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CHildhood Obesity Intervention Cost Effectiveness Study

Getting the Most Bang for Your Buck in Public Health Policy: Using the CHOICES Model for Cost-Effectiveness Analysis of Childhood Physical Activity Interventions

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Active Living Research

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Prevention Research Center
on Nutrition and Physical Activity

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Why Cost Effectiveness?

When you talk to decision-makers about what can be done to improve childhood obesity, they want to know three things

- What is feasible (the intervention, program, policy)?
- How effective is it?
- What will it cost?

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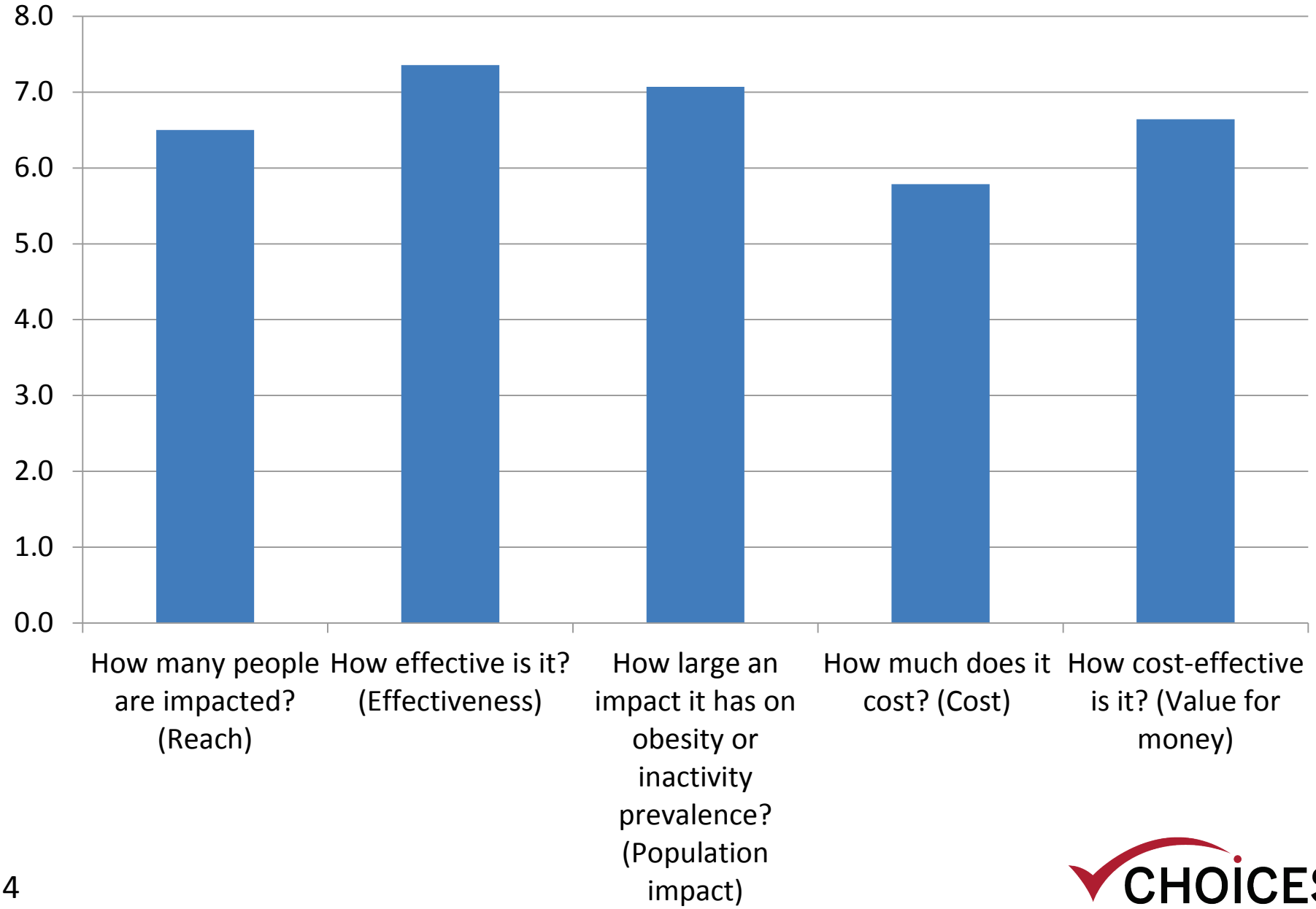
Your Survey Results



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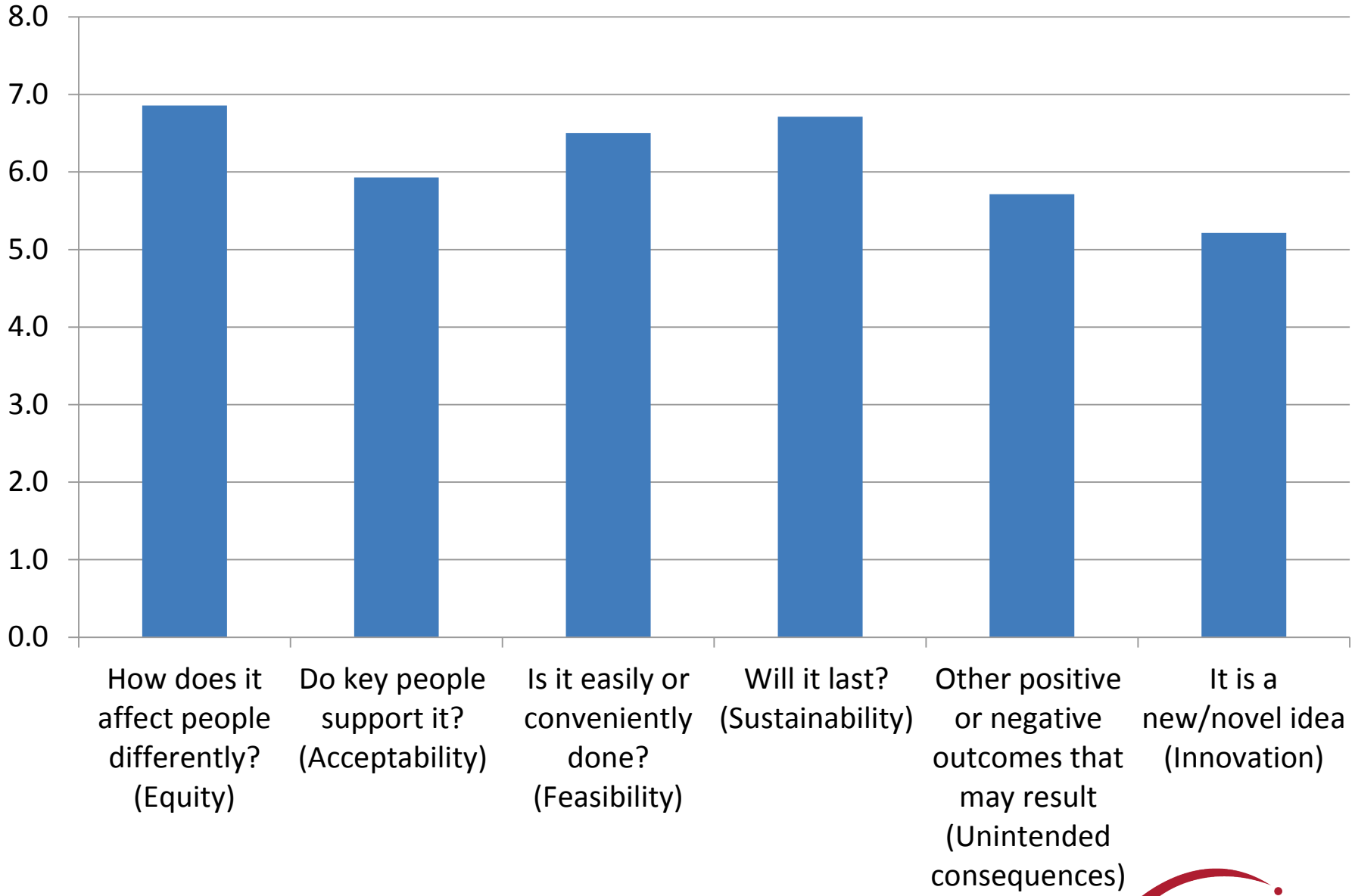
Your Survey Results



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Why Use Cost Effectiveness Analysis

- Provides a strategy to compare competing policy options
  - Cost
  - Population impacted
  - Likely outcomes
  - Suggested implementation strategies

What is Cost Effectiveness?

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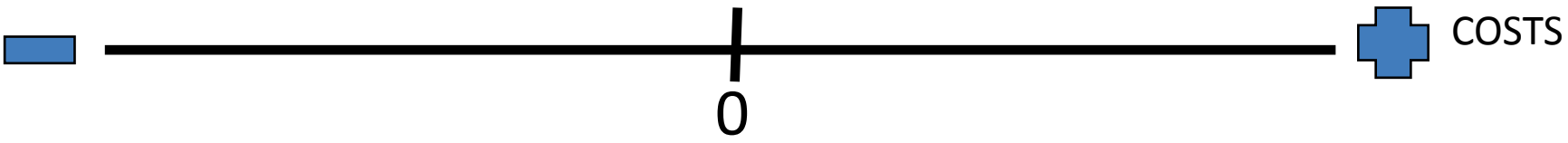
Cost-effectiveness analysis can assess…



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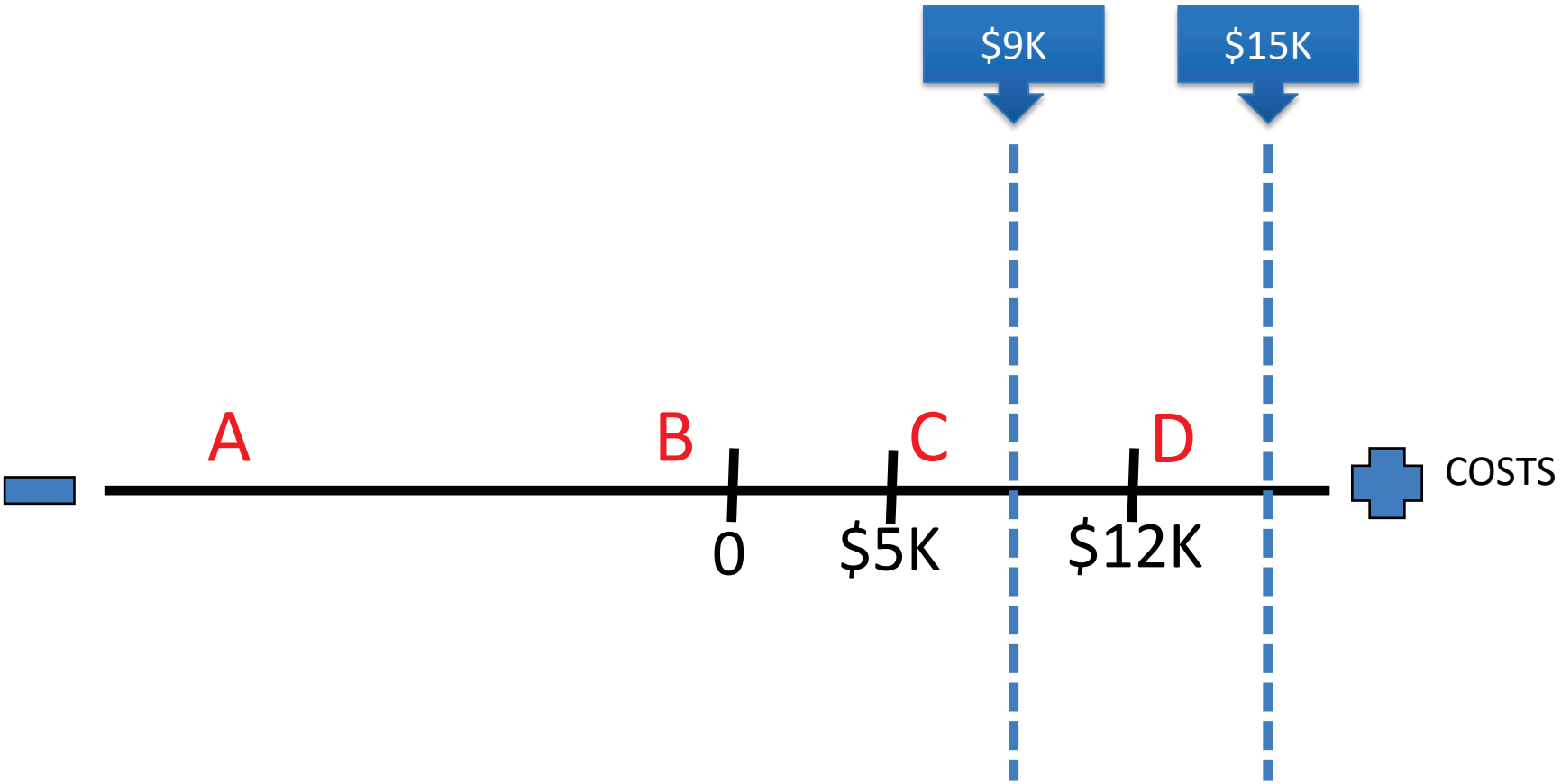
Cost-effectiveness analysis can assess affordability



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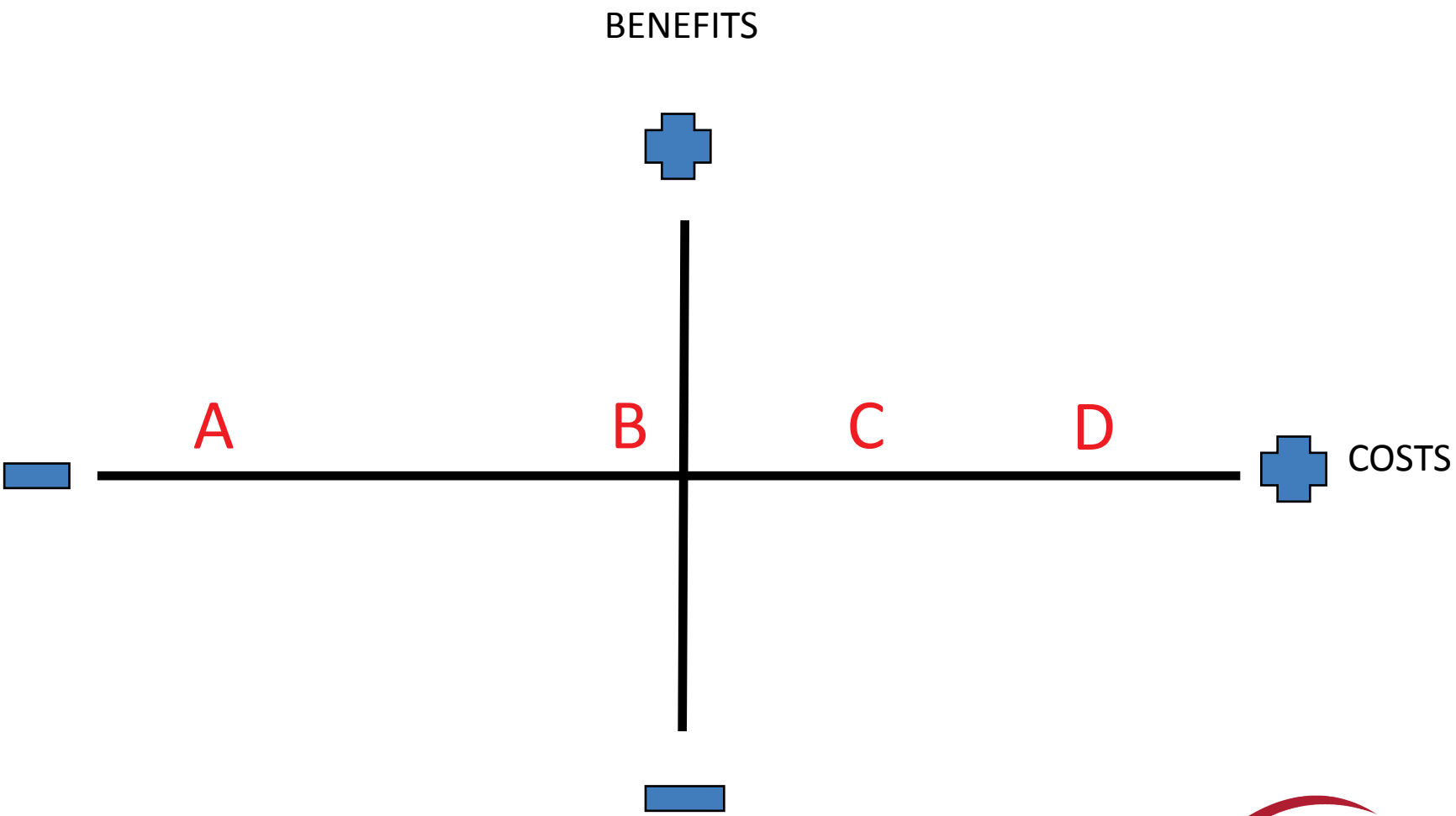
Cost-effectiveness analysis can assess…



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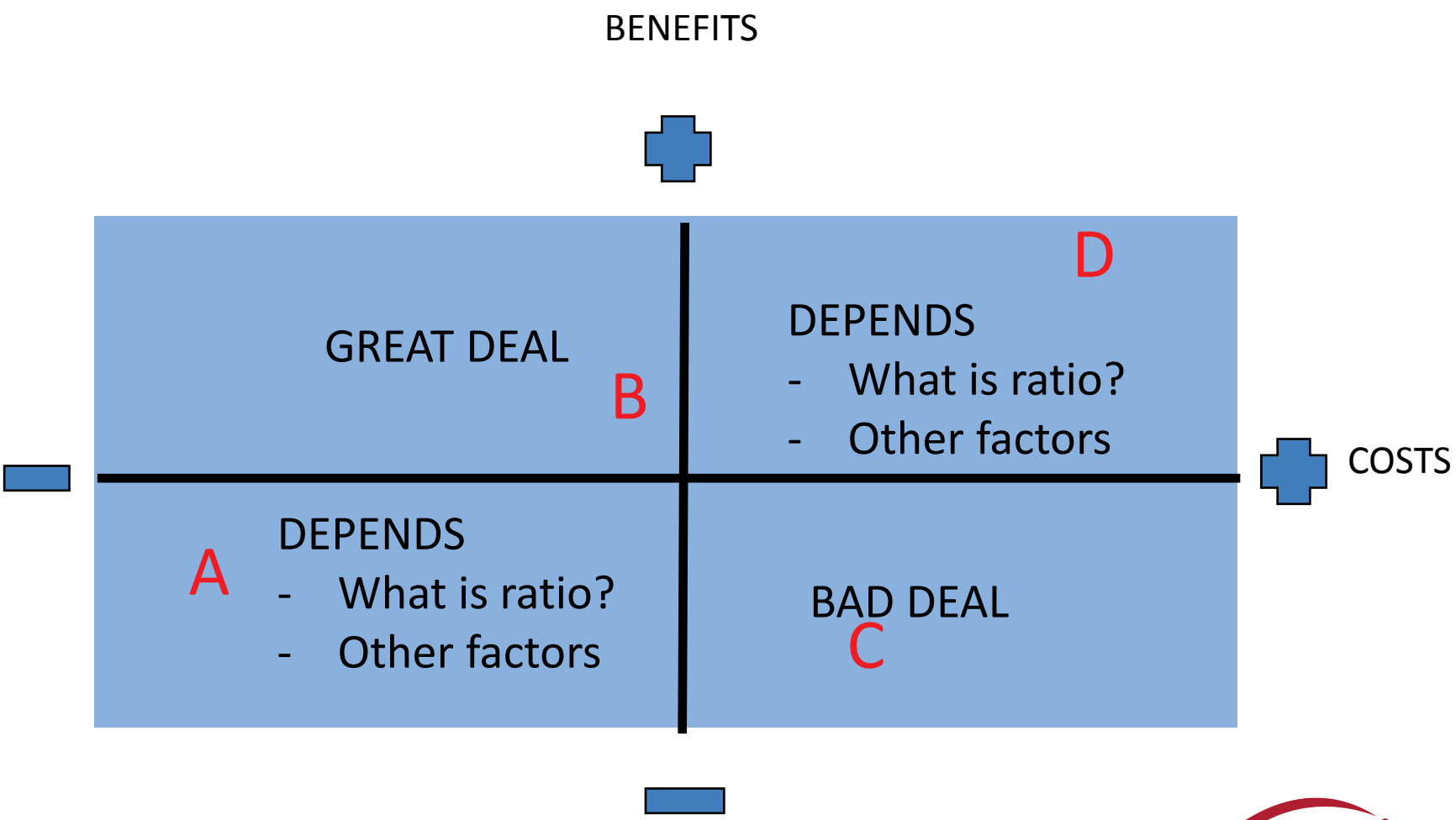
Cost-effectiveness analysis can assess value



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Cost-Effectiveness Analysis: Outcomes

- The primary outcome of a CEA is the **incremental cost effectiveness ratio**

$$\text{ICER} = \frac{\text{New Policy Cost} - \text{Usual Practice Cost}}{\text{New Policy Outcome} - \text{Usual Practice Outcome}}$$

- Program costs
- Downstream Cost

- BMI reduction
- Cases of Disease
- Years of life
- QALYs, DALYs

- ICERs are ***comparative***

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Tradeoffs between Costs and Effectiveness

Intervention	Present Value of Program Cost	Present Value of Downstream Costs	Total Present Value Costs	Present Value of Lifetime Health Effects	ICER
Usual Practice	0	$12K	$12K	30 LY	N/A
New Policy Intervention	$10K	$4000	$14K	32 LY	$2000/2 LY= **$1000 per LY**

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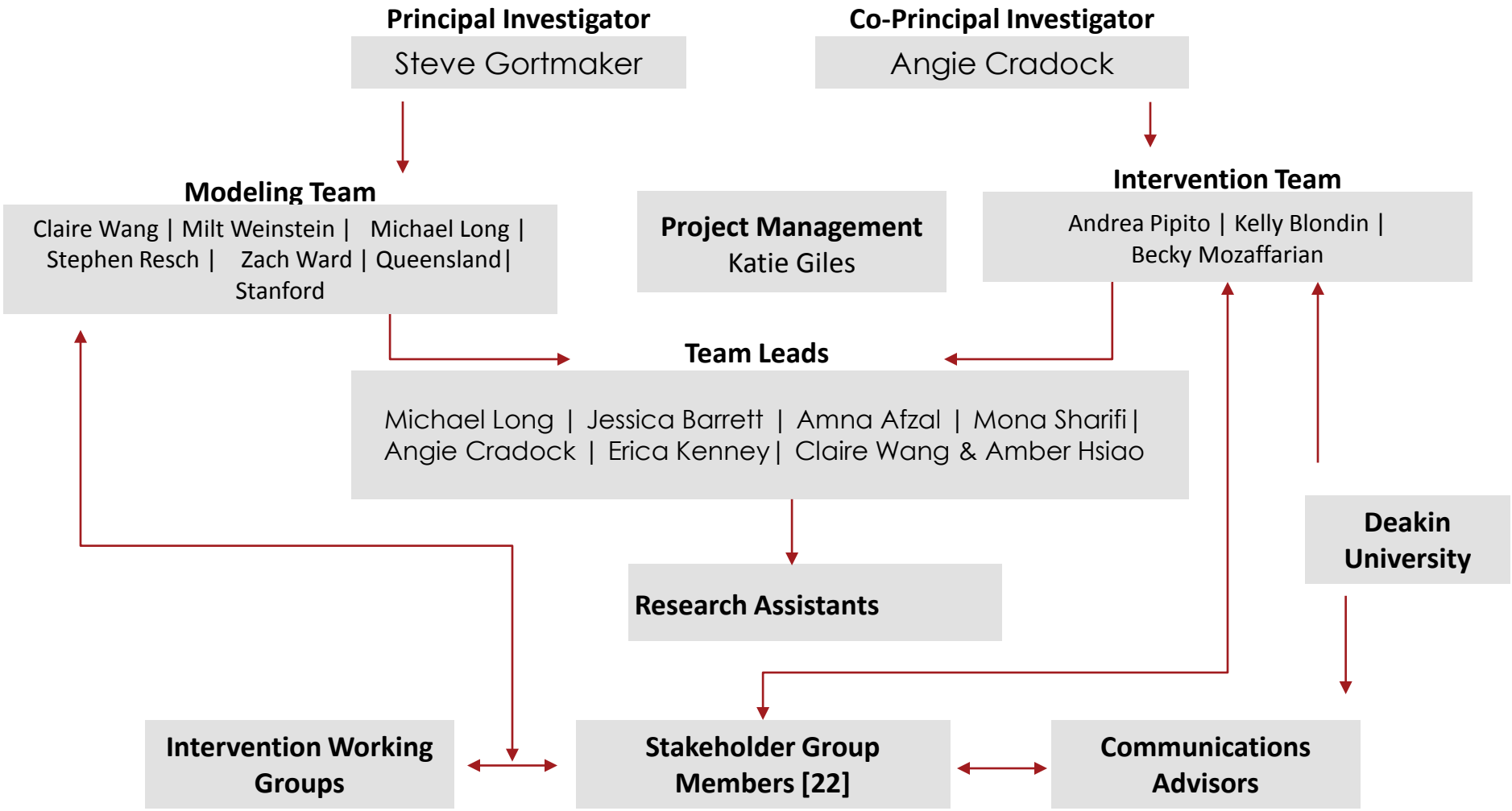
CHOICES Team



CHOICES Study Goals

- To generate cost effectiveness estimates for 40 of the most relevant childhood obesity interventions in the United States;
- To engage policymakers and the general public in this issue, and provide guidance so the most cost effective strategies for action are identified and become a focus

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Goals

- To move beyond “what is effective?” to:
  - Effectiveness
  - Population reach of interventions
  - Cost of interventions
  - Cost effectiveness

- Identify interventions providing “biggest bang for buck”

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Cost Effectiveness Analysis: CHOICES

- Some interventions that can reduce BMI and obesity prevalence may save more money for society than they cost to implement
- Other strategies may provide a relatively low cost option for reducing BMI and obesity rates compared to interventions that society is already willing to pay for (i.e. bariatric surgery)

CHOICES Outcomes

- CHOICES is concerned with ICERS related to BMI:
  - cost per BMI unit
  - cost per 1% reduction in obesity prevalence
  - Shorter-term outcomes: cost per minute of MVPA achieved
- Independent physical activity pathway

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CHOICES Outcomes

- Interventions compared to a “natural history” scenario:
  - what we would expect to happen to BMI levels, obesity rates and health outcomes if no interventions were conducted?

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CHOICES Outcomes

- Same cost-effectiveness framework used for all interventions
- Can compare the cost and health outcomes for each intervention

ACTIVITIES to DATE

- Adapted framework from ACE/Australia
- Stakeholder group convened
- Interventions selected
  - 75 interventions Considered
  - 41 Currently in CHOICES Process
- Systematic reviews for intervention-specific evidence conducted
- Gathered reach/cost data
- Model intervention inputs (effectiveness, reach and cost)
- Markov cohort and Micro-simulation models developed

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Microsimulation Overview

- Microsimulation – individual people are modeled
- Population heterogeneity can be represented
  - Geographic location (state-specific model estimates)
  - Evaluate intervention effects on disparities
  - Individual-level body measures and behaviors

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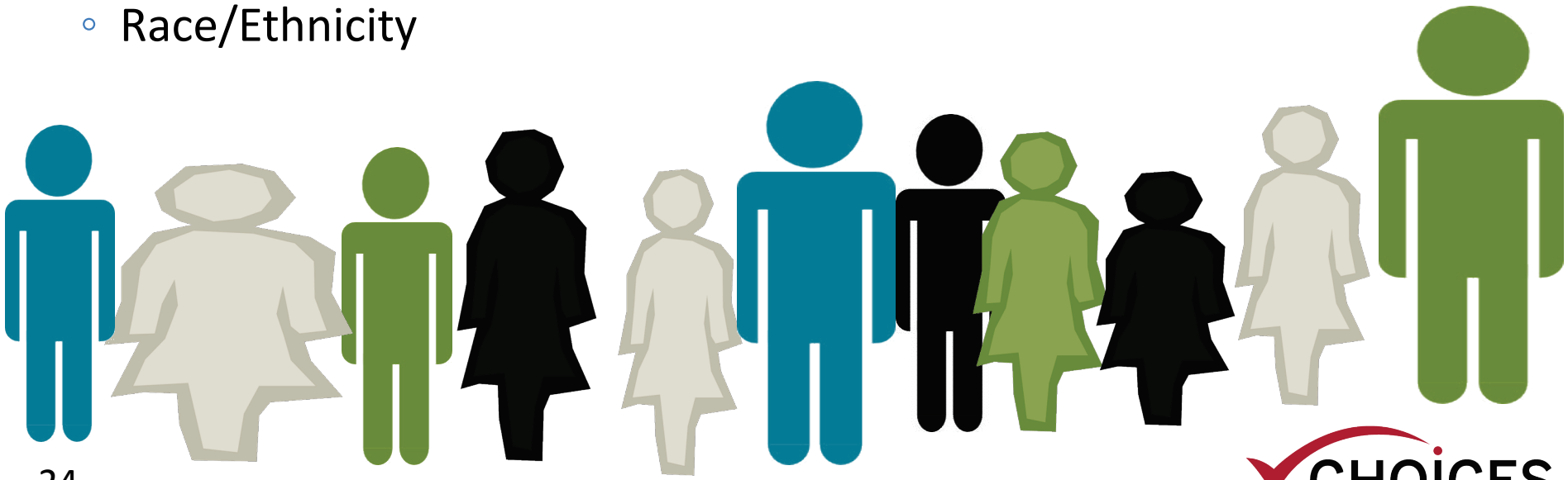
Virtual U.S. Population

Each Individual has their own:

- Demographics
  - Location
  - Age
  - Sex
  - Income
  - Poverty Level
  - Race/Ethnicity
- Body Measures
  - Height
  - Weight
  - BMI
- Behaviors
  - Dietary intake
  - School Lunch, Fast Food Frequencies, etc.



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Simulating Changes Over Time

- Model timeframe: 10-years
- Individual Level
  - Use longitudinal trajectories to project growth (height and weight) for each individual
  - Adjust for cohort effects
- Population Level
  - “Open” population – Incoming children are “born” into the model

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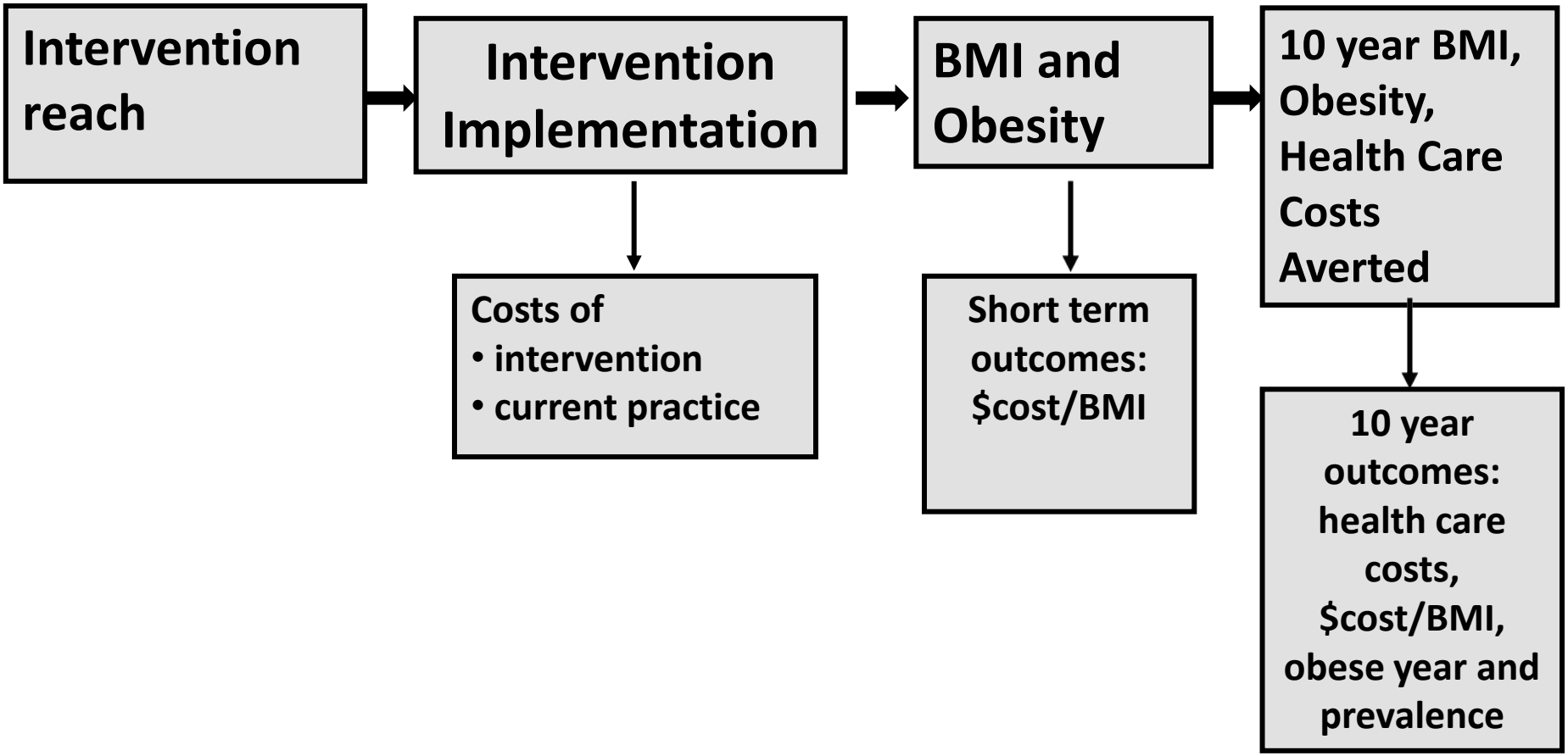
Logic Pathways and Effect Estimates

Intervention Description

- Who does what to whom?
- Logic model
  - Impact of policy and/or program activities on behavior
  - Impact of behavior on BMI
  - Impact of BMI on health care outcomes and costs

Intervention Logic Models, Effect and Costing



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Implementation and Equity Considerations

- Equity and impact on disparities
- Level of evidence (e.g. pathway to BMI)
- Acceptability to stakeholders
- Feasibility
- Impact on social and policy norms
- Sustainability
- Side effects

CHOICES Example: Active PE Intervention

- Jessica L. Barrett, MPH
- Steven L. Gortmaker, PhD
- Michael W. Long, ScD
- Zachary J. Ward, MPH
- Stephen C. Resch, PhD
- Marj L. Moodie, DrPH
- Rob Carter, PhD
- Gary Sacks, PhD
- Boyd A. Swinburn, MD
- Y. Claire Wang, MD, ScD
- Angie L. Cradock, ScD

"Cost-effectiveness of an elementary school active physical education policy"

Am J Prev Med, *in press*.

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Active PE Intervention

How will the intervention be carried out?

Policy or program: Policy

Level of implementation: State

Sector: School

Age level: School age

Implementation of a state policy directing the U.S. state boards of education to include a requirement for **50% of PE time** to be devoted to **MVPA** in the state PE curriculum for the elementary school level

- Based on policies passed by state legislatures in Texas (SB 891, 2009) & Oklahoma (SB 1876, 2010)
- Implemented within existing PE time provided

Barrett JL, Gortmaker SL, Long MW, et al. Cost-effectiveness of an elementary school active physical education policy. Am J Prev Med, *in press*.

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Group Activity

- Describe your intervention using worksheet

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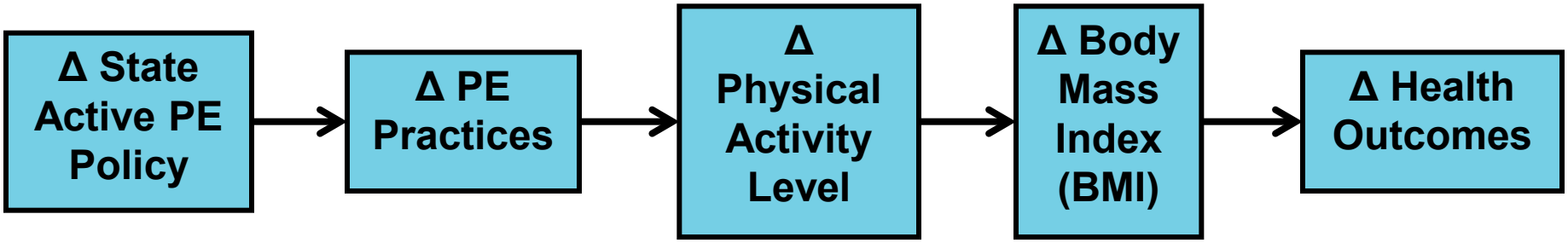
Logic Pathway



What is the best available evidence linking the steps in the pathway?

Barrett JL, Gortmaker SL, Long MW, et al. Cost-effectiveness of an elementary school active physical education policy. Am J Prev Med, *in press*.

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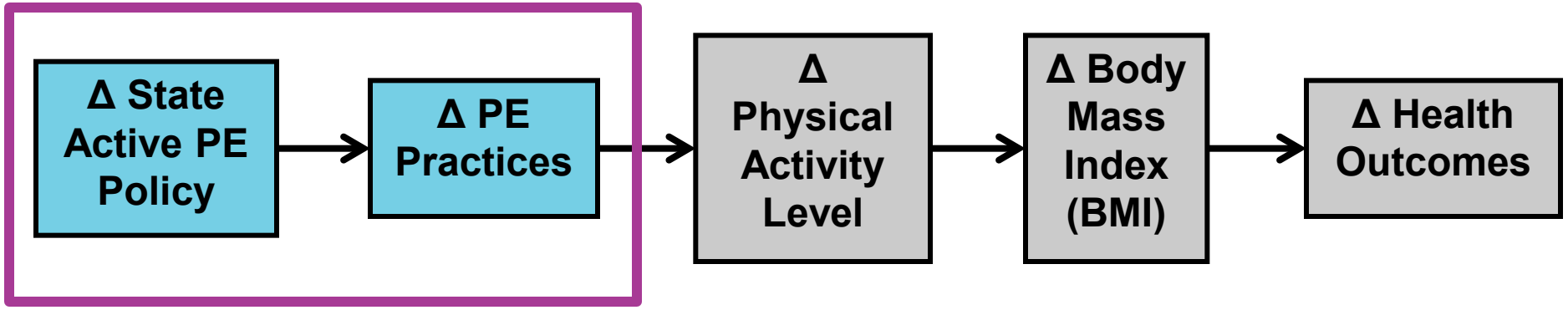
Active PE Policy Implementation



- Modeled after SPARK and CATCH PE programs
  - PE curricula, portable equipment, & teacher training designed to increase student activity levels

    - Sallis et al. 1997; McKenzie et al. 1996
- All teachers at schools providing PE would be trained
- 73% (95% UI 58-90%) of trained teachers would implement, based on studies of ongoing maintenance of CATCH PE

  - Hoelscher et al. 2004; McKenzie et al. 2003

Barrett JL, Gortmaker SL, Long MW, et al. Cost-effectiveness of an elementary school active physical education policy. Am J Prev Med, *in press*.

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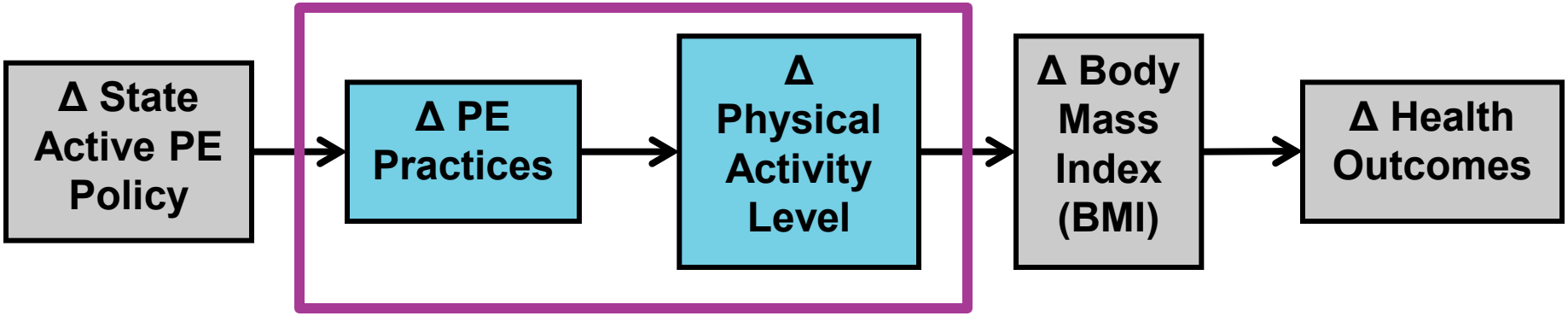
Impact of Policy on Physical Activity



- Evidence from a meta-analysis of active PE trials
  - Lonsdale et al. 2013
- Active PE would increase MVPA by 1.87 minutes (95% UI 1.23-2.51) during a 30-minute PE class

<u>16% increase</u> over existing MVPA levels during PE

Barrett JL, Gortmaker SL, Long MW, et al. Cost-effectiveness of an elementary school active physical education policy. Am J Prev Med, *in press*.

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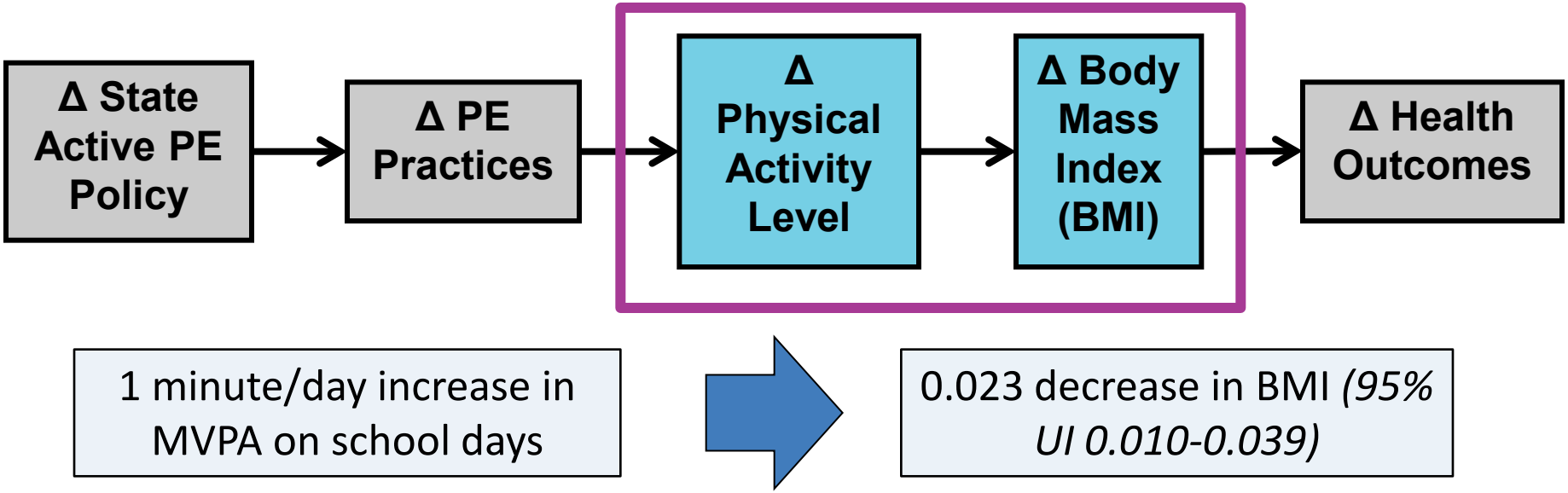
Physical Activity and BMI



Source:

- Kriemler et al. BMJ 2010 : 9-month randomized controlled trial of a school-based physical activity intervention
- Mitchell et al. Obesity 2013: 6-year longitudinal observational study estimating change in BMI from change in MVPA

Barrett JL, Gortmaker SL, Long MW, et al. Cost-effectiveness of an elementary school active physical education policy. Am J Prev Med, *in press*.

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INTERVENTION REACH

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INTERVENTION REACH

- How many children (and potentially adults) can we estimate would be effected by the intervention as specified?
  - What age groups?
  - What settings?
  - What parameters?
  - What assumptions?

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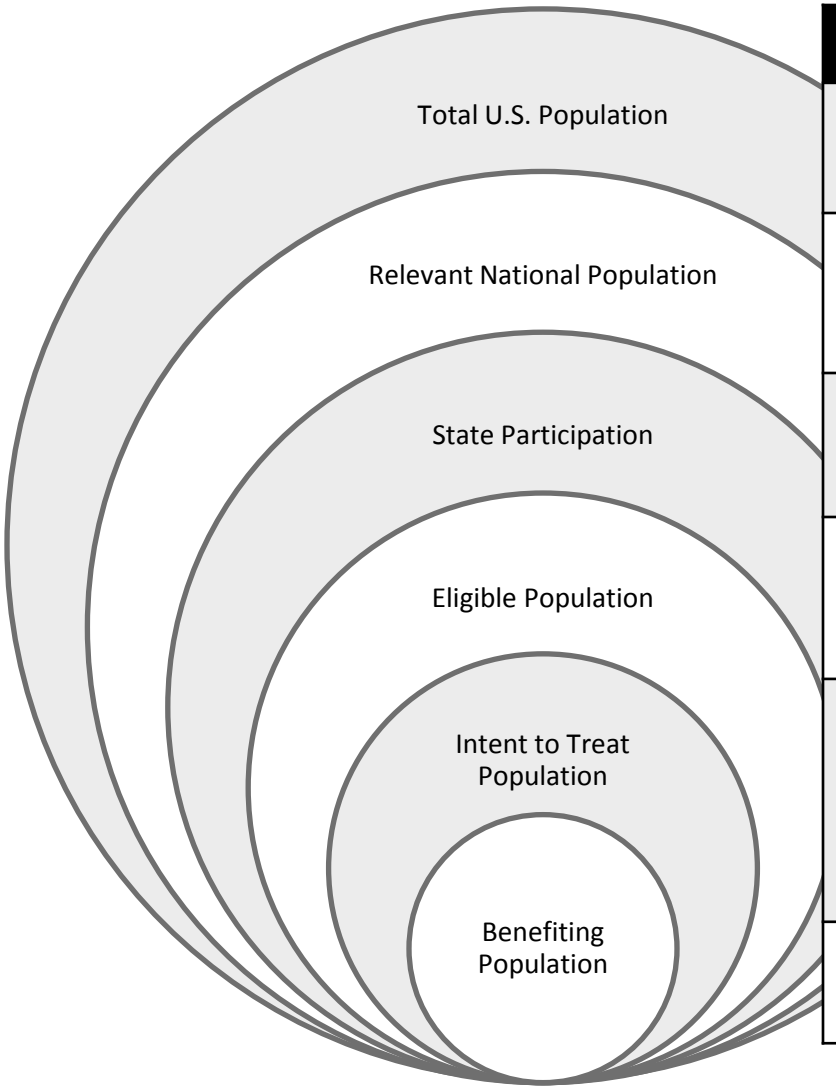
Reach of Active PE Policy



Description	Population #	Source
All children under age 18 in U.S. population	73.6 million	U.S. Census, 2015 population estimates
All children ages 6-11 attending public elementary schools	24.6 million	99% of elementary schools offer any PE (Turner et al. 2012)
All states without a current policy	(47 states)	TX, OK, AZ, & DC excluded (Carlson et al. 2013)
All children ages 5-11 attending public elementary schools in states without a current policy	18.5 million	U.S. Census, 2015 population estimates; U.S. DOE (NCES CCD; Digest of Education Statistics)
Eligible children attending PE	17.6 million	96% of elementary school children participate in PE (Office of the New York State Comptroller 2008; UCLA School of Public Health 2007)
Children among ITT population attending schools implementing the policy	12.6 million	72% of trained PE teachers implement (Hoelscher et al. 2004; McKenzie et al. 2003)

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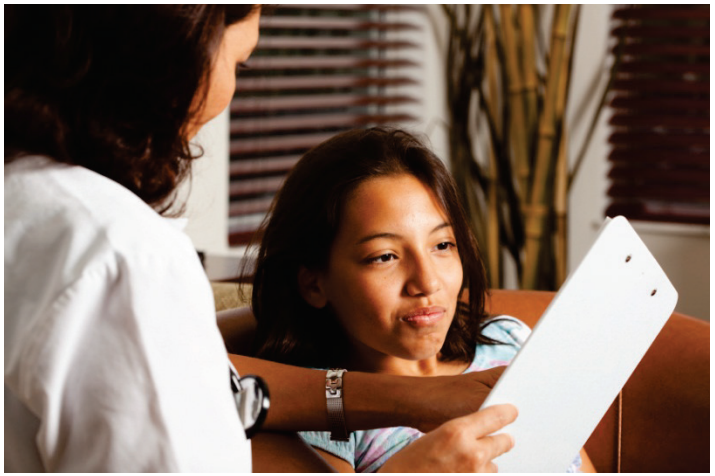
INTERVENTION COST



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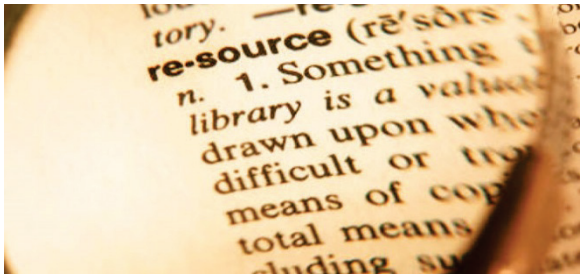
CHOICE Costing Methodology

Three steps:

1. Resource Identification
   - Identify incremental resources need to implement the intervention.
2. Resource Measurement
   - Quantify the amount of each resource needed to deliver the intervention (per person or per state).
3. Resource Valuation
   - Assign a monetary value to each identified resource.



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Key Principles of the CHOICES Costing Process

- Modified Societal Perspective
  - All resources included in cost, irrespective of who pays, except participant time.

- Opportunity Costs
  - Resources valued according to their societal opportunity cost.
    - E.g., Teacher training

- Transfer Payments
  - Not included as costs.
  - Money is *exchanged*; no resource is consumed; no societal opportunity is lost.
    - E.g., tax revenue *transferred* from consumers to government.

- Incremental Costs
  - Resources only included if different from natural history comparator.

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Cost of Implementing Active PE Policy

Activity	Resource	Payer	Population	Source/Notes	# Units	Unit Cost	Cost
Training for elementary school PE teachers through professional organizations & state trainings	PE teacher training facilitator FTE	State government	ITT	Trainer salary taken from the US Bureau of Labor Statistics (Occupation 25-9031) and 45.6% fringe was added per June 2014 US BLS report of Employer Costs for Employee Compensation.	3.1	$93,900	$294,500
	Training paper copies	State government	ITT	Based on reasonable assumption given the average weekly number of PE minutes offered per school., and per SPARK model.	591,400	$0.15	$88,700
Replacement of PE curricula & equipment for increasing MVPA	Curriculum and equipment set for PE class	Schools	ITT	Frequency of equipment replacement based on personal communication with expert stakeholders. Cost per set derived from SPARK and CATCH product websites.	9,900	$6,900	$68,000,000
Oversight of training and implementation	State PE coordinator FTE	State government	Eligible	Labor time needed based on reasonable assumption. Salary for state health coordinators based on personal communication with CDC, and 45.6% fringe was added.	3.3	$100,700	$331,000
Training for principals for assess MVPA in PE as part of annual evaluation of PE teachers	School principal FTE	Schools	ITT	Training time for principals based on consultation with school district stakeholders. School principal salary taken from the US Bureau of Labor Statistics (Occupation 11-9032) and 45.6% fringe was added.	10.8	$135,000	$1,460,000
	Principal training facilitator FTE	State government	ITT	Trainer salary taken from the US Bureau of Labor Statistics (Occupation 25-9031) and 45.6% fringe was added.	0.2	$93,900	$20,200
Oversight of monitoring	State PE coordinator FTE	State government	Eligible	Salary for state health coordinators based on personal communication with CDC, and 45.6% fringe was added.	1.4	$100,700	$142,000

TOTAL COST: $70.7 million

Barrett JL, Gortmaker SL, Long MW, et al. Cost-effectiveness of an elementary school active physical education policy. Am J Prev Med, *in press*.

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Group Activity

- Use Reach worksheet to define your populations and potential sources for finding data
- Use Resources worksheet to list your resources used and potential sources for finding data
  - List your top 4 resources that will be biggest expense

Activity	Resource	Payer	Population	Source/Notes	# Units	Unit Cost	Cost
Ex: Training for PE teachers through professional organizations & state trainings	*PE teacher training facilitator FTE*	*State government*	*ITT*	*Trainer salary from the US Bureau of Labor Statistics*	*3 FTE*	*$100,000*	*$300,000*

Group Activity

- Use your effect estimate and best guess for cost to come up with a Cost Effectiveness Ratio:
  - Cost per increased minute of MVPA achieved

Your Cost Effectiveness Guesstimates

Intervention	Effect (Minutes MVPA)	Reach	Cost	Cost per Minute MVPA
Activity in the Classroom	10	3.37 million	30 million	1
Afterschool Physical Activity and Nutrition	1	3.78 million	141.75 million	37.50
Early Child Care Center Space	1	2 million	65 million	32.50
Active Travel to School	10	150 million	1.5 billion	100

Results of Active PE Policy

	Mean (95% Uncertainty Interval)
Increase in MVPA minutes/day per person	0.87 (0.14–1.86)
BMI unit (kg/m^2) reduction per person	0.020 (0.003–0.050)
Cost per MVPA minute	0.026 (0.011–0.161)
Cost per MET-hour gained per person	0.34 (0.15–2.15)
Cost per BMI unit reduced ($)	401 (148–3,100)

Barrett JL, Gortmaker SL, Long MW, et al. Cost-effectiveness of an elementary school active physical education policy. Am J Prev Med, *in press*.

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Benchmark for Physical Activity Cost Effectiveness

- **Wu et al.** Am J Prev Med 2011;40(2)149–158
  - If the cost of sedentary behavior accounts for 2.4-5% of annual healthcare costs (Colditz 1999; Roux et al. 2008)
  - And spending for healthcare in 2008 was $7681 per person (CMS)
    - Inflated to 2014: $8446
  - Then the cost of sedentary behavior was $203-$422 per person in 2014
  - National PA recommendations for youth translate to 1095 MET-hours
  - So for youth who are sedentary, a benchmark of cost effectiveness could be **$0.19-$0.39 per MET-hour** in 2014.
    - Or $0.014-$0.029 per MVPA minute

Colditz GA. Economic costs of obesity and inactivity. Med Sci Sports Exerc 1999;31(11S):S663–7.
Roux L, Pratt M, Tengs TO, et al. Cost effectiveness of community-based physical activity interventions. Am J Prev Med 2008;35(6):578–88.
CMS. National health expenditure data. www.cms.hhs.gov/NationalHealthExpendData/02_NationalHealthAccountsHistorical.asp.

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Active PE Conclusions

- **Implementation of an Active PE policy among elementary schools could:**
- Result in a small increase in MVPA
- Potentially reduce BMI
- Have additional positive impacts related directly to physical activity increases
  - Improvements in cognitive function, fitness, and mood
  - Future reductions in risk of heart disease, diabetes mellitus, osteoporosis, and high blood pressure

Barrett JL, Gortmaker SL, Long MW, et al. Cost-effectiveness of an elementary school active physical education policy. Am J Prev Med, *in press*.

Discussion

Discussion

- How do we communicate cost effectiveness?
  - How to report to different audiences/stakeholders?
  - How to order results?
  - What language to use?

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Implementation and Equity Considerations

- Equity and impact on disparities
- Level of evidence (e.g. pathway to BMI)
- Acceptability to stakeholders
- Feasibility
- Impact on social and policy norms
- Sustainability
- Side effects

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CHOICES Conclusions

- To make better choices, we need better information
- We need to move beyond just “what is effective” to:
    - Effectiveness
    - Population reach of interventions
    - Cost of interventions
    - Cost effectiveness
- Small differences in effectiveness are magnified by reach and cost =>large differences in cost effectiveness
- Many childhood obesity preventive interventions are more cost effective than some obesity treatments

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RESOURCES

- HSPH Center for Health Decision Science: http://chds.hsph.harvard.edu
- CEA registry: https://research.tufts-nemc.org/cear/
- Society for Medical Decision Making (SMDM)
- ISPOR Good Research Practices & Issues: http://www.ispor.org/workpaper/practices_index.asp
- WHO-CHOICE: http://www.who.int/choice/en/
- US Public Health Service Panel Recommendations

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