



## **Making Data Count**

Measuring Diabetes and Obesity in the Indian Health System

December 18-20, 2007

IHS Division of Diabetes Treatment and Prevention

### **The Cost Effectiveness of Preventing Type 2 Diabetes**

**William H. Herman, MD, MPH**

Session: Plenary D

# **What is the Cost- Effectiveness of Diabetes Prevention?**

**William H. Herman, MD, MPH**

Stefan S. Fajans/GlaxoSmithKline Professor of Diabetes

Professor of Internal Medicine and Epidemiology

University of Michigan

Director, Michigan Diabetes Research and Training Center

- **What are the costs of type 2 diabetes?**
- **How do we assess cost-effectiveness?**
- **What is the cost-effectiveness of diabetes prevention?**

**What are the costs of diabetes?**

## Direct and Indirect Costs Attributable to Diabetes, United States, 2002

Total Costs  
\$132 billion

Direct Costs  
\$92 billion

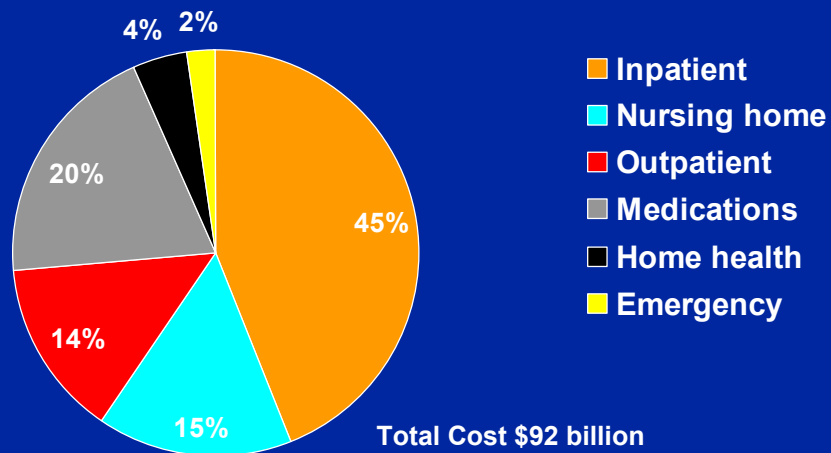
- Diabetes
- Diabetes complications
- General medical care

Indirect Costs  
\$40 billion

- Illness
- Disability
- Premature mortality

ADA. *Diabetes Care* 26:917, 2003

## Direct Costs Attributable to Diabetes by Type, United States, 2002



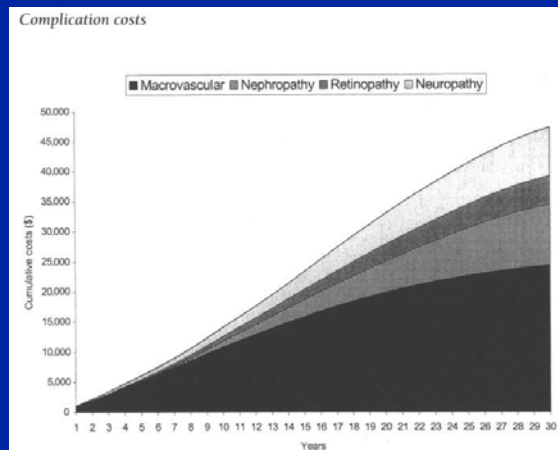
ADA. *Diabetes Care* 26:917, 2003

## Cumulative Per Patient Cost of Complications by Level of Glycemia, Type 2 Diabetes

<u>A1c %</u>	<u>30-Year Cost</u>
7.5	\$40,801
8.0	\$44,145
8.5	\$47,943
9.0	\$51,554

*Caro et al. Diabetes Care 25:476, 2002*

## Cumulative Per Patient Cost of Complications by Duration of Type 2 Diabetes



17% Neuropathy  
10% Retinopathy  
21% Nephropathy  
52% Macrovascular

*Caro et al. Diabetes Care 25:476, 2002*

## How do we assess cost-effectiveness?

$$\text{Cost-Effectiveness} = \frac{\Delta \text{ Cost}}{\Delta \text{ Health Outcomes}}$$

Where:

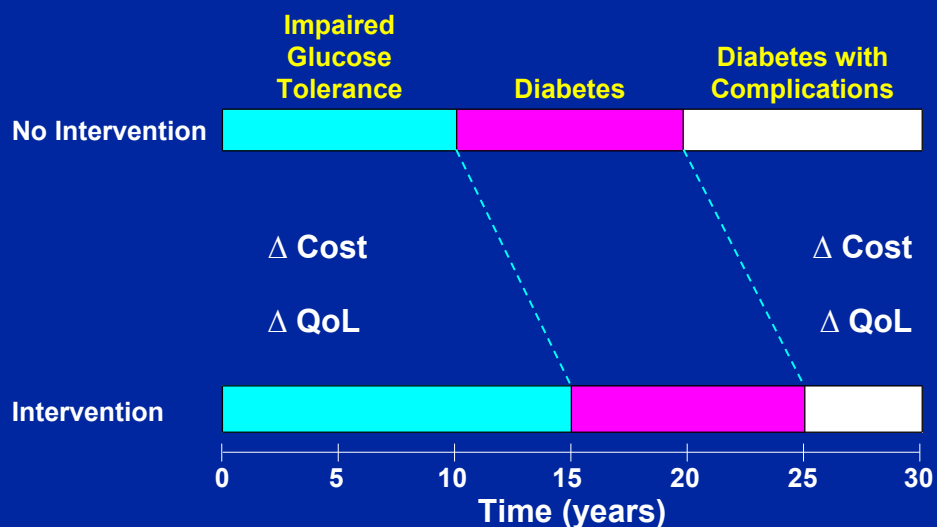
$\Delta \text{ Cost}$  = Costs associated with the intervention vs. usual care

$\Delta \text{ Health Outcomes}$  = Health outcomes associated with the intervention vs. usual care

## In cost-utility analysis

- Costs include the costs of interventions and outcomes
- Health outcomes are expressed as quality-adjusted life-years (QALYs), a metric that adjusts length of life for quality of life
- Quality of life is assessed by health utility scores where 1.0 = perfect health and 0 = death

## Natural History of Glucose Intolerance With and Without Intervention



## Example of Comparative Costs and Quality of Life

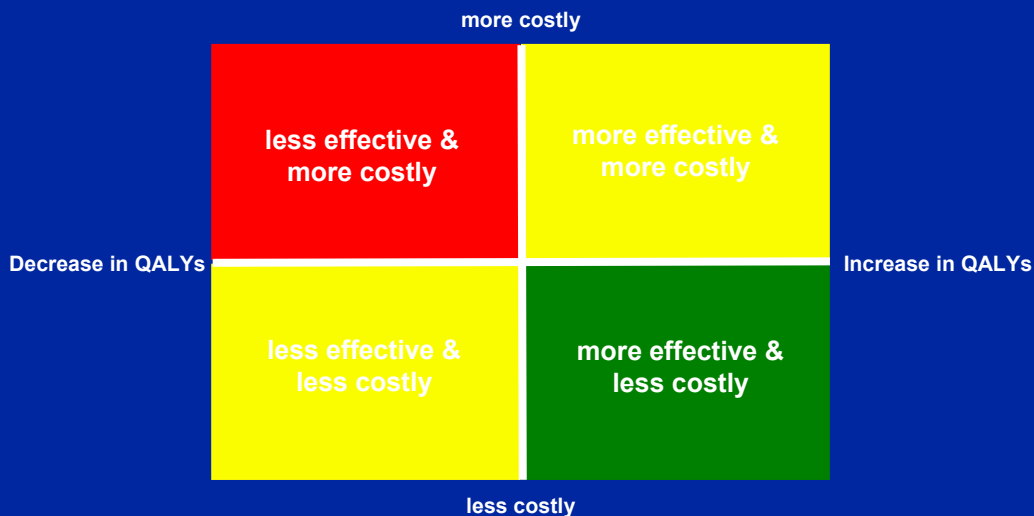
<u>Health State</u>	<u>Cost/year</u>	<u>Health Utility Score</u>
IGT-usual care	\$800	0.80
IGT-intervention	\$1,600	0.80
Diabetes	\$1,800	0.60
Diabetes with complications	\$3,000	0.40

## Costs and Health Outcomes over 30 years by Treatment

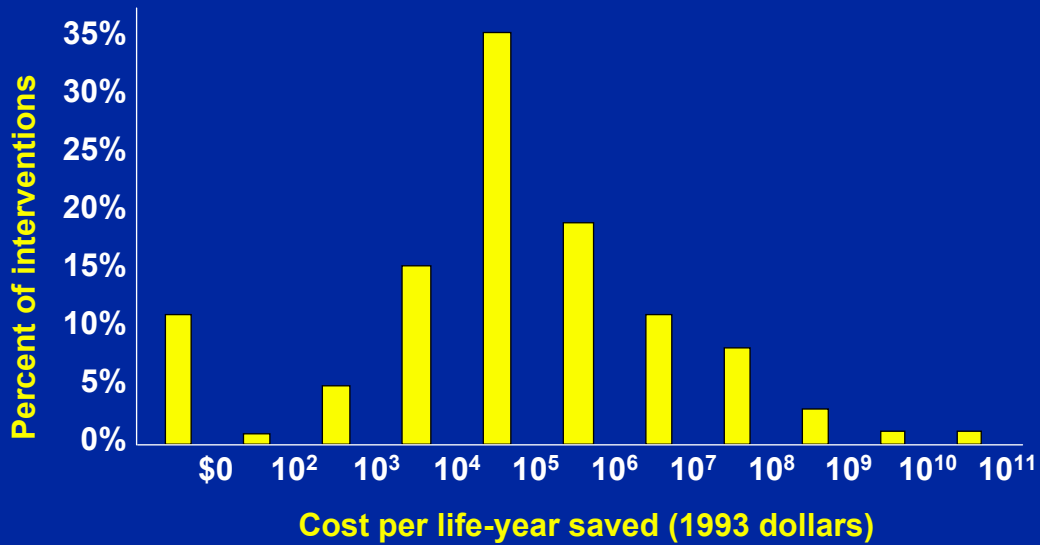
	<u>Impaired Glucose Tolerance</u>	<u>Diabetes</u>	<u>Diabetes with Complications</u>	<u>Total</u>
<b>IGT- No Intervention</b>	10 years x \$800/yr = \$8,000 x 0.80 = 8 QALYs	10 years x \$1,800/yr = \$18,000 x 0.60 = 6 QALYs	10 years x \$3,000/yr = \$30,000 x 0.40 = 4 QALYs	\$56,000  18 QALYs
<b>IGT- Intervention</b>	15 years x \$1,600/yr = \$24,000 x 0.80 = 12 QALYs	10 years x \$1,800/yr = \$18,000 x 0.60 = 6 QALYs	5 years x \$3,000/yr = \$15,000 x 0.40 = 2 QALYs	\$57,000  20 QALYs

$$\begin{aligned}
 \text{Cost Utility} &= \frac{\Delta \text{ Cost}}{\Delta \text{ Outcomes}} = \\
 &= \frac{\$57,000 - \$56,000}{20 \text{ QALYs} - 18 \text{ QALYs}} = \\
 &= \frac{\$1000}{2 \text{ QALYs}} = \\
 &= \text{\$500 per QALY-gained}
 \end{aligned}$$

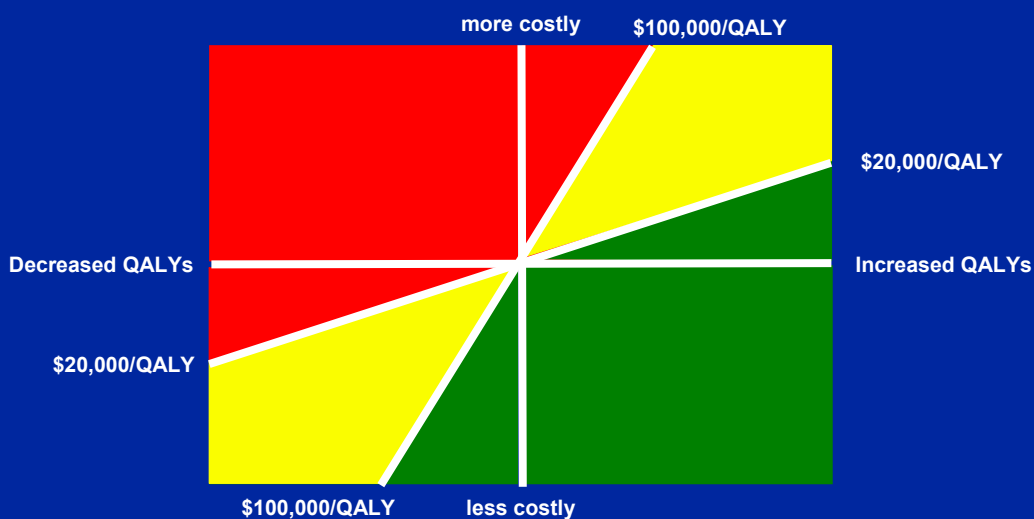
## How Attractive Does a New Technology Have to be to Warrant Adoption and Utilization?



## Distribution of Cost Per Life-Year Saved Estimates (n = 587)

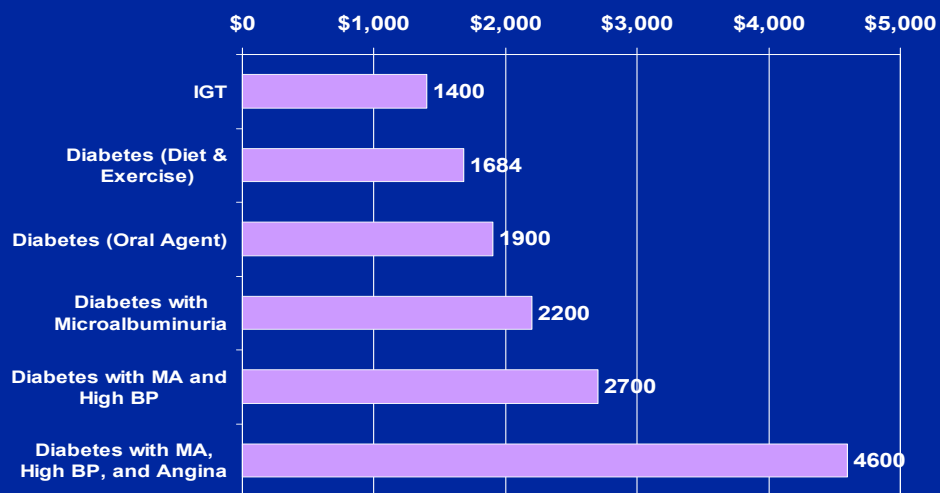


## How Attractive Does a New Technology Have to be to Warrant Adoption and Utilization?



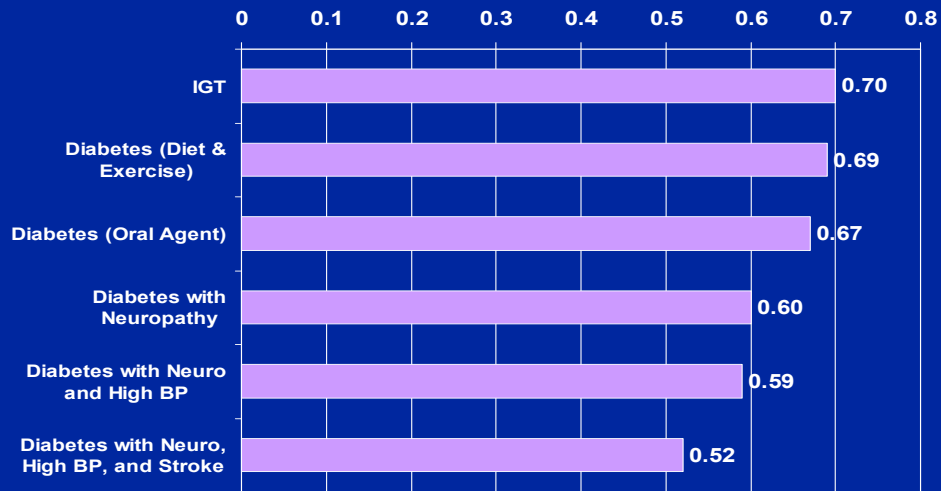
## What are the costs, quality of life, and health outcomes associated with alternative treatment strategies for glucose intolerance?

### Annual Direct Medical Costs in a Man Progressing from IGT to Diabetes with Complications



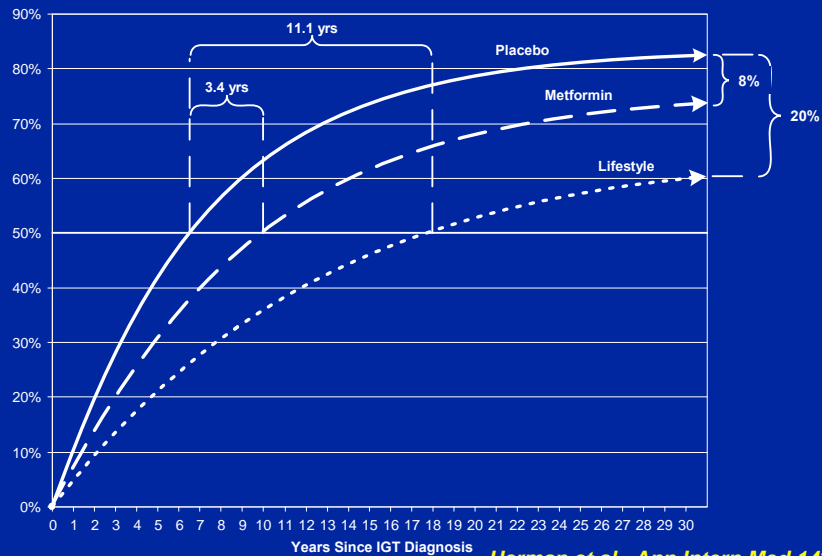
Brandle et al. *Diabetes Care* 26:2300, 2003

## Health Utility Scores in a Man Progressing from IGT to Diabetes with Complications



*Coffey et al. Diabetes Care 25:2238, 2002*

## Simulated Cumulative Incidence of Diabetes in the DPP



*Herman et al. Ann Intern Med 142:323, 2005*

## Simulated Lifetime Clinical Outcomes in the DPP

Outcome	Lifestyle	Metformin	Placebo
Diabetes (%)	63	75	83
Blindness (%)	3	5	6
ESRD (%)	0.6	0.8	1.0
Amputation (%)	1.3	1.6	1.9
Stroke (%)	19	21	21
CHD (%)	39	41	42
Life expectancy (yrs)	24.7	24.3	24.1

*Herman et al. Ann Intern Med 142:323, 2005*

## IGT Intervention - Summary Lifetime Outcomes\*

Outcome	Lifestyle	Metformin	Placebo
Lifetime Costs	\$51,974	\$55,261	\$51,339
Lifetime QALYs	10.89	10.45	10.32
Δ Cost v. Pbo	\$635	\$3,922	—
Δ QALY v. Pbo	0.57	0.13	—
Δ Cost/ Δ QALY	\$1,124	\$31,286	—

\* costs and QALYs discounted at 3% per year

## What Influences the Cost-Effectiveness of Diabetes Prevention

- Effectiveness of intervention in delaying/preventing diabetes and its microvascular and neuropathic complications
- Cost with intervention vs. usual care
- Quality of life with intervention vs. usual care
- Safety of intervention and its impact on cardiovascular disease and survival

## Interventions Proven to Delay or Prevent the Development of Type 2 Diabetes

<u>Intervention</u>	<u>% Risk Reduction</u>
Lifestyle (4 trials)	29-58%
Metformin (2 trials)	26-31%
Lifestyle & Metformin (1 trial)	28%
Acarbose (1 trial)	25%
Troglitazone (1 trial)	55%
Rosiglitazone (1 trial)	60%

## Costs

<u>Intervention</u>	<u>Cost vs. Usual Care</u>
Lifestyle	\$1,400 in yr 1 then \$700/yr
Metformin	\$300/yr AWP
Acarbose	\$1,400/yr AWP
TZDs	\$2,000/yr AWP

### But...

- Higher costs of lifestyle intervention are partially offset by lower costs of other medical care

### And...

- Medications become generic and generic cost is usually ~25% that of brand cost

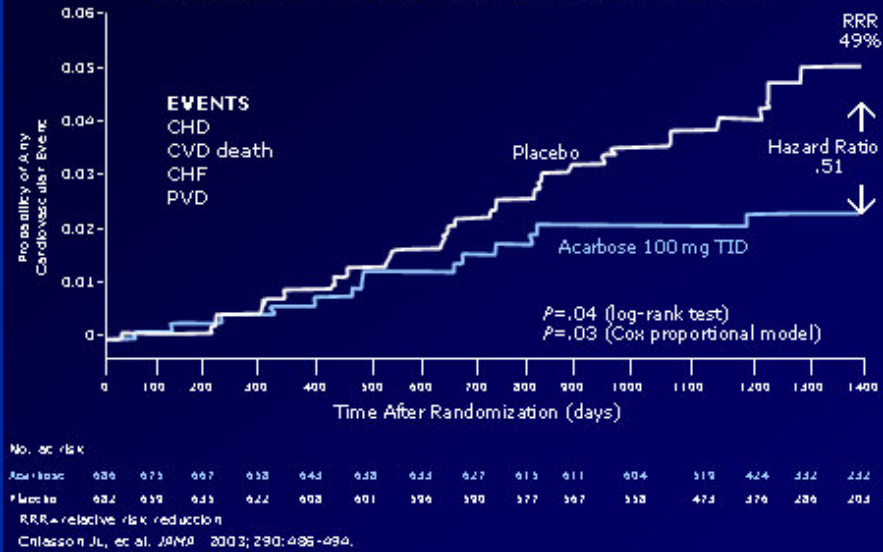
## Quality of Life

<u>Intervention</u>	<u>Quality of Life vs. Usual Care</u>
Lifestyle	Better
Metformin	No difference
Acarbose	?
TZDs	?

## Long-Term Health Outcomes

<u>Intervention</u>	<u>Safety</u>	<u>CVD</u>	<u>Survival</u>
Lifestyle	Yes	?	?
Metformin	Yes	?	?
Acarbose	Yes	Yes	?
TZDs	?	?	?

## The STOP-NIDDM Study: Reduction in the Risk of CVD in IGT



**What is the cost-effectiveness  
of diabetes prevention?**

## Lifestyle Interventions vs. Usual Care for Primary Prevention of Type 2 Diabetes

Author, Year	Country	Time Horizon	Cost/LY	Cost/QALY
Segal, 1998	Australia	25 yrs	Cost-saving to \$1,659	—
Palmer, 2004	Australia, France, Germany, Switzerland, UK	Lifetime	Cost-saving to \$8,056	—
Caro, 2004	Canada	10 yrs	\$551	—
DPP, 2005	US	Lifetime	—	\$1,100
Eddy, 2005	US	30 yrs	—	\$143,000

*Segal. Health Promot Int 13:197, 1998*

*Palmer. Clin Ther 26:304, 2004*

*Caro. Diab Med 21:1229, 2004*

*DPP. Ann Int Med 142:323, 2005*

*Eddy et al. Ann Int Med 143:251, 2005*

## Metformin vs. Usual Care for the Primary Prevention of Type 2 Diabetes

Author, Year	Country	Time Horizon	Cost/LY	Cost/QALY
Palmer, 2004	Australia, France, Germany, Switzerland, UK	Lifetime	Cost-saving to \$6,836	—
Caro, 2004	Canada	10 yrs	Cost-saving	—
DPP, 2005	US	Lifetime	—	\$1,800
Eddy, 2005	US	30 yrs	—	\$35,400

*Palmer. Clin Ther 26:304, 2004*

*Caro. Diab Med 21:1229, 2004*

*DPP. Ann Int Med 142:323, 2005*

*Eddy et al. Ann Int Med 143:251, 2005*

## Acarbose vs. Usual Care for the Primary Prevention of Type 2 Diabetes

Author, Year	Country	Time Horizon	Cost/LY	Cost/QALY
Caro, 2004	Canada	10 yrs	Cost-saving	—
Josse, 2006	Spain, Germany, Sweden	3 yrs	Cost-saving to \$947	—

Caro. *Diabet Med* 21:1229, 2004  
Josse. *Int J Clin Pract* 60:847, 2006

## Differences In Studies – DPP vs. Eddy

- Intervention costs
  - Lifestyle intervention stops at the onset of diabetes (DPP) vs. lifestyle intervention continues for the duration of the simulation (Eddy)
- Progression of diabetes and complications
  - HbA1c increases over time according to UKPDS (DPP) vs. HbA1c remains < 7% (Eddy)

## Comparative Outcomes of Placebo Intervention (%)

	<u>DPP (lifetime)</u>	<u>Eddy (30 yrs)</u>
Diabetes	83	72
Blindness	6	3
ESRD	1.0	0.07
Amputation	1.9	0.03
Stroke	21	12
MI	42	12
Survival	0	86

## Conclusion

From a payer perspective, interventions for diabetes prevention represent a good value for money.