



**Department  
of Health**

**Evidence-Based Public Health:  
Supporting the New York State  
Prevention Agenda**

**MODULE 7:  
ECONOMIC EVALUATION**

July 23, 2015

**Franklin Laufer, PhD**

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## **Economic Evaluation**

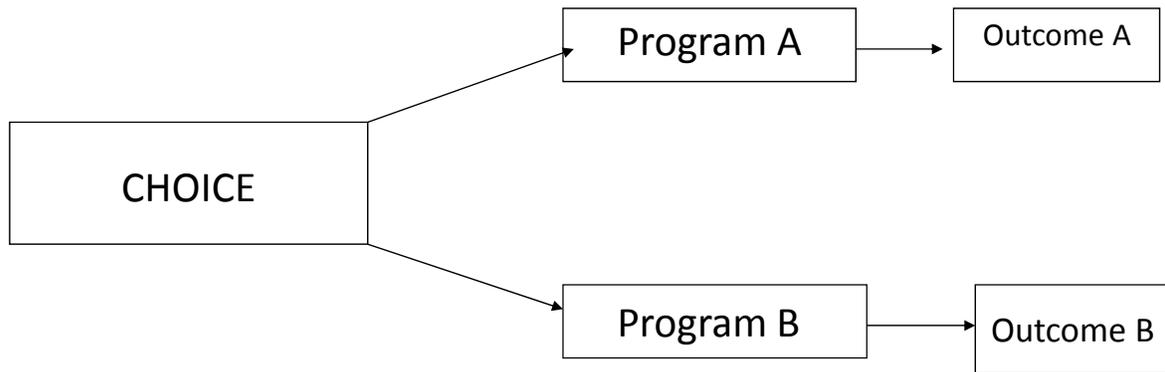
- A set of analytic techniques that are applied to identify, measure, value, and compare the costs and consequences of two or more alternative programs or interventions



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## Making a Choice



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## Which program to implement?

- Physical Activity Program
  - Annual cost of \$400,000, saves 20 years of life
- Nutrition Program
  - Annual cost of \$800,000, saves 25 years of life
- Smoking Cessation Program
  - Annual cost of \$350,000, saves 15 years of life

## Economic Evaluation: Agenda

- Introduction
- Overview of main types of economic evaluation
- Steps in conducting an economic evaluation
  - Cost calculations (direct, indirect)
  - Benefits/consequences (money, life years, etc.)
  - Perspectives (individual, group, society)
  - Time horizon (discounting)
  - Base case
  - Uncertainty
- Exercise
- Financial returns on wellness programs

## Learning Objectives

- Know the differences between types of economic evaluations
- Understand key terms in economic evaluation
- Be able to use economic evaluation studies to justify, prioritize, and implement prevention and treatment strategies

## Introduction

- What is economic evaluation?
- Why do it?
- What can it tell us?
- How can it be used?

## What is an economic evaluation?

### Definition:

- Analysis that compares the outcomes (benefits) and costs of alternative interventions to inform decisions about the allocation of scarce resources using an established set of economic tools
- It is one decision-making tool
- It compares a new or alternative intervention against a standard (business as usual)

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## Why do economic evaluation?

- Resources are scarce
- Need to be economically efficient
  - Maximize benefit
  - Minimize cost
- To determine the most cost-effective way to provide a service



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## Why do economic evaluation?

- Organizes information about interventions
  - Relevant alternatives to be considered because of their
    - Efficacy - Can it work, providing more good than harm?
    - Effectiveness - Does it work for those who access it?
    - Availability – Is it reaching or can it reach those who need it?
  - Better able to understand differences in effectiveness, costs, and outcomes associated with alternatives
- Allows decision makers to evaluate trade-offs and choose among alternatives



## Trade-offs between costs and benefits

|                 |   |  |  |
|-----------------|---|--|--|
| Increased Costs | A:<br>Costs more;<br>Worsens health     | B:<br>Costs more;<br>No health<br>difference     | C:<br>Costs more;<br>Improves health     |
| No Change       | D:<br>Costs the same;<br>Worsens health | E:<br>Costs the same;<br>No health<br>difference | F:<br>Costs the same;<br>Improves health |
| Cost Savings    | G:<br>Costs less;<br>Worsens health     | H:<br>Costs less;<br>No health<br>difference     | I:<br>Costs less;<br>Improves health     |

Worse Outcomes

No Change

Improved Outcomes



## Main types of economic evaluation

- Cost-minimization analysis (CMA)
- Cost-benefit analysis (CBA)
- Cost-effectiveness analysis (CEA)
- Cost-utility analysis (CUA)



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## Economic Evaluation

- Methods differ in how benefits are measured
- Best done by comparing incremental costs and benefits
  - Even if currently “doing nothing”
- Evaluate the trade-off (ratio) between incremental costs and benefits
- Choice may not be the alternative that is cost-saving
  - Not all beneficial programs save money



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## Types of economic evaluation

- Cost minimization analysis (CMA)
  - Compares costs of alternatives for which outcomes assumed to be the same
- Cost-benefit analysis (CBA)
  - Evaluates benefits in monetary terms
  - Benefits may not be identical



## Types of economic evaluation

- Cost-effectiveness analysis (CEA)
  - Based on some common effect (e.g., life-years saved, infections averted, percent reduction in body fat)
- Cost-utility analysis (CUA)
  - Measures outcomes as quality-adjusted life-years (QALYs) gained
  - Sometimes also referred to as cost-effectiveness analysis

## Cost-Minimization Analysis

- Definition: CMA compares the costs of different programs that produce the same health-related outcomes
- Benefits: Not assessed as outcomes are assumed to be equal or approximately so
- Question: While keeping outcomes constant, which is the lower-cost intervention?
- Decision: Select the effective intervention with the lower cost (cost-saving strategy)

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## Cost-Minimization Analysis - Example

- Consider two cardiovascular disease risk-reduction programs with equivalent consequences
  - Purchase gym membership
  - Nutritionist designs a diet to reduce fat intake
- Cost
  - Gym membership - \$300 per person per year
  - Nutritionist - \$250 per person per year
- Benefit
  - Both lower risk of cardiovascular disease by 10%
- Decision – As benefits are the same, choose the nutritionist as the lower-cost alternative



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## Cost-Benefit Analysis

- Definition: CBA compares the costs and benefits of the same (or different) program using monetary outcomes
  - Also known as a return-on-investment (ROI) analysis
- Benefits: Expressed in monetary units
- Question: Are the net benefits greater than net costs?
- Decision: Accept if the effects are worth more than the cost
  - Select the intervention that has a benefit-cost ratio of greater than 1.



## Cost-Benefit Analysis - Example

School-based obesity prevention program (adapted from Wang et al., 2003)

- Cost of the intervention = \$33,677
- Benefits
  - Cases of adulthood overweight prevented = 5.805
  - Medical care costs averted = \$2,737 per case or \$15,887
  - Value of lost productivity averted = \$4,325 per case or \$25,104
- Net benefit
  - $(\$15,887 + \$25,104) - \$33,677 = \$7,313$
- Benefit-cost ratio
  - $\$40,991 / \$33,677 = 1.22$

## Net benefits vs. benefit-cost ratio

- Costs
  - Intervention A: \$200 per person
  - Intervention B: \$100 per person
- Benefits
  - A produces \$300 in benefits for each of 1,000 persons
  - B produces \$300 in benefits for each of 100 people
- Net benefits
  - A:  $\$300,000$  minus  $\$200,000 = \$100,000$
  - B:  $\$30,000$  minus  $\$10,000 = \$20,000$
- Benefit-cost ratio
  - A:  $\$300,000 / \$200,000 = 1.5$
  - B:  $\$30,000 / \$10,000 = 3.0$

## Cost-Effectiveness Analysis

- Definition: CEA compares the incremental costs and benefits of different programs using the same outcome measure
- Benefit: Effectiveness expressed in natural units related to the program objective
- Question: Is the incremental effectiveness worth the incremental costs?
- Decision: Adopt if incremental gains are worth the incremental costs, in terms of lowest CEA ratio or benchmark if no comparator

## Cost-Effectiveness Analysis - Example

School-based obesity prevention program (adapted from Wang et al., 2003 from the payer perspective)

- Cost of the intervention = \$33,677
- Benefits
  - Cases of adulthood overweight prevented = 5.805
  - Medical care costs averted = \$2,737 per case or \$15,887
- Incremental cost-effectiveness ratio
  - $(\$33,677 - \$15,887) / 5.805 = \$3,064$  per case averted

## Cost-Utility Analysis

- Definition: CUA compares the costs and benefits of the same (or different) program
- Outcomes: Health improvement
- Answers: Are the gains in health worth the incremental costs?
- Decision: Adopt if incremental gains are worth the incremental costs, in terms of lowest CEA ratio or benchmark if no comparator

## Cost-Utility Analysis - Example

School-based obesity prevention program (adapted from Wang et al., 2003)

- Cost of the intervention = \$33,677
- Benefits
  - Cases of adulthood overweight prevented = 5.805
  - Quality-adjusted life-years (QALY) gained = 4.13 (5.805 X 0.712 years of healthy life gained per case)
  - Medical care costs averted = \$2,737 per case or \$15,887
- Incremental cost-utility ratio
  - $(\$33,677 - \$15,887) / 4.13 = \$4,305$  per QALY gained

## Steps in cost-effectiveness analysis

1. Determine costs
2. Determine effectiveness
3. Perform discounting
4. Calculate a cost-effectiveness ratio
  - Steps 1 through 4 produce a “base case” -
5. Conduct sensitivity analyses to test assumptions

## Determining costs

- Perspective
  - Costs incurred by whoever is paying – e.g., insurer, state and/or local health department
  - Broader “societal” perspective to account for all costs regardless of who pays

## Determining costs

- Who is affected?
  - Service providers
  - Clients
  - Caregivers
  - Oversight agencies
- Estimate direct costs
  - Service provision and administration
    - Costs to treat, including side-effects
    - Costs, not charges
  - Financial vs. imputed costs
    - Volunteers and other in-kind contributions

## Determining costs

- Indirect costs
  - Clients, families, and/or other caregivers
    - Transportation, lost wages, etc.
  - Costs saved or averted
    - If the intervention results in some actual or projected cost savings, these are recognized as an offset to the direct and other indirect costs of the intervention

## Costs to include in a CEA - Example

School-based obesity prevention program (from Wang et al., 2003)

- Two-year costs of the intervention = \$33,677
  - Workshop trainers
  - Teacher reimbursement (stipend plus meals)
  - Wellness activity training for teachers at participating schools
  - Incentives paid to schools
  - Cost of curriculum book provided to each participating school

## Determining effectiveness

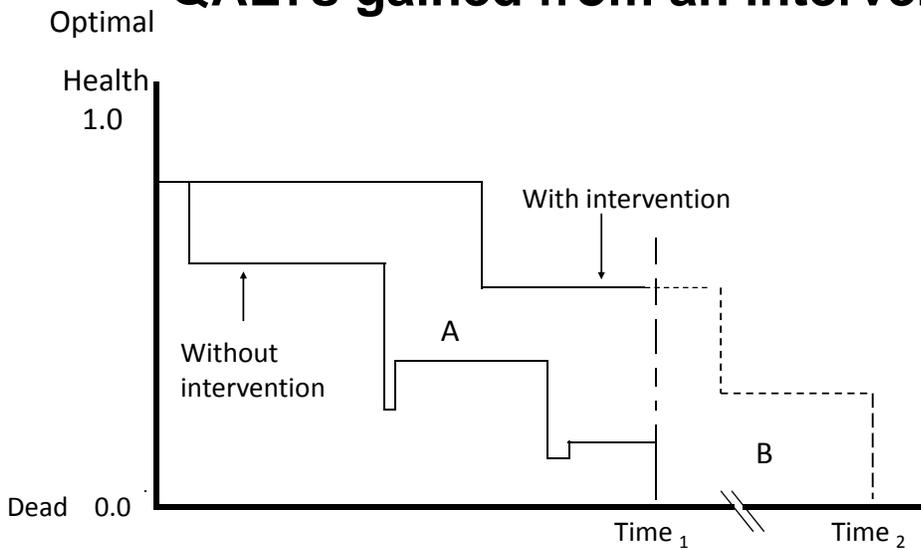
- Physical units that represent the intended outcome of the intervention
  - Wang et al. measure projected cases of adulthood overweight prevented
  - Others include years of life saved, infections prevented
- Health status classification systems for cost-utility analysis
  - Scoring systems that have developed preference scores for potential health states within such attributes as mobility, physical activity, social activity, etc.
  - Based on surveys and intended to represent the preferences of the general public for certain health states
  - Examples include the Quality of Well-Being Scale, EuroQol, and the Health Utilities Index

## Quality-Adjusted Life Years (QALYs)

- Quality Adjusted Life Years (QALYs) gained
  - Combines duration of life with judgments about quality of life
  - Most useful when comparing programs for which there are no comparable outcome measures (e.g., obesity prevention vs. cancer prevention vs. HIV prevention)



## QALYs gained from an intervention



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## Quality-Adjusted Life Years (QALYs)

- Subjective and difficult to measure
- Whose QALY values should be used?
  - A representative sample of the population
  - The affected group only
- QALY scales will differ depending on:
  - Age group represented
  - Health status represented



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## Disability-Adjusted Life Years (DALYs)

- Alternative to QALYs, seen often in World Health Organization and other analyses outside US
- DALYs are a measure of the burden of disease
  - Years of healthy life lost through premature death and disability
  - Uses disability weights to measure loss of functioning
- DALYs and QALYs not comparable
  - Based on different assumptions and methodologies
  - Express as DALYs saved, compared to QALYs gained

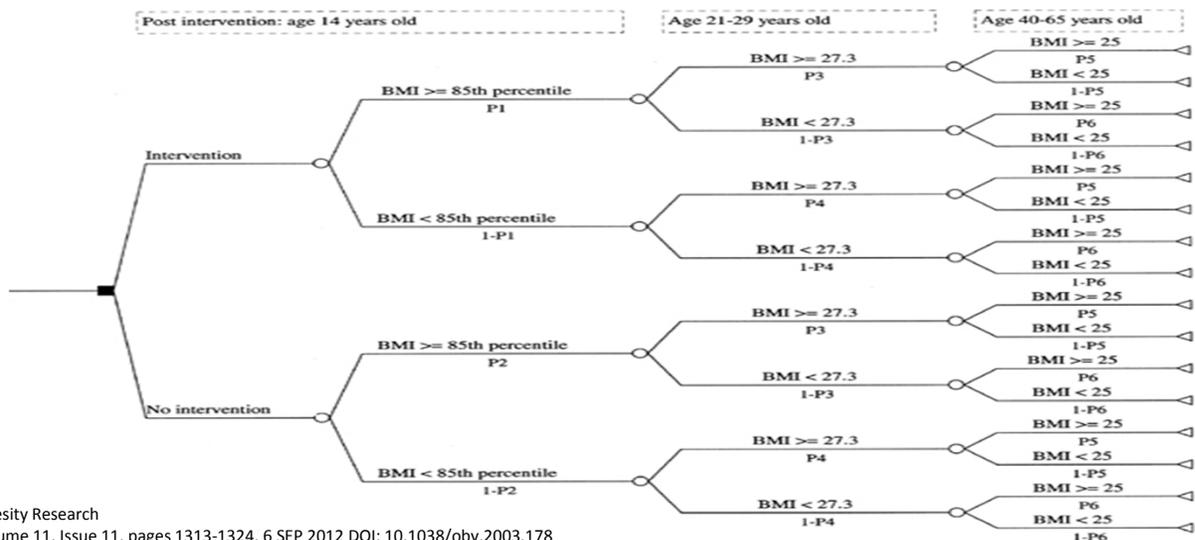


# Retrospective vs. prospective analysis

- Retrospective analysis
  - Intervention already in place, so dealing with costs incurred and outcomes realized
- Prospective analysis
  - Evaluating a proposed intervention
  - Requires some modeling of effects
  - Need to project or estimate costs and outcomes
  - Construct a decision tree to
    - Set out sequences of events
    - Incorporate probabilities and costs
    - Recognizes uncertainties



# Economic analysis of a school-based obesity prevention program



Obesity Research  
 Volume 11, Issue 11, pages 1313-1324, 6 SEP 2012 DOI: 10.1038/oby.2003.178  
<http://onlinelibrary.wiley.com/doi/10.1038/oby.2003.178/full#f1>

# Discounting

- If time frame for the analysis is over one year, need to “discount” costs and benefits
  - Applies to benefits in cost-benefit and cost-utility analysis
- Recognizes that both costs and benefits have a time value or time preference
  - Costs incurred and benefits realized in the future are valued less than if put to use or realized today
  - With respect to cost, differs from inflation, which measures changes in purchasing power
- Costs and benefits are discounted (usually by 3% or 5%, the so-called “social rate of discount”) to reflect how they would be valued in the “present”



# Effect of discounting on costs

| Discount factors for present value calculations at rate of 5% |                      |                                 | Expenditure and present value of a hypothetical project by year |             |                 |                   |
|---|----------------------|---------------------------------|---|-------------|-----------------|-------------------|
| Year  | $(1+r)^n$            | Discount factor = $1 / (1+r)^n$ | Year  | Expenditure | Discount factor | Net present value |
| 1   | $(1+0) = 1$          | 1.000                           | 1   | \$15,700    | 1.000           | \$15,700          |
| 2   | $(1+0.05) = 1.050$   | 0.952                           | 2   | \$16,171    | 0.952           | \$15,395          |
| 3   | $(1+0.05)^2 = 1.025$ | 0.907                           | 3   | \$16,656    | 0.907           | \$15,107          |
| 4   | $(1+0.05)^3 = 1.158$ | 0.864                           | 4   | \$17,156    | 0.864           | \$14,823          |
| 5   | $(1+0.05)^4 = 1.218$ | 0.823                           | 5   | \$17,670    | 0.823           | \$14,543          |
|   |                      |                                 | Total   | \$83,353    |                 | \$75,567          |

Note: Assumes costs incurred at the beginning of each year

Note: Assumes 3% annual increases in expenditures



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## Calculating a cost-effectiveness ratio

Cost-effectiveness ratio = Incremental costs /  
incremental benefits

Expresses cost-effectiveness of an intervention as the  
amount of money spent per measure of  
effectiveness realized



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## Calculating a cost-utility ratio

Cost-utility ratio = Incremental costs /  
number of QALYS gained

Expresses the cost-utility of an intervention as the  
amount of money spent per quality-adjusted life-year  
gained

(Also may be reported as cost-effectiveness ratio)



## Examples of ratios

School-based obesity prevention program (adapted from Wang et al., 2003)

- Cost-effectiveness ratio
  - $\$17,790 / 5.805$  overweight cases prevented =  $\$3,065$  per overweight case prevented
- Cost-utility ratio
  - $\$17,790 / 4.13$  QALYs gained =  $\$4,305$  per QALY gained
- Base case results

## Is there benchmark ratio?

- Historically,  $\$50,000$  per QALY gained is often cited as the “threshold”
- Problems
  - Supposedly represented what society would pay under Medicare for kidney dialysis (not true)
  - In use since 1980s, never adjusted for inflation
  - Often attributed to 1992 article co-authored by a Canadian researcher who says “I have no idea why 50K would be attributed to me.”
- Review of studies by Hirth et al. (2000) yields median value of  $\$506,000$  per QALY gained in 2015 US\$

## Sensitivity Analysis

- Information on which base case scenario is done is subject to variability or uncertainty
  - Base case result may be “sensitive” to values used for one or more of the components
- Vary the information used to calculate CE/CU ratio within a range of values
  - Costs incurred and/or averted
  - Probabilities, participation rates
  - Discount value

## Sensitivity Analysis

1. Identify parameters
2. Choose those that are most important to analyze as they are
  - the most uncertain
  - have the greatest variability
  - influence large percentage of total costs/effects
  - subject to disagreement

## Sensitivity Analysis

3. Choose the range of values to substitute
4. Incorporate the values into the analysis
  - Can do univariate or multivariate
5. Interpret the findings

## Sensitivity Analysis - Example

School-based obesity prevention program (adapted from Wang et al., 2003)

- Varied 10 parameters both individually and all together over a range of plausible values
  - Base case CUA ratio = \$4,305 / QALY gained
  - For univariate analyses of parameters, mean CUA ratios change from \$4,306 / QALY gained to \$4,525 / QALY gained
  - Multivariate analysis – mean CUA increases to \$4,397 / QALY gained

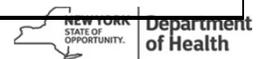
## Summary

- Economic evaluation is a technique for comparing the costs and consequences of alternative interventions to determine the most efficient and effective allocation of scarce resources.
- Economic evaluation provides information for rational decision making by public health professionals and policy makers.



## Types of economic evaluation

| Type of Evaluation       | Outcome (Benefit)  | Measurement of Benefits   |
|--------------------------|--|---|
| Cost Minimization (CMA)  | Identical, but costs are different<br><i>Can we do it for less?</i>  | None (or kept constant)   |
| Cost Effectiveness (CEA) | Single common benefit (or outcome)<br><i>Are the (natural) outcomes worth the cost?</i>                              | Natural units such as life years gained, cases averted, change in intended effect |
| Cost Utility (CUA)       | One or more benefits (outcomes) standardized into a single value<br><i>Are standardized outcomes worth the cost?</i> | QALYs gained<br>DALYs saved   |
| Cost Benefit (CBA)       | Single or multiple benefits expressed in dollars<br><i>Do we save more than we spend?</i>                            | Present value of \$\$   |



## What can the results be used for?

- Resource allocation decisions - ranking or prioritizing
  - Compare the cost-effectiveness of a current intervention with alternative intervention(s)
    - Current intervention can be “do nothing”
    - Some interventions may be cost-saving in the long run, and ideally should fund these first
- Results should not be taken as the only basis for decision making

## Words to the wise...

“(T)he power of these analytic techniques should not be overstated. None of the approaches is intended to be a magic formula for removal of judgement, responsibility, or risk from decision-making activities, though each is capable of improving the quality and consistency of decision-making. At root, they are methods of critical thinking, of approaching choices – and often of placing difficult choices out in the open for discussion. While they generate quantitative statements about the value of programme costs and consequences, qualitatively they are simply frameworks for comprehensive identification and display of (economic) factors involved in decision making.”

- Drummond et al. (1998). *Methods for the economic evaluation of health care programmes*, 2<sup>nd</sup> ed. New York: Oxford University Press.

## NYS Prevention Agenda

- A five-year (2013-17) collaboration among the NYSDOH, local health departments, hospitals, and other community groups to:
  - Improve health status in five priority areas and reduce health disparities
  - Promote attention to the health implications of policies and actions outside the health sector
  - Create and strengthen public-private partnerships to achieve sustainable health improvement at the state and local levels
  - Increase investment in prevention and public health to improve health, control health care costs, and increase economic productivity
  - Strengthen public health agencies and resources



## NYS Prevention Agenda - Priorities

- Prevention priorities and the number of counties adopting them:
  - Prevent chronic diseases (# counties = 57)
  - Prevent HIV, STDs, and vaccine-preventable diseases and health care-associated infections (3)
  - Promote healthy women, infants, and children (16)
  - Promote mental health and prevent substance abuse (29)
  - Promote a healthy and safe environment (9)



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## NYS Prevention Agenda - Preventing Chronic Diseases

- Focus area 1 – Reduce obesity in children and adults
  - Goal #1.3 – Expand the role of health care and health service providers and insurers in obesity prevention
    - Ensure public and private health insurance coverage of, access to and incentives for routine obesity prevention screening, diagnosis and treatment, including diabetes prevention programs.



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## NYS Prevention Agenda - Preventing Chronic Diseases

- Focus area 1 – Reduce obesity in children and adults
  - Goal #1.4 – Expand the role of public and private employers in obesity prevention
    - Increase the number of employers offering benefits, coverage and/or incentives for obesity prevention;
    - Develop community partnerships to increase comprehensive worksite wellness programs among small- to medium-sized employers; and
    - Implement evidence-based wellness programs for all public and private employees, retirees, and their dependents



## Modifiable Health Risk Factors

- Study by Goetzel et al. (2012) shows that ten modifiable health risk factors affect 22.4% of employer-employee health care spending
- Seven of the ten modifiable health risk factors resulted in higher average medical expenditures per capita
- Remaining three resulted in lower average medical expenditures per capita
- Total expenditures attributable to all high-risk factors = \$1,056 per capita
  - Obesity and physical inactivity account for 59% of this increased cost



## Increase in Employer and Employee Shares of Medical Payments (Goetzel et al., 2012)

| <u>Risk measure</u> | <u>Difference (%)</u> |
|---------------------|-----------------------|
| Depression          | 48.0                  |
| High blood glucose  | 31.8                  |
| High blood pressure | 31.6                  |
| Obesity             | 27.4                  |
| Tobacco use         | 16.3                  |

| <u>Risk measure</u>              | <u>Difference (%)</u> |
|----------------------------------|-----------------------|
| Physical inactivity              | 15.3                  |
| Stress                           | 8.6                   |
| High cholesterol                 | -2.5                  |
| Poor nutrition and eating habits | -5.2                  |
| Alcohol use                      | -9.5                  |



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## Do workplace wellness programs save money?

- Meta-analysis of 22 workplace disease prevention and wellness programs (Baicker et al., 2010)
  - Reviewed 22 studies, 90% of which involved programs at large employers (1,000+ employees), most of which focused their programs on obesity and tobacco use
  - Reported average returns on investment (ROI) of 3.27 on medical costs and 2.73 on absenteeism
- Wellness and disease prevention (Schwartz et al., 2014)
  - Examined the sustained economic impact of a program delivered through a regional health insurer between 2002-2009
  - ROI over the eight years averaged 2.02 (range: 1.16 to 2.83)



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## Do workplace wellness programs save money?

- Review of studies of workplan health promotion programs (Baxter et al., 2014)
  - Examined 47 studies of which 46 saved money
  - Those that saved money showed an average ROI of 1.45
- Small employers in Colorado (Goetzel et al., 2014)
  - Reductions occurred in all modifiable health risks among employees of 121 small employers and who participated in the programs
  - ROI in terms of both medical care and productivity was 2.03



## Motivating small and midsized employers

- Results from studies of employers with fewer than 1,000 employees (Hughes et al., 2010 and Witt et al., 2014)
- Why adopt a program
  - Lower health care costs for employer and employee (lower premiums)
  - Employee well-being
  - Increase productivity
- Concerns expressed
  - Financial burden predominates, both initially and ongoing
  - Employee buy-in and participation
  - Time constraints



## Motivating small and midsized employers

- Conclude and recommend
  - Approach small and midsized firms as being amenable to relevant programming
  - Connect the concept of improved productivity to ROI and lower relative costs
    - Emphasis on company success-related factors
  - Help small and midsized firms analyze health risk assessment and claims data and connect these data to lowered costs, days away from work, and productivity measures
  - Identify low-cost programming and/or grant writing assistance



## References – Workplace Wellness Programs

- Baicker K, Cutler D, Song Z. Workplace wellness programs can generate savings. *Health Affairs* 2010;29(2):304-311.
- Baxter S, Sanderson K, Venn AJ, et al. The relationship between return on investment and quality of study methodology in workplace health promotion programs. *American Journal of Health Promotion* 2014;28:347-363.
- Goetzel RZ, Pei X, Tabrizi MJ, et al. Ten modifiable health risk factors are linked to more than one-fifth of employer-employee health care spending. *Health Affairs* 2012;31(11):2474-2484.
- Goetzel RZ, Tabrizi M, Henke RM, et al. Estimating the return on investment from a health risk management program offered to small Colorado-based employers. *Journal of Occupational and Environmental Medicine* 2014;56(5):554-560.



## References – Workplace Wellness Programs

- Hughes MC, Patrick DL, Hannon PA, et al. Understanding the decision-making process for health promotion programming at small to mid-sized businesses. *Health Promotion Practice* 2011;12(4):512-521.
- Schwartz SM, Mason ST, Wang C, et al. Sustained economic value of a wellness and disease prevention program: An 8-year longitudinal evaluation. *Population Health Management* 2014;17(2):90-99.
- Witt LB, Olsen D, Ablah E. Motivating factors for small and mid-sized businesses to implement worksite health promotion. *Health Promotion Practice* 2014;14(6):876-884.

