An Overview of the Global Burden of Diabetes: Prevalence, Costs, Temporal Trends, and Prevention

William H. Herman, MD, MPH

Stefan S. Fajans/GlaxoSmithKline Professor of Diabetes

Professor of Internal Medicine and Epidemiology

University of Michigan

Director, Michigan Center for Diabetes Translational Research

Speaker Financial Disclosure Information

Nothing to disclose

How can we describe the current and future burden of diabetes?

- by combining existing data using an explicit framework of simplifying assumptions and by modeling the data to describe current and future trends

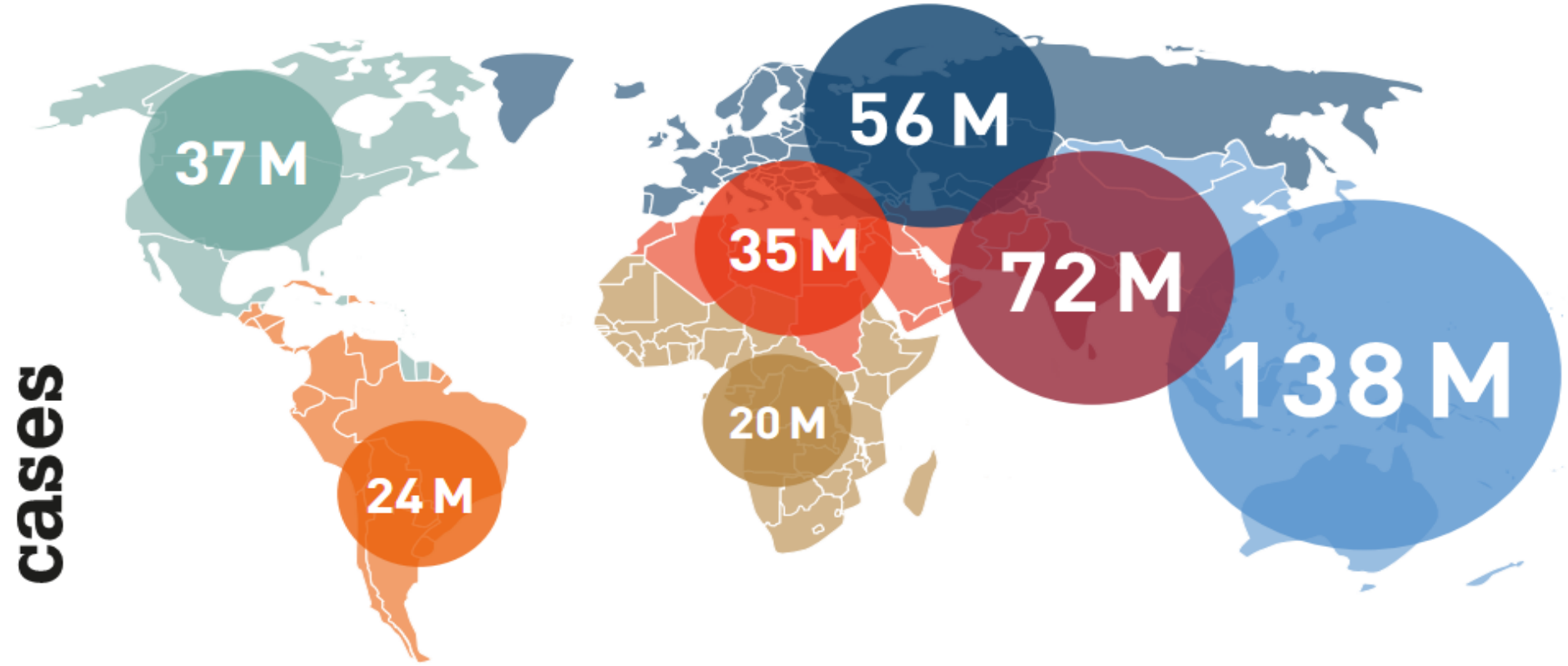
The IDF Diabetes Atlas

- For each country, age-, sex-, and setting-specific estimates of diabetes prevalence were multiplied by UN population estimates to calculate the numbers of adults with diabetes
- Country-specific estimates were aggregated for each of the 7 International Diabetes Federation regions and 4 World Bank income groups
- Global estimates were calculated by aggregating the total cases of diabetes

The Global Burden of Type 2 Diabetes

- **In 2013, 382 million people worldwide were estimated to have type 2 diabetes**

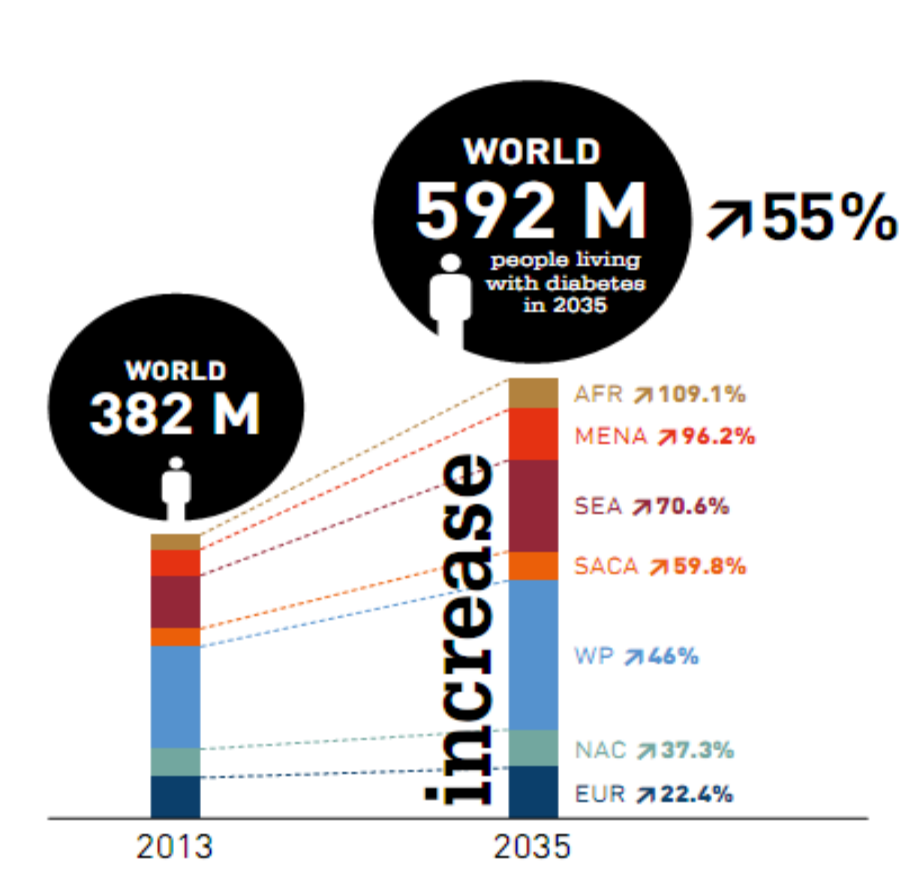
www.idf.org/diabetesatlas



Number of people with diabetes (20-79 years), 2013

www.idf.org/diabetesatlas

The number of people with diabetes is growing



382 million people have diabetes

By 2035, this number will increase to 592 million

www.idf.org/diabetesatlas

Most of the growth in the population with diabetes will occur in developing regions

IDF REGION	2013 MILLIONS	2035 MILLIONS	INCREASE %
Africa	19.8	41.4	109%
Middle East and North Africa	34.6	67.9	96%
South-East Asia	72.1	123	71%
South and Central America	24.1	38.5	60%
Western Pacific	138.2	201.8	46%
North America and Caribbean	36.7	50.4	37%
Europe	56.3	68.9	22%
World	**381.8**	**591.9**	**55%**

www.idf.org/diabetesatlas

Reasons for the Increasing Numbers of People with Diabetes

- Population growth
- Aging of population
- Changing population demographics (urbanization, westernization)
- Increased incidence of diabetes
- Decreased diabetes mortality
- More frequent diagnosis of diabetes

The Global Costs of Type 2 Diabetes

In 2013, the global cost of diabetes was estimated to be $548 billion or 11% of all health care costs

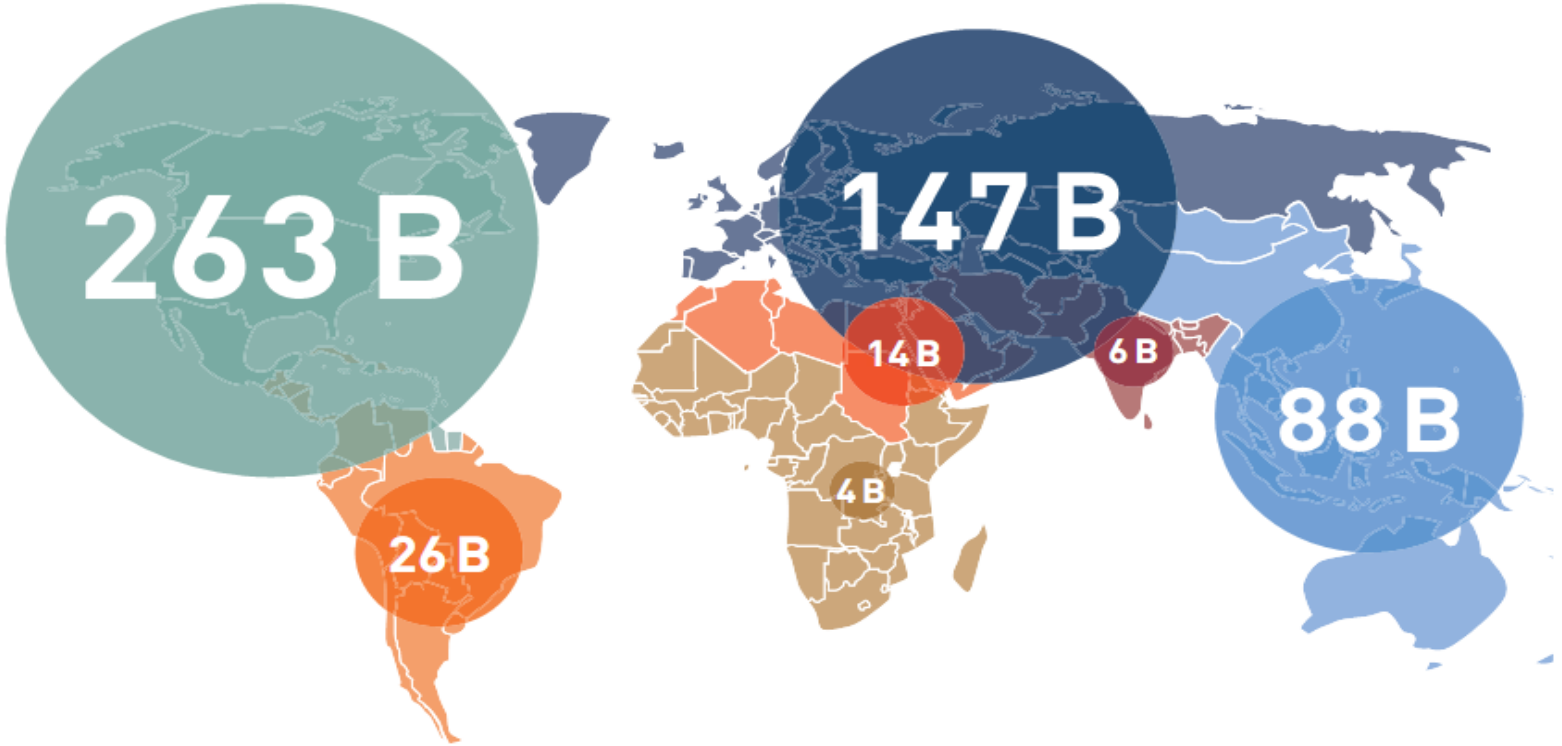
www.idf.org/diabetesatlas

91% of global health expenditures for diabetes were from the world's richest regions:

- **48% North America**
- **27% Europe**
- **16% Western Pacific**

www.idf.org/diabetesatlas

expenditures



Health expenditure (USD) due to diabetes (20-79 years), 2013

Mean Annual Health Expenditure per Person with Diabetes by Region, 2010

Region	Mean annual expenditure per person with diabetes
North America	$5,751
Europe	$1,991
Western Pacific	$508
South America and Central America	$458
Eastern Mediterranean	$210
Africa	$112
Southeast Asia	$53

Zhang et al. Diabetes Res Clin Pract 87:293, 2010

The Global Costs of Diabetes, 2035

By 2035, the global cost of diabetes will increase by 14%, from $548 billion to ~$627 billion*

***assumes constant per capita health care expenditures for diabetes**

www.idf.org/diabetesatlas

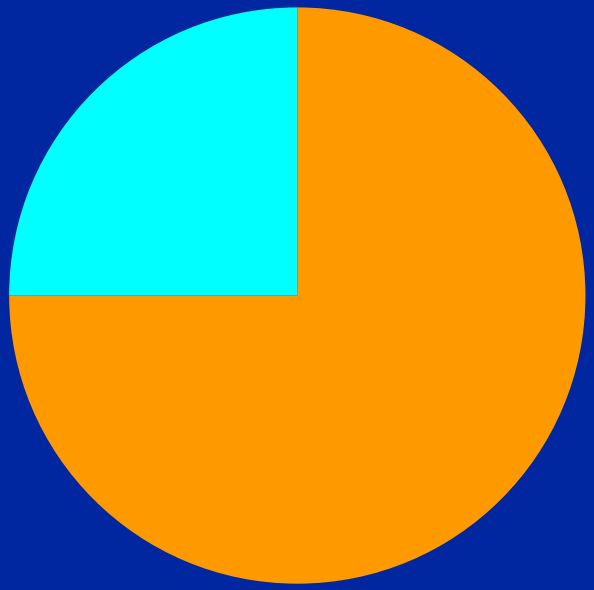
Developed countries are projected to have a 27% increase in expenditures for diabetes and developing countries a 67% increase in expenditures for diabetes

Zhang et al. Diabetes Res Clin Pract 87:293, 2010

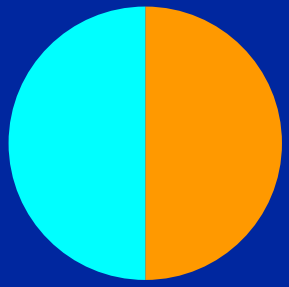
Economic development is associated with an increase in per capita health care expenditures

Expenditures for Diabetes by Development Status

Developed Countries



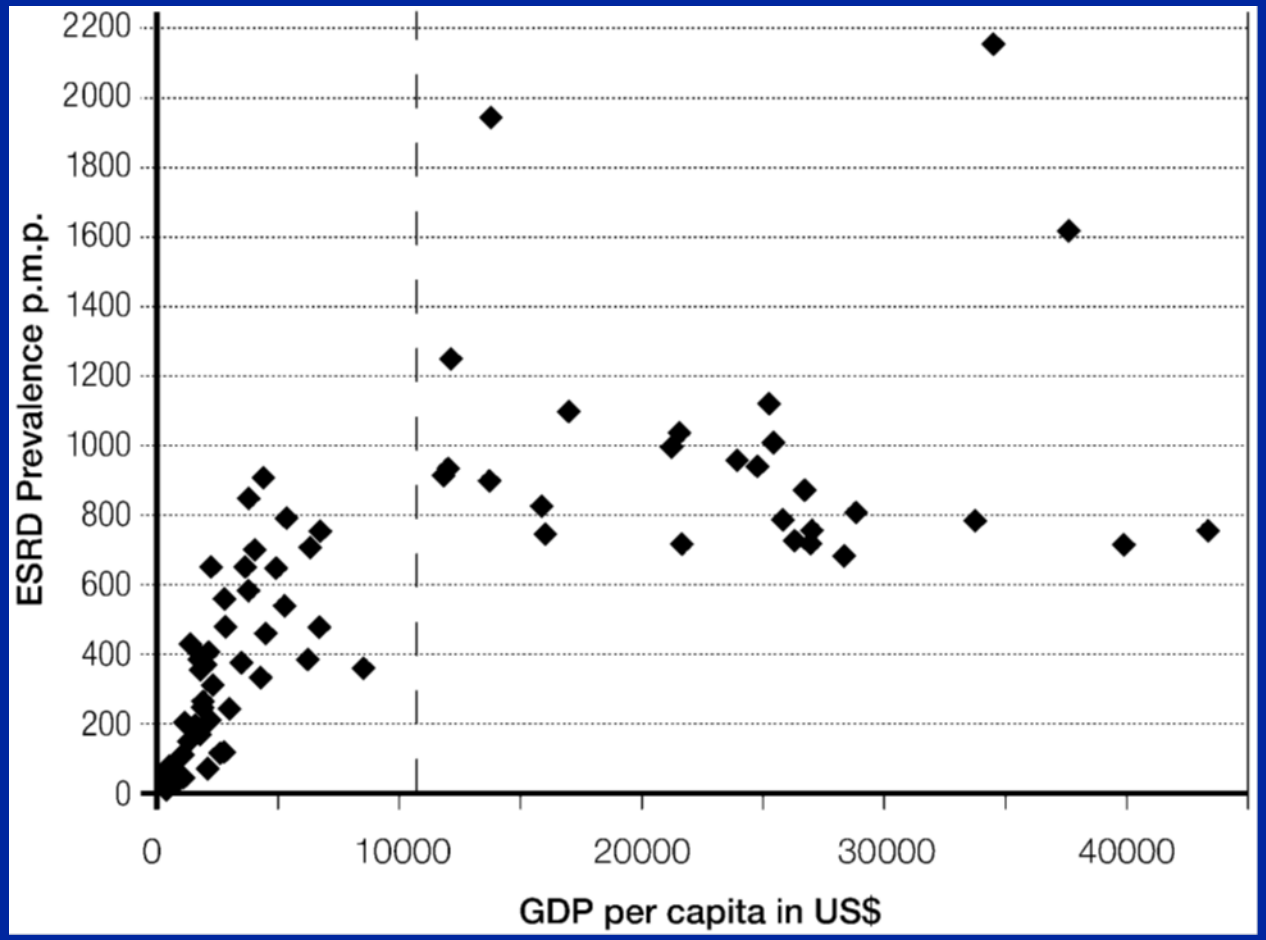
Developing Countries



- Antihyperglycemic therapy
- Treatment of complications and comorbidities

Zhang et al. Diabetes Res Clin Pract 87:293, 2010

ESRD Treatment by National Economic Wealth



The dashed line represents the boundary between high-income countries and low- and middle-income countries as classified by the World Bank Group

Grassman et al. Artif Organs 30:895, 2006

The projected increase in health care costs attributable to diabetes and its complications is unsustainable!

Why are the costs of diabetes increasing?

1. There are more people with diabetes
2. The average cost per person with diabetes per year is increasing

Between 2012 and 2017, ~½ of increase in cost of diabetes in the U.S. was due to growth of the population with diagnosed diabetes and ~½ was due to the increase in the average cost per person with diabetes per year

ADA. Diabetes Care 41:917-928, 2018

Strategies to Control the Costs of Diabetes

- **Prevent diabetes**
- **Control the per-capita costs of diabetes**

Lifestyle and pharmacologic interventions are effective for the prevention of type 2 diabetes

Knowler WC. N Engl J Med 346:393-403, 2002

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

Intervention	% Risk Reduction
Lifestyle (4 trials)	29-58%
Metformin (2 trials)	26-31%
Lifestyle & Metformin (1 trial)	28%
Acarbose (1 trial)	25%
Voglibose (1 trial)	41%
Troglitazone (1 trial)	55%
Rosiglitazone (1 trial)	60%
Pioglitazone (1 trial)	72%
Orlistat (1 trial)	37%

Progress to Date

- **~1/3,000 Americans with prediabetes have participated in the one year National Diabetes Prevention Program**
- **<4% of continuously insured patients with diagnosed prediabetes are prescribed metformin within 3 years of diagnosis**

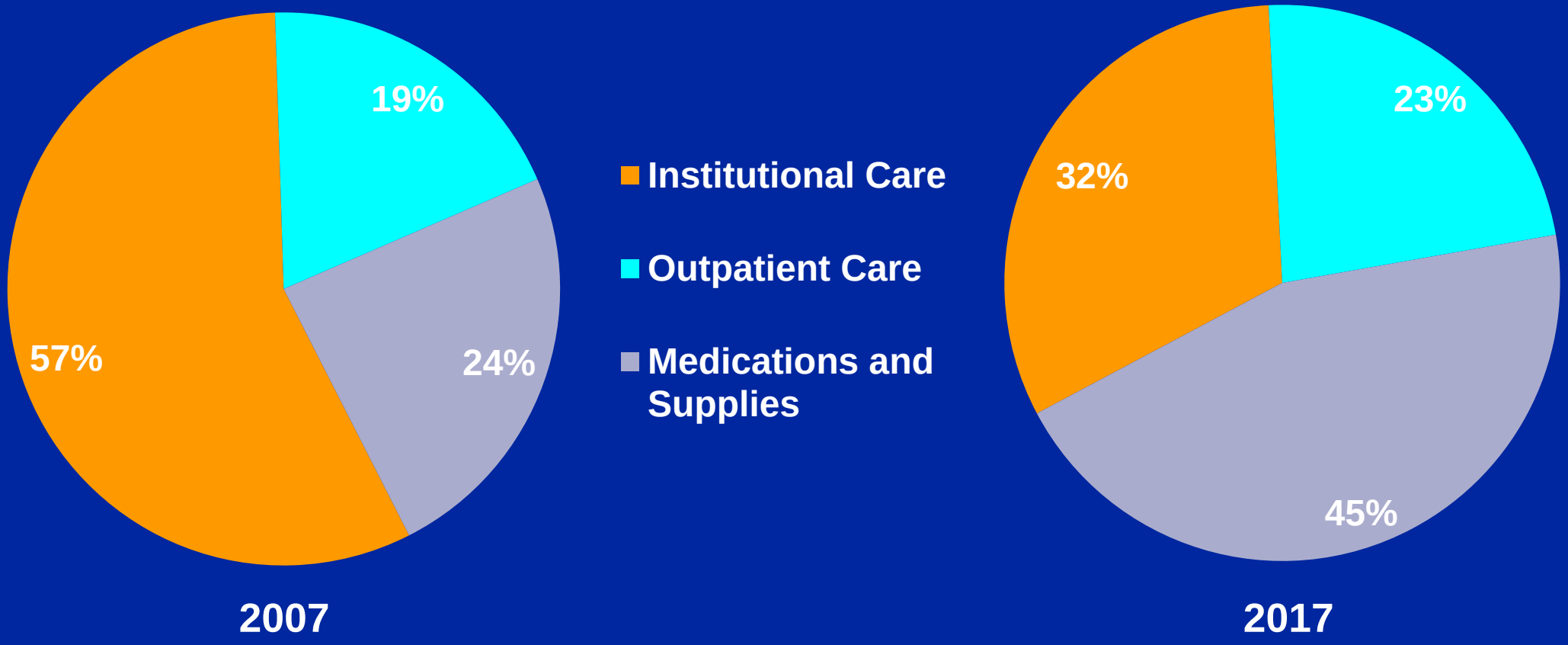
Ely EK. Diabetes Care 40:1331-1341, 2017
Moin T. Ann Intern Med 162:542-548, 2015

Both targeted interventions and effective population-level interventions are needed to prevent diabetes

Strategies to Control the Costs of Diabetes

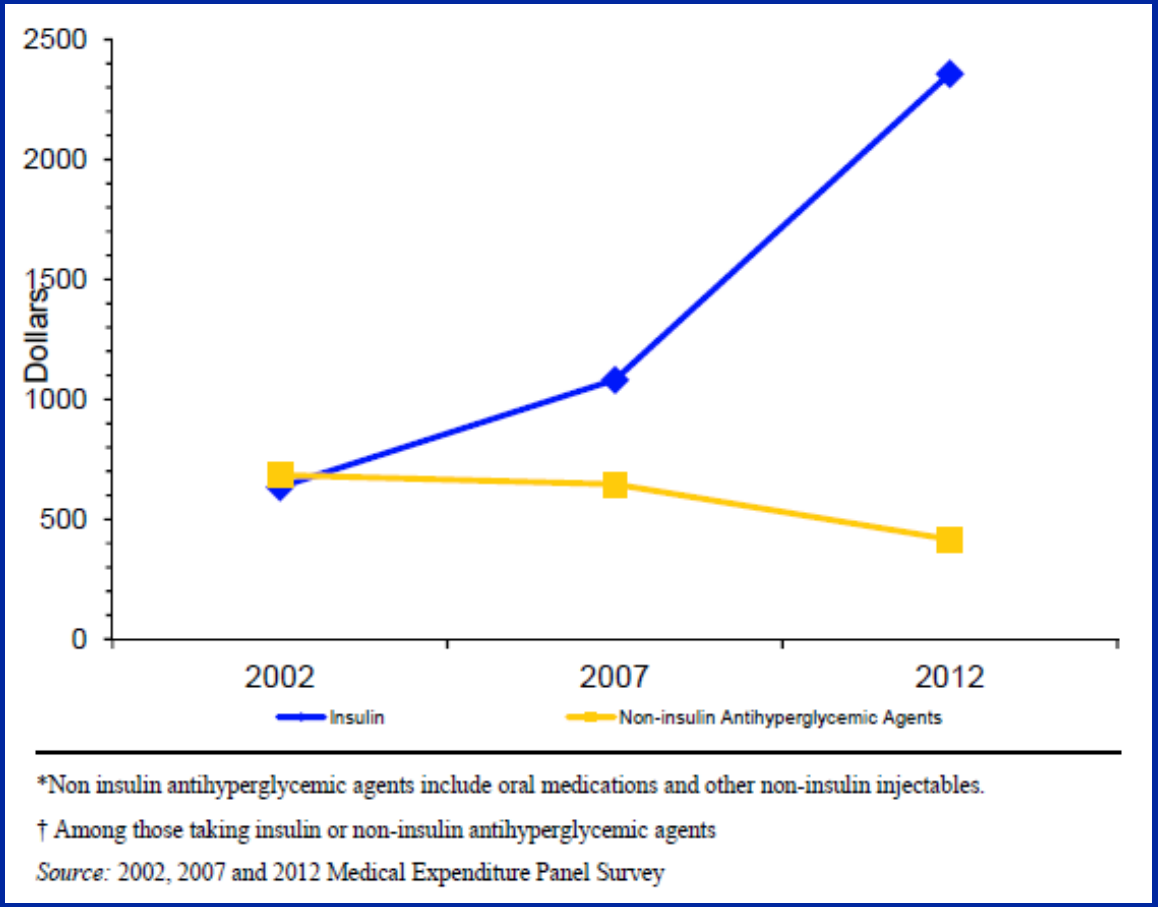
- Prevent diabetes
- Control the per-capita costs of diabetes

Distribution of Per Capita Healthcare Costs Attributed to Diabetes in the U.S. by Type of Service and Year



ADA. Diabetes Care 41:917-928, 2018

Trends in Per Capita Expenditures for Antihyperglycemic Medications* Among Adults With Diabetes† by Class, U.S., 2002-2012



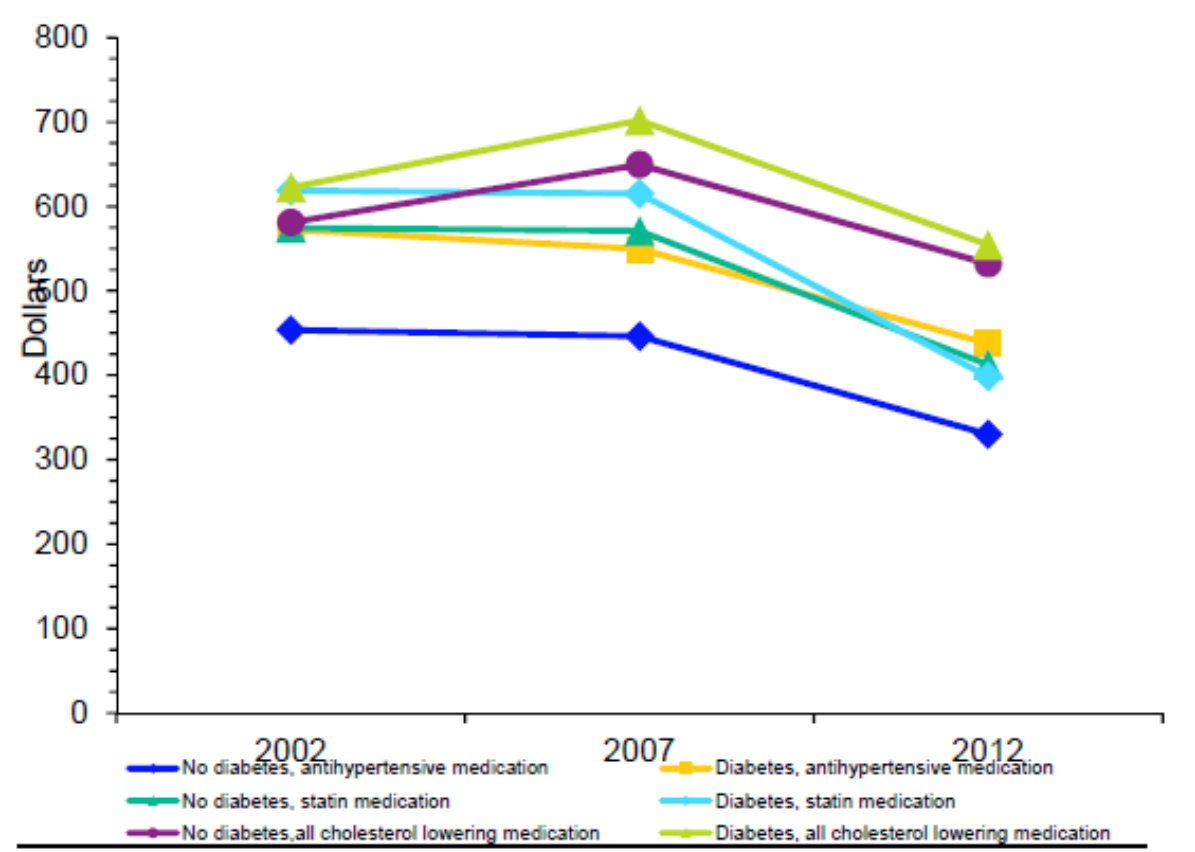
*Non insulin antihyperglycemic agents include oral medications and other non-insulin injectables.

† Among those taking insulin or non-insulin antihyperglycemic agents

Source: 2002, 2007 and 2012 Medical Expenditure Panel Survey

McEwen LN. Diabetes in America, 3rd Edition, Chapter 40, 2017

Trends in Per Capita Expenditures for Antihypertensive and Cholesterol Lowering Medications Among Adults* by Diabetes Status and Medication Class, U.S., 2002-2012



* Among those taking the medication designated in the legend.
Source: 2002, 2007, and 2012 Medical Expenditure Panel Survey

McEwen LN. Diabetes in America, 3rd Edition, Chapter 40, 2017

Why has the cost of insulin therapy increased so much between 2002 and 2012?

- More patients treated
- Higher daily doses
- Changes in insulin prices
- Change in insulin types (animal to human to analog)

Average Wholesale Price of Insulin U.S., 2016

Human Insulins	**(Reli-On)**	**$26 / 10 ml**
	(Humulin)	**$154 / 10 ml**
	(Novolin)	**$153 / 10 ml**
Short-acting Analogs	**(Humalog)**	**$284 / 10 ml**
	(Novolog)	**$284 / 10 ml**
Long-acting Analogs	**(Lantus)**	**$298 / 10 ml**
	(Levemir)	**$322 / 10 ml**
	(Tresiba)	**$355 / 1000 units**

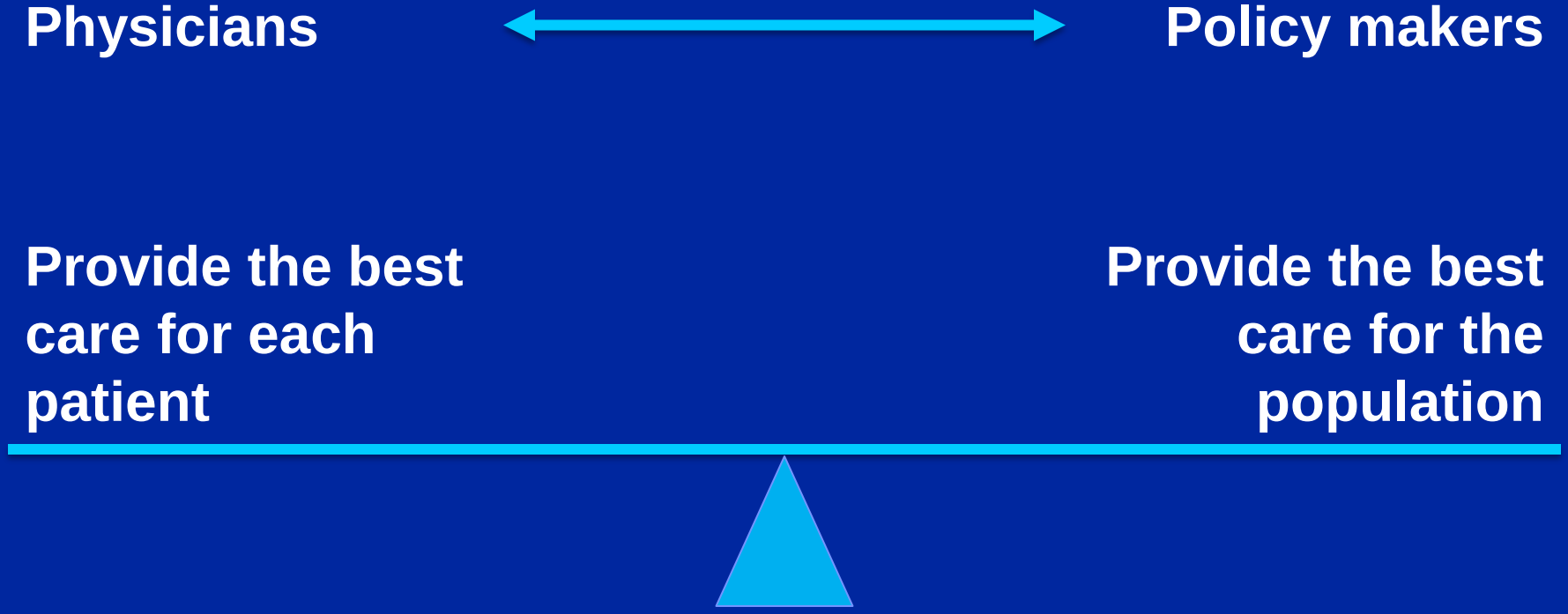
Red Book, 2016

Insulin Prescriptions Dispensed by Type, U.S., 2012

Type	Percentage	
Combination human	6%	13% human $26-$154*
Intermediate-acting human	4%	
Short-acting human	3%	
Long-acting analog	52%	87% analog $284-$355*
Fast-acting analog	27%	
Combination analog	8%	

***2016 cost for 1000 units**

Hampp C. Diabetes Care 37:1367-1374, 2014


Physicians
Policy makers
Provide the best care for each patient
Provide the best care for the population

From a health policy perspective, diabetes treatment should be delivered at as low a cost as possible to do the most good for the most people.