The Importance of Cost-Effectiveness Research in Implementing and Evaluating Interventions

Michael Pratt, MD, MPH
CDC

Department of Health and Human Services
Centers for Disease Control and Prevention

Objectives

- Evidence-based public health: A context for the economics of physical activity
- Health Economics 101
- Cost effectiveness of interventions to increase physical activity
- Issues in carrying out, understanding and applying economic research

Defining Evidence-based Public Health (Kohatsu, Fielding)

- The process of integrating science-based interventions with community preferences to improve the health of populations

A Research Context for Evidence-based Public Health

1. Is it important? Causes of disease, health and economic burden, health impacts, and preventability

2. What works? Evaluation of interventions, evidence-based reviews, cost effectiveness

3. How can we make it happen? Policy analysis and implementation research

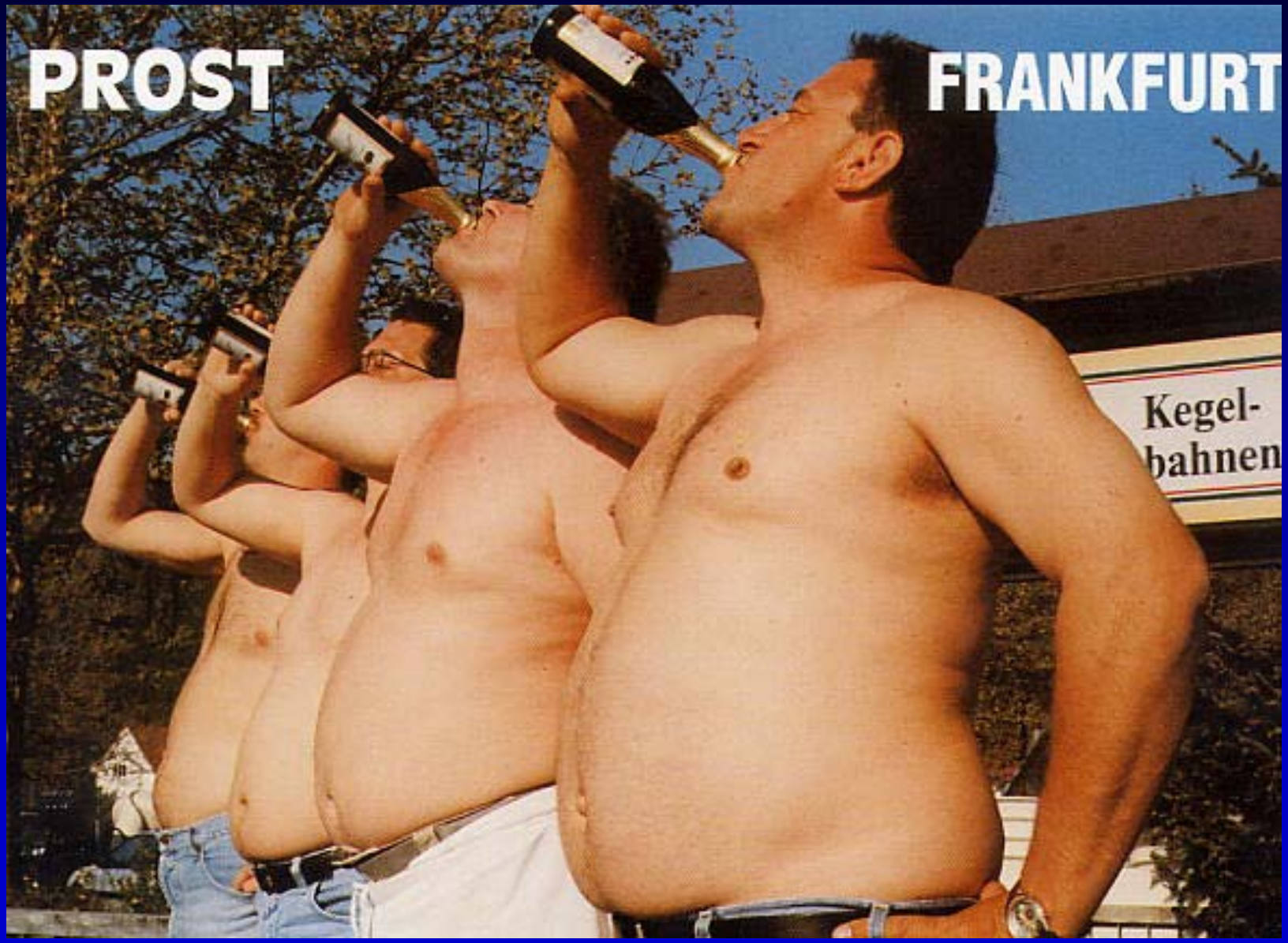
Why Use Economic Analyses?

- Maximizing health outcomes is important
- Understand the incremental benefits provided from resources expended
- Resources are limited and difficult resource allocation decisions must be made
- Economics matters to decision makers

An Economist's Perspective

- Health is only one of many values
- People maximize "utility"
- Market Failure is the only justification for public policy intervention
  - Information deficit
  - Externality
  - Public good
  - Failure of rationality

A good choice?



Economic Evaluation

Applied analytic methods to:

- identify
- measure
- value
- compare

the costs and consequences of prevention and treatment strategies

Types of Economic Analyses

- **Costs only**
  - Cost-of-illness studies
  - Cost analyses (intervention costs)

- **Balancing costs and benefits**
  - Cost-benefit analyses (CBAs)
  - Cost-utility analyses (CUAs)
  - Cost-effectiveness analyses (CEAs)

Cost-Effectiveness Analysis (CEA)

A method used to compare the cost of an intervention to its effectiveness where effectiveness is measured in natural health outcomes (i.e., cases averted, years of life saved).

Cost-Effectiveness of Trails

- $98 cost/person to become more active
- $142 cost/person for general health
- $884 cost/person for weight loss

Wang et al, Preventive Medicine 2004

Cost-Utility Analysis (CUA)

A method used to compare costs and benefits of interventions where benefits are expressed as the number of life years saved adjusted to account for loss of quality, often reported as

$ / QALY gained.

Cost Effectiveness of Community-Based Physical Activity Interventions

Larissa Roux, MD, MPH, PhD, Michael Pratt, MD, MPH, MS, Tammy O. Tengs, ScD, Michelle M. Yore, MSPH, Teri L. Yanagawa, MKin, MBA, Jill Van Den Bos, MA, Candace Rutt, PhD, Ross C. Brownson, PhD, Kenneth E. Powell, MD, MPH, Gregory Heath, DHSc, Harold W. Kohl III, PhD, Steven Teutsch, MD, MPH, John Cawley, PhD, I-Min Lee, ScD, MD, Linda West, MSPH, David M. Buchner, MD, MPH

Background: Physical inactivity is associated with the increased risk of many chronic diseases. Such risks decrease with increases in physical activity. This study assessed the cost-effectiveness of population-wide strategies to promote physical activity in adults and followed disease incidence over a lifetime.

Methods: A lifetime cost-effectiveness analysis from a societal perspective was conducted to estimate the costs, health gains, and cost-effectiveness (dollars per quality-adjusted life year [QALY] gained, relative to no intervention) of seven public health interventions to promote physical activity in a simulated cohort of healthy U.S. adults stratified by age, gender, and physical activity level. Interventions exemplifying each of four strategies strongly recommended by the Task Force on Community Preventive Services were evaluated: community-wide campaigns, individually adapted health behavior change, community social-support interventions, and the creation of or enhanced access to physical activity information and opportunities. Each intervention was compared to a no-intervention alternative. A systematic review of disease burden by physical activity status was used to assess the relative risk of five diseases (coronary heart disease, ischemic stroke, type 2 diabetes, breast cancer, and colorectal cancer) across a spectrum of physical activity levels. Other data were obtained from clinical trials, population-based surveys, and other published literature.

Results: Cost-effectiveness ratios ranged between $14,000 and $69,000 per QALY gained, relative to no intervention. Results were sensitive to intervention-related costs and effect size.

Conclusions: All of the evaluated physical activity interventions appeared to reduce disease incidence, to be cost-effective, and—compared with other well-accepted preventive strategies—to offer good value for money. The results support using any of the seven evaluated interventions as part of public health efforts to promote physical activity.

(Am J Prev Med 2008;35(6):578–588)

Cost-Benefit Analysis (CBA)

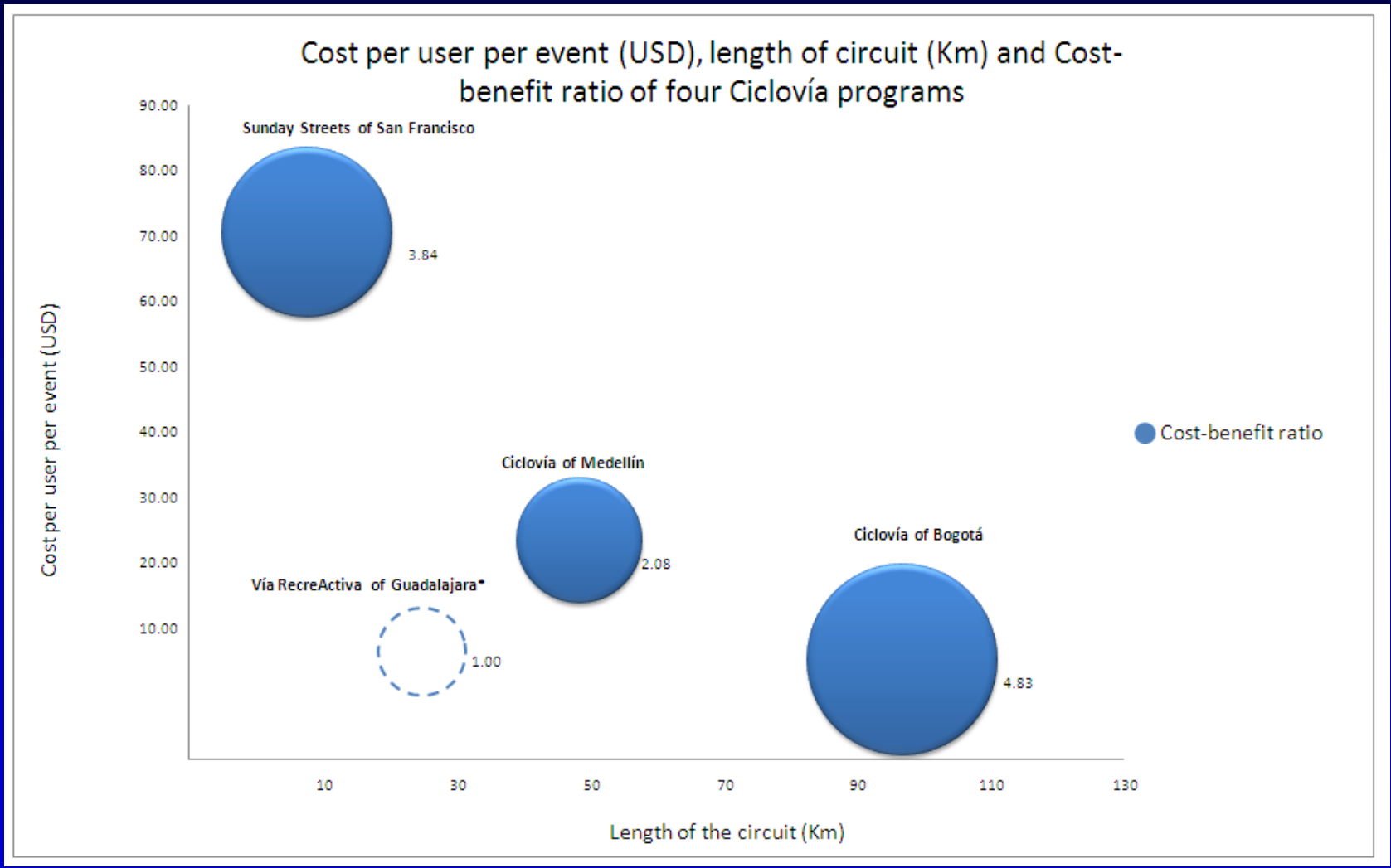
A method used to compare costs and benefits of an intervention where all the consequences and benefits are valued in monetary terms.

A Cost-Benefit Analysis of Physical Activity Using Trails

- For every dollar invested in trail construction and maintenance there is $2.94 (range $1.65 to $13.40) in direct medical benefit.

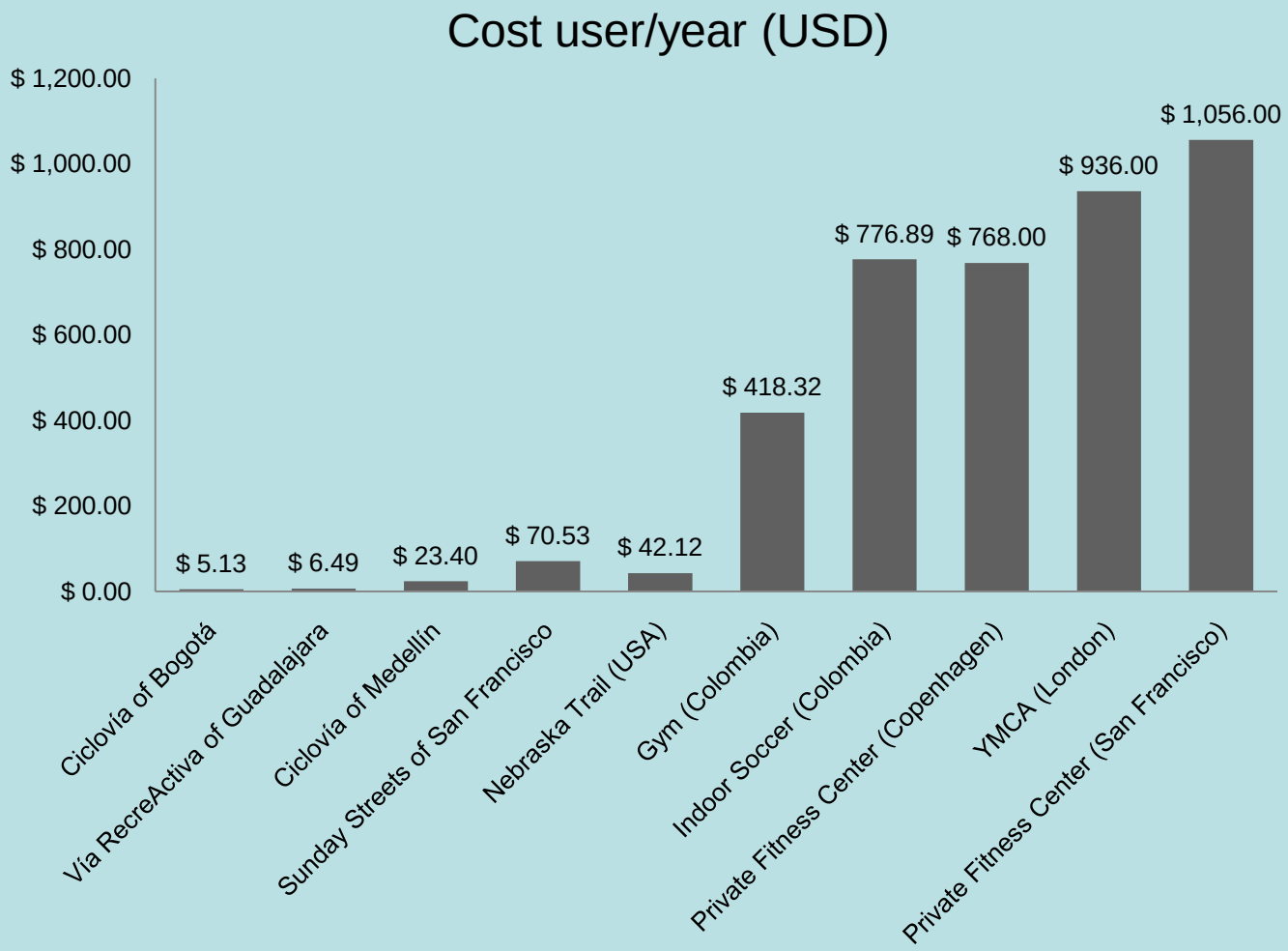
  Wang et al, AJPH 2004

Montes et al. Ciclovías Recreativas
Length of the circuit (Km), Cost user/event (USD) and Cost-benefit ratio

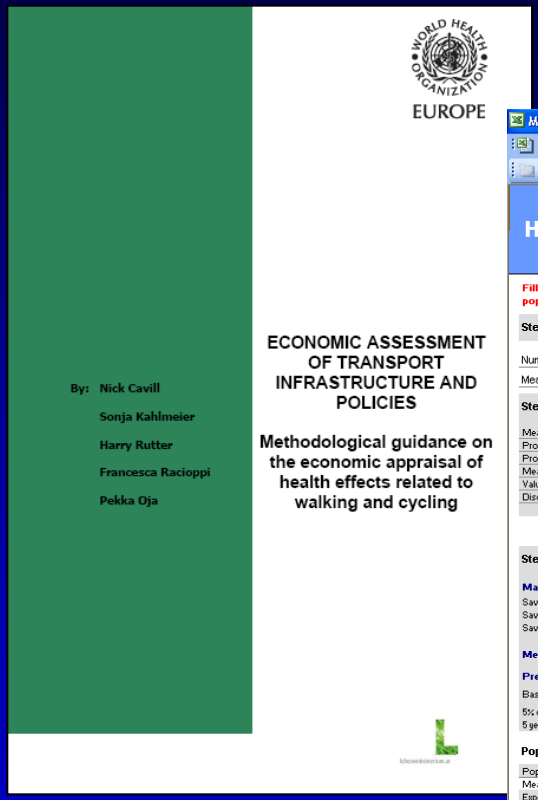


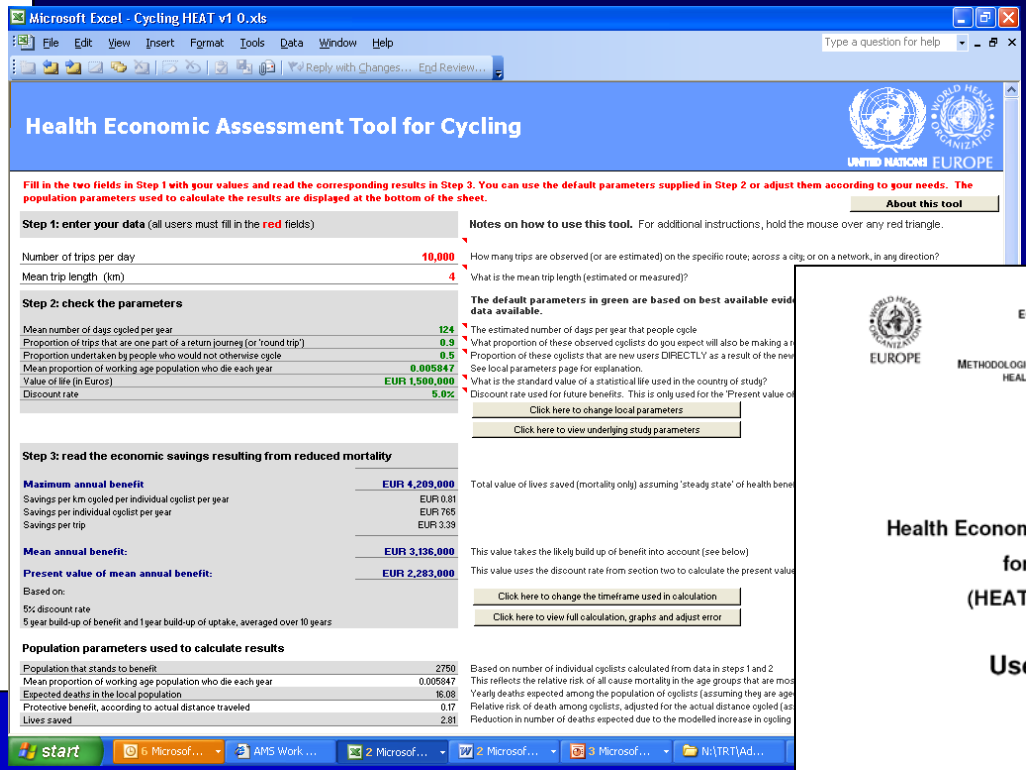
*In the case of Guadalajara, the Cost-Benefit ratio was assumed to be the lower bound

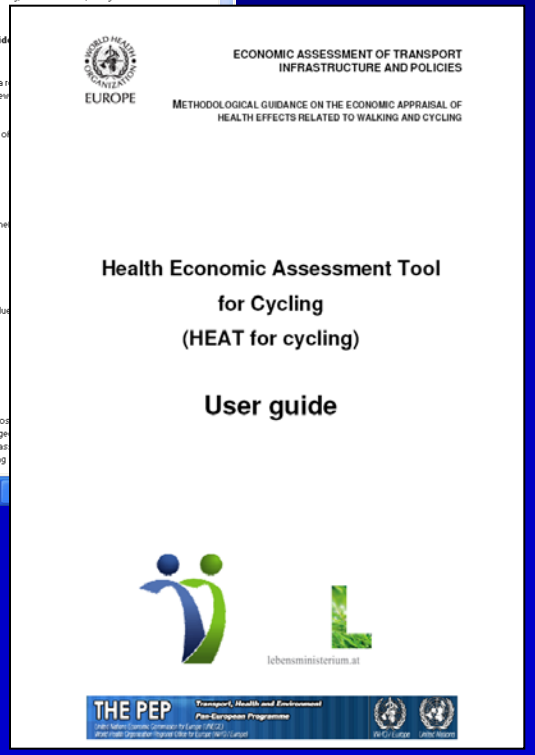
Ciclovías Recreativas and other PA centers costs user/year (USD) (Montes et al)



WHO guidance and tool for economic assessment of cycling and walking







Download the guidance document, HEAT for cycling and user guide from
www.euro.who.int/transport/policy/20070503_1

WHO guidance and tool for economic assessment of cycling and walking

- 17 papers or reports reviewed
- Wide range of data sources, health outcomes, methods
- 16 showed positive cost-benefit ratios, but “the median cost-benefit ratios should only be presented with caution”
- Being adapted to the US and for walking

CDC Project MOVE Research Question

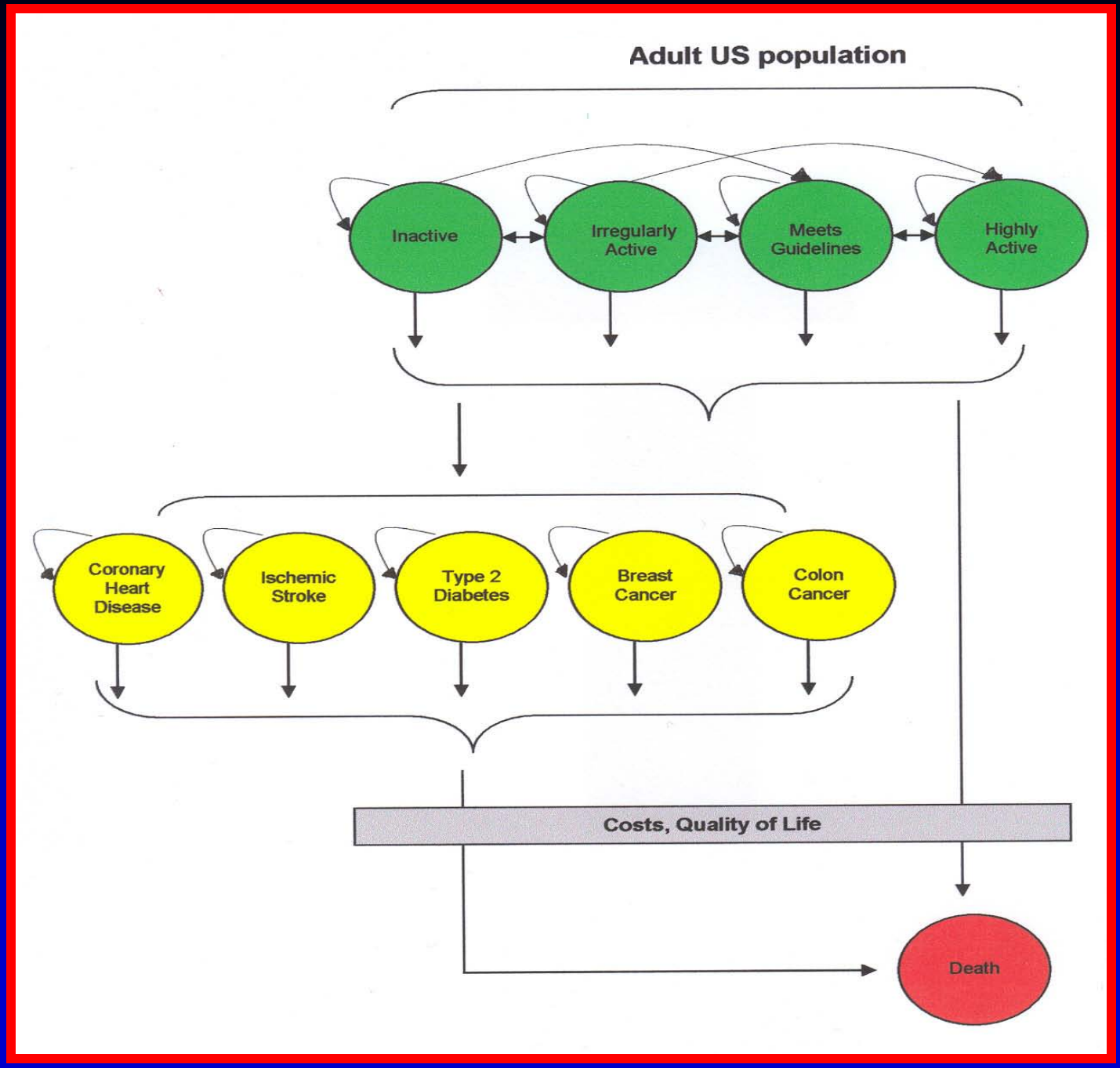
Compared with no intervention, which of the recommended "Community Guide" interventions to promote physical activity represent efficient uses of societal resources?

Intervention Effectiveness

- Recommendations (8 of 14 for PA)
- Based on scientific evidence
- Systematic reviews
- Coordinated by CDC and University Team
- Determined by independent Task Force

Study Design
Decision analytic approach
Cost-utility analysis ($/QALY)

Analytic perspective:	Societal
Intervention time frame:	1 year
Analytic time horizon:	10, 20, 30, and 40 years
Target population:	2004 census-projected population of 25-65 year old US adults

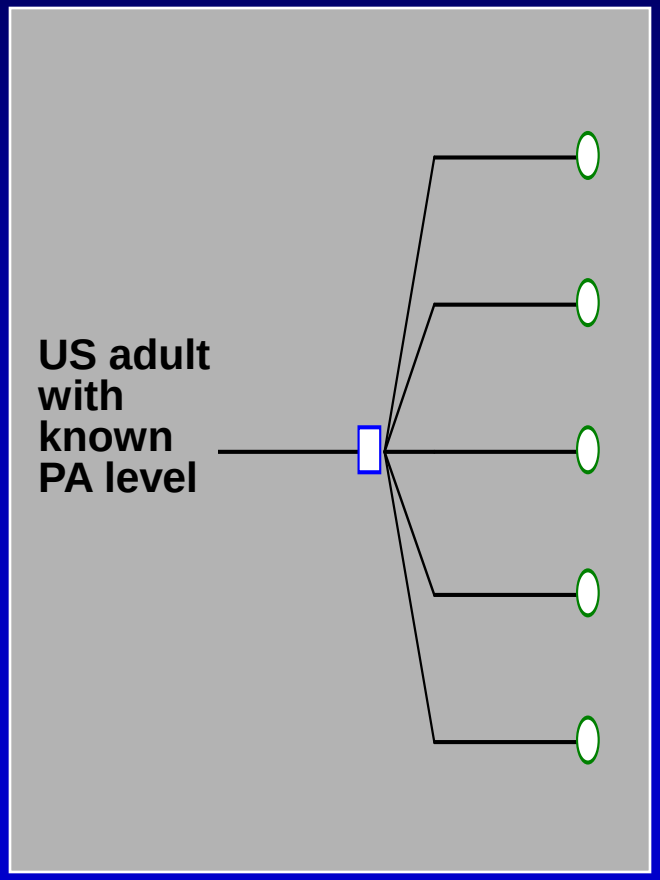

Adult US population
Inactive
Irregularly Active
Meets Guidelines
Highly Active
Coronary Heart Disease
Ischemic Stroke
Type 2 Diabetes
Breast Cancer
Colon Cancer
Costs, Quality of Life
Death

Model Assumptions

- All individuals are able to participate in the interventions
- All individuals are “healthy” (free from modeled health outcomes) at the start of the model
- Each individual can acquire only one health outcome (not multiple)
- Relationships between physical activity level and each health outcome are linear

Interventions to Promote PA

In addition to modeling no intervention, 7 one-year interventions, across 4 strategies, were evaluated



Strategies

- No intervention/Natural history
- Community-wide campaign (CC)
- Social support (SS)
- Individually-adapted health behaviors (IA)
- Enhanced access to PA opportunities (EA)

Results – Base Case

Average cost-effectiveness (per person)

Author	Intervention category	Total cost	Total life-years	Total QALYs	Cost/ QALY
	No Intervention	**$195,013.10**	**19.370**	**14.767**	**---**
Reger	CC	**$195,713.10**	**19.401**	**14.816**	**$14,300**
Lombard	SS	**$195,724.80**	**19.387**	**14.793**	**$27,400**
Linenger	EA	**$197,925.00**	**19.433**	**14.869**	**$28,500**
Jeffrey	IA	**$196,917.70**	**19.410**	**14.831**	**$29,800**
Kriska	SS	**$196,243.50**	**19.389**	**14.798**	**$39,700**
DPP	IA	**$197,734.10**	**19.406**	**14.825**	**$46,900**
Young	CC	**$195,972.90**	**19.379**	**14.781**	**$68,600**

MOVE CEA conclusions

- **All of the physical activity interventions assessed are good public health investments (**$14,000/QALY to $68,000/QALY**)**
- **CEA provides useful information for guiding public health policy, programs and investments**
- **No recommended PA intervention strategy is clearly more cost effective than the other recommended strategies**

National Report: Netherlands

- Cost effectiveness and health gains in realising policy ambitions for physical activity and overweight: underpinning the National Action Plan for Sport and Physical Activity.

  Wendel-Vos *et al*, 2005.

  (reportnr: 260701001, *in Dutch)*

www.rivm.nl

Conclusions

- Two part national intervention:
  Community based approach aimed at 90% of Dutch population
  Intensive lifestyle intervention: 10% of overweight population

- Achieving policy targets (PA and overweight) could prevent thousands of disease cases over 20 years

- Costs are approximately € 6000 / QALY gained and are well within socially accepted boundaries

What do we know?

- Very few CEA of PA interventions have been completed, fewer still using the most widely accepted methods (Cost / QALY)
- Cost / QALY of PA interventions are consistently in “CE” range
- Most studies have focused on high risk or older populations or work sites
- Indirect cost benefits of PA are generally greater than direct medical benefits, but are even less well studied

What do we know?

- Community-wide PA interventions appear to be cost effective
  - Netherlands €6000 / QALY for combined community-wide and targeted high intensity intervention at national level
  - US $14000 to 68000 / QALY for two comprehensive community campaigns
  - Brazil Agita São Paulo campaign Cost Saving
  - Ciclovias in Bogotá, Colombia and 3 other cities: positive CB ratio

Gaps and Limitations

- Very small number of studies with highly variable methods and quality
- Few studies address population level interventions
- Few, but growing number of studies in low and middle income countries
- Key methodological issues not yet widely standardized
- Interpreting results across countries and health systems is complex

Recommendations

- More and higher quality studies using standard methods
- Better inclusion of indirect costs, productivity, absenteeism, and presenteeism in CEA studies
- Incorporate CEA into population level PA interventions and collect prospective cost data for specific populations and settings
- Continued development of practical policy tools based on CEA

Economics Research Issues

- Standardizing methods
- Balancing rigor and complexity with feasibility and clarity
- Epidemiologic versus economic methods
- Societal versus other perspectives
- Factoring in multiple health and non-health outcomes
- Cross sector collaboration
- Simplicity of cost analyses and complexity of CEA

Policy Issues

- Communicating complex research clearly to policy makers in their language
- Different standards of evidence across sectors
- Communicating uncertainty without compromising credibility
- Balancing conservative approaches with high impact results
- Thresholds for CE
- Generalizability
- Balancing need for more and better data with urgency of action

CDC Project MOVE

Cost-of-Illness Analysis

- Estimates total costs incurred because of a disease or condition

  (i.e., medical costs, productivity losses).
- Generally reported as
  - annual total cost
  - average patient lifetime or annual cost.
- Used to show potential benefits of prevention efforts
- Can be very important for “making the case”

Medline, Pubmed, Ovid, EMBASE, Web of Science Searches

- Nguyen 2008 Prev Chronic Disease
  - 4766 older adults in health plan offered a health club benefit (Silver Sneakers)
  - Year 1: No differences in health care costs between participants and matched controls
  - Year 2: Participants had fewer hospital admissions and lower health care costs
  - Dose response effect: health club visits and health care cost reductions

NICE (UK) Costing Reports

- Annual Cost of inactivity £ 8.2 billion
- Brief interventions in primary care are cost saving (health system perspective)
- PA and Environment: 8 studies on walking and biking
- Cost:Benefit ratios from 1.35 to 32.5
- Limited evidence, but suggests that walking and cycling interventions are “profitable to society”

US Evidence-based Reveiws

- Guide to Clinical Preventive Services: Insufficient evidence for effectiveness of PA counseling in primary care

- Community Guide: Insufficient literature to assess cost effectiveness of recommended interventions

Exemplar Interventions

Jeffery RW *et al,* 1998 (IA)

- Use of personal trainers and financial incentives to increase exercise

Diabetes Prevention Program (DPP) (IA)

- Intensive lifestyle modification program involving exercise testing, individual counseling, educational curriculum, exercise sessions, scheduled assessments

Lombard DN *et al.* 1995 (SS)

- Use of an initial informational training session to facilitate walking, followed by ongoing telephone support

Kriska AM *et al,* 1986 (SS)

- Use of organized walking groups, social gatherings, phone calls and home visits to enhance exercise compliance and promote PA

Linenger JM *et al,* 1991 (EA)

- Exposure of intervention community to an environment that emphasizes and supports a more active lifestyle (bike paths, extended fitness facility hours, cycling clubs, marked running courses)

Reger B *et al.* 2002 (CC)

- Wheeling Walks Project: multifaceted walking promotion effort making use of paid media (TV, radio, newspapers, WWW) and local on-site (e.g., worksite, church) initiatives

Young DR *et al.* 1996 (CC)

- Stanford Five-City Project: an integrated multi-factorial health education effort for improving PA, making use of print materials, radio, TV, seminars, worksite and school-based programs

Intervention Efficacy and Cost

PA intervention	Efficacy at 1 year (delta MET-min/wk)		One-year per person cost (US $, 2003)
	Men	Women	
Jeffery (IA)	456	551	3980
DPP (IA)	435	435	4670
Lombard (SS)	210	210	1540
Kriska (SS)	228	275	2430
Linenger (EA)	954	1152	4980
Reger (CC)	316	316	1730
Young (CC)	50	32	1320

Sources for Other Data Inputs

Input variable	Source
Intervention efficacy	RCTs from Community Guide review and expert consultation
Intervention efficacy dissipation	Literature
Intervention costs	Intervention-specific protocols (CDC team)
Relative risks	Literature and commissioned review (RTI)
Disease incidence	Literature, SEER and CDC diabetes surveillance system databases
Medical costs	Claims database and MEPS
Quality of life	NHIS and QWB
Disease-specific mortality	Literature, National Vital Statistics Reports, and SEER database

Medical Costs

- Longitudinal medical costs for the diseases evaluated were gathered from a 350,000 member claims database and annualized using actuarial methods
- The effective annual cost for each illness was applied from diagnosis until death (e.g.; women with CHD)

Coronary Artery Disease: FEMALE

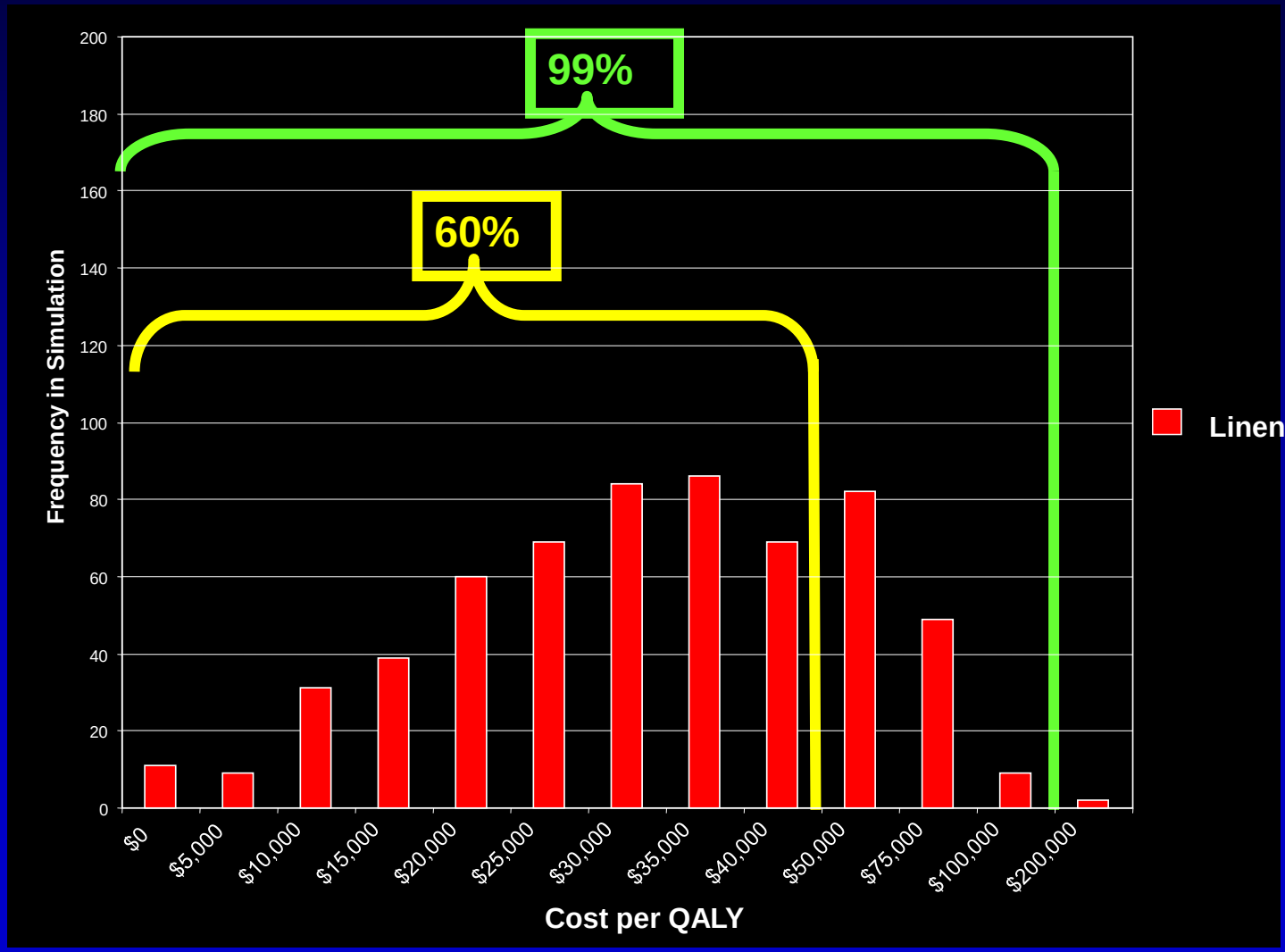
	FROM CLAIMS DATA								
Year	-2	-1	0	1	2	3	4	5	6
Total Claims	$ 28,924,191	$ 43,448,977	$ 185,648,717	$ 79,907,686	$ 54,852,213	$ 40,213,038	$ 29,046,066	$ 17,042,691	$ 10,122,578
Exposure	4,778	6,324	9,182	7,098	5,340	3,808	2,649	1,665	862
PMPY	**$ 2,951**	**$ 3,768**	**$ 20,218**	**$ 11,258**	**$ 10,272**	**$ 10,561**	**$ 10,966**	**$ 10,234**	**$ 11,742**
Survival	**1.0**	**1.0**	**1.0**	**0.96**	**0.93**	**0.89**	**0.86**	**0.83**	**0.80**
Discount Factor	**94%**	**97%**	**100%**	**103%**	**106%**	**109%**	**113%**	**116%**	**119%**
PV at Yr 0	**$ 3,131**	**$ 3,881**	**$ 20,218**	**$ 10,529**	**$ 8,985**	**$ 8,640**	**$ 8,390**	**$ 7,323**	**$ 7,857**
Discounted Survival	**1.061**	**1.030**	**1.000**	**0.935**	**0.875**	**0.818**	**0.765**	**0.716**	**0.669**

MODEL VALUE $ 10,764.25

- To improve the generalizability of these cost estimates, they were adjusted by nationally-representative MEPS data

Monte Carlo Simulation

Histogram: variation of intervention costs and effects

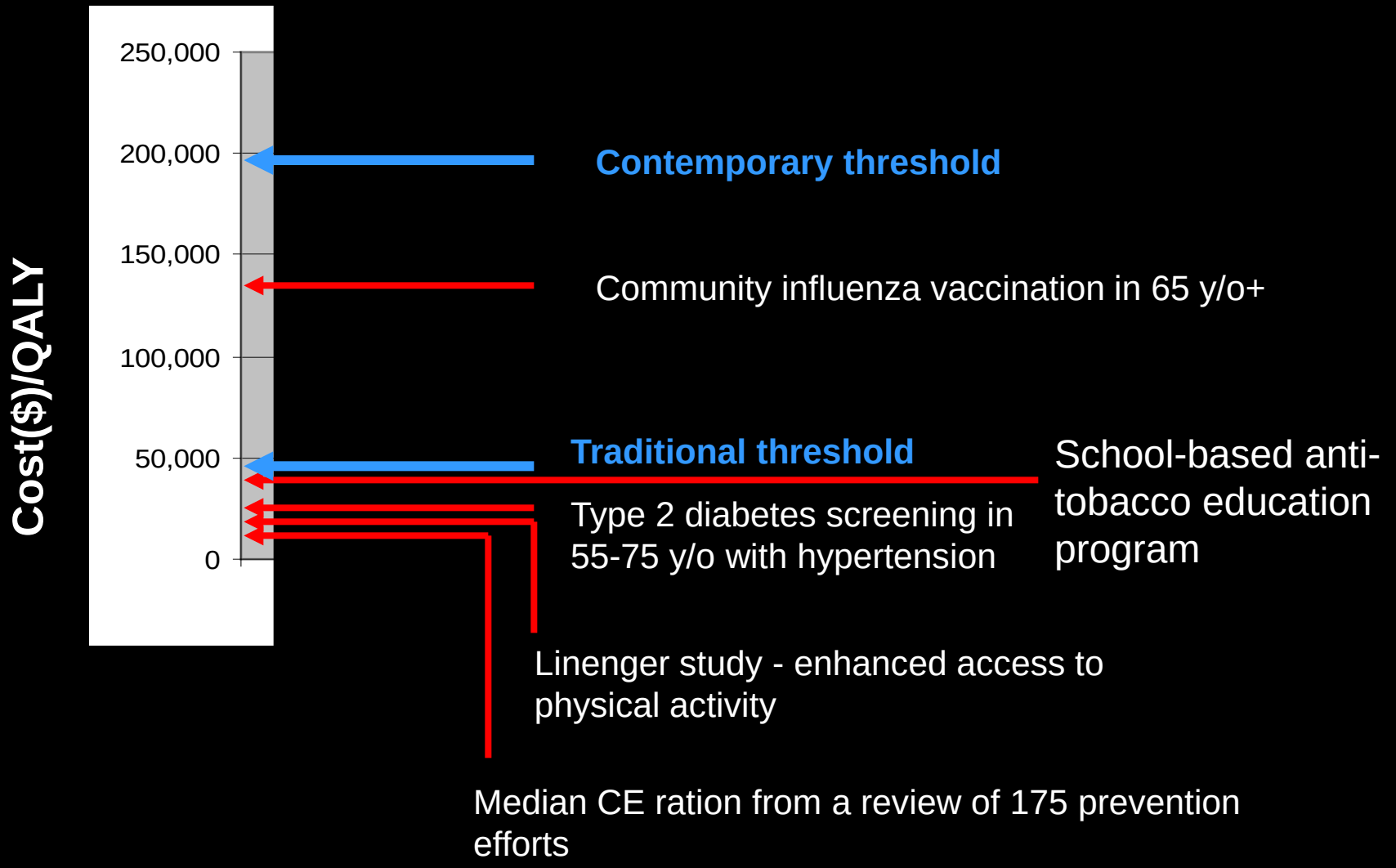


Validation of Results

All-cause mortality model

Author	Intervention category	Cost ($)/QALY	
		All-cause mortality	Disease-specific mortality
Reger	Community-wide campaign	28,303	14,286
Lombard	Social support	34,838	27,373
Linenger	Enhanced access	34,815	28,548
Jeffery	Individually-adapted health behavior	36,172	29,759
Kriska	Social support	41,576	39,690
DPP	Individually-adapted health behavior	44,609	46,914
Young	Community-wide campaign	55,886	68,557

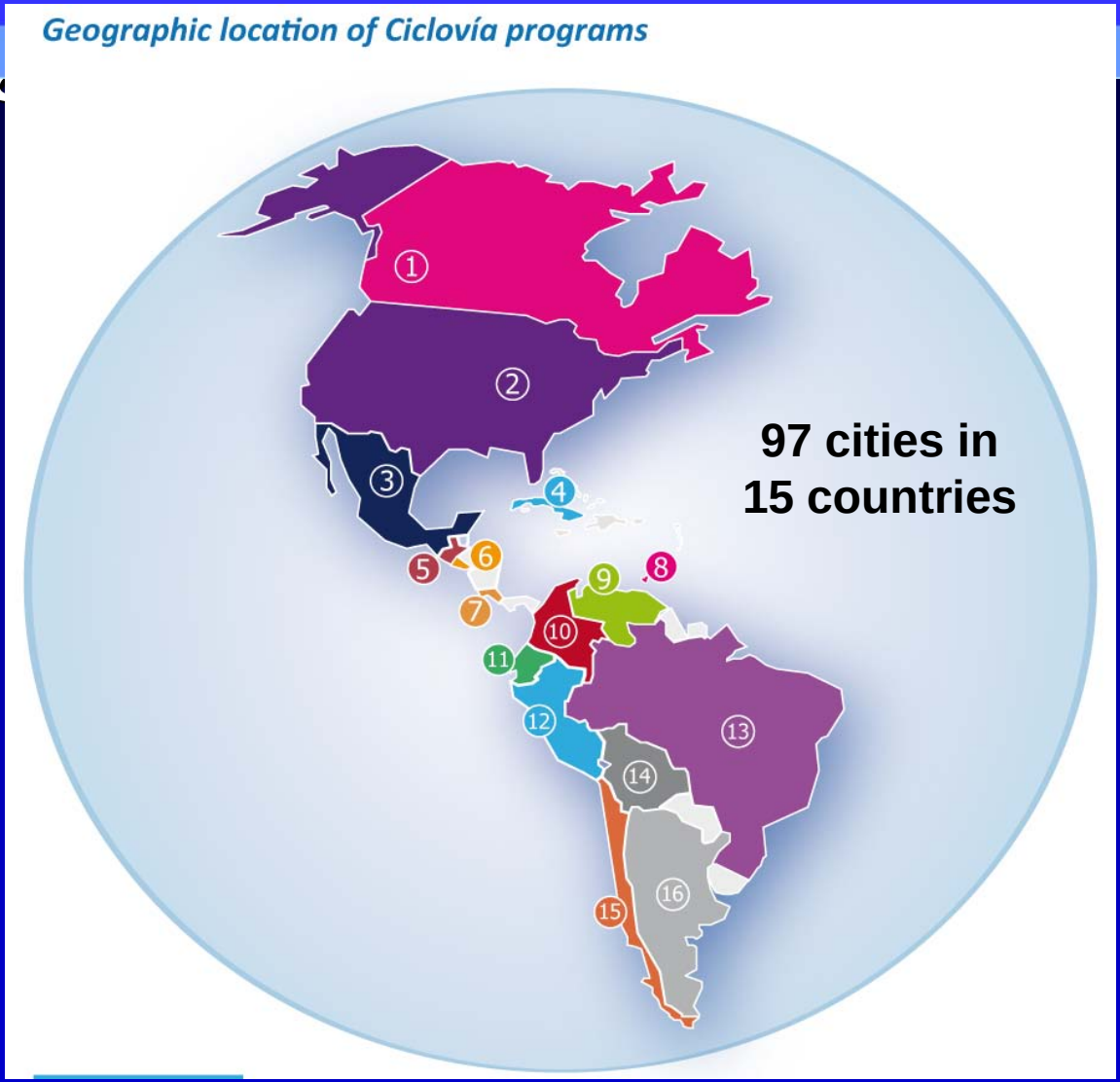
Cost-effectiveness in Context



Ciclovía Recreativa: Definition

Community based regular mass program in which streets are temporary closed to motorized transport allowing exclusive access to individuals for leisure activities.

Ciclovías Recreativas in the Americas & the Caribbean

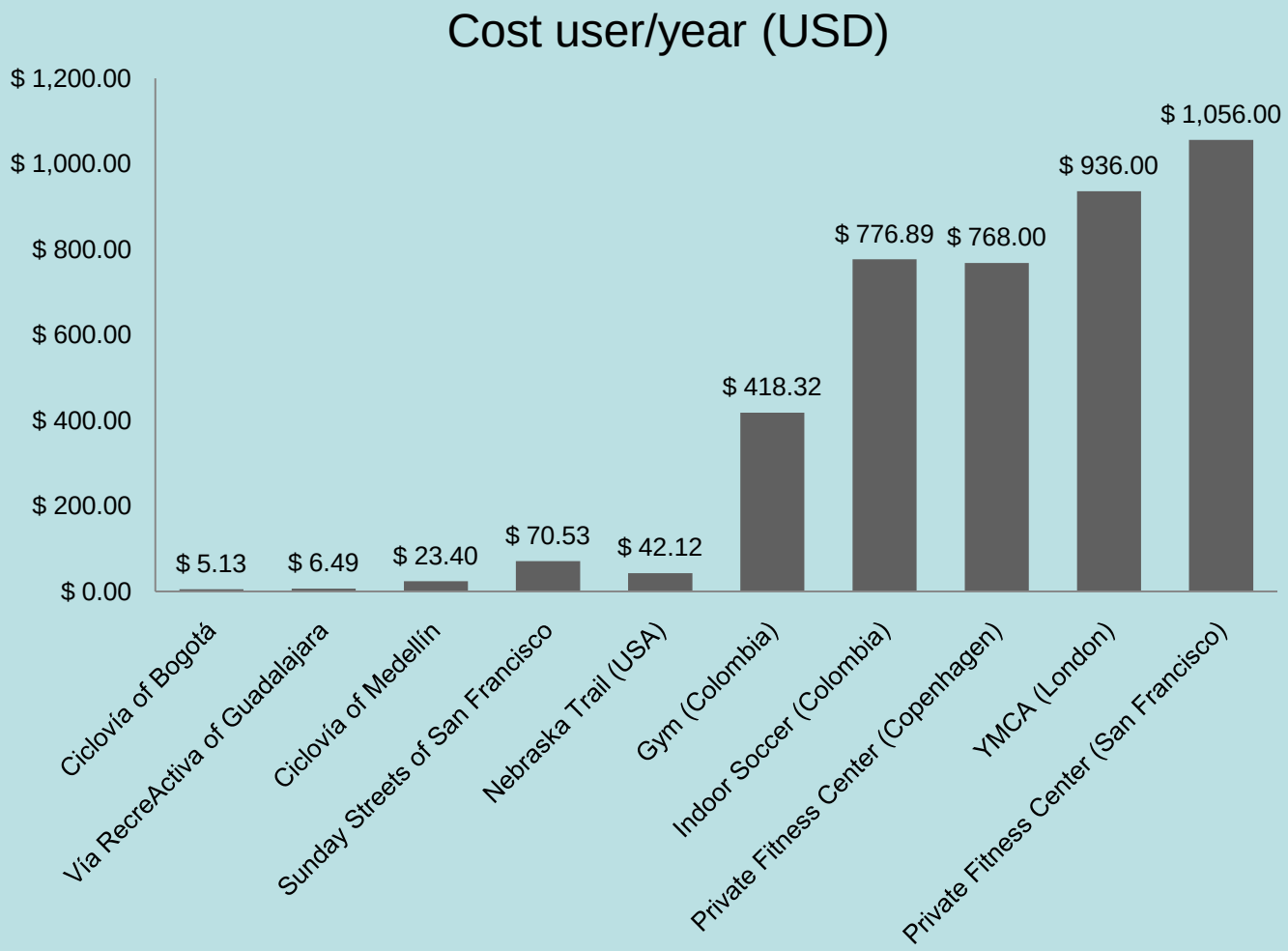


Sarmiento OL, Torres A, Jacoby E, Pratt M, Schmid T, Stierling G. The Ciclovía-recreativa: a mass recreational program with public health potential. *Journal of Physical Activity & Health 2010, 7 (suppl 2) S163-S180.*

38 active programs, 4 pilot programs in 11 countries

Ciclovías Recreativas in the Americas
Cases of Bogotá, Medellín, Guadalajara, and San Francisco

Ciclovías Recreativas and other PA centers costs user/year (USD) (Montes et al)



Ciclovías Recreativas
Circuit length, Total annual cost (USD) and number of users