Building the Business Case for Investment in Childhood Obesity Prevention: Financial Simulation Tool

User Guide

Nemours® Children's Health System

Building the Business Case for Investment in Childhood Obesity Prevention: Financial Simulation Tool

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Introduction

Almost one in five children in the United States is overweight or obese.[1] Obesity poses serious negative consequences for the health and wellbeing of these children as they grow up, and the costs to the healthcare systems that treat resulting obesity-related co-morbidities are significant. Investment in childhood obesity prevention by child health stakeholders, including state Medicaid agencies, managed care organizations (MCOs), and other public agencies, is urgently needed. However, lack of information on the business case for investing in obesity prevention is a barrier to stakeholders' investment.

With support from the Robert Wood Johnson Foundation, Nemours Children's Health System (Nemours) and SVT Group developed a prospective financial simulation tool to estimate the costs to Medicaid or MCOs of investing in childhood obesity treatment and prevention, the savings resulting from the intervention, the expected health benefits, and the time period over which the savings will be achieved. This information is intended to help Medicaid agencies and MCOs evaluate the business case for investing in various types of obesity prevention initiatives and allow them to make informed decisions based on the potential return on investment or cost-effectiveness of interventions. By fostering investment in preventing or treating childhood obesity, this tool can support efforts to prevent adulthood obesity and its associated co-morbidities that negatively affect many lives.

Project Background

The need for a financial simulation tool arose during development of Nemours' Roadmap of Medicaid Prevention Pathways project, also funded by the Robert Wood Johnson Foundation. The Roadmap toolkit illustrates the range of Medicaid and Children's Health Insurance Program (CHIP) authorities that states can use to invest in health prevention and address chronic disease. It also includes examples of how states have successfully created sustainable financing through Medicaid and CHIP for preventing chronic disease, including childhood obesity, at both the individual and population levels. The financial simulation tool builds on this work by providing another tool for state Medicaid agencies and MCOs to use to pursue health prevention initiatives for children.

Through discussions with key state Medicaid and MCO staff during the project, Nemours learned how they make decisions about investing or not investing in health prevention. A major barrier to investing in upstream prevention initiatives is the lack of economic evidence to demonstrate the return on investment. These organizations cannot justify investment in initiatives when they have no information on expected savings, returns, and outcomes and the time period over which the savings will be achieved. This tool will help to bridge this gap and potentially promote more investment by Medicaid agencies and MCOs in childhood obesity prevention.

Childhood Obesity: A Key Health Concern

Childhood obesity is a serious health issue with many harmful consequences for children, consequences that occur across the lifespan. Healthcare costs associated with obesity are significant,[2] but the negative impacts that obesity has on quality of life are of even greater importance. Children with overweight and obesity are more likely than other children to be overweight and obese in adulthood.[3] They are also at a higher risk of serious health conditions, such as diabetes and cardiovascular disease, and psychological conditions, such as depression and anxiety. Not only does

obesity have serious co-morbidities, but it also affects other aspects of the lives of children and adults. Children with overweight and obesity are more likely to be subject to bullying and stigmatization, which is linked to lower school performance and higher school absenteeism.[4] Adults with overweight and obesity are often discriminated against when seeking employment, and studies have linked obesity to lower wages.[5] Adults with overweight and obesity may be unable to pursue jobs and careers that require a specific level of weight and fitness, such as military jobs. Over 30 percent of young adults are ineligible to join the military because they are overweight or obese.[6]

Improvements in obesity rates benefit society broadly, and thus everyone has a stake in systems that can reduce obesity rates. This financial simulation tool can support discussion of the appropriate investment roles for state policymakers, Medicaid agencies, MCOs, and other sectors serving children in supporting obesity prevention. Intervening in childhood to prevent or treat overweight and obesity is particularly important because key behavioral changes involve stepwise multi-generational processes and do not provide quick results.

Project Goal

The goal of this project is to develop a tool to inform Medicaid, MCO, and other state decision makers on the return on investment in childhood obesity prevention. The field currently lacks examples of Medicaid funding for upstream prevention, particularly obesity prevention, even though it is allowable under current Medicaid authority.[7] The tool will estimate the potential return on investment or cost-effectiveness of interventions, the timeframe for savings, and improvements in health outcomes. The business case information generated by the financial simulation tool provides the opportunity for a breakthrough in exploring Medicaid and MCO funding and reimbursement for upstream obesity prevention initiatives.

While the tool is valuable, it does have limitations. The financial simulation tool utilizes conservative estimates for the healthcare costs of people with severe obesity (see Appendix C), which may result in underestimated healthcare savings. In addition, the tool does not include the benefits of reduced childhood obesity outside the health sector. Because of the complexity of attempting to model all health benefits of reduced childhood obesity, and based on the advice of expert advisors, Nemours and SVT Group decided to address only key co-morbidities: hyperlipidemia, type II diabetes, hypertension, and asthma. Therefore, the tool does not account for all the health and social benefits associated with childhood obesity prevention, but it is an important starting point that provides valuable information on investing in obesity prevention initiatives.

Theory of Change

As stewards of public funds, state agencies, such as Medicaid, must evaluate the investment costs, anticipated outcomes, and potential for savings before funding any healthcare initiatives. When an agency lacks information on costs, savings, and outcomes, it is unable to justify such investments. This financial simulation tool seeks to fill the information gap by providing estimates that Medicaid and MCOs need to make business decisions. As outlined in Figure 1, the tool compares the estimated healthcare costs and health outcomes related to obesity for the target population if the agency invests in a preventative intervention to the expected outcomes without the intervention. The tool helps decision makers understand the extent to which investment in childhood obesity prevention can reduce child and adult obesity, influence key co-morbidities, and reduce related healthcare costs.

Figure 1. Conceptual Model of Financial Simulation Tool
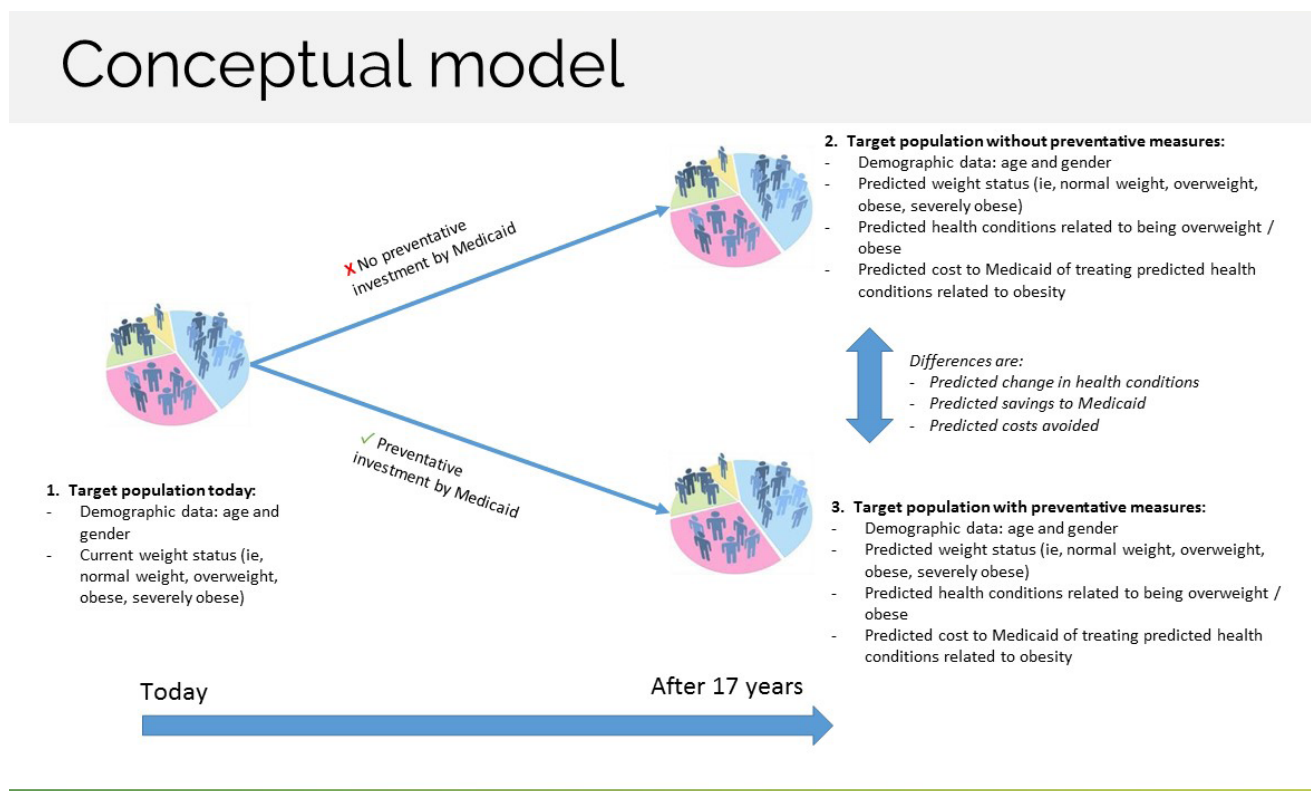
While the tool is designed for state Medicaid agencies and MCOs, additional agencies play a role in the health and wellbeing of children and can collaborate with state Medicaid agencies to invest in childhood obesity intervention initiatives. The financial simulation tool allows users to explore joint investment in childhood obesity prevention.

Key Types of Childhood Obesity Prevention Interventions

To help users of the financial simulation tool, the user guide includes (in **Appendix B**) several types of childhood obesity interventions, as well as information about these interventions that users can input into the tool if they do not have data on the specific program in which they are interested in investing. The intervention types were selected based on discussions between the project team and advisory group members on the types of interventions that are of the greatest interest to state Medicaid agencies and MCOs, are innovative and effective, and have research literature evaluating their effectiveness.

Key types of childhood obesity prevention programs are as follows:

1. **Home visiting programs**
   a) provision of parenting support on feeding practices for at-risk infants and families
   b) assessment of the home environment of children with obesity and offers of education, education, and medication adherence assistance

2. **Community-based interventions**
   a) group nutritional education and physical activity coaching for children
   b) group nutritional education
   c) physical activity coaching for children
   d) combination of nutrition education and physical activity
   e) family component

3. **Children's hospital weight management programs**

4. **Children's hospital weight management programs that focus on addressing social needs through community/ social service resources (referral, community services, and follow-up coordination)**

5. **Basic body mass index (BMI) assessment, education, and counseling in clinical or non-clinical settings**

6. **School-based interventions**
   a) group nutritional education and physical activity coaching for children
   b) group nutritional education
   c) increased availability of nutritional food
   d) physical activity coaching for children
   e) combination of nutrition education and physical activity
   f) family component

7. **Early care and education-based interventions**
   a) group nutritional education and physical activity coaching for children
   b) group nutritional education
   c) increased availability of nutritional food
   d) increased physical activity coaching for children
   e) combinations of nutrition education and physical activity
   f) family component

8. **Environmental/policy change supporting healthy eating and physical activity in different settings where Medicaid-enrolled children spend time**

This is not a comprehensive list of all childhood obesity interventions. However, it does include examples of obesity prevention interventions that are likely to be the types of interventions that state Medicaid agencies and MCOs would consider for investment. **Appendix B** provides information about the intervention types from studies selected using the following criteria:

1. Date of study (prioritizing recent studies)

2. Quality of study (prioritizing randomized controlled trials and other rigorous methodologies)

3. Sample size (prioritizing studies with larger samples)

4. Availability of effectiveness data in the form accepted by the tool (changes in weight category, changes in BMI score, and changes in BMI z-score)

5. Similarity to Medicaid population (prioritizing studies that come closest to reflecting the Medicaid population)

6. Research that is considered a seminal study (when available)

The data in **Appendix B** are not representative of the full research literature, but they offer examples of research that users can input into the tool if they do not have their own data available. Note that the literature on childhood obesity prevention is not static; it changes and evolves over time. Therefore, users should continue to test innovative approaches to obesity prevention in different settings and not treat the information provided in this user guide as the final word on the best mechanisms for preventing childhood obesity.

Cost of the Intervention Types

Users may or may not have a good idea of the likely cost of the intervention they are modeling. If they do not, the academic research on literature provides some guidance, but the data are patchy, and no standard protocol has been established to account for the costs of child obesity treatment and prevention programs. Cost data that are available often omit costs such as the following:

• opportunity costs (e.g., the value of doing something else instead of participating)

• cost of training of staff to deliver the intervention

• cost of the infrastructure needed

• early set-up and development costs (e.g., costs incurred before the intervention commences, such as development of training packages, recruitment, and coordination)

Nonetheless, the following studies provide indicative guidance on the costs, and in some cases cost-effectiveness, of the types of interventions noted above.

1. Home visiting programs
   • One study, a family-based behavioral treatment program, targeted fifty 8- to 12-year-old children with overweight/obesity and their parents with overweight/obesity. The average cost per family under this program was $1,448, resulting in a child cost-effectiveness of $209.17 per 1 percent reduction in BMI.[8]
   • Another study estimated that the cost of a certain home visiting obesity treatment program was $2,000 per participant.[9]

2) Community-based interventions
   • One study included schools, neighborhoods, and a variety of community organizations, and the intervention cost $50 per child. The study showed a large impact on cost-effectiveness from attributing a share of intervention costs to a wide network of organizations due to the collective impact of the study's community and environmental objectives.[10]
   • An Australian study included schools, neighborhoods, and community organizations and cost 2,908 Australian dollars (U.S. $2,068) per child. These costs included set-up and overhead costs.[11]

3) Prevention programs within children's hospital weight management programs and 4) children's hospital weight management programs that focus on addressing social needs

- One targeted program for children with obesity in a hospital setting cost $1,896 per child. This program included medical screenings in the child's home prior to medical treatment. The study assumed that 50 percent of doctors had the equipment necessary for the program and that 100 percent of children who participated would complete the entire program.[12]

4) Basic BMI assessment, education, and counseling in clinical or non-clinical settings

- A scan of the relevant literature found a wide variety of programs in this category, particularly for programs with a primary focus on directly changing individual behavior through physical activity, but no cost data. The diversity of studies potentially creates an obstacle for collection of cost-effectiveness data because it inhibits comparability.[13]

5) School-based interventions

- Costs for school-based interventions ranged from $14 to $473 per student, with an average cost of $159 per child.
- One school-based intervention designed to reduce obesity in youth of middle-school age, for example, cost a total of $33,677, or $14 per student per year.[14]
- A program that included education to improve nutrition and increase physical activity cost $211 per child per year. This study included school coordination costs for a national program, did not include teacher time costs, assumed that uptake by schools does not vary by type of school (public or private), and did not price parent involvement in the program.[15]
- A program that included education to improve nutrition and increase physical activity cost $473 per child per year. This study included school coordination costs for a national program, did not include teacher time costs, assumed all schools had physical education teachers, assumed that uptake by schools does not vary by type of school, and did not price parent involvement in the program.[16]
- A study targeted at children with overweight and obesity that included a peer-led program with 8th-grade student "counselors" and children with obesity in grades 2 to 5 cost $129 per child.[17]
- An education program to reduce consumption of carbonated drinks cost $28 per child. This study assumed that each child received the intervention once during primary school and that no additional school staff costs were required.[18]
- An education program to reduce TV viewing among school-aged children cost $103 per child. Modeling included the cost of national/state project officers to implement a national program and full training costs for teachers, but not teacher time in the classroom (as the program was integrated into the curriculum).[19]

6) Early care and education-based initiatives

- Cost data for this type of intervention are relatively robust, although many cost-effectiveness studies in this category are not conclusive and include ratios of financial analysis without presenting actual implementation costs.[20]
- One family-based program that targeted children with overweight and moderate obesity in a preprimary school setting cost $650 per child.[21]
- A program in a childcare setting cost $407 per child. This study included salary costs.[22]
- An intervention that focused on improving early care and education policies and practices cost $64 per child.[23]

7) Environmental/policy change supporting healthy eating and physical activity in different settings where Medicaid-enrolled children spend time

- This type of intervention is very diverse; therefore, costs per participant can vary significantly.

- In one study, three types of interventions—excise tax, elimination of the tax deduction, and nutrition standards for food and beverages sold in schools outside of meals—saved more in healthcare costs than they cost to implement and were shown to be particularly effective in the reduction of childhood obesity.[24]

- One study involved the reduction of TV advertising of high-fat and high-sugar foods and drinks to children (media and marketing). The cost of this program was $0.54 per viewer. The study excluded costs other than the cost of monitoring/enforcing compliance with the revised regulations. Excluded costs included the cost of changing the regulations, any additional food costs to families, and any impact on the revenue streams of advertising companies and food producers.[25]

- Another study involved a sugar-sweetened beverage excise tax. The cost was $0.15 cents per participant.[26]

- A study involving restaurant menu calorie labeling showed a cost of $0.10 per participant per year.[27]

- The elimination of a tax subsidy for advertising unhealthy food to children cost $0.01 per participant.[28]

- A study on nutrition standards for school meals demonstrated a cost of $40 per child.[29]

- A different study on nutrition standards for all other food and beverages sold in schools found a cost of $0.50 per child.[30]

- An outlier in terms of cost, a study that looked at increased access to bariatric surgery for adolescents revealed a cost of $8,360 per child.[31]

Financial Simulation Tool Overview

Purpose of the Financial Simulation Tool

Childhood obesity is a serious health challenge in the United States: almost one in five children are overweight or obese. However, some childhood obesity interventions have been proven to be effective.

The tool will help state Medicaid agencies and MCO staff fill the void of information on the business case for investing in childhood obesity prevention and treatment interventions. The outputs from the tool regarding the intervention costs, savings to healthcare, timing of savings, and health outcomes will help agencies decide whether to invest in childhood obesity prevention and treatment initiatives.

Intended Users of the Tool

The tool was developed to help Medicaid and MCO policy, data, and decision-making staff assess the business case for investment in childhood obesity prevention. An understanding of Medicaid and MCO data would be helpful to a user but is not necessary for use of the tool. Anyone interested in the healthcare costs, savings, and timing of savings associated with childhood obesity prevention and treatment may find the tool useful.

Tool Outputs

The tool provides these types of information as outputs:

1. The projected change in weight status of the participating children (and parents if applicable) 17 years after the intervention.
2. The projected change in rates of key co-morbidities for the participating children 17 years after the intervention.
3. The costs of the intervention over time, the expected amount and timing of healthcare savings, and timing of the financial break-even point for Medicaid and other healthcare payors.
4. Charts of the data generated by the tool.

Use of the Tool Outputs

The output from the tool can be used to do the following:

1. Determine whether the amount or timing of expected savings from the intervention justifies the investment financially.
2. Compare the amount or timing of expected savings from different kinds of interventions.
3. Frame the business case for investment in a childhood obesity prevention and treatment intervention and demonstrate how the intervention can help the Medicaid agency or MCO achieve its goals.

Data Needed for Tool Inputs

The user will need to enter the following data into the tool:

1. Cost of intervention per participant.

   If you do not have this information, you can find example cost data from research in this user guide (see Cost of the Intervention Types).

2. The portion of the cost of the intervention that Medicaid and other potential partners will cover.

3. The number and age of children in the intervention.

4. The number of parents targeted by the intervention if parents are involved in the intervention activities.

5. The expected effectiveness of the intervention on the children (and on parents, if applicable).

   If you do not have this information, you can find example data from research in Appendix B.

Technical Guide to the Tool

This section provides users with step-by-step instructions to use the financial simulation tool. It also provides guidance on the ways that users can customize default data in the tool if they have detailed data on their intervention population available. The instructions below supplement the instructions embedded throughout the tool.

Technical Specifications and Computing Needs

The tool requires Microsoft Excel. The tool was built using Excel 2016 for Mac, and some of the design work was done in Excel 2013 and 2015. The tool contains macros, so when opening the tool after downloading it, the user should accept the macros.

The tool was screened for viruses by Nemours' Corporate Information Security department prior to public release. If users would like to conduct additional virus screens, they should use programs that are compatible with Microsoft Excel, such as Microsoft Windows Defender, McAfee anti-virus software, or Norton Security.

Note that some of the user interface, such as whether an entire tab is visible on the user's screen without adjustment or whether all text fits in a cell, may depend on the user's settings. The user's computer make and model, operating system, and version of Excel will affect the appearance of the tool, and the user may need to manually adjust some of the formatting to ensure that all text is readable.

Tool Inputs

The tool uses three sets of data:

Set 1: Default data: The default data that are automatically input into the tool are in the blue cells in the three user-controlled tabs. Sources for the default data are provided in Appendix C. Users can change the default data (see Changing Default Data, below).

Set 2: Embedded data: Data that are embedded in the tool and are used to generate results include the following:

1. estimates of the likelihood of people being in a given weight category at a given age;
2. estimated costs of obesity to the healthcare system; and
3. prevalence and estimated incidence rates for obesity-related health conditions.

Sources of the embedded data are provided in Appendix C.

Set 3: Data input by users: The user enters data into the yellow cells, as detailed below.

User Inputs

The tool contains three tabs or worksheets that require users to input data (user-input tabs):

1. Your Intervention
2. Cohort
3. Effect

Users need to input data into the **yellow cells** of these tabs to generate the results (on the Results tab) and the accompanying charts (on the tabs that start with "Chart-…").

Your Intervention Tab

Selecting Your State: Using the first drop-down box, select your state.

Selecting Intervention Type: Using the second drop-down box, select the intervention type, using the typology developed for the Roadmap of Medicaid Prevention Pathways. If the intervention fits more than one type, pick the closest one.

Entering the Program Cost: Enter the expected program cost, or investment, per participant for the intervention (including adults if they are targeted by it) in cell F/G22. *If you do not know the costs, refer to the Cost of the Intervention Types section above for guidance.*

Enter the share of the investment that will be covered by each of the following:

1. Medicaid (federal and state Medicaid);
2. Private insurers (e.g., other healthcare payors); and
3. Other funding sources, such as public health departments, the education system, foundations, etc.

The percentages must total 100 percent.

Cohort Tab

Entering Number of Child Participants: Enter the number of children who will participate in the intervention by their age at the time of the intervention (in column D). (See Changing Default Data below for details on how to override the state default weight categories.)

Entering Number of Parent Participants: Enter the total number of participating parents (in cell C42) (this is relevant for interventions that include parents in the intervention activities).

Effect Tab

Choosing Estimate of Effectiveness for Children: The tool allows users to enter estimates of the effectiveness of obesity prevention interventions (effect sizes) for **children** in one of three ways (in row 18, cells M to X):

1. the percentage of participants in each of four weight categories after the intervention;
2. the average (mean) reduction in BMI score for participants due to the intervention; or
3. the average (mean) reduction in BMI z-score for participants due to the intervention.

If using option 1, users should change the tool defaults for the percentage of participants in each of the four weight categories before the intervention to make a valid "before vs. after" comparison (see Changing Default Data).

Choosing Estimate of Effectiveness for Parents: Similarly, users can enter estimates of the effectiveness of obesity prevention programs (effect sizes) for **participating parents** in one of two ways (in row 41, cells M to V):

1. the percentage of participants in each of four weight categories after the intervention; or
2. the average (mean) reduction in BMI score for participants due to the intervention.

There is no option to enter the average (mean) reduction in BMI z-score for parents because parental weight change is not measured by changes in BMI z-scores.

Users should enter effect sizes for children and parents using only one of these ways; otherwise, the tool will double-count effects and produce invalid results.

Predicting Duration of Effectiveness: Users also need to predict how long the effect of the intervention will last (in row 45) from a drop-down menu. Participants may revert to their pre-intervention behavior and weight trajectory very soon after the intervention or may never do so. The duration of the effect is typically not provided in research papers, as long-term follow-up of participants is rare. Users must use their own judgment when selecting which of the three preset trajectories of the duration of intervention effectiveness to use or enter their own estimates using the Override Defaults tab.

The three default trajectory options are as follows:

- Long-term (initial effect does not fade)
- Medium-term (initial effect slowly fades)
- Short-term (initial effect fades quickly)

It is possible, though unlikely, that the effect of the intervention could increase rather than decrease over time. For example, the intervention could make such a strong impression on participants regarding the long-term importance of physical activity and nutrition that the effect on their adult weight is greater than the effect on their childhood weight. To model this, users can override defaults to enter percentages higher than 100 percent (see Changing Default Data).

Dealing with Standardized Effect Sizes

Some research papers describe the effect of an obesity prevention program using a standardized effect size rather than a change in a measure of obesity. A standardized effect size is a measure that has been converted, using a statistical formula, to a common measure of effect sizes that can be compared to effect sizes of other interventions, even very different ones.

If the effect size of an intervention is given as a standardized effect size, it will be possible to calculate the unstandardized effect size if the underlying data are also provided. If the underlying data are not provided, conversion of the standardized measure to the unstandardized measure will not be possible.

Limits of Customization

The tool is designed to be simple to use. This simplicity comes at the expense of some ability to customize the tool. In particular, the tool applies the average reduction in BMI or BMI z-score to all children in a cohort. As a result, users cannot do the following:

1. enter different effect sizes for different ages; or
2. enter different effect sizes for participants in different weight categories (e.g., one effect size for children with overweight and a different effect size for children with obesity).

To circumvent this limitation, users can choose one of these approaches:

1. estimate the average effect for the entire cohort, such as by estimating a weighted average; or
2. create separate models for sub-groups, such as one model for each age or one model for each weight category, and add the results of the models to get results for the whole cohort.

Creating separate models for different weight categories would require changing the default data for weight categories (see Changing Default Data).

Changing Default Data

In some cases, users may have detailed information on the population they would target with an intervention and want to obtain estimates based on the specific characteristics of the population. For example, a state Medicaid agency might want to target children with overweight with an intervention that has a goal of preventing the participants from becoming obese. To account for this target population, the user would want to change the share of intervention participants in the initial weight categories.

Users can change the default data on the Override Defaults tab.

When the Override Defaults tab is open, users can override the tool defaults by entering data in the yellow cells. The changes made in this tab appear in the blue cells in the three user-controlled tabs.

If users decide to switch back to the default data after entering custom data, they must delete the data they entered in the Override Defaults tab.

Users who want to change the default percentages for the number of children and participating parents in each of the four weight categories should note that the weight categories are based on Centers for Disease Control and Prevention (CDC) standards, with severe obesity defined as a BMI of 40 or higher for adults, as shown in Table 1.[i]

Users cannot change other tool parameters.

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i   The only exception, to facilitate the calculation, is that for children the definition of severe obesity used in the model is >99th percentile of the reference group, rather than the CDC's definition of severe obesity, which is 120 percent or more of the 95th percentile of the reference group. This difference is unlikely to significantly affect the results unless the intervention is targeted to a group of children that is already severely obese.

Table 1. Weight Categories by BMI and BMI Z-Scores

	BMI score		BMI z-score (children only)		
Weight Category	Low	High	Low	High	Percentile of reference group
Normal/underweight	–	<	0	1.036	<85th percentile
Overweight	25	<	>1.036	1.645	85th-95th percentile
Obese	30	<40	>1.645	2.326	95th-99th percentile
Severely obese	40	–	>2.326	–	>99th percentile

Sources: Centers for Disease Control and Prevention. Defining Adult Overweight and Obesity. 2016. Available at: **https://www.cdc.gov/obesity/adult/defining.html**. Centers for Disease Control and Prevention. About Child & Teen BMI. 2015. Available at: **https://www.cdc.gov/healthyweight/assessing/bmi/childrens_bmi/about_childrens_bmi.html**. MeasuringU. Percentile to Z-Score Calculator. Available at: **https://measuringu.com/zcalcp/**. Accessed September 11, 2018.

Sensitivity Analysis

All the parameters in the tool are subject to uncertainty. Sources are provided in **Appendix C** to assist users in understanding the uncertainty in the tool and formulating their own judgments. The tool does not have built-in sensitivity analysis because the inclusion of it would make the tool very complex and slow it down. Users can conduct their own sensitivity analysis by adjusting the parameters that are user controlled and by changing the defaults.

Saving Results

The user can save as many versions of the results as desired by saving the tool under a new name each time.

Interpreting Results

How to Interpret Outputs of the Tool

The tool outputs are indicative, not precise, predictions of what is expected to occur based on the best available data (see **Appendix C**). All predictions contain uncertainty, and the tool uses generalized data and averages that may not be appropriate for every context and population.

The tool predicts obesity-related healthcare costs, potential savings from investments in preventing childhood obesity, and potential benefits in the rates of four specific health conditions for 17 years after the intervention (e.g., if the intervention occurs in year 1, predictions are made up to and including year 17). The reasons for this timeframe are as follows:

- The best data available for predicting future weight categories of children and young people end at age 35 (17 years after 18-year-olds participate in any program). No appropriate sources for predicting weight categories after this age are available.
- Users of the tool are likely to be interested in time horizons that are 17 years or less. In other words, the tool assumes that predictions beyond 17 years will not have much influence on today's decisions made by Medicaid or MCOs.

In terms of estimating the duration of the effect of a particular intervention, very little research has addressed the duration of the effects of childhood obesity prevention and treatment initiatives. Therefore, the model provides three potential trajectories (long-, medium-, and short-term duration) based on assumptions of reasonable durations. Users can select one of these trajectories or enter their own trajectory using the Override Defaults tab.

The tool outputs should not be used alone to guarantee savings to any healthcare payor. The outputs are estimates and are subject to uncertainty. Nemours does not guarantee the accuracy of the tool predictions, nor the results of any childhood obesity prevention or treatment interventions. This tool is intended to offer general predictions that estimate costs, savings, and outcomes. The limitations and assumptions underlying the tool are discussed in **Appendix C**.

The data outputs in each block on the Results tab and in the chart tabs are explained briefly here.

"Intervention" Block

This block summarizes the user's key inputs: the type of intervention, the number of participating children, and the number of participating parents, if relevant.

"Investment" Block

This block shows the total investment required for an intervention and the amounts expected to be provided by different healthcare payors. The numbers in the cells for the different types of payors are overlapping and not additive. The amounts in the cells relate to each other using the following equation:

Total investment required = cost per participant × number of participants = investment from all healthcare payors (federal Medicaid, state Medicaid match, private) + investment from non-healthcare payors (e.g., department of health, foundations, etc.).

This block does not separate the amount to be paid by non-healthcare payors.

"Change in Weight Categories" Block

This block explores the long-term impact of the intervention on weight of participants after the intervention through several measures:

1. The number of individuals (children and adults) by weight category at the time of intervention.
2. The number of individuals (children and adults) by weight category in year 17, assuming the intervention **did not** take place.
3. The number of individuals (children and adults) by weight category in year 17, assuming the intervention **did** take place.
4. The difference between 2 and 3, due to the intervention.
5. The difference between 2 and 3 due to the intervention for children only, excluding participating parents.

"Change in Selected Health Conditions" Block

This block provides estimates of the cumulative reduction in the number of years a person is expected to have a health condition, referred to as person-years, for four obesity-related health conditions after the intervention. One person-year is equal to one year of one person not having the health condition. Five person-years could be interpreted as one person not having the condition for five years, or five people not having the condition for one year each.

"Cumulative Healthcare Savings" Block

This block provides the following estimates:

1. The cost of obesity to healthcare systems (e.g., the cost due to people being overweight, obese, or severely obese compared to normal weight) for the participating population over 17 years assuming that there is **no** prevention intervention in year 1.
2. The cost of obesity as for 1, assuming that there is a prevention intervention in year 1.
3. The difference between 1 and 2, which equals the savings due to the intervention.
4. The healthcare savings from 3 (e.g., the savings as in 3 minus the investment in year 1).

These outputs consider the perspective of three sets of investors:

1. Federal and state Medicaid only
2. All healthcare payors (federal and state Medicaid, and private healthcare payors)
3. All investors (healthcare payors and other sectors, such as public health, education, etc.)

This block shows the investment from all three sets of investors, but the downstream cost **savings** due to the intervention are estimated for **healthcare** payors only. This is because the model estimates cost savings for healthcare investors only. It cannot calculate cumulative savings of all kinds for investors whose savings are outside the healthcare system (savings due to reduced employee absences, improved school attendance, etc.).

"Break-Even Point" Block

This block contains the number of years required for the savings that result from lower cost of obesity to exceed the investment in the intervention. This break-even point is calculated twice:

- For federal and state Medicaid. Because the initial investment and downstream savings are split proportionately between federal and state Medicaid, the break-even point is the same for both.
- For all healthcare payors (federal and state Medicaid, and private healthcare payors).

As in the "Cumulative Healthcare Savings" block, the tool does not estimate a break-even point for all investors (when investors other than healthcare payors are involved), because only the potential savings for healthcare are included.

The tool projects costs and savings for 17 years. If savings do not exceed the investment required within 17 years, the tool shows ">17 years," which means it will take more than 17 years for payor savings to exceed the investment.

Chart Tabs

The tool provides several charts of the output. These charts allow the user to better visualize the expected intervention outcomes. The charts include the following:

Chart—obesity levels children: Compares the estimated number of children by weight category for each year after the intervention for 17 years with and without the intervention taking place.

Chart—obesity levels adult: Compares the estimated number of participating parents by weight category for each year after the intervention for 17 years with and without the intervention taking place.

Chart—obesity levels all: Compares the estimated number of children and participating parents by weight category for each year after the intervention for 17 years with and without the intervention taking place.

Chart—net savings to Medicaid: Shows the net cumulative savings to both federal and state Medicaid for each year after the intervention up to 17 years.

Chart—net savings to all payors: Shows the net cumulative savings to all healthcare payors (federal and state Medicaid, and private healthcare) for each year after the intervention up to 17 years.

Chart—change in health outcomes: The cumulative reduction in person-years of four health conditions for each year after the intervention up to 17 years.

Illustrative Example: Modeling a Children's Hospital Weight Management Program

Utilizing the illustrative example of children's hospital weight management programs provided in Appendix B, below is a demonstration of how to enter inputs into the tool and how to interpret the outputs and develop the larger story of the intervention for the funding agency.

Your Intervention Tab

Figure 2. Your Intervention Tab

Description of your intervention
The state selected determines the State Medicaid match, the default weight categories and Medicaid eligibility as adults.

State:	Maryland

Intervention type	Investment needed per participant	Sources of Investment				State Medicaid match (%)	Federal Medicaid assistance per participant ($)	State Medicaid match per participant ($)
		Medicaid	Private Insurers and Medicare	Other sources (e.g. public health, education)	Total			
Individual - IL3	$150.00	100%	0%	0%	100%	38.9%	$91.65	$58.35

Intervention Type Key			
Intervention Type	Code		Description
Individual	IL - 1		Physician or other licensed practitioner (OLP) provides individual Medicaid enrollee a preventive service in a medical setting.
	IL - 2		In addition to IL-1, provider refers the individual to a community-based organization for non-medical supportive and upstream services. May also include provision of case management or care coordination.
	IL - 3	Individual Medicaid enrollee receives preventive service in non-traditional way:	**A:** Physician or OLP provides individual Medicaid enrollee a preventive service outside of a medical setting in the community.
			B: Non-traditional provider delivers an individual Medicaid enrollee a preventive service.
			C: Individual Medicaid enrollee receives an upstream or non-medical service in the community.

Beginning at the top of the Your Intervention tab (Figure 2), the user selects the state in which the childhood obesity intervention will be simulated. In this example, the user will model implementation of the intervention in Maryland.

Using the information in the illustrative example form, the user will select the intervention type (circled in red in Figure 3) from the drop-down menu in the yellow cell. In the next column, "Investment needed per participant," the user will enter, in the yellow cell, the program cost per participant that the intervention payor would have to invest in the intervention.

Figure 3. Intervention Type(s)

Intervention Type(s)	(3) Children's hospital weight management programs
Intervention Summary	This study addressed the efficacy of family-based, behavioral weight control in the management of severe pediatric obesity. Study participants included 192 severely obese children; their parents also participated in part of the program.
Effect of Intervention (use data to populate Effect tab in model)	
Change in Weight Category/BMI/BMI z-score *Enter information into appropriate columns (m-x) in row 19 on the Effect tab of model*	The intervention was associated with a 7.58% decrease in child percent overweight at 6 months.
Medicaid Information Listed below each intervention type are examples of the Medicaid/CHIP statutory authority that a state could potentially use to cover the intervention. The classification in **blue** is from the Nemours Roadmap. **Click here to access the Roadmap for more detail.**	Group nutrition counseling (including but not limited to Medicaid/CHIP recipients) at a medical center **(IL-3, PL-1)** • EPSDT: Section 1905(r) • Preventive services: Section 1905(a)(3) Lifestyle coach to review records/set weekly goals **(IL-3B, PL-1)** • Preventive services: Section 1905(a)(13) for Medicaid recipients only • Managed care: "value added" services for Medicaid recipients only • Section 1115 waiver *Most states also have approval to use managed care through State Plan authority (Section 1932(a)) or waiver authority (Section 1915(a) or (b)). Medicaid managed care organizations have flexibility to cover a non-medical "value added" service if the service improves healthcare quality under 45 CFR Section 158.150. In addition, a Section 1115 waiver could provide authority for a state to cover individuals and services not typically covered by Medicaid.*

Next, under "Sources of investment," the user will enter, in the yellow cells, the share of the cost that each payor will contribute to the investment needed for the intervention. The tool will automatically calculate the investment costs per participant for the federal and state Medicaid programs based on the federal Medicaid assistance percentage (FMAP) for each state.

After filling in the yellow cells, the user will select the Cohort tab.

Cohort Tab

Figure 4. Cohort Tab

Children in cohort		Weight category @ intervention				Gender		Eligibility for Medicaid	
Age of children receiving intervention	Number of children	Normal / underweight	Overweight	Obese	Severly obese	Male	Female	Eligibility under 18	Eligibility as adult
All ages:	190	66.4%	16.7%	11.4%	5.5%	50.0%	50.0%	100.0%	34.0%
2		66.4%	16.7%	11.4%	5.5%	50.0%	50.0%	100.0%	34.0%
3		66.4%	16.7%	11.4%	5.5%	50.0%	50.0%	100.0%	34.0%
4		66.4%	16.7%	11.4%	5.5%	50.0%	50.0%	100.0%	34.0%
5		66.4%	16.7%	11.4%	5.5%	50.0%	50.0%	100.0%	34.0%
6		66.4%	16.7%	11.4%	5.5%	50.0%	50.0%	100.0%	34.0%
7		66.4%	16.7%	11.4%	5.5%	50.0%	50.0%	100.0%	34.0%
8	38	66.4%	16.7%	11.4%	5.5%	50.0%	50.0%	100.0%	34.0%
9	38	66.4%	16.7%	11.4%	5.5%	50.0%	50.0%	100.0%	34.0%
10	38	66.4%	16.7%	11.4%	5.5%	50.0%	50.0%	100.0%	34.0%
11	38	66.4%	16.7%	11.4%	5.5%	50.0%	50.0%	100.0%	34.0%
12	38	66.4%	16.7%	11.4%	5.5%	50.0%	50.0%	100.0%	34.0%
13		66.4%	16.7%	11.4%	5.5%	50.0%	50.0%	100.0%	34.0%
14		66.4%	16.7%	11.4%	5.5%	50.0%	50.0%	100.0%	34.0%
15		66.4%	16.7%	11.4%	5.5%	50.0%	50.0%	100.0%	34.0%

On the Cohort tab (Figure 4), the user will scroll down to enter the characteristics of the population that the intervention will target. Using the information on the target group in the illustrative example (circled in purple in Figure 5), the user will enter, in the yellow cells in the "Number of children" column, the expected number of individuals served by the intervention in the target age range. In this example, the user enters an equal number of children at each age (8 to 12 years). In the "Weight category @ intervention" columns, the user can retain the default values, which are the state averages for the child weight categories, or the user can input different values, for example, if the intervention targets children with overweight, obesity, and severe obesity only. The user can also change the default values for the gender of the children in the intervention population, if appropriate. The tool assumes that all the children in the intervention will be Medicaid enrollees. In the final column, the share of the children expected to enroll in Medicaid in adulthood defaults to the national average.

If the user has specific information on the targeted population, the user can override the defaults using the Override Defaults tab, as described previously.

Figure 5. Intervention Characteristics in Illustrative Example

Intervention Characteristics	
Target Group BMI Category	Severely Obese (BMI >97th percentile)
Target Group Age Range	8-12 years
Other Population Information	Not specified
Provider Type (physician, other licensed provider, nontraditional provider)	Physician
Setting (e.g., medical, community)	Medical
Mode of Delivery (in-person/virtual, individual/group)	In-person, group
Focus (prevention, treatment, both)	Treatment
Intervention Component(s)	Dietary intake, behavioral strategies
Dosage	Twenty 60-minute group sessions over the first six months and six booster sessions in the six months after treatment.
Study Design	Randomized controlled trial
Article Details	Kalarchian MA, Levine MD, Arslanian SA, et al. Family-based treatment of severe pediatric obesity: randomized, controlled trial. Pediatrics. 2009;124(4):1060-1068.

In this illustrative example, the intervention is targeted to children with severe obesity, and parents are not involved. Therefore, the user must access the Override Defaults tab to set the correct share of children in the weight categories. As seen in Figure 6, the user sets the weight categories to categorize all the participants as severely obese. No other defaults need to be overridden, so the user selects the next tab, the Effect tab.

Figure 6. Override Defaults Tab

Intervention tab

State Medicaid match (%)

If cells are left blank, the tool uses the default figures. Use zeroes instead of blanks to override default figures

Cohort tab

Children

	Weight category at intervention				Gender		Eligibility for Medicaid	
	Normal/ underweight	Overweight	Obese	Severely obese	Male	Female	Eligibility under 18	Eligibility as adult
All ages	Enter data for each age	Enter data for each age	Enter data for each age	Enter data for each age	Enter data for each age	Enter data for each age	Enter data for each age	Enter data for each age
2								
3								
4								
5								
6								
7								
8	0.0%	0.0%	0.0%	100.0%				
9	0.0%	0.0%	0.0%	100.0%				
10	0.0%	0.0%	0.0%	100.0%				
11	0.0%	0.0%	0.0%	100.0%				
12	0.0%	0.0%	0.0%	100.0%				
13								
14								
15								
16								

Effect Tab

On the Effect tab (Figure 7), the user enters information into the yellow cells based on the anticipated effects of the intervention on the cohort (circled in green in Figure 3). This user assumes that the 7.58 percent reduction in the number of overweight children meant that 7.6 percent of the participants transitioned from severely obese to normal weight during the intervention. Therefore, the user entered 7.6 percent into the "After intervention" normal weight category and the remainder of the participants in the severely obese category.

Figure 7. Effect Tab

Effects on children

Age of children receiving intervention	Number of children	Before intervention				After intervention				Change in BMI score	Change in BMI z-score
		Normal / underweight (%)	Overweight (%)	Obese (%)	Severely obese (%)	Normal / underweight (%)	Overweight (%)	Obese (%)	Severely obese (%)		
All ages:	190	66.4%	16.7%	11.4%	5.5%	7.6%			92.4%		
2	0	66.4%	16.7%	11.4%	5.5%	7.6%	0.0%	0.0%	92.4%		
3	0	66.4%	16.7%	11.4%	5.5%	7.6%	0.0%	0.0%	92.4%		
4	0	66.4%	16.7%	11.4%	5.5%	7.6%	0.0%	0.0%	92.4%		
5	0	66.4%	16.7%	11.4%	5.5%	7.6%	0.0%	0.0%	92.4%		
6	0	66.4%	16.7%	11.4%	5.5%	7.6%	0.0%	0.0%	92.4%		
7	0	66.4%	16.7%	11.4%	5.5%	7.6%	0.0%	0.0%	92.4%		
8	38	0.0%	0.0%	0.0%	100.0%	7.6%	0.0%	0.0%	92.4%		
9	38	0.0%	0.0%	0.0%	100.0%	7.6%	0.0%	0.0%	92.4%		
10	38	0.0%	0.0%	0.0%	100.0%	7.6%	0.0%	0.0%	92.4%		
11	38	0.0%	0.0%	0.0%	100.0%	7.6%	0.0%	0.0%	92.4%		
12	38	0.0%	0.0%	0.0%	100.0%	7.6%	0.0%	0.0%	92.4%		
13	0	66.4%	16.7%	11.4%	5.5%	7.6%	0.0%	0.0%	92.4%		
14	0	66.4%	16.7%	11.4%	5.5%	7.6%	0.0%	0.0%	92.4%		
15	0	66.4%	16.7%	11.4%	5.5%	7.6%	0.0%	0.0%	92.4%		
16	0	66.4%	16.7%	11.4%	5.5%	7.6%	0.0%	0.0%	92.4%		
17	0	66.4%	16.7%	11.4%	5.5%	7.6%	0.0%	0.0%	92.4%		
18	0	66.4%	16.7%	11.4%	5.5%	FALSE	0.0%	0.0%	92.4%		

Next, the user must select a time frame for the estimated drop-off of effect for each year. This allows the user to simulate a decrease in the impact of an intervention over time. In this case, the user input is Long-term (initial effect does not fade) as shown in Figure 8.

Figure 8. Estimated duration of effect

Estimated duration of effect

Duration of effect	Long-term (initial effect does not fade)

Percent of effect that happens each year after the intervention (year of implementation is year 1)																
Year	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
% Effect	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%

The user is now done entering inputs into the tool and can begin to review the results and assess the expected outcomes of the intervention.

Results Tab

Figure 9. Results Tab

| RESULTS. See also the "Chart" tabs for graphs of these results | SEE THE USER GUIDE FOR HELP USING THIS TOOL |

Intervention Summary

Intervention			Investment			
Intervention type	Number of children	Number of participating parents	Total investment required	From private and public healthcare payors	From Federal and State Medicaid	From State Medicaid only
Community - PL2	190	0	$28,500	$28,500	$28,500	$11,087

Change in weight categories after 17 years

	Normal / underweight	Overweight	Obese	Severely obese
In year 1	0	0	0	190
Expected in year 17 without program	5	19	24	141
Expected in year 17 with program	10	22	25	132
Change (all)	5	3	1	-9
Change for children only	5	3	1	-9

Change in selected health conditions over 17 years

	Diabetes (types I and II)	Hypertension	Hyperlipidemia	Asthma
Reduction in total person-years with condition	0.28	0.31	0.41	0.73
Reduction for children only	0.28	0.31	0.41	0.73

On the Results tab, the user will find outputs from the tool regarding the expected outcomes of the intervention. At the top of the tab is a summary of the intervention and investment inputs. The rest of the tab presents estimates of the expected outcomes in changes of weight status for the target population 17 years after the intervention begins, as well as estimated reductions in the rates of key obesity co-morbidities (as shown in Figure 9).

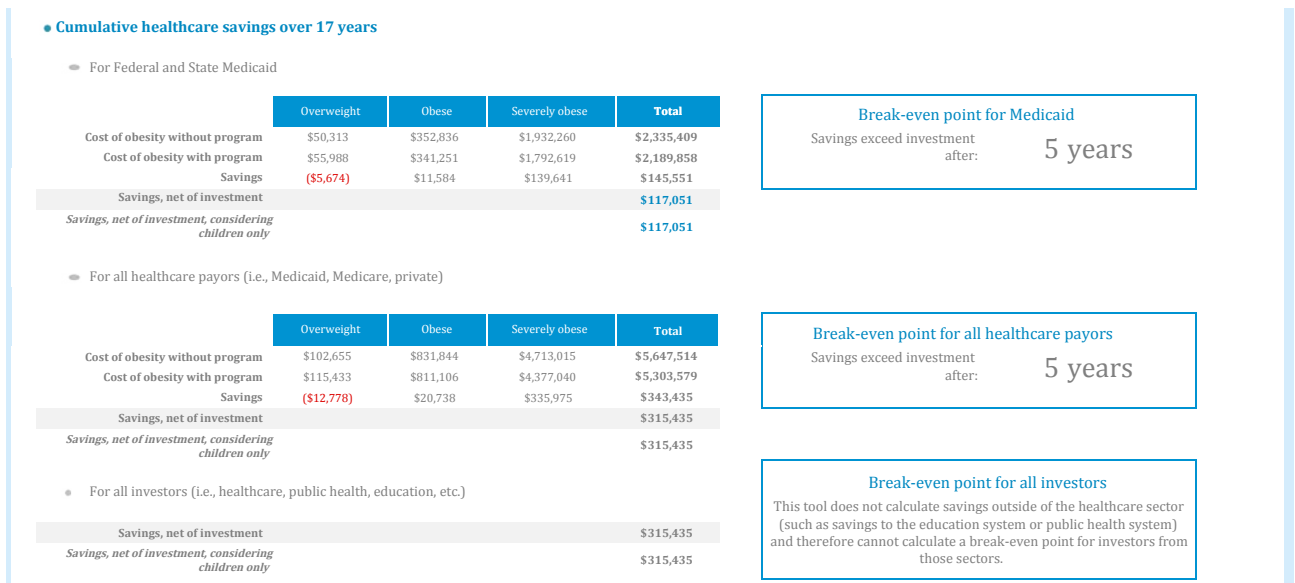In this example, the user finds that of the total investment needed in the intervention ($28,500), Maryland's Medicaid agency would be responsible for $11,087 of the investment, and the federal Medicaid dollars would cover the rest of the costs.

In terms of changes in weight for participating children, the tool shows that after 17 years, the intervention could reduce the number of children with severe obesity (some of whom will be adults by then) by 9. This particular intervention also is estimated to result in reductions in rates of asthma for the participating children after 17 years.

Figure 10. Results Tab (continued)

Cumulative healthcare savings over 17 years

For Federal and State Medicaid

	Overweight	Obese	Severely obese	Total
Cost of obesity without program	$50,313	$352,836	$1,932,260	$2,335,409
Cost of obesity with program	$55,988	$341,251	$1,792,619	$2,189,858
Savings	($5,674)	$11,584	$139,641	$145,551
Savings, net of investment				$117,051
Savings, net of investment, considering children only				$117,051

Break-even point for Medicaid
Savings exceed investment after: **5 years**

For all healthcare payors (i.e., Medicaid, Medicare, private)

	Overweight	Obese	Severely obese	Total
Cost of obesity without program	$102,655	$831,844	$4,713,015	$5,647,514
Cost of obesity with program	$115,433	$811,106	$4,377,040	$5,303,579
Savings	($12,778)	$20,738	$335,975	$343,435
Savings, net of investment				$315,435
Savings, net of investment, considering children only				$315,435

Break-even point for all healthcare payors
Savings exceed investment after: **5 years**

For all investors (i.e., healthcare, public health, education, etc.)

	Total
Savings, net of investment	$315,435
Savings, net of investment, considering children only	$315,435

Break-even point for all investors
This tool does not calculate savings outside of the healthcare sector (such as savings to the education system or public health system) and therefore cannot calculate a break-even point for investors from those sectors.

In addition to estimating health outcomes, the tool predicts the cost savings associated with the intervention and the number of years until the intervention's cost would equal its resulting savings, also called the break-even point. The predicted cost savings for the intervention are broken out by the costs associated with individuals in the different weight categories and estimated savings for the various payors who would fund the intervention. With this example, the intervention is expected to break even for Medicaid after 5 years (Figure 10). The model also estimates that after 17 years, the intervention will yield a net savings of $117,051 for Medicaid and more than $315,000 for all healthcare payors (Medicaid and others) combined.

Crafting the Business Case

Generating outputs from the financial simulation tool on investment costs, savings, and outcomes is only the first step in building a business case for investing in childhood obesity prevention. State Medicaid agencies, MCOs, and their partners can use outputs from the tool to frame discussions with key stakeholders around investing in important health priorities. As discussed above, childhood obesity affects not just children's health and their health in adulthood, but also aspects of their lives that are key priorities for multiple state and federal agencies, such as school performance, employment and income, and military readiness. State Medicaid agencies can use the tool outputs to tell the bigger story of why investment in childhood obesity is important and valuable and how it can move the needle of health improvement over the course of a child's life.

State Medicaid Agencies

The first step for a state Medicaid agency using the tool to build a business case is to identify the key factors that will influence the decision to invest in a childhood obesity intervention. Potential considerations include the following:

- The amount of potential cost savings achieved by an intervention
- The estimated savings that would accrue to the state Medicaid program if Medicaid and other funding sources are combined for the investment
- When the savings will have paid for the investment (the break-even point)
- Whether the intervention is cost-effective even if it does not achieve overall savings
- The estimated impact on obesity co-morbidities

The agency's priorities and needs will determine which tool outputs will be of greatest importance in the decision making. Even if an agency's decision may be based on expected savings, the tool provides other key information on the outcomes of an intervention that are key to building support for an intervention, such as expected reductions in the number of children who grow up to be overweight or obese and may experience co-morbidities such as type II diabetes. Even when finances are a key part of an agency's investment decisions, it is important to communicate the larger picture and the full range of financial and health outcomes that are expected to be important to stakeholders such as policymakers. The tool provides concrete estimates that can help an agency communicate the benefits of investing in a childhood prevention initiative and the broader value of the initiative in terms of improving population health by reducing not just obesity rates but also rates of hypertension, type II diabetes, asthma, and other conditions.

The tool generates several charts that provide a visual, easy-to-digest representation of the expected health outcomes and savings from an intervention. Tool users can use or adapt these charts to clearly show decision makers and stakeholders the advantages or disadvantages of various interventions.

Figure 11. Net Savings to Medicaid
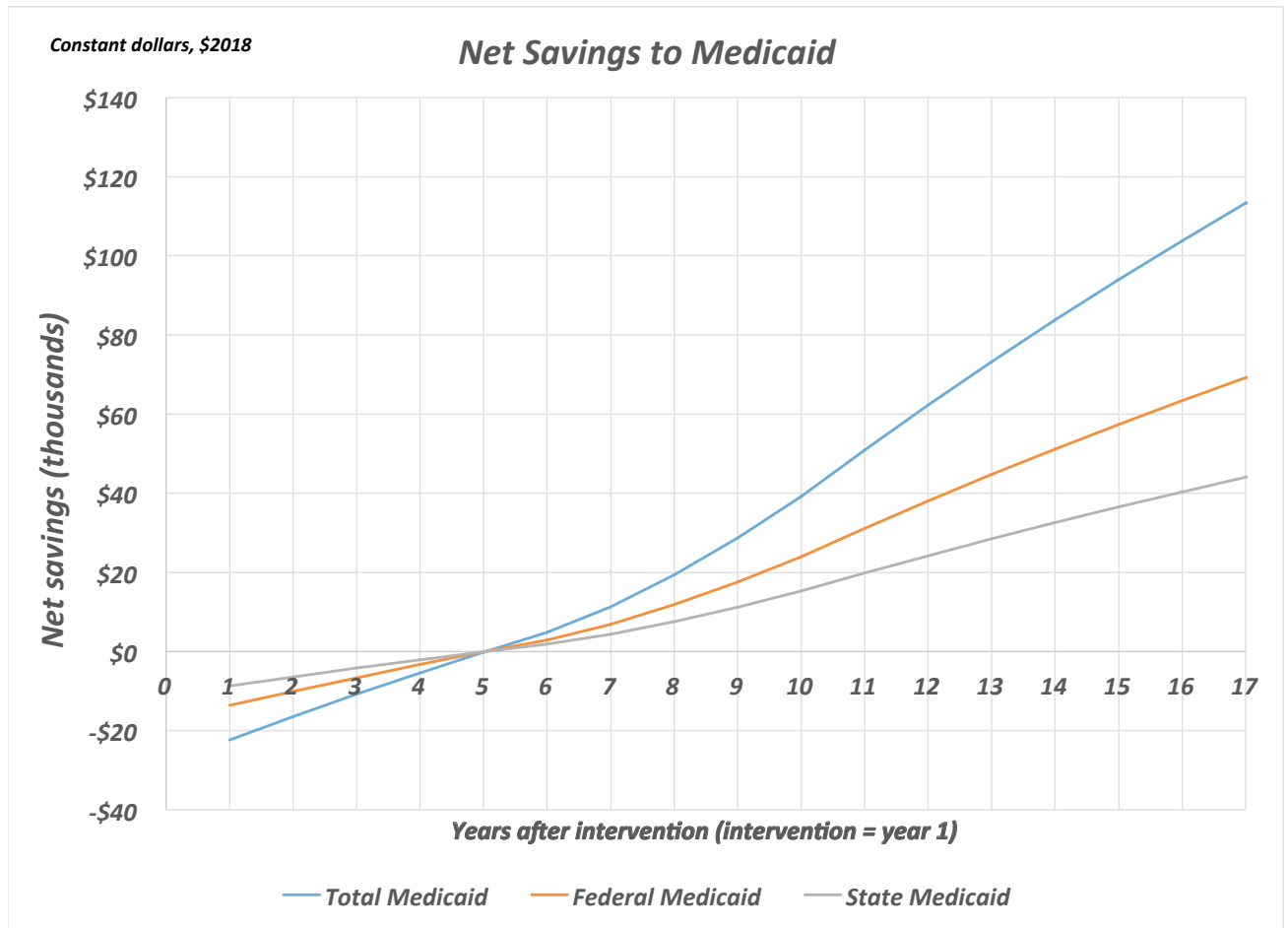
For example, the chart generated by the tool in Figure 9 shows clearly how the illustrative example modeled above results in significant savings to both federal Medicaid and Maryland Medicaid over 17 years. This chart can help Medicaid staff make a compelling case for investment in the intervention due to anticipated savings.

State Medicaid agencies do not make decisions based on financial considerations alone. They must fulfill their mission, not just to provide healthcare coverage, but to also promote health in the long term when possible. Figure 10, another chart provided by the tool, provides important information about the wider health impacts of the obesity treatment intervention modeled in the example. The chart shows how the intervention can affect obesity co-morbidity trends. Medicaid staff could compare the predicted rates of the four key co-morbidities after the intervention to the current rates in the targeted population. This type of comparison can demonstrate how childhood obesity prevention and treatment interventions can help the state achieve its health outcome goals.

Figure 12. Cumulative Reduction in Selected Co-morbidities
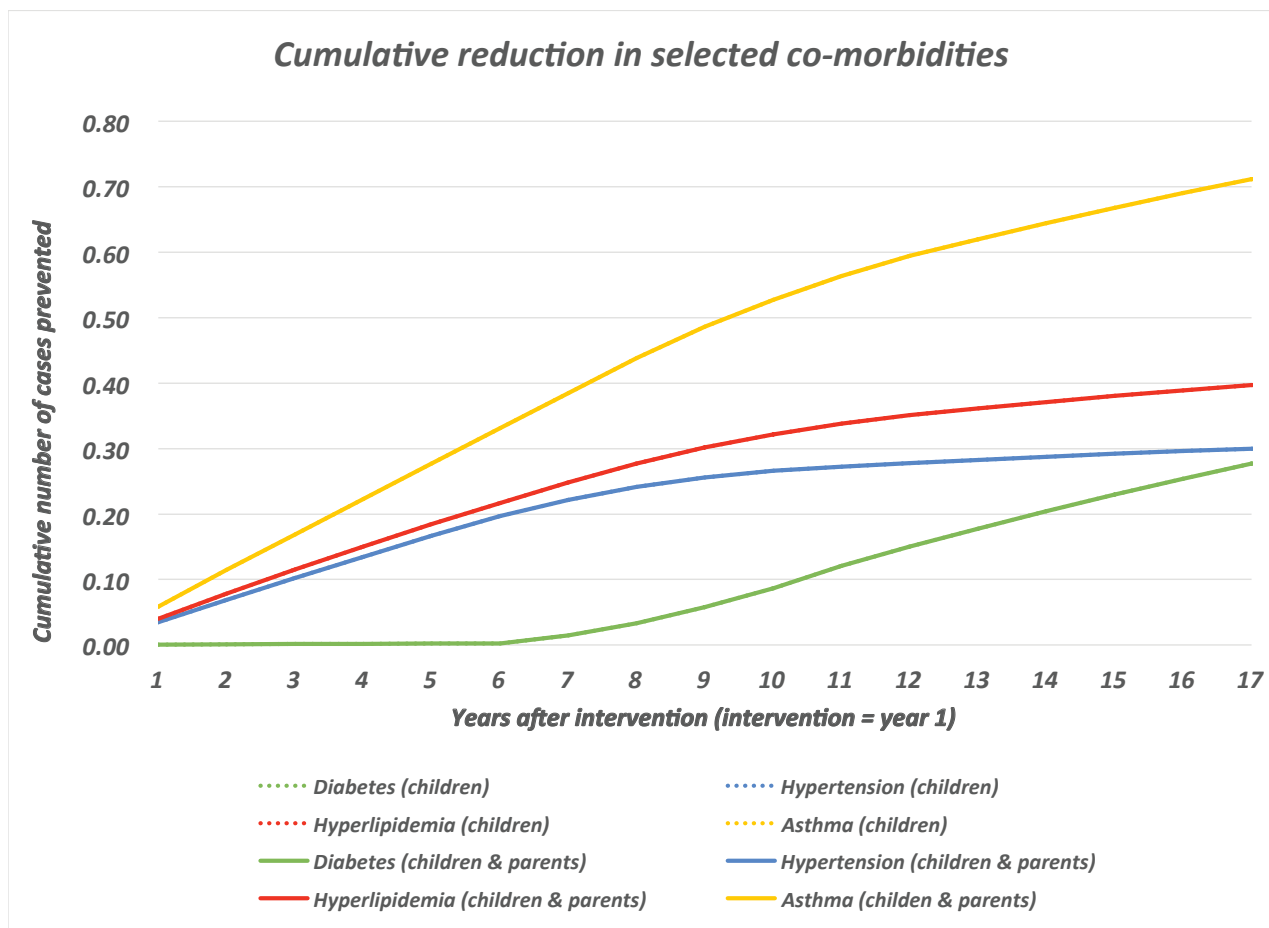
Braided Funding

If state Medicaid agencies are interested in collaborating with other agencies, such as public health departments, to invest in a childhood obesity prevention intervention, the tool allows the user to break out the investment costs and savings of the multiple investors. This key information may enable agencies to work with other organizations to share the cost of an intervention or to cover portions of an intervention's services that Medicaid cannot cover.

MCOs

Most state Medicaid agencies rely on MCOs to provide care to a portion or all of their Medicaid population. The priorities and needs of MCOs are different from those of state Medicaid agencies. MCOs can provide services not required in a state plan amendment and pay for the services out of their capitated payment rate if they believe the services are a worthwhile investment in the health of their members.

The tool can be a valuable resource to MCOs in estimating the potential savings from an intervention and particularly the timeline for when the intervention may break even. Some MCOs may have population health metrics included in their contracts with state Medicaid agencies. Aside from helping MCOs estimate costs and savings of obesity prevention and treatment interventions, this tool can help MCOs assess various childhood obesity interventions and their potential to help the MCOs meet their population health metrics.

Intervention Payment Mechanisms

Once a state Medicaid agency has selected an intervention for investment, the agency must then consider what mechanisms are available to facilitate that investment. **Nemours' Roadmap Appendix A: Medicaid Authorities for Prevention – Reference Document** describes various ways that Medicaid agencies can invest in or cover health prevention services. In the illustrative examples in **Appendix B**, potential options for investment are provided as guidance, as Medicaid state plans differ.

Role of Maryland Department of Health

Maryland Department of Health: A Key Project Partner

The Maryland Department of Health (MDH), under which the state Medicaid agency falls, has been a key partner in the development and testing of the financial simulation tool. MDH chose to participate and advise on the development of the financial simulation tool because the agency saw the value this tool would offer in its planning efforts. MDH's mission is to provide access to healthcare for low-income children and families, but the agency understands that this role is broader than ensuring that illness is treated; it also includes supporting overall health and wellbeing. As MDH navigates the shifting landscape of healthcare and moves in the direction of promoting prevention, the agency sees the need for tools to provide critical information about the costs, savings, and health outcomes from health prevention initiatives.

MDH's state healthcare transformation plan—which extends across health care payers, providers and systems—incorporates population health improvement as a goal, and the agency is scaling to work to improve health outcomes and health equity for Marylanders. As MDH pursues population health improvement, it is increasingly interested in investing in preventative health interventions. To invest in preventative health, however, the agency needs tools to help assess initiatives and select the best ones for investment. This financial simulation tool offers a first step to address that need for the Medicaid child population in Maryland. MDH believes that this tool, and similar tools, will help agencies understand the benefits of preventative health initiatives for the populations they serve and aid their stewardship of limited public funds. The tool can also help MDH make internal program design decisions to optimize its investments.

Current MDH Obesity Prevention Initiative

MDH, with technical assistance from Nemours, brought together an interested dietitian, MCO and Head Start program to work through the logistics of the delivery of Medicaid-covered nutritional counseling services, in a Head Start center in Baltimore, by a licensed dietitian in the fall of 2018. Medically necessary individual and group nutritional counseling services are covered benefits for children enrolled in Maryland Medicaid as part of the Early and Periodic Screening, Diagnostic, and Treatment (EPSDT) benefit. The pilot effort followed Maryland Medicaid's decision to add group nutritional counseling for children as a billable service. For the pilot, the state worked with one Medicaid MCO and an enrolled dietitian to develop a model to deliver group nutritional counseling services to children in a Head Start program center. The MCO would reimburse the dietitian for services for children who met MCO enrollment and medical necessity criteria. Due to the small number of eligible children at the pilot site, the partners decided not to move forward with the project. The partners are considering other potential sites to pilot the model in the future.

In the future, the financial simulation tool may help MDH make decisions on investing in other childhood obesity prevention initiatives to reduce childhood obesity rates in Maryland.

Medicaid State Agency Perspective

During the development of the financial simulation tool, MDH provided critical perspective on a state Medicaid agency's need for a financial simulation tool and offered insight on the detailed needs of a user in terms of the content and design. Key MDH staff participated in discussions with the research team and advisory group, and provided valuable insight into state Medicaid agency capacity and constraints to inform the design of the tool so that it can be widely disseminated to other states. In addition, MDH worked with the research team to obtain Maryland Medicaid data to test and validate the tool.

MDH's Future Use of the Tool

Moving forward, MDH plans to use the tool to estimate the relative cost-effectiveness of the childhood obesity prevention initiatives, such as its home visiting program, as well as to compare them with other types of interventions. MDH will use the tool to identify what interventions may have the largest impact on the populations it serves, particularly to estimate how the agency could facilitate progress on Maryland state goals related to asthma, type II diabetes and infant mortality. MDH will serve as an example to other states of how a Medicaid agency can utilize the tool in its planning decisions.

Conclusion

The financial simulation tool can serve as an important resource for staff at state Medicaid agencies and MCOs who are evaluating the business case for childhood obesity prevention and treatment interventions. The estimates of potential return on investment, timing of savings, and health outcomes offer key pieces of information to organizations interested in investing in child health prevention.

If users have questions about the tool or user guide, they should contact Janet Viveiros at janet.viveiros@nemours.org.

Appendix A. Resources

The financial simulation tool is built on three types of information resources:

1. Data sources used to create the tool
2. Research on obesity interventions
3. Other useful information sources

Information about the data sources used to create the tool can be found in the body of the User Guide and in **Appendix C**.

This appendix contains information on research on obesity interventions and other useful information sources.

Research on Obesity Interventions

Nemours and SVT Group conducted a literature review that yielded 288 studies (see **List of Abstracts Reviewed**). Obesity prevention interventions conducted in schools, early education settings, and community settings were most common among the studies, particularly in studies focusing on prevention rather than treatment. Basic body mass index (BMI) assessment was a commonly utilized metric of intervention success. Studies of interventions in hospital settings, especially those that included a social service component, were less prevalent. Similarly, studies of interventions in home-based settings were rare. In addition, intervention cost information was absent from nearly all the research articles and is an area in which further research is needed.

Other Useful Information Sources

Users of the financial simulation tool may find the following data resources that informed the model to be helpful.

Source	Short name	Description	Website (if applicable)
Medical Expenditure Panel Survey (MEPS)	MEPS	MEPS is a set of large-scale surveys of families and individuals, their medical providers (doctors, hospitals, pharmacies, etc.), and employers across the United States. MEPS collects data on the specific health services that Americans use, how frequently they use them, the cost of these services, and how they are paid for, as well as data on the cost, scope, and breadth of health insurance held by and available to U.S. workers.	https://meps.ahrq.gov/mepsweb/

Source	Short name	Description	Website (if applicable)
National Health Expenditure Accounts	NHEA	Expenditures on healthcare are tracked by the Centers for Medicare & Medicaid Services. Health accounts by state of residence provide aggregate and per capita estimates of healthcare spending by the type of establishment delivering care (hospitals, physicians and clinics, nursing homes, etc.) and for medical products (prescription drugs, over-the-counter medicines and sundries, and durable medical products such as eyeglasses and hearing aids) purchased in retail outlets. Aggregate and per-enrollee estimates of funding sources by state are provided for Medicare, Medicaid, and private health insurance.	https://www.cms.gov/Research-Statistics-Data-and-Systems/Statistics-Trends-and-Reports/NationalHealthExpendData/index.html
National Survey of Children's Health	NSCH	This national survey was conducted by telephone in 2003-2004, 2007-2008, 2011-2012, and 2016. Telephone numbers were called at random to identify households with one or more children under 18 years old. In each household, one child was randomly selected to be the subject of the interview. The survey results are weighted to represent the population of non-institutionalized children age 0 to 17 nationally and in each of the 50 states plus the District of Columbia.	http://www.childhealthdata.org/learn-about-the-nsch/NSCH
Behavioral Risk Factor Surveillance System (BRFSS)	BRFSS	BRFSS is the nation's premier system of health-related telephone surveys that collect state data about U.S. residents regarding their health-related risk behaviors, chronic health conditions, and use of preventive services. Established in 1984 with 15 states, BRFSS now collects data in all 50 states as well as the District of Columbia and three U.S. territories. BRFSS completes more than 400,000 adult interviews each year, making it the largest continuously conducted health survey system in the world.	https://www.cdc.gov/brfss/
National Health and Nutrition Examination Survey	NHANES	This program of studies is designed to assess the health and nutritional status of adults and children in the United States. The survey is unique in that it combines interviews and physical examinations.	https://www.cdc.gov/nchs/nhanes/index.htm

Source	Short name	Description	Website (if applicable)
American Community Survey (ACS)		This ongoing survey provides vital information on a yearly basis about the United States and its people. Information from the survey generates data that help determine how federal and state funds are distributed. The ACS addresses a range of social, economic, and demographic topics of interest to policymakers and planners, including educational attainment, employment, health insurance coverage, poverty levels, and supplemental nutrition benefits.	https://www.census.gov/programs-surveys/acs/about.html
Kaiser Family Foundation		Data include state Medicaid enrollment and spending.	https://www.kff.org/medicaid/
2017 National Health Center Data	HRSA	Health centers deliver affordable, accessible, quality, and cost-effective primary healthcare to patients regardless of their ability to pay. Health centers provide comprehensive, patient-centered care, coordinating a wide range of medical, dental, mental health, substance abuse, and patient support services. Nearly 1,400 health centers operate more than 11,000 service delivery sites in every U.S. state, the District of Columbia, Puerto Rico, the U.S. Virgin Islands, and the Pacific Basin. Data from the Health Resources and Services Administration on the health center program include demographics, diagnoses, and health outcomes.	https://bphc.hrsa.gov/uds/datacenter.aspx
National Center for Health Statistics life tables for U.S. population	US Life tables	Life tables present the likelihood of living in future years.	https://www.cdc.gov/nchs/products/life_tables.htm
Youth Risk Behavior Surveillance System	(YRBSS)	Data for youth obesity include the percentage of high school students who are obese (defined as BMI above the 95th percentile for age/sex).	https://urldefense.proofpoint.com/v2/url?u=https-3A__www.cdc.gov_healthyyouth_data_topics_npao.htm&d=DwMFaQ&c=X2IGR6v8ax_mLhSmU1r3Aw&r=f_sirWt5xExSeC0yrPTUyN_Z16MfB6FCgxjJl2ryytI&m=eBJiZbwP2vn39Ryf07aAD-vHcTxLRSSTKPMGTE8sekw&s=BDEI2FfMOjymeSXTkytd2GkbspDY1m5ZrxK7CWTAI7k&e=
U.S. Census Bureau Current Population Reports		The report Health Insurance Coverage in the United States: 2016 presents statistics on health insurance coverage in 2016 and changes in health insurance coverage rates from previous years, based on information collected in U.S. Census Bureau surveys.	https://www.census.gov/content/dam/Census/library/publications/2017/demo/p60-260.pdf

Source	Short name	Description	Website (if applicable)
Prospective study of body mass index, weight change, and risk of adult-onset asthma in women		This prospective study looked at BMI, weight change, and risk of adult-onset asthma in women.	https://www.ncbi.nlm.nih.gov/pubmed/10573048
State of Obesity		This website, a project of the Robert Wood Johnson Foundation, provides national and state-level data on obesity	https://stateofobesity.org/childhood-obesity-trends/

Appendix B. Examples of Evidence from Research

Types of Key Childhood Obesity Prevention and Treatment Initiatives

1. Home visiting programs
   a) provision of parenting support on feeding practices for at-risk infants and families
   b) assessment of the home environment of children with obesity and offers of education, education, and medication adherence assistance

2. Community-based interventions
   a) group nutritional education and physical activity coaching for children
   b) group nutritional education
   c) physical activity coaching for children
   d) combination of nutrition education and physical activity
   e) family component

3. Children's hospital weight management programs

4. Children's hospital weight management programs that focus on addressing social needs through community/social service resources (referral, community services, and follow-up coordination)

5. Basic body mass index (BMI) assessment, education, and counseling in clinical or non-clinical settings

6. School-based interventions
   a) group nutritional education and physical activity coaching for children
   b) group nutritional education
   c) increased availability of nutritional food
   d) physical activity coaching for children
   e) combination of nutrition education and physical activity
   f) family component

7. Early care and education-based interventions
   a) group nutritional education and physical activity coaching for children
   b) group nutritional education
   c) increased availability of nutritional food
   d) increased physical activity coaching for children
   e) combinations of nutrition education and physical activity
   f) family component

8. Environmental/policy change supporting healthy eating and physical activity in different settings where Medicaid-enrolled children spend time

This appendix includes summaries of research evidence on each of the eight key intervention types that users can input into the model if they do not have data for the intervention they want to model. The studies summarized here are not meant to indicate the range of possible results that can be expected from a given intervention type; rather, they are intended to assist the user by providing evidence of results from actual interventions that can be used for modeling purposes when users lack their own research evidence.

The eight profiled studies were selected from a review of the peer-reviewed obesity prevention literature for abstracts containing statistically significant, positive results of obesity-related interventions. The article abstracts were reviewed to identify studies that corresponded with each intervention type, with particular attention to the intervention setting and provider type. Of the studies that corresponded with the eight intervention types, studies that featured more recent interventions, more rigorous research methodologies, larger sample sizes, considered a seminal study (when available), and a Medicaid-appropriate population were preferred. Finally, studies that showed results as change in weight category, BMI, or BMI z-score were selected because the tool is built to accommodate these measures only. In addition, all results are reported in standardized format to ensure compatibility with the tool.

Examples of Evidence from Research

Intervention Type(s)	(1) Home visiting programs
Intervention Summary	This study examined 667 first-time mothers and their infants to reduce children's BMI. The Healthy Beginnings Trial was conducted in socially and economically disadvantaged areas of Sydney, Australia, and was designed to reduce childhood obesity.
Effect of Intervention (use data to populate Effect tab in model)	
Change in Weight Category/BMI/BMI z-score *Enter information into appropriate columns (m-x) in row 19 on the Effect tab of model*	Mean BMI was significantly lower in the intervention group (16.53) than in the control group (16.82), with a difference of 0.29.
Medicaid Information Listed below each intervention type are examples of the Medicaid/CHIP statutory authority that a state could potentially use to cover the intervention. The classification in **blue** is from the Nemours Roadmap. **Click here to access the Roadmap for more detail.**	Home visiting by nurses to provide obesity prevention services to Medicaid-eligible children **(IL-3)*** • EPSDT: Section 1905(r) • Preventive services: Section 1905(a)(13) • Managed care: "value added" services *Home visiting is not a covered benefit under Medicaid, but components can be covered. Medicaid-enrolled providers (e.g., nurses) can seek reimbursement for Medicaid-covered services (e.g., nutrition counseling, health education, preventive services, case management). In addition, a number of states use waivers to cover home visiting programs. *Most states also have approval to use managed care through State Plan authority (Section 1932(a)) or waiver authority (Section 1915(a) or (b)). Medicaid managed care organizations have flexibility to cover a non-medical "value added" service if the service improves healthcare quality under 45 CFR Section 158.150. In addition, a Section 1115 waiver could provide authority for a state to cover individuals and services not typically covered by Medicaid.*
Intervention Characteristics	
Target Group BMI Category	All (Underweight, Normal Weight, Overweight, Obese)
Target Group Age Range	0-2 years
Other Population Information	Socially and economically disadvantaged
Provider Type (physician, other licensed provider, nontraditional provider)	Other licensed provider (nurse and research nurse)
Setting (e.g., medical, community)	Home-based
Mode of Delivery (in-person/virtual, individual/group)	In-person, individual
Focus (prevention, treatment, both)	Prevention
Intervention Component(s)	Nutrition, physical activity, behavioral strategies
Dosage	Eight home visits: one in the antenatal period and seven at 1, 3, 5, 9, 12, 18, and 24 months after birth. Visits focused on improving infant feeding and toddler eating practices, increasing active play, reducing television viewing, and reducing family behavioral risk factors.
Study Design	Randomized controlled trial
Article Details	Wen LM, Baur LA, Simpson JM, Rissel C, Wardle K, Flood VM. Effectiveness of home based early intervention on children's BMI at age 2: randomised controlled trial. *BMJ.* 2012;344;e3732.

Intervention Type(s)	(2) Community-based intervention
Intervention Summary	This study explored a community-based after-school program's effect on obesity in minority children. Study participants included 178 third through fifth graders enrolled in America SCORES Bay Area.
Effect of Intervention (use data to populate Effect tab in model)	
Change in Weight Category/BMI/BMI z-score *Enter information into appropriate columns (m-x) in row 19 on the Effect tab of model*	BMI z-score decreased by 0.04 among all participants and by 0.5 among obese participants.
Medicaid Information Listed below each intervention type are examples of the Medicaid/CHIP statutory authority that a state could potentially use to cover the intervention. The classification in **blue** is from the Nemours Roadmap. **Click here to access the Roadmap for more detail.**	Screening BMI (for Medicaid recipients) for children in an after-school program **(IL-3, PL-1)** • EPSDT: Section 1905(r) • Preventive services: Section 1905(a)(13) • Medicaid Health Homes: Section 1945 • Managed care: "value added" services Structured physical activity classes (not limited to Medicaid/CHIP recipients) for children in an after-school program **(PL-1)** • CHIP Health Services Initiative: Section 2105(a)(1)(D)(ii) • Section 1115 waiver *Most states also have approval to use managed care through State Plan authority (Section 1932(a)) or waiver authority (Section 1915(a) or (b)). Medicaid managed care organizations have flexibility to cover a non-medical "value added" service if the service improves healthcare quality under 45 CFR Section 158.150. In addition, a Section 1115 waiver could provide authority for a state to cover individuals and services not typically covered by Medicaid.*
Intervention Characteristics	
Target Group BMI Category	All (Underweight, Normal Weight, Overweight, Obese)
Target Group Age Range	8-11 years
Other Population Information	47% Latino, 25% Asian, 18% African American; all children enrolled in schools with high percentage of low-income families
Provider Type (physician, other licensed provider, nontraditional provider)	Nontraditional provider
Setting (e.g., medical, community)	Community
Mode of Delivery (in-person/virtual, individual/group)	In-person, group
Focus (prevention, treatment, both)	Prevention
Intervention Component(s)	Physical activity
Dosage	Participants played soccer three days a week: two practice days with moderate to vigorous physical activity and one inter-school game day with a warm-up period followed by a one-hour game.
Study Design	Randomized controlled trial
Article Details	Madsen KA, Thompson HR, Wlasiuk L, Queliza E, Schmidt C, Newman TB. After-school program to reduce obesity in minority children: a pilot study. J Child Health Care. 2009;13(4):333-346.

Intervention Type(s)	(3) Children's hospital weight management programs
Intervention Summary	This study addressed the efficacy of family-based, behavioral weight control in the management of severe pediatric obesity. Study participants included 192 severely obese children; their parents also participated in part of the program.
Effect of Intervention (use data to populate Effect tab in model)	
Change in Weight Category/BMI/BMI z-score *Enter information into appropriate columns (m-x) in row 19 on the Effect tab of model*	The intervention was associated with a 7.58% decrease in child percent overweight at 6 months.
Medicaid Information Listed below each intervention type are examples of the Medicaid/CHIP statutory authority that a state could potentially use to cover the intervention. The classification in **blue** is from the Nemours Roadmap. **Click here to access the Roadmap for more detail.**	Group nutrition counseling (including but not limited to Medicaid/CHIP recipients) at a medical center **(IL-3, PL-1)** • EPSDT: Section 1905(r) • Preventive services: Section 1905(a)(3) Lifestyle coach to review records/set weekly goals **(IL-3B, PL-1)** • Preventive services: Section 1905(a)(13) for Medicaid recipients only • Managed care: "value added" services for Medicaid recipients only • Section 1115 waiver *Most states also have approval to use managed care through State Plan authority (Section 1932(a)) or waiver authority (Section 1915(a) or (b)). Medicaid managed care organizations have flexibility to cover a non-medical "value added" service if the service improves healthcare quality under 45 CFR Section 158.150. In addition, a Section 1115 waiver could provide authority for a state to cover individuals and services not typically covered by Medicaid.*
Intervention Characteristics	
Target Group BMI Category	Severely Obese (BMI >97th percentile)
Target Group Age Range	8-12 years
Other Population Information	Not specified
Provider Type (physician, other licensed provider, nontraditional provider)	Physician
Setting (e.g., medical, community)	Medical
Mode of Delivery (in-person/virtual, individual/group)	In-person, group
Focus (prevention, treatment, both)	Treatment
Intervention Component(s)	Dietary intake, behavioral strategies
Dosage	Twenty 60-minute group sessions over the first six months and six booster sessions in the six months after treatment.
Study Design	Randomized controlled trial
Article Details	Kalarchian MA, Levine MD, Arslanian SA, et al. Family-based treatment of severe pediatric obesity: randomized, controlled trial. Pediatrics. 2009;124(4):1060-1068.

Intervention Type(s)	(4) Children's hospital weight management programs that focus on addressing social needs through community/social service resources (referral, community services, and follow-up coordination)
Intervention Summary	This study evaluated the effects of implementing the American Academy of Pediatrics overweight/obesity recommendations using a standard care approach alone or with the addition of an enhanced program in a safety-net pediatric primary care setting for 360 children.
Effect of Intervention (use data to populate Effect tab in model)	
Change in Weight Category/BMI/BMI z-score *Enter information into appropriate columns (m-x) in row 19 on the Effect tab of model*	The rate of change in the mean BMI z-score decreased 0.12 units in the standard care intervention group and 0.15 units in the enhanced program intervention group. There was no significant difference between these groups, but a significant difference between these groups and the control group was observed.
Medicaid Information Listed below each intervention type are examples of the Medicaid/CHIP statutory authority that a state could potentially use to cover the intervention. The classification in **blue** is from the Nemours Roadmap. **Click here to access the Roadmap for more detail.**	Quarterly pediatrician visits in a medical setting to address weight management for Medicaid/CHIP-eligible children at 85% BMI **(IL-1)** • EPSDT: Section 1905(r) • Medicaid Health Homes state plan amendment: Section 1945 Eight skill-building sessions* and monthly post-care support for Medicaid/CHIP-eligible children and their families in medical setting (and sometimes local parks) with a multidisciplinary team (dietitian, social worker, and fitness instructor) **(IL-1, IL-3)** • EPSDT 1905(r) • Preventive services: Section 1905(a)(13) • Medicaid Health Homes state plan amendment: Section 1945 *A state Medicaid program may need a state plan amendment to allow group counseling in the skill building sessions. Some states only cover individual nutrition counseling sessions, not group, through EPSDT. *Most states also have approval to use managed care through State Plan authority (Section 1932(a)) or waiver authority (Section 1915(a) or (b)). Medicaid managed care organizations have flexibility to cover a non-medical "value added" service if the service improves healthcare quality under 45 CFR Section 158.150. In addition, a Section 1115 waiver could provide authority for a state to cover individuals and services not typically covered by Medicaid.*
Intervention Characteristics	
Target Group BMI Category	Obese (≥85th American percentile for age and sex)
Target Group Age Range	7-12 years
Other Population Information	74% self-identified as Hispanic/Latino; majority low-income
Provider Type (physician, other licensed provider, nontraditional provider)	Physician
Setting (e.g., medical, community)	Medical
Mode of Delivery (in-person/virtual, individual/group)	In-person, individual
Focus (prevention, treatment, both)	Treatment
Intervention Component(s)	Behavioral strategies, dietary intake, physical activity

Dosage	Quarterly pediatrician visits for two years. The enhanced program was enriched with eight skill-building core and monthly post-core support sessions.
Study Design	Randomized controlled trial
Article Details	Wylie-Rosett J, Groisman-Perelstein AE, Diamantis PM, et al. Embedding weight management into safety-net pediatric primary care: randomized controlled trial. Int J Behav Nutr Phys Act. 2018;15(1):12.

Intervention Type(s)	(5) Basic BMI assessment, education, and counseling in clinical or non-clinical settings
Intervention Summary	This study addressed Steps to Growing Up Healthy, an obesity prevention intervention program that tests the efficacy of brief motivational counseling and the added value of monthly contact with community health workers in the prevention/reversal of child obesity in 418 urban-dwelling children.
Effect of Intervention (use data to populate Effect tab in model)	
Change in Weight Category/BMI/BMI z-score *Enter information into appropriate columns (m-x) in row 19 on the Effect tab of model*	BMI percentile decreased by 0.33 percentile in the intervention group, compared with a mean increase of 8.75 percentile in the control group.
Medicaid Information Listed below each intervention type are examples of the Medicaid/CHIP statutory authority that a state could potentially use to cover the intervention. The classification in **blue** is from the Nemours Roadmap. **Click here to access the Roadmap for more detail.**	Obesity prevention by clinician in medical office for Medicaid enrollee **(IL-1)** • EPSDT: Section 1905(r) Obesity prevention by community health worker over phone for Medicaid enrollee **(IL-3)** • Preventive services: Section 1905(a)(13) • Managed care: "value added" services Obesity prevention by community health worker in Medicaid-eligible child's home **(IL-3)** • Preventive services: Section 1905(a)(13) • Managed care: "value added" services • Section 1115 waiver *Most states also have approval to use managed care through State Plan authority (Section 1932(a)) or waiver authority (Section 1915(a) or (b)). Medicaid managed care organizations have flexibility to cover a non-medical "value added" service if the service improves healthcare quality under 45 CFR Section 158.150. In addition, a Section 1115 waiver could provide authority for a state to cover individuals and services not typically covered by Medicaid.*
Intervention Characteristics	
Target Group BMI Category	All (Underweight, Normal Weight, Overweight, Obese)
Target Group Age Range	2-4 years
Other Population Information	82% Hispanic and 18% African American
Provider Type (physician, other licensed provider, nontraditional provider)	Physician
Setting (e.g., medical, community)	Clinic, home-based

Mode of Delivery (in-person/virtual, individual/group)	In-person, individual
Focus (prevention, treatment, both)	Both
Intervention Component(s)	Behavioral strategies
Dosage	Monthly clinic visits, phone calls, and home visits
Study Design	Randomized controlled trial
Article Details	Gorin AA, Wiley J, Ohannessian CM, Hernandez D, Grant A, Cloutier MM. Steps to Growing Up Healthy: a pediatric primary care based obesity prevention program for young children. BMC Public Health. 2014;14:72.

Intervention Type(s)	(2) Community-based interventions, (6) School-based interventions
Intervention Summary	This study compared the effectiveness of two school-based programs—Coordinated Approach to Child Health (CATCH) BasicPlus and CATCH BasicPlus with a community component—that prioritize K-5 classroom curricula, a physical education program, a child nutrition services component, and family involvement. A total of 1,107 children participated in these programs.
Effect of Intervention (use data to populate Effect tab in model)	
Change in Weight Category/BMI/BMI z-score *Enter information into appropriate columns (m-x) in row 19 on the Effect tab of model*	The number of students classified as overweight/obese from schools that implemented CATCH BasicPlus with a community component decreased by 8.3%, compared with a decrease of 1.3% in overweight/obese students from schools that implemented just CATCH BasicPlus.
Medicaid Information Listed below each intervention type are examples of the Medicaid/CHIP statutory authority that a state could potentially use to cover the intervention. The classification in **blue** is from the Nemours Roadmap. **Click here to access the Roadmap for more detail.**	Child nutrition services in schools (for Medicaid recipients) **(IL-3)** • Preventive services: Section 1905(a)(13) • Medicaid Health Homes: Section 1945 • 2014 Free Care Guidance School social marketing/health promotion resources **(PL-1)** • CHIP Health Services Initiative: Section 2105(a)(1)(D)(ii) *Most states also have approval to use managed care through State Plan authority (Section 1932(a)) or waiver authority (Section 1915(a) or (b)). Medicaid managed care organizations have flexibility to cover a non-medical "value added" service if the service improves healthcare quality under 45 CFR Section 158.150. In addition, a Section 1115 waiver could provide authority for a state to cover individuals and services not typically covered by Medicaid.*
Intervention Characteristics	
Target Group BMI Category	All (Underweight, Normal Weight, Overweight, Obese)
Target Group Age Range	9-10 years
Other Population Information	14% African American, 61% Hispanic, 17% White/Other; 88.6% economically disadvantaged
Provider Type (physician, other licensed provider, nontraditional provider)	Nontraditional provider
Setting (e.g., medical, community)	School

Mode of Delivery (in-person/virtual, individual/group)	In-person, group
Focus (prevention, treatment, both)	Prevention
Intervention Component(s)	Dietary intake, physical activity, behavioral strategies
Dosage	Outcomes were observed after one year of program participation.
Study Design	Cross-sectional study
Article Details	Hoelscher DM, Springer AE, Ranjit N, et al. Reductions in child obesity among disadvantaged school children with community involvement: the Travis County CATCH Trial. Obesity (Silver Spring). 2010;18(suppl 1):S36-S44.

Intervention Type(s)	(7) Early care and education-based interventions
Intervention Summary	This study evaluated a preschool-based intervention in New South Wales, Australia, which aimed to decrease overweight and obesity prevalence among children by improving fundamental movement skills, increasing fruit and vegetable intake, and decreasing unhealthy food consumption.
Effect of Intervention (use data to populate Effect tab in model)	
Change in Weight Category/BMI/BMI z-score *Enter information into appropriate columns (m-x) in row 19 on the Effect tab of model*	BMI decreased by an average of 0.03 (pre-intervention n = 335; post-intervention n = 286). Results were statistically significant.
Medicaid Information Listed below each intervention type are examples of the Medicaid/CHIP statutory authority that a state could potentially use to cover the intervention. The classification in **blue** is from the Nemours Roadmap. **Click here to access the Roadmap for more detail.**	Twice-weekly structured sessions taught by preschool teachers to increase movement in preschool children **(IL-3)*** • Preventive services: Section 1905(a)(13) • Managed care: "value added" services Parent workshops taught by health professionals to increase movement and healthy eating in preschoolers **(IL-3)**** • EPSDT: Section 1905(r) • Preventive services: Section 1905(a)(13) Health education campaigns to encourage active play and healthy eating **(PL-1)** • Managed care: "value added" services • CHIP Health Services Initiative: Section 2105(a)(1)(D)(ii) *If preschool teachers qualify as a provider in the state, they might be able to bill for services to Medicaid- or CHIP-eligible children. **Provider could potentially bill for services provided to parents of Medicaid or CHIP-eligible children even though sessions may include parents whose children are not eligible for Medicaid or CHIP. *Most states also have approval to use managed care through State Plan authority (Section 1932(a)) or waiver authority (Section 1915(a) or (b)). Medicaid managed care organizations have flexibility to cover a non-medical "value added" service if the service improves healthcare quality under 45 CFR Section 158.150. In addition, a Section 1115 waiver could provide authority for a state to cover individuals and services not typically covered by Medicaid.*

Intervention Characteristics	
Target Group BMI Category	All (Underweight, Normal Weight, Overweight, Obese)
Target Group Age Range	3-6 years
Other Population Information	Not specified
Provider Type (physician, other licensed provider, nontraditional provider)	Nontraditional provider
Setting (e.g., medical, community)	Preschool
Mode of Delivery (in-person/virtual, individual/group)	In-person (group), virtual (individual and group)
Focus (prevention, treatment, both)	Prevention
Intervention Component(s)	Behavioral strategies, physical activity, dietary intake
Dosage	Participants played prescribed games twice a week and received consistent health messaging throughout the year; parents participated in one-time nutrition and exercise workshops.
Study Design	Cluster randomized controlled evaluation
Article Details	Adams J, Zask A, Dietrich U. Tooty Fruity Vegie in preschools: an obesity prevention intervention in preschools targeting children's movement skills and eating behaviours. Health Promot J Austr. 2009;20(2):112-119.

Intervention Type(s)	(2) Community-based interventions, (6) School-based interventions, (8) Environmental/policy change supporting healthy eating and physical activity in different settings where Medicaid-enrolled children spend time
Intervention Summary	This study assessed the impact of Healthy Living Cambridge Kids, a multicomponent intervention targeting the community, schools, families, and individuals. The intervention included city policies and community awareness campaigns, physical education enhancements, food service reforms, farm-to-school-to-home programs, family outreach, and BMI and fitness reports. A total of 1,858 children participated in this intervention.
Effect of Intervention (use data to populate Effect tab in model)	
Change in Weight Category/BMI/BMI z-score *Enter information into appropriate columns (m-x) in row 19 on the Effect tab of model*	After 3 years of intervention, the mean unadjusted BMI z-score decreased by 0.04; the prevalence of obesity decreased by 2.2%.

Medicaid Information	Public health education campaign to promote healthy eating and active living **(PL-1)**
Listed below each intervention type are examples of the Medicaid/CHIP statutory authority that a state could potentially use to cover the intervention. The classification in **blue** is from the Nemours Roadmap. **Click here to access the Roadmap for more detail.**	• CHIP Health Services Initiative: Section 2105(a)(1)(D)(ii) Nutrition education and fitness classes for Medicaid and non-Medicaid eligible population at "school-based family nights" **(IL-3, PL-1)** • Section 1115 waivers • Delivery System Reform Incentive Payment (DSRIP) Waiver initiatives • Center for Medicare & Medicaid Innovation (CMMI) health care payment models Nutrition counseling for families with Medicaid-eligible children at "obesity management agency" **(IL-3)** • Preventive services: Section 1095(a)(13) • Medicaid Health Homes: Section 1945 • Managed care: "value added" services *Most states also have approval to use managed care through State Plan authority (Section 1932(a)) or waiver authority (Section 1915(a) or (b)). Medicaid managed care organizations have flexibility to cover a non-medical "value added" service if the service improves healthcare quality under 45 CFR Section 158.150. In addition, a Section 1115 waiver could provide authority for a state to cover individuals and services not typically covered by Medicaid.*

Intervention Characteristics	
Target Group BMI Category	All (Underweight, Normal Weight, Overweight, Obese)
Target Group Age Range	5-11 years
Other Population Information	37.3% Black, 14% Hispanic, 37.1% White, 14.3% Asian; 43.3% lower-income
Provider Type (physician, other licensed provider, nontraditional provider)	Nontraditional provider
Setting (e.g., medical, community)	Community, school
Mode of Delivery (in-person/virtual, individual/group)	In-person, virtual, group
Focus (prevention, treatment, both)	Prevention
Intervention Component(s)	Dietary intake, physical activity, behavioral strategies
Dosage	The intervention ran for three years.
Study Design	Longitudinal study
Article Details	Chomitz VR, McGowan RJ, Wendel JM, et al. Healthy Living Cambridge Kids: a community-based participatory effort to promote healthy weight and fitness. Obesity (Silver Spring). 2010;18(suppl 1):S45-S53.

Appendix C. Technical Information

The main elements of the financial simulation tool are the following estimations:

1. Likelihood of obesity;
2. Changes in likelihood of obesity;
3. Changes in costs of obesity; and
4. Changes in health conditions.

The technical approach to each is discussed in turn below.

The tool was constructed in Microsoft Excel for Mac, version 16.5.

1. Likelihood of obesity

The base of the tool is a set of estimated probabilities of the risk of obesity at ages 5, 10, 15, 20, 25, 30, and 35, for the current population of children in the United States currently aged between 2 and 18 years old, differentiated by gender. The source of these estimated probabilities was Ward ZJ, Long MW, Resch SC, Giles CM, Cradock AL, Gortmaker SL. Simulation of growth trajectories of childhood obesity into adulthood. *N Engl J Med*. 2017;377(22):2145-2153.

Based on the default or user-entered starting percentages for a target population, the probabilities are used to predict the number of children and adults in four weight categories (normal or underweight, overweight, obese, severely obese) using body mass index (BMI) categories based on Centers for Disease Control and Prevention (CDC) standards, with severe obesity defined as a BMI of 40 or higher for adults and 120 percent or more of the 95th percentile for children.

These probabilities are used to estimate the future numbers of children and adults at each age up to 35 years of age using the Excel MMULT function for the user-entered population (referred to as the baseline model). The MMULT function estimates the size of Markov model cohorts. Estimates of intermediate ages between the 5-year intervals were made using a straight-line estimate.

The sources for each state's default starting percentages for weight status are as follows:

- For children: Data Resource Center for Child and Adolescent Health. 2016 National Survey of Children's Health (NSCH) data query. Retrieved June 14, 2018, from www.childhealthdata.org/. Child and Adolescent Health Measurement Initiative. Retrieved June 14, 2018, from www.cahmi.org/.
- For adults: Estimates from the Behavioral Risk Factor Surveillance System. Retrieved June 14, 2018, from www.cdc.gov/brfss/.

Because these data sets combine obesity and severe obesity, we estimated the breakdown of these two categories within the general category of obesity as follows:

- For children, 32.4 percent severely obese and 67.6 percent obese, based on Skinner AC, Skelton JA. Prevalence and trends in obesity and severe obesity among children in the United States, 1999-2012. *JAMA Pediatr*. 2014;168(6):561-566.
- For adults, 19.4 percent severely obese and 80.6 percent obese, based on Hales CM, Fryar CD, Carroll MD, Freedman DS, Ogden CL. Trends in obesity and severe obesity prevalence in US youth and adults by sex and age, 2007-2008 to 2015-2016. *JAMA*. 2018;319(16):1723-1725.

2. Changes in likelihood of obesity

The user estimates the effects of the obesity prevention program under simulation as described in the main section of this user guide. The estimated change in the number of children in each weight category for the first year after the intervention is used as the new input into the baseline model to produce a revised model. In other words, the immediate effect of the intervention changes the number of children at the beginning of each trajectory.

The effect of the program is the difference between the baseline model and the revised model. To account for potential decay in the effect of the intervention over time, this difference between the baseline and the revised model is multiplied by the estimated percentages that the user enters in the tool's Effect tab.

3. Changes in costs of obesity

The estimated cost of obesity to the healthcare system for the intervention population is simply the number of people in each weight category per year multiplied by the relevant annual cost of obesity (e.g., the cost to the system over and above the cost of a normal/underweight person). The sources used to estimate the annual cost of obesity are shown in Table 1. The costs were inflated to 2018 dollars using the personal health care (PHC) inflation factor (see Agency for Healthcare Research and Quality. Medical Expenditure Panel Survey: Using appropriate price indices for analyses of health care expenditures or income across multiple years. Retrieved from **https://meps.ahrq.gov/about_meps/ Price_Index.shtml#t1a3**).

No single, definitive source was available for each estimate needed. Preference was given to Tsai et al. (2011) and Kim & Basu (2016), as these were both systematic reviews. Where neither provided an estimate, the average of all estimates was used. No research estimated the difference between the cost of obesity and the cost of severe obesity for children, so the model uses the same estimate for both.

Table 1. Estimates of Annual Cost of Obesity (in 2018 Dollars)

	Overweight		Obese		Severely obese	
Source	Per Adult	Per Child	Per Adult	Per Child	Per Adult	Per Child
Finkelstein et al. (2008) [32]		$228		$279		
Finkelstein et al. (2009) [33]			$1,813			
Finkelstein et al. (2010) [34]	$394		$1,486		$1,954 & $2,133	
Ma & Frick (2011) [35]		$334	$1,961			
Trasande & Chatterjee (2009) [36]		$230		$438		
Trasande (2010) [37]			$1,028			
Cawley et al. (2015) [38]			$3,977		$3,977	
Tsai et al. (2011) [39]	$318		$2,062			
Kim & Basu (2016) [40]			$2,014			
Wang et al. (2015) [41]			$987		$2,098	
Used in model	**$318**	**$264**	**$2,038**	**$359**	**$2,541**	**$359**
Rationale for estimate	Tsai et al. (2011)	Average of all estimates	Average of Tsai et al. (2011) and Kim & Basu (2016)	Average of all estimates	Average of all estimates	Assume same as obese

These estimates were adjusted to reflect differences in spending on healthcare by state using an index created from Medicaid spending per enrollee (full or partial benefit) by state in 2014 from the Kaiser Family Foundation website. This index was chosen because the focus of the tool is on the economic cost to Medicaid. However, because per enrollee spending on Medicaid is not necessarily reflective of per capita spending across all health payors, this adjustment is likely to introduce an error into the all-payor estimates of the model.

The tool also accounts for the fact that once children become adults, they are less likely to be covered by Medicaid. The healthcare cost of children to Medicaid was assumed to be 100 percent up to age 18, reflecting the assumption that all participants are Medicaid enrollees. For adults, the healthcare cost to Medicaid was based on the statewide coverage rate for adults age 18 to 35 years. The estimates of the likelihood of an adult being covered by Medicaid are from the Kaiser Family Foundation's 2016 estimates based on the U.S. Census Bureau's March Current Population Survey, 2014-2017 (retrieved July 2018 from **https://www.kff.org/other/state-indicator/low-income-adults/?currentTimeframe=0&sortModel=%7B%22colId%22:%22Location%22,%22sort%22:%22asc%22%7D)**.

The estimate of the split between the federal and state shares of Medicaid expenditure was from the Kaiser Family Foundation, Federal and State Share of Medicaid Spending (May 11, 2017; retrieved June 2017 from **https://www.kff.org/medicaid/state-indicator/federalstate-share-of-spending/?currentTimeframe=0&sortModel=%7B%22colId%22:%22Location%22,%22sort%22:%22asc%22%7D**).

4. Estimating changes in health conditions

The advisory group for the project recommended estimating the expected reduction in the number of cases each year of four health conditions of both children and any participating parents alongside the changes in healthcare costs. These conditions are

– type II diabetes;
– hypertension;
– hyperlipidemia; and
– asthma.

The underlying assumption is that reducing the level of obesity leads to a reduction in the annual number of new cases (i.e., incidence) of each condition, based on the relative risk ratios that relate the odds of getting one of these conditions to being in each of the four weight categories.

In the absence of readily available incidence data, the modeling involved this process:

a) Imputing the annual incidence of each of the four conditions for every age, using published prevalence data and the following equation:

Prevalence (for age group i years to j years) = ((Estimated cumulative number of cases up to year i) + (Estimated new cases between i and j)) / (Population aged between i and j).

The number of new cases, starting from age 2, was estimated by solving this equation for every value of i and j using the following sources of prevalence:

• Diabetes:
  ○ For ages 0-17: Mayer-Davis EJ, Lawrence JM, Dabelea D, et al. Incidence trends of type 1 and type 2 diabetes among youths, 2002-2012. N Engl J Med. 2017;376(15):1419-1429.

  ○ For ages 18-44, 45-64, and 65-74: CDC Diabetes Atlas (**https://gis.cdc.gov/grasp/diabetes/DiabetesAtlas.html**).

- Hypertension:
  - For ages 0-17: Kaelber DC, Liu W, Ross M, et al. Diagnosis and medication treatment of pediatric hypertension: a retrospective cohort study. *Pediatrics*. 2016;38(6):e20162195.
  - For ages 18-39, 40-59, and 60+: Zhang Y, Moran AE. Trends in the prevalence, awareness, treatment, and control of hypertension among young adults in the United States, 1999 to 2014. *Hypertension*. 2017;70(4):736-742.
- Hyperlipidemia:
  - For ages 6-19: Nguyen D, Kit B, Carroll M. Abnormal cholesterol among children and adolescents in the United States, 2011-2014. NCHS Data Brief. 2015;228:1-8.
  - For ages 20-39, 40-59, and 60+: Carroll MD, Kit BK, Lacher DA. Total and high-density lipoprotein cholesterol in adults: National Health and Nutrition Examination Survey, 2009-2010. *NCHS Data Brief*. 2012;92:1-8.
- Asthma:
  - For ages 0-4, 5-14, 15-19, 20-24, 25-34, 35-64, and 65+: CDC's National Current Asthma Prevalence, 2016 (May 15, 2018; retrieved from **https://www.cdc.gov/asthma/most_recent_data.htm**).

b) Pro-rating the incidence results from (a) using risk ratios (i.e., the relative risk of having each health condition depending on level of obesity) to estimate the incidence of each of the four conditions based on level of obesity and by age. The risk ratios were weighted according to the total number of U.S. adults and children respectively in each weight category.

The ratios came from a systematic review and meta-analysis: Guh DP, Zhang W, Bansback N, Amarsi Z, Birmingham CL, Anis AH. The incidence of co-morbidities related to obesity and overweight: a systematic review and meta-analysis. *BMC Public Health*. 2009;9:88.

Because the article does not provide a risk ratio for severe obesity, it was assumed to be the same as the risk ratio for obesity.

c) Multiplying the incidence estimates resulting from (b) by the number of program participants with and without the intervention. The effect on health conditions is the difference between the two.

This approach

- uses a common method for estimating the impact on the program for each condition;
- uses readily available prevalence data; and
- is simple to understand and relatively easy to calculate.

The weaknesses of this approach are as follows:

- It assumes that prevalence is stable in the past and in the future. This assumption is more reasonable for some conditions than others. Adjusting, changing, and/or predicting levels of prevalence would add significantly to the complexity and uncertainty of the calculation.
- It leads to some counterintuitive results, such as negative incidence rates for hyperlipidemia between ages 20 and 39 (e.g., more people are "cured" than get the condition between these ages), because of the assumption of constant incidence rates for each age cohort where the prevalence data are available. In such cases, the risk ratios were inverted to account for the effect of a reduction in obesity leading to a higher likelihood of being cured.

Endnotes

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