790) 38 (-48 to 144) 78 (-8 to 203) 185 (25 to 409)	-35 (-106 to 64) -12 (-80 to 97) 11 (-1 to 29) 17 (4 to 36) 20 (1 to 43)	$\begin{array}{r} -17 \\ (-151 \text{ to } 163) \\ 38 \\ (-99 \text{ to } 233) \\ 26 \\ (-13 \text{ to } 79) \\ 36 \\ (-2 \text{ to } 91) \\ 57 \\ (9 \text{ to } 114) \end{array}$	52 (11 to 111) 75 (30 to 146) 19 (7 to 36) 23 (11 to 41) 3 (-7 to 16)	126 (21 to 262) 168 (62 to 313) 14 (-17 to 49) 20 (-9 to 56) 21 (2 to 44)	55 (11 to 115) 73 (28 to 138) 3 (-4 to 12) 6 (-1 to 12) 4 (-1 to 15) 4 (-1 to 11)	44 (-36 to 129) 70 (-7 to 162) 8 (1 to 17) 11 (3 to 21) 1 (-8 to 11) 17
43 44			For poor roviow only	h.u., //l. *					17

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	+industry	73	256	26	70	6	28	6	4
1	response	(18 to 155)	(84 to 504)	(8 to 51)	(23 to 129)	(-3 to 20)	(10 to 53)	(1 to 13)	(-5 to 14)
² Other	consumer	-2	20	7	1	4	8	-1	3
3 Other	behavior	(-21 to 26)	(-31 to 89)	(-1 to 19)	(-20 to 26)	(0 to 11)	(1 to 16)	(-3 to 2)	(-6 to 13)
4	+industry	6	41	9	5	6	10	0	4
5	response	(-13 to 36)	(-9 to 115)	(1 to 21)	(-15 to 31)	(1 to 12)	(4 to 19)	(-2 to 3)	(-5 to 14)
6									
7 Thyroid									
0	consumer								
⁸ Age 9	behavior	374 (114	to 751)	10 (-69	to 125)	84 (44	to 144)	34 (7	to 68)
10	+industry								
11	response	683 (349	to 1130)	67 (-17	to 200)	117 (70	to 187)	52 (22	to 91)
12 Race/Ethnicity									
13 Non-	oonoumor								
A Hispanic	consumer	96	52	-28	-15	21	28	20	8
15 White	behavior	(-59 to 382)	(-59 to 273)	(-85 to 56)	(-64 to 58)	(1 to 62)	(1 to 73)	(2 to 47)	(-9 to 31)
16	+industry	205	131	-8	3	33	40	28	14
17 No.	response	(-15 to 563)	(-26 to 395)	(-63 to 92)	(-43 to 85)	(5 to 80)	(12 to 90)	(9 to 58)	(-3 to 40)
NOD-	consumer	29	7	8	3	12	2	1	1
¹⁸ Hispanic Black	behavior	(-10 to 113)	(-10 to 36)	(-1 to 24)	(-3 to 12)	(6 to 22)	(-2 to 8)	(-2 to 5)	(0 to 2)
19	+industry	52	16	12	5	14	3	2	2
20	response	(-1 to 153)	(-4 to 50)	(2 to 30)	(-1 to 15)	(8 to 26)	(-1 to 10)	(0 to 7)	(1 to 3)
21 ₂₂ Hispanic	consumer	68	59	15	13	2	4	2	0
	behavior	(1 to 201)	(6 to 151)	(-5 to 39)	(2 to 30)	(-4 to 12)	(0 to 9)	(-1 to 6)	(-1 to 3)
23	+industry	113	84	21	16	4	5	3	1
24	response	(22 to 276)	(26 to 189)	(2 to 48)	(6 to 35)	(-2 to 15)	(2 to 12)	(0 to 8)	(-1 to 3)
25 26 Other	consumer	-4	13	6	1	5	5	-1	0
20	behavior	(-38 to 59)	(-13 to 56)	(-4 to 20)	(-7 to 12)	(2 to 10)	(3 to 8)	(-2 to 1)	(-2 to 3)
27	+industry	12	23	8	3	6	6	0	1
28	response	(-25 to 82)	(-2 to 70)	(-1 to 23)	(-5 to 14)	(3 to 11)	(4 to 9)	(-2 to 2)	(-1 to 4)
29									
30 Multiple									
31 Myeloma									
³² Age	consumer								
33	behavior	370 (113	to 743)	78 (-46	to 242)	181 (85	to 308)	63 (7 t	o 128)
34	+industry								
35	response	653 (327	to 1120)	164 (29	to 357)	243 (142	2 to 385)	97 (41	to 169)
36 Race/Ethnicity									
an Non-	consumer								
Hispanic	behavior	27	102	-14	-4	24	96	20	23
38 White		(-34 to 138)	(-61 to 375)	(-50 to 50)	(-96 to 139)	(3 to 67)	(25 to 204)	(1 to 52)	(-23 to 83)
40	+industry	64	207	-1	29	36	125	28	39
41	response	(-22 to 204)	(0 to 544)	(-38 to 74)	(-60 to 199)	(9 to 87)	(52 to 246)	(8 to 65)	(-5 to 111)
42									
43									18
44									10
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Non-	consumer	39	22	14	27	19	11	4	10	
¹ Hispanic Black	behavior	(-9 to 135)	(-63 to 178)	(-1 to 43)	(-15 to 95)	(4 to 45)	(-22 to 60)	(-4 to 17)	(2 to 22)	
2	+industry	` 66 ́	`	`22 ´	`	`24 ´	` 18 ´	`6 ´	`13 ´	
3	response	(1 to 183)	(-30 to 242)	(4 to 55)	(-3 to 113)	(9 to 54)	(-13 to 71)	(-1 to 20)	(5 to 26)	
4 Hispapia	consumer	26	111	7	25	2	15	2	0	
5 Hispanic	behavior	(0 to 79)	(12 to 277)	(-5 to 24)	(-3 to 68)	(-4 to 11)	(3 to 32)	(-1 to 7)	(-5 to 7)	
6	+industry	43	154	10	33	4	19	3	1	
7	response	(6 to 110)	(50 to 340)	(0 to 30)	(6 to 82)	(-2 to 15)	(8 to 39)	(0 to 9)	(-3 to 9)	
⁸ Other	consumer	0	8	7	0	1	4	-0	1	
9	behavior	(-7 to 11)	(-11 to 41)	(3 to 12)	(-10 to 12)	(1 to 4)	(1 to 9)	(-1 to 1)	(-3 to 6)	
10	+industry	2	16	8	1	2	5	0	1	
11	response	(-4 to 16)	(-3 to 53)	(4 to 13)	(-8 to 15)	(0 to 5)	(2 to 11)	(-1 to 1)	(-2 to 6)	
¹²										
13 Stomach										
14 (Gastric										
14 Cardia)	oonoumor									
16 Age	consumer behavior	338 (49	to 803)	58 (-90) to 264)	182 (70	to 3/17)	54 (-10	to 149)	
17	+industry	550 (43		00 (-93	10 204)	102 (70	10 047)	54 (-13	10 143)	
18	response	607 (241	to 1140)	141 (-2)	0 to 378)	240 (129	(10, 420)	86 (15 to 190)		
¹⁹ Race/Ethnicity	response	007 (241	(0 1 1 + 0)		0 10 07 0)	240 (120	10 420)	00(10	10 100)	
²⁰ Non-										
²¹ Hispanic	consumer	18	208	-9	24	15	145	14	34	
²² White	behavior	(-19 to 77)	(-55 to 648)	(-31 to 25)	(-128 to 233)	(4 to 37)	(35 to 304)	(3 to 28)	(-36 to 124)	
23	+industry	43	380	-1	86	22	187	18	58	
24	response	(-6 to 117)	(51 to 886)	(-24 to 38)	(-67 to 322)	(9 to 47)	(77 to 364)	(8 to 35)	(-9 to 160)	
25 Non-	consumer	7	6	2	7	3	3	0	3	
26 Hispanic Black	behavior	(-2 to 21)	(-19 to 44)	(0 to 6)	(-5 to 24)	(1 to 7)	(-6 to 15)	(0 to 2)	(1 to 5)	
27	+industry	`12 ´	` 19 ´	` 3 ´	` 10 <i>´</i>	<u> </u>	`5	` 1 <i>´</i>	`3 ´	
28	response	(2 to 28)	(-8 to 62)	(1 to 7)	(-2 to 29)	(2 to 8)	(-4 to 17)	(0 to 2)	(2 to 6)	
29 Hispanic	consumer	15	63	5	16		7	1	1	
²⁹ Hispanic 30	behavior	(1 to 39)	(-7 to 170)	(0 to 13)	(-4 to 45)	(-2 to 5)	(0 to 18)	(0 to 3)	(-3 to 5)	
31	+industry	24	95	7	22	2	/ 10	1	2	
32	response	(6 to 52)	(21 to 214)	(2 to 16)	(3 to 54)	(-1 to 6)	(3 to 23)	(0 to 3)	(-2 to 7)	
³³ Other	consumer	-1	5	5	0	1	4	0	1	
34	behavior	(-7 to 10)	(-14 to 34)	(2 to 9)	(-8 to 12)	(0 to 3)	(1 to 9)	(-1 to 1)	(-3 to 6)	
35	+industry	2	12	6	2	2	5	0	2	
36	response	(-5 to 14)	(-7 to 46)	(3 to 10)	(-6 to 15)	(0 to 4)	(2 to 10)	(-1 to 1)	(-2 to 7)	
27										
37 38 Gallbladder										
39 Age	consumer									
40	behavior	161 (67	to 263)	51 (8	to 100)	76 (47 to 109)		29 (11	to 51)	
41	+industry	/		/ / -						
42	response	282 (181	to 396)	86 (43	to 138)	101 (73	to 137)	44 (25	5 to 66)	
43									19	
44									10	
45			For peer review only	/ - http://bmjopen	.bmj.com/site/about	/guidelines.xhtml				
					-	-				

Race/Ethnicity									
¹ Non-	consumer								
2 Hispanic	behavior	24	19	0	1.97	19	23	16	6
3 White	Denavior	(-10 to 71)	(-13 to 61)	(-25 to 30)	(-17 to 24)	(5 to 38)	(6 to 42)	(3 to 31)	(-5 to 17)
4	+industry	47	39	9	9	27	29	21	9
5	response	(10 to 99)	(5 to 88)	(-16 to 42)	(-10 to 34)	(12 to 48)	(13 to 50)	(8 to 37)	(-1 to 21)
6 Non-	consumer	27	2	11	6	14	4	2	2
7 Hispanic Black	behavior	(-6 to 70)	(-17 to 26)	(0 to 24)	(-4 to 18)	(4 to 26)	(-4 to 12)	(-2 to 7)	(0 to 4)
8	+industry	45	<u>11</u>	15	9	17	5	4	3
9	response	(11 to 93)	(-8 to 38)	(4 to 29)	(-1 to 21)	(8 to 30)	(-2 to 14)	(-1 to 9)	(1 to 5)
	consumer	32	4 2	`10 ´	<u> </u>	3	7	3	0
¹⁰ Hispanic 11	behavior	(2 to 73)	(-10 to 106)	(-4 to 26)	(-2 to 34)	(-5 to 11)	(1 to 15)	(-1 to 7)	(-3 to 4)
12	+industry	5 3 ′	65 ′	` 15 ´	`19 ´	`5´´	9	`4 [´]	` 1 <i>´</i>
	response	(19 to 96) 🧹	(11 to 130)	(1 to 31)	(3 to 39)	(-2 to 14)	(3 to 18)	(1 to 9)	(-2 to 5)
13	consumer	0	3	6	0	3	3	0	1
14 Other	behavior	(-11 to 18)	(-6 to 15)	(1 to 13)	(-4 to 5)	(0 to 7)	(1 to 5)	(-1 to 1)	(-1 to 3)
15	+industry	5	7	7	1	4	3	0	1
16	response	(-7 to 24)	(-2 to 19)	(2 to 14)	(-3 to 6)	(1 to 8)	(1 to 5)	(-1 to 2)	(-1 to 3)
17	10000100	(1 to 2 t)	(= 10 10)	(2.00.1.)	(0.00)	(1.00)	(1.00.0)	(1 to 2)	(1 10 0)
¹⁸ Advanced									
¹⁹ Prostate									
20	consumer								
₂₁ Age	behavior	163 (9	to 360)	37 (-54	to (146)	106 (33	to 194)	35 (-14	l to 91)
22	+industry	100 (0	10 000)	57 (54	(0 140)	100 (00	10 104)	55 (1-	10 0 1)
23	response	300 (130) to 507)	85 (-6 to 203)		142 (67 to 240)		56 (9 to 119)	
24 Race/Ethnicity	response	500 (150	5 (0 007)	00 (0)	10 2007	142 (07	10 240)	50 (5 (0110)
25 Non-									
26 Hispanic	consumer		86		-1		75		24
27 White	behavior	0	(-24 to 267)	0	(-80 to 98)	0	(9 to 162)	0	(-23 to 80)
28	+industry	0	162	0	30	0 0	100	0	40
29	response	0	(32 to 350)	0	(-48 to 144)		(36 to 199)	0	(-5 to 102)
30 Non-	consumer	0	(32 10 330)	0	21	0	16	0	(-5 (5 102)
31 Hispanic Black	behavior	0	(-61 to 97)	0	(-17 to 69)	0	(-13 to 51)	0	(2 to 17)
	+industry	0	34	0	31	0	22	0	11
32		0		0		0		0	
33	response	0	(-33 to 145) 59	0	(-5 to 83) 13	0	(-7 to 57) 9	0	(4 to 20) 1
³⁴ Hispanic	consumer behavior	U	(8 to 133)	U		U	-	U	•
35		0		0	(-3 to 37)	0	(2 to 20)	0	(-3 to 5)
36	+industry	0	82 (28 to 102)	0	18	0	12 (5 to 22)	0	2
37	response	0	(28 to 163)	0	(1 to 44)	0	(5 to 23)	0	(-2 to 7)
38 Other	consumer	0	3	0	0	0	4	0	
39	behavior	0	(-10 to 21)	0	(-7 to 8)	0	(2 to 8)	0	(-3 to 5)
	+industry	0	8	0	1	0	5	0	2
40									
40 41	response		(-5 to 28)		(-5 to 9)		(3 to 9)		(-2 to 6)
41			(-5 to 28)		(-5 to 9)		(3 to 9)		(-2 to 6)
41 42			(-5 to 28)		(-5 to 9)		(3 to 9)		
41			(-5 to 28)		(-5 to 9)		(3 to 9)		(-2 to 6) 20

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Ovarian

Ovarian									
1 2 Age 3	consumer behavior +industry	66 (-10 to	180)	16 (-20 to	75)	31 (11 to	69)	28 (11 to	961)
4	response	129 (16 to	277)	33 (-6 to	102)	45 (17 to	87)	37 (19 to	75)
5 Race/Ethnicit 6 Non- 7 Hispanic 8 White	y consumer behavior	34 (-25 to 147)	0	-4 (-38 to 54)	0	20 (2 to 55)	0	25 (8 to 57)	0
9 10	+industry response	71 (-23 to 220)	0	7 (-30 to 72)	0	30 (6 to 71)	0	32 (15 to 70)	0
₁₁ Non- ₁₂ Hispanic Blac	consumer ck behavior	11 (-5 to 41)	0	4 (0 to 13)	0	6 (3 to 13)	0	1 (-1 to 5)	0
13 14	+industry response	19 (-3 to 56)	0	6 (0 to 17)	0	8 (4 to 16)	0	2 (0 to 6)	0
15 Hispanic 16	consumer behavior	21 (-2 to 67)	0	8 (-1 to 21)	0	1 (-3 to 8)	0	1 (-1 to 5)	0
17 18	+industry response	34 (1 to 91)	0	11 (3 to 26)	0	3 (-1 to 10)	0	2 (0 to 6)	0
19 Other	consumer behavior	-8 (-19 to 13)	0	6 (2 to 13)	0	2 (1 to 5)	0	0 (-1 to 1)	0
20 21	+industry response	-3 (-15 to 21)	0	7 (3 to 14)	0	3 (1 to 6)	0	0 (-1 to 2)	0
23	e the median estimate	es (95% uncertainty interva	als) of each distril	bution of 1000 simulations.					
24 25									
26 27									
28 29									
30 31									
32 33									
34 35									
36									
37 38									
39 40									
41 42									
43 44									21
45 46		Fc	or peer review o	only - http://bmjopen.bm	nj.com/site/ab	out/guidelines.xhtml			
47									

Supplementary Table 11. Estimated cancer deaths reduced by the federal menu calorie labeling in the US by age, sex, race/ethnicity, and cancer type, over a lifetime (U.S. population=235,162,844)¹

Cancer Type	Policy	20-4						i + y	
	Scenario	Female	Male	Female	Male	Female	Male	Female	Male
Breast Postmenopa usal)									
Age	consumer behavior	2490 (260) to 4980)	151 (-20	04 to 521)	285 (129	to 479)	126 (3	0 to 227)
_ /	+industry response	4610 (229	0 to 7240)	336 (-2	26 to 725)	396 (237	to 598)	178 (8	2 to 284)
Race/Ethnicity Non- Hispanic White	consumer behavior	1350 (-652 to 3690)	0	-55 (-373 to 278)	0	165 (33 to 327)	0	103 (10 to 204)	0
	+industry response	2620 (480 to 5150)	0	54 (-264 to 419)	0	238 (105 to 401)	0	139 (47 to 244)	0
Non- Hispanic Black	consumer behavior	560 (-109 to 1280)	0	85 (-11 to 200)	0	95 (32 to 173)	0	13 (-12 to 40)	0
	+industry response	901 (238 to 1660)	0	126 (26 to 247)	0	117 (53 to 196)	0	21 (-4 to 49)	0
Hispanic	consumer behavior	572 (45 to 1180)	0	76 (-7 to 163)	0	9 (-21 to 44)	0	10 (-3 to 24)	0
	+industry response	922 (364 to 1570)	0	104 (21 to 193)	0	21 (-9 to 57)	0	15 (2 to 30)	0
Other	consumer behavior +industry	0 (-306 to 378) 125	0	39 (9 to 76) 45	0	15 (2 to 31) 19	0	-1 (-6 to 3) 0	0
	response	(-185 to 532)	0	(16 to 84)	0	(6 to 35)	0	(-5 to 5)	0
Liver	00000000								
Age	consumer behavior	2840 (897	' to 4890)	628 (-18	31 to 1570)	852 (411	to 1340)	227 (1	8 to 455)
Race/Ethnicity	+industry response	4900 (276	0 to 7190)	1200 (34	45 to 2210)	1140 (689	to 1650)	357 (14	6 to 587)
Non- Hispanic White	consumer behavior	139 (-108 to 504)	1040 (-237 to 2780)	15 (-147 to 207)	-70 (-749 to 722)	98 (31 to 196)	440 (93 to 858)	63 (6 to 130)	97 (-88 to 2
WINE .	+industry response	310 (42 to 719)	1900 (449 to 3830)	67 (-93 to 276)	199 (-478 to 1040)	137 (67 to 240)	565 (241 to 1020)	85 (30 to 159)	161 (-18 to :
							1020)		

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1	Non-	consumer	134	72	49	193	43	100	6	29
2	Hispanic Black	behavior +industry	(-25 to 317) 214	(-601 to 932) 382	(3 to 110) 68	(-133 to 632) 276	(12 to 85) 54	(-95 to 336) 139	(-6 to 22) 10	(-4 to 69) 41
3 4		response consumer	(51 to 425) 199	(-273 to 1280) 1020	(23 to 133) 87	(-37 to 729) 285	(24 to 97) 12	(-49 to 377) 99	(-2 to 27) 15	(8 to 83) 6
5	Hispanic	behavior	(17 to 473)	(88 to 2210) 1430	(2 to 189) 116	(13 to 630) 365	(-26 to 62) 26	(18 to 201)	(-4 to 35)	(-28 to 46) 17
6 7		+industry response	316 (111 to 623)	(482 to 2690)	(31 to 223)	(94 to 729)	(-11 to 78)	131 (48 to 242)	21 (3 to 43)	(-15 to 59)
8 9	Other	consumer behavior	2 (-47 to 68)	90 (-110 to 339)	32 (7 to 65)	-2 (-88 to 108)	12 (0 to 28)	30 (4 to 61)	0 (-6 to 6)	7 (-22 to 42)
10		+industry	22	168	36	<u> </u>	` 16 ´́	39	1	11
11 12		response	(-28 to 93)	(-26 to 434)	(13 to 71)	(-70 to 130)	(4 to 32)	(14 to 74)	(-4 to 8)	(-18 to 46)
13	Endometrial	consumer								
14 15	Age	behavior	1190 (309	9 to 2140)	251 (-24	l8 to 785)	394 (177	to 659)	213 (51	to 378)
16		+industry response	2100 (120	0 to 3110)	512 (26	to 1060)	548 (325	to 817)	302 (13	9 to 472)
17 18	Race/Ethnicity									
19	Non- Hispanic	consumer behavior	440 (-210 to 1170)	0	-42 (-511 to 440)	0	206 (36 to 399)	0	173 (13 to 319)	0
20 21	White	+industry	(-210101170) 858		(-511 (0 440)		(30 10 399) 298		234	
22		response	(218 to 1620)	0	(-351 to 606)	0	(127 to 491)	0	(76 to 388)	0
23 24	Non- Hispanic Black	consumer behavior	412 (-90 to 937)	0	139 (-9 to 293)	0	157 (42 to 295)	0	26 (-24 to 83)	0
25 26	•	+industry response	666 (177 to 1210)	0	`201 (51 to 361)	0	` 195 ∕ (81 to 338)	0	42 (-8 to 97)	0
27	Hispanic	consumer	315	0	105	0	16	0	` 19 ´	0
28 29	inopanio	behavior +industry	(22 to 645) 505		(-22 to 222) 144		(-33 to 70) 34		(-7 to 44) 28	
30		response	(197 to 854)	0	(21 to 261)	0	(-14 to 89)	0	(3 to 54)	0
31 32	Other	consumer behavior	8 (-99 to 139)	0	51 (13 to 99)	0	17 (1 to 36)	0	-3 (-10 to 5)	0
33		+industry response	50 (-56 to 187)	0	58 (21 to 107)	0	22 (6 to 41)	0	0 (-8 to 7)	0
34 35	Kidaas		(000000)		(,		(0.10.1.)		(• •• •)	
36 37	Kidney (Renal Cell)									
38	Age	consumer behavior	1050 (284	4 to 1830)	263 (-15	53 to 695)	506 (225	to 778)	182 (20) to 338)
39 40		+industry	1880 (110	0 to 2680)	539 (10	6 to 977)	679 (402	to 954)	276 (11)	2 to 429)
41	Race/Ethnicity	response				,			(,
42 43										23
44			F	or peer review only	/ - http://hmionen	.bmj.com/site/abou	ıt/auidelines xhtml			-
45 46				- peer erren om						
47										

1	Non- Hispanic	consumer	57 (22 to 150)	332	-16 (128 to 100)	26 (251 to 200)	72	287	66 (0 to 121)	81 (68 to 210)
2	White	behavior	(-23 to 159)	(-183 to 922)	(-128 to 106)	(-351 to 396)	(14 to 138)	(42 to 525)	(9 to 124)	(-68 to 219)
3		+industry	111	663	22	168	105	378	89	133
4		response	(27 to 224)	(123 to 1280)	(-90 to 146)	(-199 to 552)	(46 to 171)	(138 to 623)	(33 to 148)	(-12 to 272)
5	Non-	consumer	67	48	24	59	30	35	5	16
6	Hispanic Black	behavior	(-16 to 162)	(-225 to 326)	(-2 to 53)	(-40 to 171)	(10 to 56)	(-32 to 106)	(-5 to 16)	(3 to 28)
7		+industry	113	174	34	87	37	49	8	20
8		response	(25 to 218)	(-96 to 461)	(9 to 64)	(-14 to 199)	(17 to 63)	(-17 to 121)	(-2 to 20)	(7 to 33)
9	Hispanic	consumer behavior	111 (9 to 229)	367 (0 to 792)	30 (-3 to 62)	118 (-15 to 261)	6 (-13 to 29)	47 (5 to 98)	7 (-2 to 17)	4 (-12 to 23)
10		+industry	(9 10 229)	(0 (0 792)	(-3 to 62) 40	(-13 to 201) 157	13	(3 10 98) 64	(-2 10 17)	(-12 (0 23) 9
11		response	(67 to 305)	(168 to 968)	(8 to 74)	(23 to 303)	(-5 to 36)	(22 to 116)	(1 to 21)	(-7 to 28)
12	_	consumer	3	33	15	0	(0 10 00)	16	-1	4
13	Other	behavior	(-23 to 34)	(-40 to 122)	(5 to 28)	(-28 to 33)	(1 to 11)	(5 to 29)	(-3 to 2)	(-8 to 17)
14		+industry	13	63	17	6	6	20	0	5
15 16		response	(-12 to 45)	(-10 to 156)	(7 to 30)	(-22 to 39)	(2 to 12)	(9 to 33)	(-2 to 3)	(-6 to 18)
10		·	, , , , , , , , , , , , , , , , , , ,		, ,	· · · · ·	х <i>,</i>	× ,	, ,	· · · ·
17	Pancreatic									
19	Age	consumer	656 (220) to 1160)	74 (-16	6 to 350)	362 (175	to 581)	131 (2)	0 to 250)
20	, igo	behavior	000 (220			0.0000	002 (110		101 (2)	0 10 200)
		+industry	1160 (70	7 to 1730)	243 (1	to 535)	483 (293	to 708)	199 (8	7 to 321)
21	Paco/Ethnicity	response	1160 (70	7 to 1730)	243 (1	to 535)	483 (293	to 708)	199 (8	7 to 321)
21 22	Race/Ethnicity	•	,	·	243 (1		, ,	,	· ·	,
21 22 23	Non-	response	101	213	-44	-13	79	193	56	50
21 22 23 24	Non- Hispanic	response	,	·	Č Č		, ,	,	· ·	,
21 22 23	Non-	response consumer behavior	101	213	-44	-13	79	193	56	50
21 22 23 24 25	Non- Hispanic	response consumer behavior +industry	101 (-40 to 310)	213 (-100 to 659)	-44 (-143 to 78)	-13 (-216 to 221)	79 (24 to 158)	193 (44 to 384)	56 (3 to 117) 78	50 (-45 to 162) 84
21 22 23 24 25 26	Non- Hispanic	response consumer behavior	101 (-40 to 310) 196	213 (-100 to 659) 420	-44 (-143 to 78) -10	-13 (-216 to 221) 67	79 (24 to 158) 111	193 (44 to 384) 250	56 (3 to 117)	50 (-45 to 162) 84 (-10 to 203) 9
21 22 23 24 25 26 27	Non- Hispanic White	response consumer behavior +industry response	101 (-40 to 310) 196 (42 to 425)	213 (-100 to 659) 420 (85 to 911) 16 (-72 to 117)	-44 (-143 to 78) -10 (-111 to 120) 22 (-1 to 49)	-13 (-216 to 221) 67 (-140 to 326) 27 (-18 to 78)	79 (24 to 158) 111 (51 to 198) 29 (8 to 57)	193 (44 to 384) 250 (102 to 448)	56 (3 to 117) 78 (25 to 146)	50 (-45 to 162) 84 (-10 to 203) 9 (1 to 17)
21 22 23 24 25 26 27 28 29 30	Non- Hispanic White Non-	response consumer behavior +industry response consumer behavior +industry	101 (-40 to 310) 196 (42 to 425) 48 (-7 to 125) 78	213 (-100 to 659) 420 (85 to 911) 16 (-72 to 117) 57	-44 (-143 to 78) -10 (-111 to 120) 22 (-1 to 49) 31	-13 (-216 to 221) 67 (-140 to 326) 27 (-18 to 78) 39	79 (24 to 158) 111 (51 to 198) 29 (8 to 57) 36	193 (44 to 384) 250 (102 to 448) 18 (-15 to 56) 24	56 (3 to 117) 78 (25 to 146) 5 (-5 to 17) 8	50 (-45 to 162) 84 (-10 to 203) 9 (1 to 17) 12
21 22 23 24 25 26 27 28 29 30 31	Non- Hispanic White Non-	response consumer behavior +industry response consumer behavior +industry response	101 (-40 to 310) 196 (42 to 425) 48 (-7 to 125) 78 (18 to 162)	213 (-100 to 659) 420 (85 to 911) 16 (-72 to 117) 57 (-33 to 164)	-44 (-143 to 78) -10 (-111 to 120) 22 (-1 to 49) 31 (9 to 62)	-13 (-216 to 221) 67 (-140 to 326) 27 (-18 to 78) 39 (-3 to 91)	79 (24 to 158) 111 (51 to 198) 29 (8 to 57) 36 (15 to 65)	193 (44 to 384) 250 (102 to 448) 18 (-15 to 56) 24 (-8 to 63)	56 (3 to 117) 78 (25 to 146) 5 (-5 to 17) 8 (-1 to 20)	50 (-45 to 162) 84 (-10 to 203) 9 (1 to 17) 12 (4 to 19)
21 22 23 24 25 26 27 28 29 30 31 32	Non- Hispanic White Non- Hispanic Black	response consumer behavior +industry response consumer behavior +industry response consumer	101 (-40 to 310) 196 (42 to 425) 48 (-7 to 125) 78 (18 to 162) 55	213 (-100 to 659) 420 (85 to 911) 16 (-72 to 117) 57 (-33 to 164) 175	-44 (-143 to 78) -10 (-111 to 120) 22 (-1 to 49) 31 (9 to 62) 24	-13 (-216 to 221) 67 (-140 to 326) 27 (-18 to 78) 39 (-3 to 91) 42	79 (24 to 158) 111 (51 to 198) 29 (8 to 57) 36 (15 to 65) 4	193 (44 to 384) 250 (102 to 448) 18 (-15 to 56) 24 (-8 to 63) 16	56 (3 to 117) 78 (25 to 146) 5 (-5 to 17) 8 (-1 to 20) 5	50 (-45 to 162) 84 (-10 to 203) 9 (1 to 17) 12 (4 to 19) 1
21 22 23 24 25 26 27 28 29 30 31 32 33	Non- Hispanic White Non-	response consumer behavior +industry response consumer behavior +industry response consumer behavior	101 (-40 to 310) 196 (42 to 425) 48 (-7 to 125) 78 (18 to 162) 55 (5 to 118)	213 (-100 to 659) 420 (85 to 911) 16 (-72 to 117) 57 (-33 to 164) 175 (13 to 374)	-44 (-143 to 78) -10 (-111 to 120) 22 (-1 to 49) 31 (9 to 62) 24 (-4 to 53)	-13 (-216 to 221) 67 (-140 to 326) 27 (-18 to 78) 39 (-3 to 91) 42 (-5 to 97)	79 (24 to 158) 111 (51 to 198) 29 (8 to 57) 36 (15 to 65) 4 (-10 to 20)	193 (44 to 384) 250 (102 to 448) 18 (-15 to 56) 24 (-8 to 63) 16 (-2 to 40)	56 (3 to 117) 78 (25 to 146) 5 (-5 to 17) 8 (-1 to 20) 5 (-2 to 13)	50 (-45 to 162) 84 (-10 to 203) 9 (1 to 17) 12 (4 to 19) 1 (-7 to 10)
21 22 23 24 25 26 27 28 29 30 31 32 33 34	Non- Hispanic White Non- Hispanic Black	response consumer behavior +industry response consumer behavior +industry response consumer behavior +industry	101 (-40 to 310) 196 (42 to 425) 48 (-7 to 125) 78 (18 to 162) 55 (5 to 118) 88	213 (-100 to 659) 420 (85 to 911) 16 (-72 to 117) 57 (-33 to 164) 175 (13 to 374) 245	$\begin{array}{c} -44 \\ (-143 \text{ to } 78) \\ -10 \\ (-111 \text{ to } 120) \\ 22 \\ (-1 \text{ to } 49) \\ 31 \\ (9 \text{ to } 62) \\ 24 \\ (-4 \text{ to } 53) \\ 32 \end{array}$	$\begin{array}{c} -13 \\ (-216 \text{ to } 221) \\ 67 \\ (-140 \text{ to } 326) \\ 27 \\ (-18 \text{ to } 78) \\ 39 \\ (-3 \text{ to } 91) \\ 42 \\ (-5 \text{ to } 97) \\ 57 \end{array}$	79 (24 to 158) 111 (51 to 198) 29 (8 to 57) 36 (15 to 65) 4 (-10 to 20) 9	193 (44 to 384) 250 (102 to 448) 18 (-15 to 56) 24 (-8 to 63) 16 (-2 to 40) 23	56 (3 to 117) 78 (25 to 146) 5 (-5 to 17) 8 (-1 to 20) 5 (-2 to 13) 8	50 (-45 to 162) 84 (-10 to 203) 9 (1 to 17) 12 (4 to 19) 1 (-7 to 10) 4
21 22 23 24 25 26 27 28 29 30 31 32 33 34 35	Non- Hispanic White Non- Hispanic Black Hispanic	response consumer behavior +industry response consumer behavior +industry response consumer behavior +industry response	101 (-40 to 310) 196 (42 to 425) 48 (-7 to 125) 78 (18 to 162) 55 (5 to 118) 88 (33 to 158)	213 (-100 to 659) 420 (85 to 911) 16 (-72 to 117) 57 (-33 to 164) 175 (13 to 374) 245 (83 to 462)	-44 (-143 to 78) -10 (-111 to 120) 22 (-1 to 49) 31 (9 to 62) 24 (-4 to 53) 32 (6 to 63)	$\begin{array}{c} -13 \\ (-216 \text{ to } 221) \\ 67 \\ (-140 \text{ to } 326) \\ 27 \\ (-18 \text{ to } 78) \\ 39 \\ (-3 \text{ to } 91) \\ 42 \\ (-5 \text{ to } 97) \\ 57 \\ (10 \text{ to } 113) \end{array}$	79 (24 to 158) 111 (51 to 198) 29 (8 to 57) 36 (15 to 65) 4 (-10 to 20) 9 (-5 to 25)	193 (44 to 384) 250 (102 to 448) 18 (-15 to 56) 24 (-8 to 63) 16 (-2 to 40) 23 (5 to 48)	$56 \\ (3 \text{ to } 117) \\ 78 \\ (25 \text{ to } 146) \\ 5 \\ (-5 \text{ to } 17) \\ 8 \\ (-1 \text{ to } 20) \\ 5 \\ (-2 \text{ to } 13) \\ 8 \\ (1 \text{ to } 16) \\ \end{cases}$	50 (-45 to 162) 84 (-10 to 203) 9 (1 to 17) 12 (4 to 19) 1 (-7 to 10) 4 (-4 to 13)
21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36	Non- Hispanic White Non- Hispanic Black	response consumer behavior +industry response consumer behavior +industry response consumer behavior +industry response consumer	101 (-40 to 310) 196 (42 to 425) 48 (-7 to 125) 78 (18 to 162) 55 (5 to 118) 88 (33 to 158) -2	$\begin{array}{c} 213\\ (-100 \text{ to } 659)\\ 420\\ (85 \text{ to } 911)\\ 16\\ (-72 \text{ to } 117)\\ 57\\ (-33 \text{ to } 164)\\ 175\\ (13 \text{ to } 374)\\ 245\\ (83 \text{ to } 462)\\ 16\end{array}$	$\begin{array}{r} -44 \\ (-143 \text{ to } 78) \\ -10 \\ (-111 \text{ to } 120) \\ 22 \\ (-1 \text{ to } 49) \\ 31 \\ (9 \text{ to } 62) \\ 24 \\ (-4 \text{ to } 53) \\ 32 \\ (6 \text{ to } 63) \\ 14 \end{array}$	$\begin{array}{c} -13 \\ (-216 \text{ to } 221) \\ 67 \\ (-140 \text{ to } 326) \\ 27 \\ (-18 \text{ to } 78) \\ 39 \\ (-3 \text{ to } 91) \\ 42 \\ (-5 \text{ to } 97) \\ 57 \\ (10 \text{ to } 113) \\ 0 \end{array}$	79 (24 to 158) 111 (51 to 198) 29 (8 to 57) 36 (15 to 65) 4 (-10 to 20) 9 (-5 to 25) 7	$ \begin{array}{r} 193 \\ (44 \text{ to } 384) \\ 250 \\ (102 \text{ to } 448) \\ 18 \\ (-15 \text{ to } 56) \\ 24 \\ (-8 \text{ to } 63) \\ 16 \\ (-2 \text{ to } 40) \\ 23 \\ (5 \text{ to } 48) \\ 9 \\ \end{array} $	$56 \\ (3 \text{ to } 117) \\ 78 \\ (25 \text{ to } 146) \\ 5 \\ (-5 \text{ to } 17) \\ 8 \\ (-1 \text{ to } 20) \\ 5 \\ (-2 \text{ to } 13) \\ 8 \\ (1 \text{ to } 16) \\ 0 \\ \end{bmatrix}$	50 (-45 to 162) 84 (-10 to 203) 9 (1 to 17) 12 (4 to 19) 1 (-7 to 10) 4 (-4 to 13) 2
21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37	Non- Hispanic White Non- Hispanic Black Hispanic	response consumer behavior +industry response consumer behavior +industry response consumer behavior +industry response consumer behavior	101 (-40 to 310) 196 (42 to 425) 48 (-7 to 125) 78 (18 to 162) 55 (5 to 118) 88 (33 to 158)	213 (-100 to 659) 420 (85 to 911) 16 (-72 to 117) 57 (-33 to 164) 175 (13 to 374) 245 (83 to 462) 16 (-23 to 63)	$\begin{array}{r} -44 \\ (-143 \text{ to } 78) \\ -10 \\ (-111 \text{ to } 120) \\ 22 \\ (-1 \text{ to } 49) \\ 31 \\ (9 \text{ to } 62) \\ 24 \\ (-4 \text{ to } 53) \\ 32 \\ (6 \text{ to } 63) \\ 14 \\ (3 \text{ to } 27) \end{array}$	$\begin{array}{c} -13 \\ (-216 \text{ to } 221) \\ 67 \\ (-140 \text{ to } 326) \\ 27 \\ (-18 \text{ to } 78) \\ 39 \\ (-3 \text{ to } 91) \\ 42 \\ (-5 \text{ to } 97) \\ 57 \\ (10 \text{ to } 113) \end{array}$	79 (24 to 158) 111 (51 to 198) 29 (8 to 57) 36 (15 to 65) 4 (-10 to 20) 9 (-5 to 25)	193 (44 to 384) 250 (102 to 448) 18 (-15 to 56) 24 (-8 to 63) 16 (-2 to 40) 23 (5 to 48)	$56 \\ (3 \text{ to } 117) \\ 78 \\ (25 \text{ to } 146) \\ 5 \\ (-5 \text{ to } 17) \\ 8 \\ (-1 \text{ to } 20) \\ 5 \\ (-2 \text{ to } 13) \\ 8 \\ (1 \text{ to } 16) \\ \end{cases}$	50 (-45 to 162) 84 (-10 to 203) 9 (1 to 17) 12 (4 to 19) 1 (-7 to 10) 4 (-4 to 13)
21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38	Non- Hispanic White Non- Hispanic Black Hispanic	response consumer behavior +industry response consumer behavior +industry response consumer behavior +industry response consumer behavior +industry response consumer behavior +industry	$ \begin{array}{c} 101 \\ (-40 \text{ to } 310) \\ 196 \\ (42 \text{ to } 425) \\ 48 \\ (-7 \text{ to } 125) \\ 78 \\ (18 \text{ to } 162) \\ 55 \\ (5 \text{ to } 118) \\ 88 \\ (33 \text{ to } 158) \\ -2 \\ (-23 \text{ to } 25) \\ 7 \end{array} $	$\begin{array}{c} 213\\ (-100 \text{ to } 659)\\ 420\\ (85 \text{ to } 911)\\ 16\\ (-72 \text{ to } 117)\\ 57\\ (-33 \text{ to } 164)\\ 175\\ (13 \text{ to } 374)\\ 245\\ (83 \text{ to } 462)\\ 16\\ (-23 \text{ to } 63)\\ 32\end{array}$	$\begin{array}{r} -44 \\ (-143 \text{ to } 78) \\ -10 \\ (-111 \text{ to } 120) \\ 22 \\ (-1 \text{ to } 49) \\ 31 \\ (9 \text{ to } 62) \\ 24 \\ (-4 \text{ to } 53) \\ 32 \\ (6 \text{ to } 63) \\ 14 \\ (3 \text{ to } 27) \\ 16 \end{array}$	$\begin{array}{c} -13 \\ (-216 \text{ to } 221) \\ 67 \\ (-140 \text{ to } 326) \\ 27 \\ (-18 \text{ to } 78) \\ 39 \\ (-3 \text{ to } 91) \\ 42 \\ (-5 \text{ to } 97) \\ 57 \\ (10 \text{ to } 113) \\ 0 \\ (-18 \text{ to } 20) \\ 3 \end{array}$	79 (24 to 158) 111 (51 to 198) 29 (8 to 57) 36 (15 to 65) 4 (-10 to 20) 9 (-5 to 25) 7 (1 to 14) 9	$ \begin{array}{r} 193 \\ (44 \text{ to } 384) \\ 250 \\ (102 \text{ to } 448) \\ 18 \\ (-15 \text{ to } 56) \\ 24 \\ (-8 \text{ to } 63) \\ 16 \\ (-2 \text{ to } 40) \\ 23 \\ (5 \text{ to } 48) \\ 9 \\ (3 \text{ to } 17) \\ 11 \end{array} $	$56 \\ (3 \text{ to } 117) \\ 78 \\ (25 \text{ to } 146) \\ 5 \\ (-5 \text{ to } 17) \\ 8 \\ (-1 \text{ to } 20) \\ 5 \\ (-2 \text{ to } 13) \\ 8 \\ (1 \text{ to } 16) \\ 0 \\ (-3 \text{ to } 3) \\ 1 \end{bmatrix}$	$50 \\ (-45 \text{ to } 162) \\ 84 \\ (-10 \text{ to } 203) \\ 9 \\ (1 \text{ to } 17) \\ 12 \\ (4 \text{ to } 19) \\ 1 \\ (-7 \text{ to } 10) \\ 4 \\ (-4 \text{ to } 13) \\ 2 \\ (-5 \text{ to } 11) \\ 3 \end{array}$
21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37	Non- Hispanic White Non- Hispanic Black Hispanic	response consumer behavior +industry response consumer behavior +industry response consumer behavior +industry response consumer behavior	$\begin{array}{c} 101 \\ (-40 \text{ to } 310) \\ 196 \\ (42 \text{ to } 425) \\ 48 \\ (-7 \text{ to } 125) \\ 78 \\ (18 \text{ to } 162) \\ 55 \\ (5 \text{ to } 118) \\ 88 \\ (33 \text{ to } 158) \\ -2 \\ (-23 \text{ to } 25) \end{array}$	213 (-100 to 659) 420 (85 to 911) 16 (-72 to 117) 57 (-33 to 164) 175 (13 to 374) 245 (83 to 462) 16 (-23 to 63)	$\begin{array}{r} -44 \\ (-143 \text{ to } 78) \\ -10 \\ (-111 \text{ to } 120) \\ 22 \\ (-1 \text{ to } 49) \\ 31 \\ (9 \text{ to } 62) \\ 24 \\ (-4 \text{ to } 53) \\ 32 \\ (6 \text{ to } 63) \\ 14 \\ (3 \text{ to } 27) \end{array}$	$\begin{array}{c} -13 \\ (-216 \text{ to } 221) \\ 67 \\ (-140 \text{ to } 326) \\ 27 \\ (-18 \text{ to } 78) \\ 39 \\ (-3 \text{ to } 91) \\ 42 \\ (-5 \text{ to } 97) \\ 57 \\ (10 \text{ to } 113) \\ 0 \\ (-18 \text{ to } 20) \end{array}$	79 (24 to 158) 111 (51 to 198) 29 (8 to 57) 36 (15 to 65) 4 (-10 to 20) 9 (-5 to 25) 7 (1 to 14)	$ \begin{array}{r} 193 \\ (44 \text{ to } 384) \\ 250 \\ (102 \text{ to } 448) \\ 18 \\ (-15 \text{ to } 56) \\ 24 \\ (-8 \text{ to } 63) \\ 16 \\ (-2 \text{ to } 40) \\ 23 \\ (5 \text{ to } 48) \\ 9 \\ (3 \text{ to } 17) \end{array} $	$56 \\ (3 \text{ to } 117) \\ 78 \\ (25 \text{ to } 146) \\ 5 \\ (-5 \text{ to } 17) \\ 8 \\ (-1 \text{ to } 20) \\ 5 \\ (-2 \text{ to } 13) \\ 8 \\ (1 \text{ to } 16) \\ 0 \\ (-3 \text{ to } 3) \\ \end{cases}$	50 (-45 to 162) 84 (-10 to 203) 9 (1 to 17) 12 (4 to 19) 1 (-7 to 10) 4 (-4 to 13) 2 (-5 to 11)

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1 2	Esophageal Adenocarcin oma									
3 4	Age	consumer behavior	631 (33	3 to 1320)	78 (-25	5 to 423)	348 (113	to 584)	101 (-4	2 to 239)
5 6		+industry response	1150 (52	20 to 1870)	246 (-9	6 to 601)	457 (225	to 699)	161 (1	9 to 302)
7 8	Race/Ethnicity Non- Hispanic	consumer	40	366	-8	24	24	283	22	71
9 10	White	behavior	(-23 to 112)	(-206 to 1000)	(-47 to 36)	(-314 to 359)	(6 to 47)	(55 to 516)	(4 to 41)	(-65 to 202)
11 12	Non-	+industry response consumer	81 (15 to 160) 9	732 (157 to 1400) 9	5 (-34 to 51) 3	152 (-176 to 495) 10	35 (16 to 59) 4	366 (142 to 602) 6	28 (11 to 48) 1	119 (-13 to 253) 3
13 14 15	Hispanic Black	behavior +industry	(-1 to 20) 14	(-25 to 45) 25	(0 to 7) 4	(-6 to 28) 14	(1 to 8) 5	(-6 to 18) 8	(-1 to 2) 1	(0 to 5) 4
16 17	Hispanic	response consumer behavior	(3 to 26) 25 (2 to 52)	(-10 to 62) 164 (2 to 354)	(1 to 8) 3 (-1 to 13)	(-2 to 33) 40 (-7 to 99)	(2 to 9) 1 (-3 to 7)	(-3 to 21) 21 (3 to 42)	(0 to 3) 1 (-1 to 4)	(1 to 6) 1 (-6 to 10)
18 19 20		+industry response	40 (15 to 68)	235 (70 to 425)	5 (0 to 16)	55 (6 to 114)	(0 to 7) 3 (-1 to 8)	28 (10 to 50)	2 (0 to 4)	(0 to 10) 4 (-4 to 12)
20 21 22	Other	consumer behavior +industry	-1 (-9 to 10) 3	9 (-14 to 35) 18	5 (1 to 9) 6	-1 (-10 to 10) 1	2 (0 to 4) 2	6 (2 to 10) 7	0 (-1 to 1) 0	1 (-3 to 7) 2
23 24		response	(-6 to 14)	(-5 to 46)	(2 to 10)	(-8 to 12)	(1 to 5)	(3 to 11)	(-1 to 1)	(-3 to 7)
25 26	Colorectal									
27	Age	consumer behavior	430 (13	39 to 779)	56 (-48	3 to 184)	150 (77	to 241)	63 (13	3 to 119)
28 29 30	Race/Ethnicity	+industry response	764 (45	0 to 1160)	133 (2	3 to 268)	203 (126	to 304)	95 (46	6 to 153)
31	Non-	consumer	49	119	-21	-10	32	72	31	22
32 33	Hispanic White	behavior	(-36 to 181)	(-75 to 391)	(-65 to 40)	(-89 to 97)	(7 to 67)	(11 to 150)	(6 to 63)	(-17 to 64)
34 35	Non-	+industry response consumer	106 (4 to 261) 26	248 (28 to 545) 27	-6 (-49 to 59) 8	24 (-60 to 140) 18	46 (20 to 85) 13	96 (36 to 176) 9	41 (16 to 76) 2	35 (-3 to 81) 5
36 37 38	Hispanic Black	behavior +industry	(-7 to 70) 44	(-36 to 104) 58	(0 to 21) 12	(-9 to 53) 25.1	(4 to 24) 15	(-10 to 31) 13	(-2 to 7) 3	(0 to 10) 6
39 40	Hispanic	response consumer behavior	(9 to 94) 36 (2 to 88)	(-7 to 145) 136 (21 to 300)	(4 to 26) 13 (0 to 27)	(-1 to 61) 37 (5 to 74)	(7 to 27) 2 (-4 to 10)	(-6 to 36) 13 (2 to 28)	(-1 to 9) 2 (-1 to 7)	(2 to 12) 1 (-5 to 6)
41 42		Sonavior	(2 10 00)		(0 (0 21)		(11010)	(2 10 20)	(107)	(0.00)
43 44										25
45 46			I	or peer review only	- http://bmjoper	.bmj.com/site/abou	t/guidelines.xhtm			
40 47										

1 2 3 4 5 6	Other	+industry response consumer behavior +industry response	58 (17 to 120) -1 (-15 to 20) 5 (-9 to 27)	188 (65 to 366) 16 (-21 to 65) 30 (-5 to 83)	16 (5 to 32) 5 (-1 to 11) 6 (1 to 13)	45 (14 to 84) 0 (-12 to 15) 2 (-9 to 17)	4 (-2 to 13) 2 (0 to 6) 3 (1 to 7)	18 (6 to 33) 5 (1 to 9) 6 (2 to 11)	4 (0 to 8) 0 (-2 to 1) 0 (-1 to 2)	2 (-3 to 8) 1 (-3 to 6) 2 (-2 to 7)
7 8 9	Stomach (Gastric Cardia)									
10	Age	consumer behavior	286 (45	to 672)	50 (-84	4 to 224)	149 (58	to 282)	42 (-14	4 to 113)
11 12		+industry	513 (19	6 to 965)	120 (-1	4 to 321)	196 (105	to 342)	67 (13	3 to 145)
13	Race/Ethnicity	response						,		,
14 15	Non-	consumer	14	178	-7	21	13	118	11	27
16	Hispanic White	behavior	(-16 to 63)	(-46 to 545)	(-26 to 20)	(-109 to 194)	(4 to 30)	(29 to 248)	(3 to 22)	(-26 to 95)
17 18		+industry	34	322	-1	74	18	152	14	45
19	Non-	response consumer	(-5 to 95) 5	(43 to 766) 2	(-19 to 30) 2	(-58 to 270) 6	(7 to 38) 2	(63 to 296) 3	(6 to 27) 0	(-6 to 121) 2
20	Hispanic Black	behavior	(-1 to 17)	(-11 to 29)	(0 to 5)	(-5 to 22)	(1 to 5)	(-5 to 13)	(0 to 1)	(1 to 4)
21 22		+industry	9	7	2	9	3	4	1	3
23		response consumer	(2 to 22) 13	(-5 to 43) 57	(1 to 6) 5	(-2 to 26) 14	(2 to 6) 1	(-3 to 15) 6	(0 to 2) 1	(1 to 5) 0
24	Hispanic	behavior	(1 to 35)	(-6 to 154)	(0 to 12)	(-3 to 38)	(-1 to 4)	(0 to 15)	(0 to 2)	(-2 to 4)
25		+industry	22	86	6	19	1	8	1	1
26 27		response consumer	(5 to 47) -1	(20 to 194) 4	(2 to 14) 4	(3 to 46) 0	(-1 to 5)	(2 to 19) 3	(0 to 3) 0	(-1 to 6) 1
28	Other	behavior	(-5 to 7)	(-9 to 25)	(2 to 8)	(-7 to 10)	(0 to 3)	(1 to 7)	(-1 to 1)	(-2 to 5)
29		+industry	1	9	4	2	1	4	0	1
30		response	(-3 to 9)	(-4 to 34)	(2 to 8)	(-5 to 12)	(0 to 3)	(2 to 8)	(0 to 1)	(-2 to 5)
31 32 33	Multiple Myeloma									
34	Age	consumer	220 (65	to 441)	51 (-29	9 to 150)	112 (54	to 186)	42 (6	δ to 84)
35	C C	behavior +industry		,		,		·		·
36 37		response	380 (202	2 to 657)	105 (2	0 to 215)	151 (89	to 232)	63 (27	7 to 111)
38	Race/Ethnicity									
39	Non- Hispanic	consumer	11	59	-8	-3	15	58	14	15
40 41	White	behavior	(-13 to 52)	(-34 to 221)	(-32 to 31)	(-59 to 83)	(2 to 41)	(15 to 123)	(1 to 35)	(-14 to 54)
42										
43										26
44 45			F	or peer review only	/ - http://bmioper	n.bmj.com/site/abou	t/auidelines xhtm	I		
45 46				or peer review only			s guidennes.Antin	•		
47										

	+industry	26 (7 to 91)	122	-1	19 (27 to 122)	22 (C to 52)	75	19 (C to 11)	26
Non-	response consumer	(-7 to 81) 17	(1 to 321) 14	(-23 to 45) 10	(-37 to 123) 17	(6 to 53) 12	(32 to 147) 7	(6 to 44) 2	(-3 to 71) 6
Hispanic Black	behavior	(-4 to 63)	(-40 to 115)	(0 to 29)	(-10 to 59)	(3 to 28)	(-14 to 38)	(-3 to 11)	(1 to 12)
Парапіс Біаск	+industry	29	44	15	24	(3 10 20)	11	(-5 to 11) 4	7
	response	(1 to 83)	(-20 to 159)	(3 to 37)	(-1 to 70)	(6 to 34)	(-8 to 45)	(-1 to 13)	(3 to 15
	consumer	16	72	(3 (8 37)	15	(0 10 04)	10	2	0
Hispanic	behavior	(0 to 51)	(9 to 193)	(-3 to 17)	(-2 to 42)	(-3 to 8)	(2 to 22)	(-1 to 5)	(-3 to 5)
	+industry	28	100	7	21	3	13	3	1
	response	(5 to 71)	(31 to 244)	(0 to 21)	(4 to 51)	(-1 to 10)	(5 to 26)	(0 to 6)	(-2 to 6)
	consumer	0	5	4	0	1	3	0	(2 10 0
Other	behavior	(-3 to 6)	(-7 to 27)	(2 to 7)	(-6 to 7)	(0 to 2)	(1 to 6)	(-1 to 1)	(-2 to 4
	+industry	1	10	4	1	(0.02)	4	0	1
	response	(-2 to 8)	(-2 to 36)	(2 to 8)	(-5 to 9)	(0 to 3)	(2 to 7)	(-1 to 1)	(-1 to 4
	response	(2100)	(21000)	(2 10 0)	(0100)	(0 10 0)	(2 (0 7)	(101)	(104
Gallbladder									
Age	consumer behavior	136 (58	3 to 229)	44 (7	to 86)	65 (40	to 93)	24 (9	to 41)
	+industry				1. (10)	00/01		00 (0)	
	response	239 (15	3 to 341)	74 (36	to 119)	86 (61 t	:0 117)	36 (20	0 to 53)
Race/Ethnicity									
Non-		00	4 5		0	40	40	40	-
Hispanic	consumer	22	15 (10 to 52)		$\frac{2}{(11+2,10)}$	16 (4 to 22)	19 (C to 2C)	13 (2 to 25)	5
White	behavior	(-10 to 64)	(-10 to 52)	(-23 to 27)	(-14 to 19)	(4 to 32)	(6 to 36)	(2 to 25)	(-4 to 14
	+industry	43	32	8	8	23	24	17	8
	response	(9 to 90)	(4 to 72)	(-15 to 37)	(-8 to 27)	(10 to 40)	(11 to 42)	(6 to 30)	(-1 to 18
Non-	consumer	24	2	10	4	12	3	2	2
Hispanic Black	behavior	(-5 to 61)	(-14 to 21)	(0 to 21)	(-3 to 14)	(4 to 23)	(-3 to 10)	(-2 to 6)	(0 to 3)
	+industry	40	9	14	6	15	4	3	2
	response	(10 to 80)	(-7 to 31)	(4 to 27)	(-1 to 17)	(7 to 26)	(-2 to 12)	(0 to 7)	(1 to 4)
Hispanic	consumer	28	33	9	12	2	6	2	0
riispariic	behavior	(2 to 63)	(-8 to 85)	(-4 to 23)	(-2 to 30)	(-4 to 10)	(1 to 13)	(-1 to 6)	(-2 to 3
	+industry	45	51	13	16	4	8	4	1
	response	(16 to 83)	(9 to 106)	(1 to 28)	(3 to 35)	(-2 to 13)	(3 to 16)	(0 to 8)	(-1 to 4
Other	consumer	0	2	5	0	3	2	0	0
Other	behavior	(-10 to 16)	(-5 to 12)	(1 to 11)	(-2 to 2)	(0 to 6)	(1 to 4)	(-1 to 1)	(-1 to 2
	+industry	4	5	6	0	4	3	0	1
	response	(-6 to 21)	(-2 to 15)	(2 to 12)	(-1 to 3)	(1 to 7)	(1 to 5)	(-1 to 2)	(-1 to 2)
Advanced									
Prostate									
Age	consumer behavior	101 (13	8 to 214)	18 (-17	′ to 58)	33 (11	to 58)	15 (-4	4 to 38)
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				,					

1 2	Race/Ethnicity	+industry response	174 (80	to 304)	37 (1	to 83)	43 (22 te	o 71)	24 (6	to 48)
3 4 5	Non- Hispanic White	consumer behavior	0	43 (-13 to 140)	0	0 (-29 to 35)	0	20 (3 to 42)	0	10 (-9 to 32)
6 7		+industry response	0	82 (16 to 192)	0	11 (-17 to 50)	0	27 (10 to 51)	0	16 (-2 to 40)
8 9	Non- Hispanic Black	consumer behavior	0	2 (-31 to 51)	0	9 (-7 to 30)	0	7 (-5 to 20)	0	4 (1 to 9)
10 11		+industry response	0	17 (-16 to 75)	0	13 (-2 to 36)	0	9 (-3 to 23)	0	6 (2 to 11)
12 13	Hispanic	consumer behavior	0	47 (7 to 103)	0	7 (-2 to 20)	0	4 (1 to 9)	0	0 (-1 to 3)
14 15		+industry response	0	64 (23 to 127)	0	10 (1 to 25)	0	6 (2 to 11)	0	1 (-1 to 3)
16 17	Other	consumer behavior	0	1 (-4 to 12)	0	0 (-2 to 3)	0	1 (0 to 2)	0	0 (-1 to 2)
18 19		+industry response	0	2 (-1 to 16)	0	0 (-2 to 3)	0	1 (1 to 2)	0	1 (-1 to 2)
20	Ovarian									
21 22	Age	consumer behavior	45 (-3	o 114)	13 (-1	4 to 54)	24 (9 to	51)	21 (8	to 46)
23 24		+industry response	87 (19	to 175)	25 (-4	4 to 75)	34 (14 te	o 64)	28 (15	5 to 56)
25	Race/Ethnicity									
26 27 28	Non- Hispanic White	consumer behavior	21 (-15 to 89)	0	-3 (-29 to 38)	0	15 (2 to 41)	0	19 (6 to 43)	0
29 30		+industry response	45 (-10 to 131)	0	5 (-21 to 52)	0	22 (5 to 51)	0	25 (11 to 52)	0
31 32	Non- Hispanic Black	consumer behavior	7 (-3 to 27)	0	3 (0 to 11)	0	5 (2 to 11)	0	1 (-1 to 4)	0
33 34		+industry response	13 (-1 to 38)	0	5 (1 to 13)	0	7 (3 to 13)	0	1 (0 to 5)	0
35 36	Hispanic	consumer behavior	15 (0 to 48)	0	6 (-1 to 16)	0	1 (-2 to 6)	0	1 (-1 to 4)	0
37 38		+industry response	25 (2 to 64)	0	8 (2 to 20)	0	2 (-1 to 8)	0	2 (0 to 5)	0
39 40	Other	consumer behavior	-5 (-13 to 9)	0	5 (1 to 10)	0	2 (0 to 4)	0	0 (-1 to 1)	0
40 41 42		+industry response	-1 (-9 to 15)	0	5 (2 to 11)	0	2 (1 to 4)	0	0 (0 to 1)	0
43 44 45 46			Fo	or peer review only	/ - http://bmjopen	.bmj.com/site/abou	t/guidelines.xhtml			28

1 2 3 4	Thyroid Age	consumer behavior +industry		to 22)	3 (-4 1	,	6 (3 to			to 7)
5		response	16 (7	to 33)	6 (0 t	0 16)	9 (5 to	15)	5 (3	to 9)
6 7 8 9	Race/Ethnicity Non- Hispanic White	consumer behavior	0 (0 to 2)	0 (-1 to 5)	0 (-1 to 1)	-2 (-7 to 5)	0 (0 to 1)	3 (0 to 8)	1 (0 to 4)	1 (-1 to 3)
10		+industry response	0 (0 to 3)	1 (0 to 9)	0 (-1 to 2)	0 (-5 to 9)	1 (0 to 2)	4 (1 to 10)	2 (1 to 4)	1 (0 to 4)
11 12	Non-	consumer	1	1	0	0	1	0	0	0
13 14	Hispanic Black	behavior +industry	(0 to 5) 2	(-2 to 7) 2	(0 to 1) 0	(0 to 2) 0	(0 to 2) 1	(0 to 1) 0	(0 to 1) 0	(0 to 1) 0
14		response	(0 to 7)	(-1 to 10)	(0 to 2)	(0 to 2)	(0 to 2)	(0 to 1)	(0 to 1)	(0 to 1)
16 17	Hispanic	consumer behavior	3 (0 to 10)	1 (0 to 9)	1 (0 to 3)	2 (0 to 5)	0 (0 to 1)	1 (0 to 2)	0 (0 to 1)	0 (0 to 1)
18 19		+industry response	5 (1 to 14)	(0 to 12)	1 (0 to 4)	2 (1 to 7)	0 (0 to 1)	1 (0 to 3)	1 (0 to 2)	0 (0 to 1)
20	Other	consumer behavior	0	0 (-1 to 3)	0 (0 to 1)	0 (-1 to 1)	0 (0 to 1)	0 (0 to 1)	0	0 (0 to 1)
21 22		+industry response	0	0 (0 to 4)	0 (0 to 1)	0 (-1 to 2)	0 (0 to 1)	0 (0 to 1)	0	0 (0 to 1)
23 24	1. Values are the me	edian estimates (95	5% uncertainty inter	vals) of each distribution	on of 1000 simulations					
24 25										
26										
27										

Supplementary Table 12. Estimated health gains and costs associated with the federal menu calorie labeling on reducing cancer burdens in the US over a lifetime, one-way sensitivity analyses at 25% and 75% calorie compensation outside restaurant settings (US population=235,162,844)¹

	ettings (US population=235,		Labeling Policy	
7	75% Com			mpensation
3 9 10	Consumer Behavior Median (2.5% to 97.5%)	Consumer Behavior + Industry Response Median (2.5% to 97.5%)	Consumer Behavior Median (2.5% to 97.5%)	Consumer Behavior + Industry Response Median (2.5% to 97.5%)
¹ New Cancer Cases Averted, N (95	% UI)			
Liver cancer	2550 (265 to 5030)	4280 (2000 to 6770)	7760 (5160 to 10500)	12800 (9790 to 16000)
² Endometrial cancer	2490 (-633 to 5890)	4640 (1570 to 8070)	8890 (5500 to 12700)	15100 (11800 to 19100)
⁴ Kidnov concor	2360 (65 to 4510)	4160 (1900 to 6410)	7810 (5230 to 10000)	13000 (10400 to 15300)
⁵ Breast cancer (postmenopausal)	2060 (-616 to 5280)	3930 (1260 to 7200)	7640 (4560 to 11400)	13000 (9700 to 17200)
⁶ Pancreatic cancer	638 (51 to 1280)	1140 (536 to 1800)	2140 (1490 to 2890)	3590 (2840 to 4460)
⁷ Esophageal adenocarcinoma	598 (-239 to 1400)	1100 (262 to 1930)	2130 (1200 to 3000)	3560 (2600 to 4520)
⁸ Colorectal cancer	480 (56 to 940)	851 (423 to 1330)	1600 (1060 to 2140)	2660 (2030 to 3310)
⁹ Multiple myeloma	343 (61 to 674)	576 (281 to 950)	1050 (677 to 1480)	1730 (1240 to 2340)
⁰ Stomach cancer (cardia)	312 (-42 to 736)	533 (192 to 998)	994 (555 to 1530)	1640 (1060 to 2300)
¹ Thyroid cancer	185 (-70 to 498)	406 (128 to 749)	851 (473 to 1310)	1470 (963 to 2100)
² Gallbladder cancer	165 (70 to 274)	266 (167 to 378)	468 (348 to 602)	758 (626 to 912)
³ Advanced prostate cancer	162 (-28 to 360)	282 (87 to 493)	519 (304 to 768)	868 (603 to 1160)
4 Ovarian cancer	65 (-17 to 179)	119 (26 to 245)	228 (96 to 398)	384 (196 to 617)
5 Total	12700 (2430 to 24200)	22600 (12400 to 34100)	42800 (30400 to 53900)	71500 (59100 to 82800)
6Cancer Deaths Prevented, N (95%		(, , , , , , , , , , , , , , , , , , ,	, ,	, ,
7 Liver cancer	2200 (199 to 4450)	3750 (1720 to 5970)	6790 (4490 to 9270)	11200 (8570 to 14100)
8 Breast cancer (postmenopausal)	1140 (-958 to 3640)	2420 (281 to 4990)	4980 (2540 to 7860)	8670 (6030 to 12000)
9 Endometrial cancer	980 (-69 to 2030)	1710 (675 to 2770)	3160 (2020 to 4450)	5270 (4120 to 6630)
0 Kidney cancer	939 (94 to 1820)	1630 (795 to 2520)	3020 (2080 to 3930)	4990 (4020 to 6020)
Pancreatic cancer	561 (54 to 1120)	996 (473 to 1590)	1870 (1300 to 2510)	3130 (2480 to 3890)
2 Esophageal adenocarcinoma	503 (-224 to 1190)	932 (203 to 1640)	1820 (1010 to 2580)	3050 (2220 to 3890)
3 Colorectal cancer	323 (41 to 640)	571 (280 to 910)	1080 (724 to 1440)	1800 (1390 to 2240)
Stomach cancer (cardia)	264 (-32 to 623)	446 (159 to 838)	824 (454 to 1280)	1360 (887 to 1910)
5 Multiple myeloma	213 (45 to 411)	350 (178 to 576)	635 (419 to 897)	1040 (757 to 1370)
Collbladdor oppoor	141 (60 to 234)	226 (142 to 320)	398 (300 to 512)	644 (531 to 777)
^D Advanced prestate concer	80 (-12 to 179)	135 (44 to 239)	246 (144 to 373)	410 (278 to 563)
/ Ovarian cancer	49 (-7 to 123)	87 (26 to 170)	162 (76 to 270)	272 (155 to 415)
⁸ Thyroid cancer	11 (1 to 24)	19 (8 to 33)	34 (21 to 53)	56 (39.9 to 81.8)
⁹ Total	7760 (1280 to 13900)	13600 (7160 to 20100)	25600 (17900 to 32300)	42500 (34600 to 49600)
¹⁰ Life Years Gained	34700 (5070 to 66300)	62200 (32500 to 93500)	118000 (82400 to 151000)	197000 (161000 to 232000)

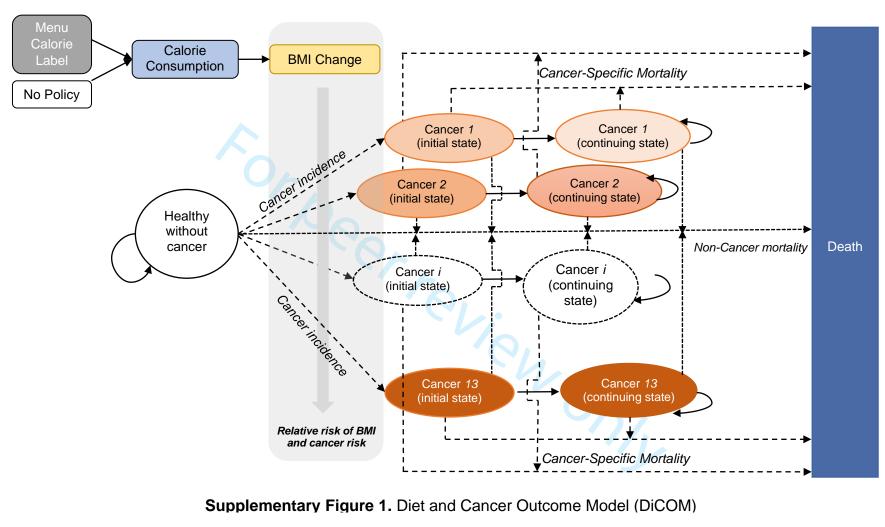
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⁻ ³ QALYs Gained	51400 (9690 to 95700)	90500 (49300 to 135000)	171000 (119000 to 218000)	284000 (234000 to 334000)
⁴ Changes in Health-Related Cos				201000 (201000 10 00 1000)
⁵ Healthcare (medical) cost	-693 (-1250 to -138)	-1210 (-1770 to -660)	-2270 (-2850 to -1640)	-3760 (-4360 to -3140)
6 Patient time cost	-47.9 (-90.0 to -11.9)	-83.6 (-126 to -47.3)	-155 (-198 to -113)	-258 (-302 to -215)
7 Productivity loss	-279 (-527 to -56.6)	-490 (-743 to -271)	-929 (-1170 to -673)	-1550 (-1800 to -1290)
8 Policy Implementation Costs (\$			· · · · · ·	,
9 Government cost	18.5 (14.5 to 25.1)	18.5 (14.4 to 25.5)	18.5 (14.5 to 25.1)	18.5 (14.4 to 25.5)
10 Administration	9.07 (8.61 to 9.56)	9.09 (8.62 to 9.55)	9.07 (8.61 to 9.56)	9.09 (8.62 to 9.55)
11 Monitoring	9.40 (5.45 to 16.1)	9.38 (5.30 to 16.3)	9.40 (5.45 to 16.1)	9.38 (5.30 to 16.3)
12 Industry cost	820 (762 to 889)	1120 (1040 to 1210)	820 (762 to 889)	1120 (1040 to 1210)
13 Compliance	820 (762 to 889)	823 (757 to 889)	820 (762 to 889)	823 (757 to 889)
14 Reformulation	Uk	296 (249 to 353)		296 (249 to 353)
15 Net Costs, Cancer Only (\$, milli				
16 Societal perspective	-174 (-1032 to 639)	-653 (-1510 to 164)	-2520 (-3390 to -1590)	-4430 (-5310 to -3510)
17 Healthcare perspective	-674 (-1229 to -120)	-1190 (-1750 to -639)	-2250 (-2830 to -1620)	-3740 (-4350 to -3120)
¹⁷ / ₁₈ ICER (dollars/QALY) ⁵				
10 Societal perspective	Dominant	Dominant	Dominant	Dominant
20 Healthcare perspective	Dominant	Dominant	Dominant	Dominant
Abbreviations: ICER, Incre	mental Cost-Effectiveness Ratio; QALY, questimates (95% uncertainty intervals) of eacl			
	re inflated to 2015 US dollars using the Pers		vention costs were inflated to 2015 US dolla	ars using the Consumer
23 Price Index. Negative co	osts represent savings.			5
3. Costs are medians from	1000 simulations so may not add up to tota		anastiva includes haalthaars asst. nationt ti	ma apata, productivity
	ed as policy costs minus health-related costs nentation costs; government perspective inc			
	luated at \$150,000/QALY. Dominant repres			
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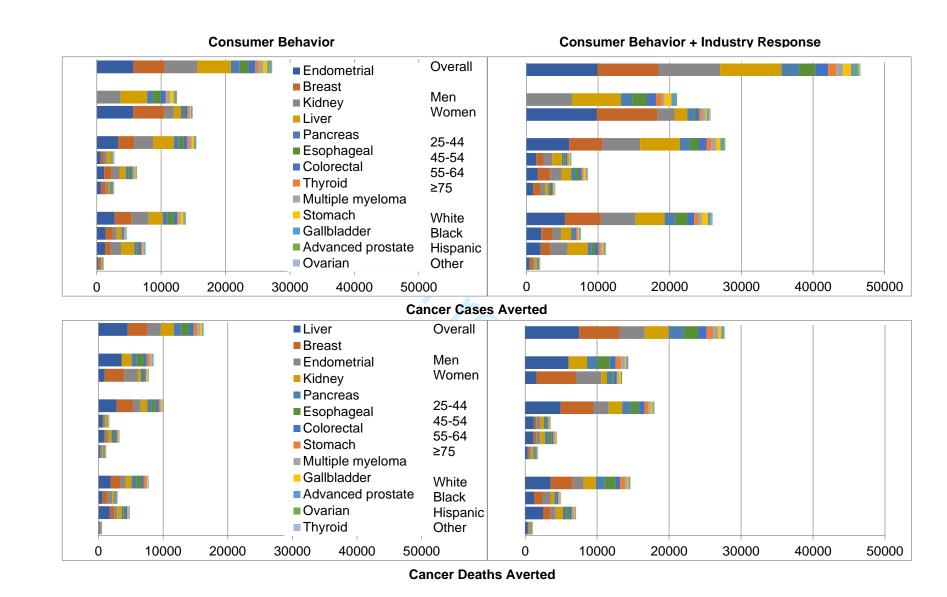
Supplementary Table 13. Estimated health gains and costs associated with the federal menu calorie labeling on reducing cancer burdens in the US over a lifetime, one-way sensitivity analysis, assuming all full-service and fast-food restaurants were covered by the policy (US population=235,162,844)¹

	Menu Calorie Labeling Policy		
	Consumer Behavior	Consumer Behavior + Industry Res	pons
	Median (2.5% to 97.5%)	Median (2.5% to 97.5%)	
New Cancer Cases Averted, N (95% UI)	7000 (1000 (+ 10100)	44400 (0400 1. 44400)	
Liver cancer	7280 (4690 to 10100)	11400 (8480 to 14400)	
Kidney cancer	6820 (4180 to 9460)	11100 (8470 to 13700)	
Endometrial cancer	5340 (1540 to 9220)	10400 (6690 to 14300)	
Breast cancer (postmenopausal)	4920 (1580 to 8420)	9380 (5960 to 13100)	
Esophageal adenocarcinoma	2060 (1170 to 3060)	3260 (2310 to 4330)	
Pancreatic cancer	1810 (1150 to 2600)	3000 (2290 to 3870)	
Colorectal cancer	1320 (772 to 1910)	2200 (1600 to 2880)	
Stomach cancer (cardia)	938 (531 to 1510)	1480 (985 to 2140)	
Thyroid cancer	746 (430 to 1180)	1270 (850 to 1820)	
Multiple myeloma	710 (377 to 1150)	1270 (879 to 1820)	
Advanced prostate cancer	430 (208 to 681)	715 (461 to 1010)	
Gallbladder cancer	329 (201 to 457)	568 (435 to 708)	
Ovarian cancer	133 (20.9 to 292)	263 (109 to 468)	
Total	32900 (20300 to 46000)	56400 (43700 to 69300)	
Cancer Deaths Prevented, N (95% UI)			
Liver cancer	6460 (4170 to 8980)	10000 (7480 to 12800)	
Breast cancer (postmenopausal)	3410 (701 to 6280)	6440 (3560 to 9750)	
Kidney cancer	2620 (1610 to 3620)	4250 (3210 to 5300)	
Endometrial cancer	1890 (654 to 3140)	> 3610 (2390 to 4900)	
Esophageal adenocarcinoma	1800 (1030 to 2670)	2840 (2010 to 3750)	
Pancreatic cancer	1580 (976 to 2250)	2620 (1990 to 3380)	
Colorectal cancer	923 (560 to 1310)	1520 (1110 to 1970)	
Stomach cancer (cardia)	785 (437 to 1270)	1240 (812 to 1790)	
Multiple myeloma	431 (234 to 709)	762 (524 to 1100)	
Gallbladder cancer	275 (170 to 385)	479 (366 to 601)	
Advanced prostate cancer	219 (117 to 351)	353 (233 to 506)	
Ovarian cancer	94 (18 to 197)	185 (91 to 317)	
Thyroid cancer	27 (13 to 45)	45 (28 to 68)	
Total	7760 (1280 to 13900)	34400 (26800 to 42400)	
Life Years Gained	97300 (62300 to 135000)	162000 (126000 to 201000)	
QALYs Gained	20500 (13100 to 28500)	230000 (178000 to 287000)	
Changes in Health-Related Costs, Cancer Only (\$, millions) ^{2,3}		
			32

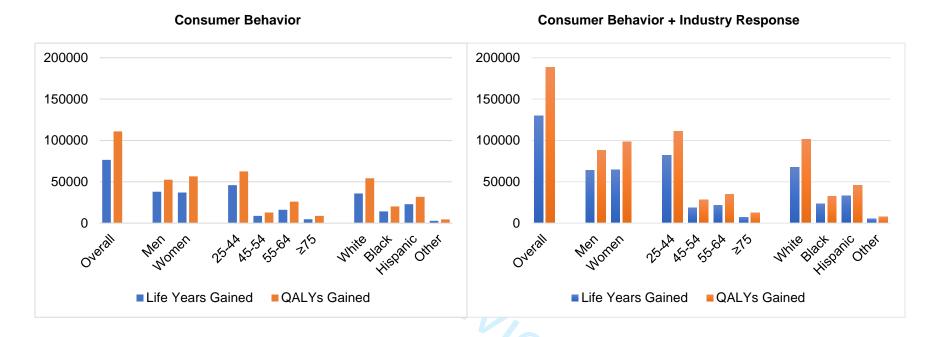
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2			
3	Healthcare (medical) cost	-1820 (-2500 to -1180)	-3060 (-3740 to -2400)
4	Patient time cost	-112 (-160 to -62.7)	-197 (-245 to -148)
5	Productivity loss	-692 (-976 to -401)	-1210 (-1490 to -916)
6	Policy Implementation Costs (\$, millions) ^{2,3}		
7	Government cost	18.4 (14.7 to 25.7)	18.4 (14.7 to 25.7)
8	Administration	9.06 (8.56 to 9.52)	9.07 (8.60 to 9.56)
9	Monitoring	9.32 (5.61 to 16.5)	9.37 (5.64 to 16.6)
10	Industry cost	821 (764 to 888)	1120 (1040 to 1200)
11	Compliance	821 (764 to 888)	821 (763 to 886)
12	Reformulation		297 (248 to 350)
13	Net Costs, Cancer Only (\$, millions) ^{2,3,4}		
14	Societal perspective	-1780 (-2790 to -831)	-1030 (-1590 to -549)
15	Healthcare perspective	-1800 (-2470 to -1160)	-1670 (-2120 to -1270)
16	ICER (dollars/QALY) ⁵		
17	Societal perspective	Dominant	Dominant
18	Healthcare perspective	Dominant	Dominant
19	Abbreviations: ICER, Incremental Cost-Effectiveness Ratio; QAL 1. Values are the median estimates (95% uncertainty intervals) of		
20	2. Health-related costs were inflated to 2015 US dollars using the		osts were inflated to 2015 US dollars using the Consumer
21	Price Index. Negative costs represent savings.		Ŭ
22	3. Costs are medians from 1000 simulations so may not add up to		
23	 Net costs were calculated as policy costs minus health-related costs, and policy implementation costs; government perspectiv 		
24	5. ICER threshold was evaluated at \$150,000/QALY. Dominant re		
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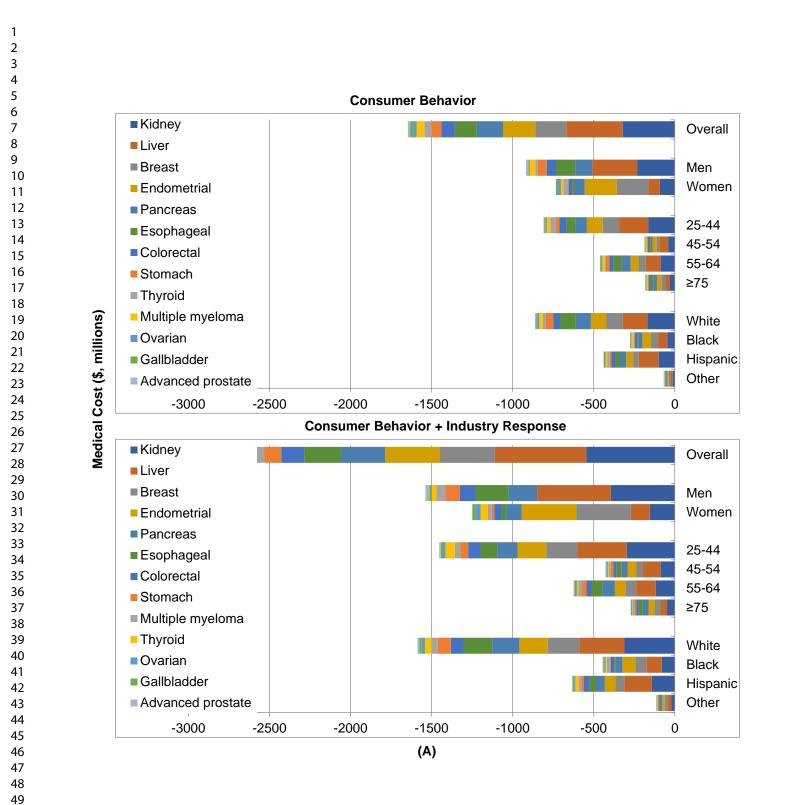
The model consists of four general health states: (a) healthy without cancer (healthy state); (b) initial cancer diagnosis (initial state) for each cancer type *i*; (c) continuing care (continuing state) for each cancer type *i*; and (d) death state. Transitions between states are based on national cancer incidence and cancer-specific mortality rates from SEER (for individual with cancer) and lifetable-based mortality rates (for individuals without cancer). The model simulates the policy impact on the number of new cases and deaths of 13 obesity-associated cancers, health-related quality of life (HRQOL), and health-related costs among U.S. adults over a lifetime by comparing a policy scenario (menu calorie label) to a non-policy scenario (status quo).

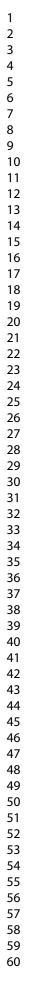


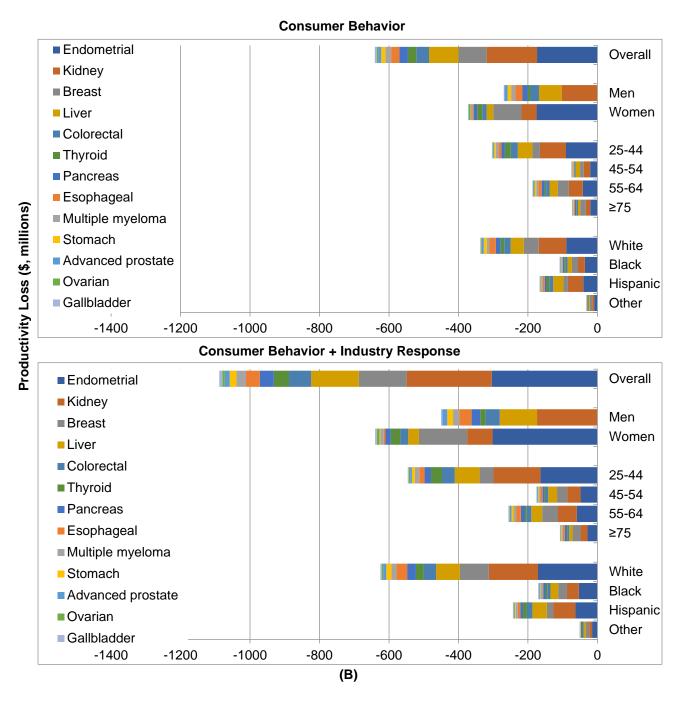
Supplementary Figure 2. Estimated reduced new cancer cases and deaths associated with the federal menu calorie labeling in the US by age, sex, race/ethnicity, and cancer type, over lifetime

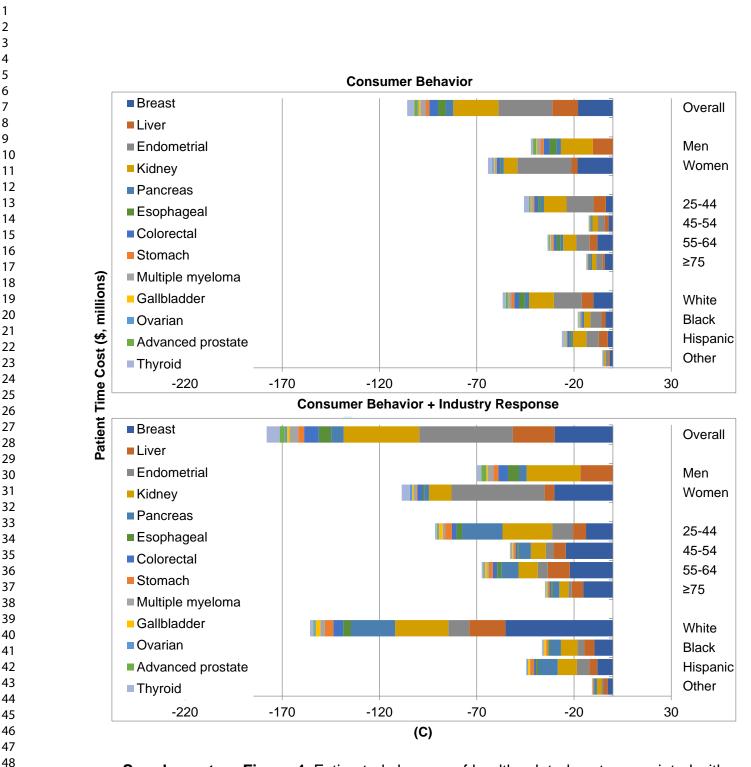


Supplementary Figure 3. Estimated life years and QALYs gained associated with the federal menu calorie labeling in the US by age, sex, and race/ethnicity, over a lifetime









Supplementary Figure 4. Estimated changes of health-related costs associated with the federal menu calorie labeling in the US by age, sex, race/ethnicity, and cancer type, over lifetime

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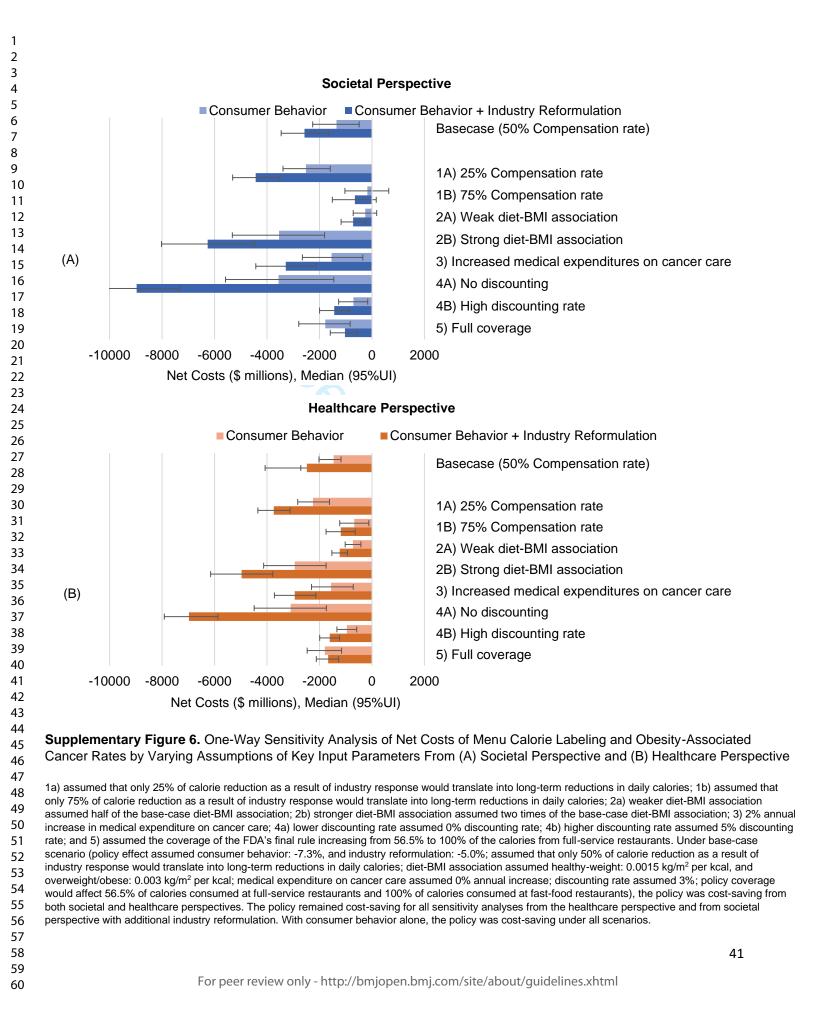
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45 46 47

Net Costs (\$ millions) **Consumer Behavior Consumer Behavior + Industry Response** 0 0 -500 -500 -1000 -1000 -1500 -1500 -2000 -2000 -2500 -2500 -3000 -3000 Overall Hispanic White women Women 275 BIRCH Overall Mer Mer 25.44 215 white other 25-44 15:54 55.64 4554 Black Hispanic Other Societal Perspective Healthcare Perspective Societal Perspective Healthcare Perspective

Supplementary Figure 5. Estimated net costs from societal and government perspectives associated with the federal menu calorie labeling policy in the US by age, sex, and race/ethnicity, over a lifetime



Consolidated Health Economic Evaluation Reporting Standards – CHEERS Checklist Page 102 of 103

CHEERS Checklist

Items to include when reporting economic evaluations of health interventions

The **ISPOR CHEERS Task Force Report**, *Consolidated Health Economic Evaluation Reporting Standards (CHEERS)—Explanation and Elaboration: A Report of the ISPOR Health Economic Evaluations Publication Guidelines Good Reporting Practices Task Force*, provides examples and further discussion of the 24-item CHEERS Checklist and the CHEERS Statement. It may be accessed via the *Value in Health* or via the ISPOR Health Economic Evaluation Publication Guidelines – CHEERS: Good Reporting Practices webpage: <u>http://www.ispor.org/TaskForces/EconomicPubGuidelines.asp</u>

Section/item	Item No	Recommendation	Reported on page No/ line No
Title and abstract			
Title	1	Identify the study as an economic evaluation or use more specific terms such as "cost-effectiveness analysis", and describe the interventions compared.	Page 1/Lines 1-2
Abstract	2	Provide a structured summary of objectives, perspective, setting, methods (including study design and inputs), results (including base case and uncertainty analyses), and conclusions.	Pages 3-4/ Lines 32-59
Introduction			
Background and objectives	3	Provide an explicit statement of the broader context for the study. Present the study question and its relevance for health policy or practice decisions.	Pages 5-6/ Lines 64-92
Methods			Daga 0/
Target population and subgroups	4	Describe characteristics of the base case population and subgroups analysed, including why they were chosen.	Page 9/ Lines 106-113
Setting and location	5	State relevant aspects of the system(s) in which the decision(s) need(s) to be made.	Page 6/Lines 96-
Study perspective	6	Describe the perspective of the study and relate this to the costs being evaluated.	Page 12/ Lines 189-197
Comparators	7	Describe the interventions or strategies being compared and state why they were chosen.	Pages 9-10/ Lines 125-140
Time horizon	8	State the time horizon(s) over which costs and consequences are being evaluated and say why appropriate.	Page 6/ Lines 98-99
Discount rate	9	Report the choice of discount rate(s) used for costs and outcomes and say why appropriate.	Page 12 /Line 198
Choice of health outcomes	10	Describe what outcomes were used as the measure(s) of benefit in the evaluation and their relevance for the type of analysis performed.	Page 11/ Lines 158-170
Measurement of effectiveness	11a	<i>Single study-based estimates:</i> Describe fully the design features of the single effectiveness study and why the single study was a sufficient source of clinical effectiveness data.	

1 2 3		11b	<i>Synthesis-based estimates:</i> Describe fully the methods used for identification of included studies and synthesis of clinical effectiveness data.	Pages 9-11/ Lines 115-170
4 5 6 7	Measurement and valuation of preference based outcomes	12	If applicable, describe the population and methods used to elicit preferences for outcomes.	
8 9 10 11 12 13 14	Estimating resources and costs	13a	Single study-based economic evaluation: Describe approaches used to estimate resource use associated with the alternative interventions. Describe primary or secondary research methods for valuing each resource item in terms of its unit cost. Describe any adjustments made to approximate to opportunity costs.	
15 16 17 18 19 20 21		13b	<i>Model-based economic evaluation:</i> Describe approaches and data sources used to estimate resource use associated with model health states. Describe primary or secondary research methods for valuing each resource item in terms of its unit cost. Describe any adjustments made to approximate to opportunity costs.	Page 11/ Lines 168-170
22 23 24 25 26 27	Currency, price date, and conversion	14	Report the dates of the estimated resource quantities and unit costs. Describe methods for adjusting estimated unit costs to the year of reported costs if necessary. Describe methods for converting costs into a common currency base and the exchange rate.	Page 12/Line 197-198
28 29 30 31	Choice of model	15	Describe and give reasons for the specific type of decision- analytical model used. Providing a figure to show model structure is strongly recommended.	Supplementary Figure 1 Pages 9-10/
32 33	Assumptions	16	Describe all structural or other assumptions underpinning the decision-analytical model.	Lines 118-120, 128-129, <u>135-140, 145-152</u>
34 35 36 37 38 39 40	Analytical methods	17	Describe all analytical methods supporting the evaluation. This could include methods for dealing with skewed, missing, or censored data; extrapolation methods; methods for pooling data; approaches to validate or make adjustments (such as half cycle corrections) to a model; and methods for handling population heterogeneity and uncertainty.	Page 13/ Lines 210-214
41 42	Results			
43 44 45 46 47	Study parameters	18	Report the values, ranges, references, and, if used, probability distributions for all parameters. Report reasons or sources for distributions used to represent uncertainty where appropriate. Providing a table to show the input values is strongly	Pages 7-8/Table 1
48 49 50 51 52 53	Incremental costs and outcomes	19	recommended. For each intervention, report mean values for the main categories of estimated costs and outcomes of interest, as well as mean differences between the comparator groups. If applicable, report incremental cost-effectiveness ratios.	Pages 16-17/ Table 2
55 54 55 56 57	Characterising uncertainty	20a	<i>Single study-based economic evaluation:</i> Describe the effects of sampling uncertainty for the estimated incremental cost and	

Consolidated Health Economic Evaluation Reporting Standards – CHEERS Checklist Page 104 of 103

		incremental effectiveness parameters, together with the impact of methodological assumptions (such as discount rate, study	
Characterising	20b	perspective). <i>Model-based economic evaluation:</i> Describe the effects on the results of uncertainty for all input parameters, and uncertainty related to the structure of the model and assumptions.	Page 21/ Lines 282-2
heterogeneity	21	If applicable, report differences in costs, outcomes, or cost- effectiveness that can be explained by variations between subgroups of patients with different baseline characteristics or other observed variability in effects that are not reducible by	Pages 18-1 Lines 267-2
Discussion Study findings,		more information.	
limitations, generalisability, and current knowledge	22	Summarise key study findings and describe how they support the conclusions reached. Discuss limitations and the generalisability of the findings and how the findings fit with	Pages 21-2-
Other	22	current knowledge.	
Source of funding	23	Describe how the study was funded and the role of the funder in the identification, design, conduct, and reporting of the analysis. Describe other non-monetary sources of support.	Page 26
Conflicts of interest	24	Describe any potential for conflict of interest of study contributors in accordance with journal policy. In the absence of a journal policy, we recommend authors comply with	Pages 26-2
		International Committee of Medical Journal Editors recommendations.	

For consistency, the CHEERS Statement checklist format is based on the format of the CONSORT statement checklist

The **ISPOR CHEERS Task Force Report** provides examples and further discussion of the 24-item CHEERS Checklist and the CHEERS Statement. It may be accessed via the *Value in Health* link or via the ISPOR Health Economic Evaluation Publication Guidelines – CHEERS: Good Reporting Practices webpage: <u>http://www.ispor.org/TaskForces/EconomicPubGuidelines.asp</u>

The citation for the CHEERS Task Force Report is:

Husereau D, Drummond M, Petrou S, et al. Consolidated health economic evaluation reporting standards (CHEERS)—Explanation and elaboration: A report of the ISPOR health economic evaluations publication guidelines good reporting practices task force. Value Health2013;16:231-50.