

# Diabetes and the Heart



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# Disclosures

- I serve on advisory boards or perform consulting activities with Eli Lilly and Glaxo Smith Kline, Sanofi Aventis
- As director of our clinical trials unit, I also serve as an investigator for clinical trials sponsored by Astra Zeneca, Novo Nordisk, Sanofi Aventis, Glaxo

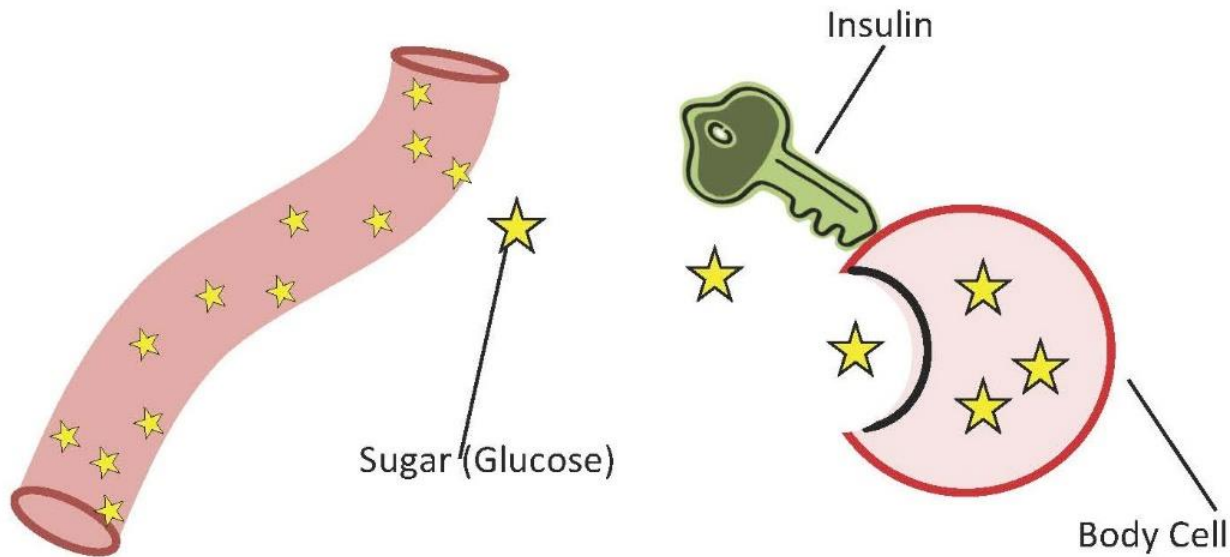


# What is Diabetes?

- Diabetes is a group of diseases characterized by high blood glucose levels that result from defects in the body's ability to produce and/or use insulin.



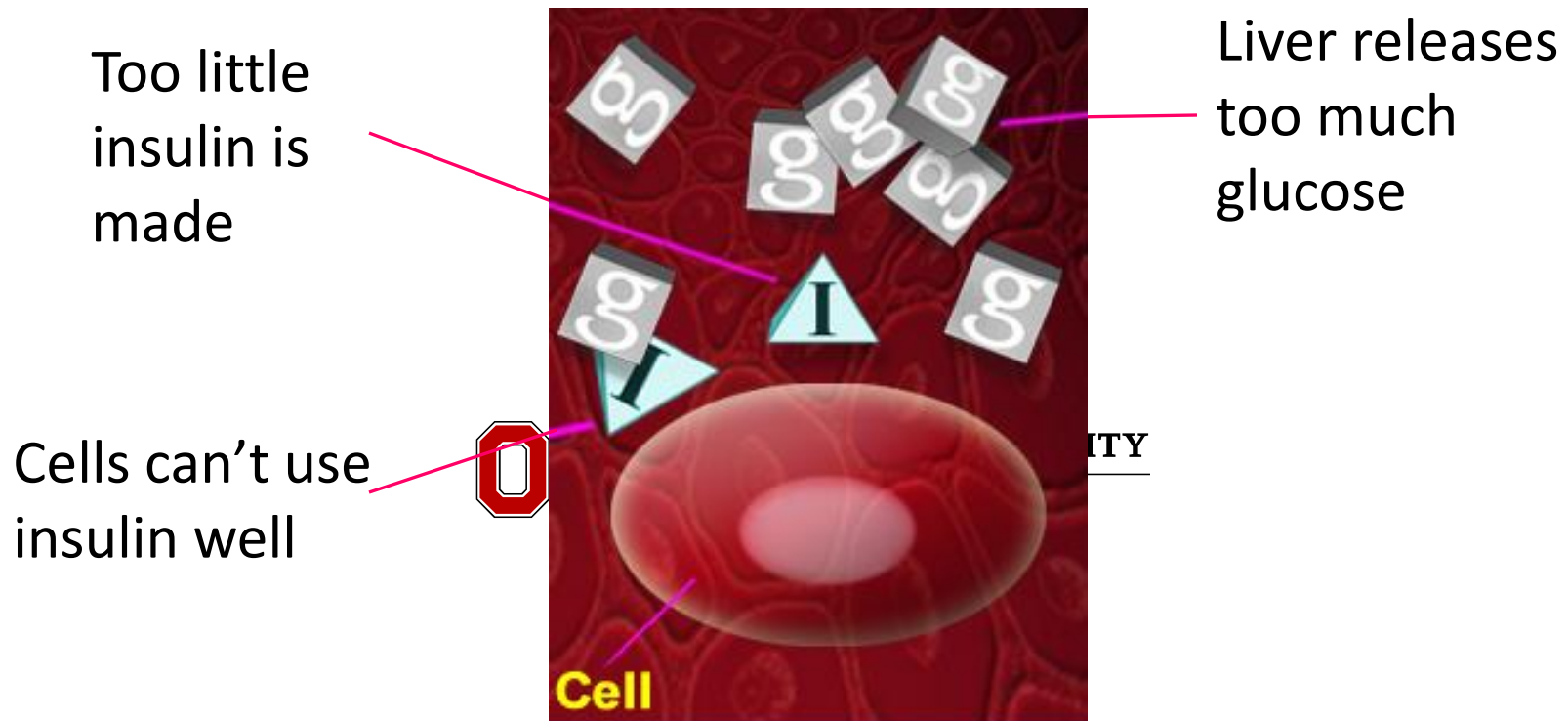
# What is Insulin?



When a cell needs energy, insulin acts as a key to unlock the cell. This opens the cell so sugar can enter and be used for energy.

## High Blood Glucose (Hyperglycemia)

In diabetes, blood glucose builds up  
for several possible reasons...



# Type 2 Diabetes

- Most people with diabetes have type 2
- Most people are over age 40 when diagnosed
- Usually subtle or no symptoms in early stages: 1 in 4 with type 2 aren't aware they have it



# Treatment for Type 2 Diabetes May Change Over a Lifetime



## Always Includes:

- Education
- Healthy eating
- Blood glucose monitoring
- Physical Activity

## May Include:

- Medications, including insulin

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# Type 1 Diabetes

- 1 in 20 people with diabetes have type 1
- Most people are under age 20 when diagnosed
- Body can no longer make insulin
- Insulin is always needed for treatment

*Eli Lilly and Company Ltd. From  
The Discovery of Insulin by Michael Bliss.*



7-year-old child before and 3 months after insulin therapy





## A SNAPSHOT

# DIABETES IN THE UNITED STATES

### DIABETES

**30.3**  
MILLION

30.3 million  
people have  
diabetes



That's about 1 out of every 10 people



**1**  
OUT  
OF **4**

don't know they  
have diabetes

### PREDIABETES

**84.1**  
MILLION



84.1 million people —  
more than 1 out of 3 adults  
— have prediabetes



**9**  
OUT  
OF **10**

don't know they  
have prediabetes



If you have  
prediabetes,  
losing weight by:



**EATING  
HEALTHY**

**&**



**BEING  
MORE  
ACTIVE**

can cut your risk of  
getting type 2 diabetes in

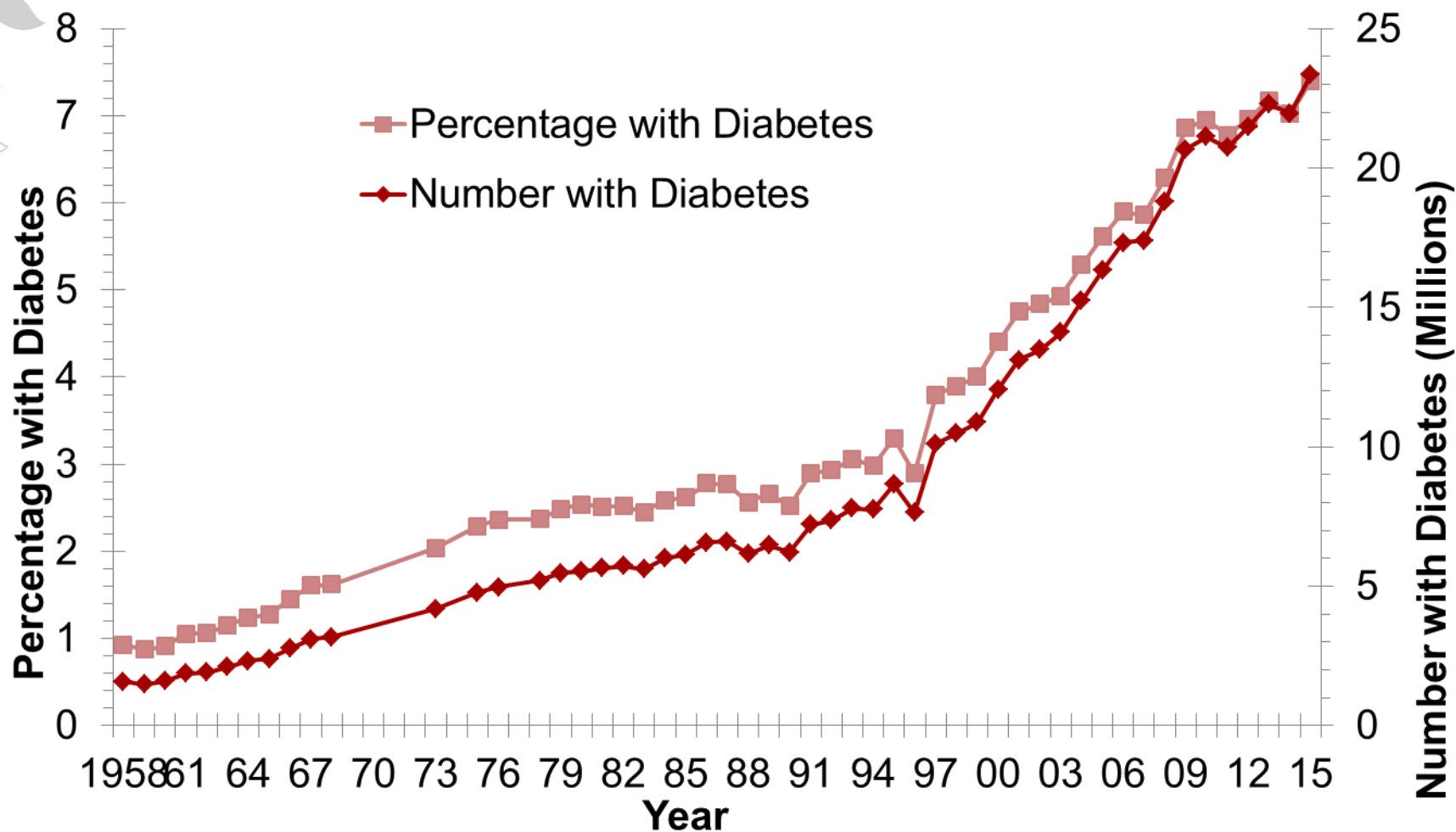
**HALF**



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# Number and Percentage of U.S. Population with Diagnosed Diabetes, 1958-2015



CDC's Division of Diabetes Translation. United States Diabetes Surveillance System  
available at <http://www.cdc.gov/diabetes/data>

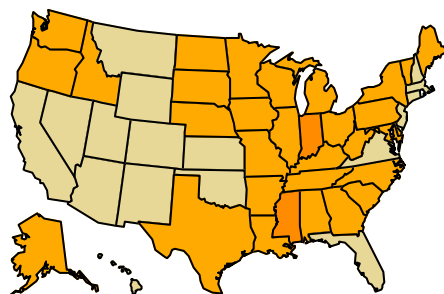


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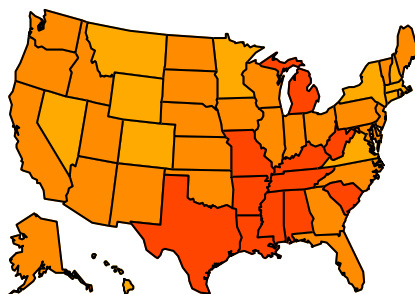
# Age-adjusted Prevalence of Obesity and Diagnosed Diabetes Among US Adults

## Obesity (BMI $\geq 30$ kg/m<sup>2</sup>)

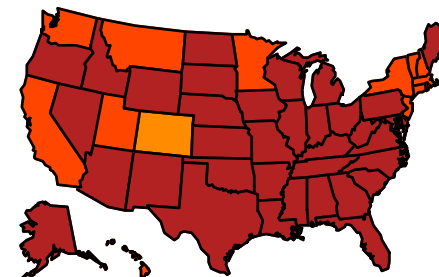
1994



2000



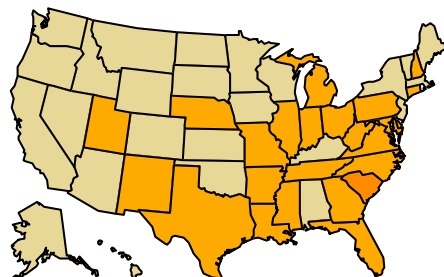
2015



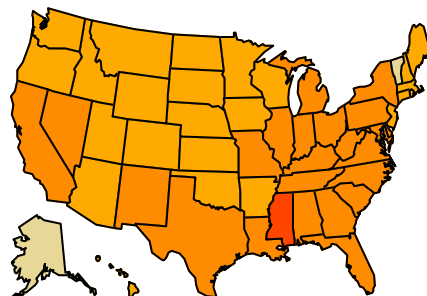
□ No Data      <14.0%      14.0%–17.9%      18.0%–21.9%      22.0%–25.9%       $\geq 26.0\%$

## Diabetes

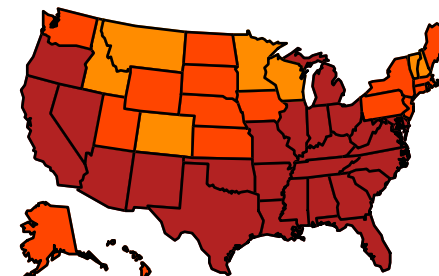
1994



2000

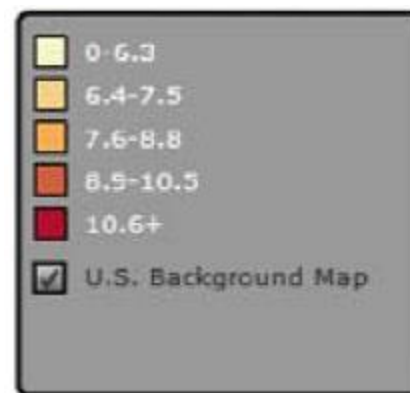


2015



□ No Data      <4.5%      4.5%–5.9%      6.0%–7.4%      7.5%–8.9%       $\geq 9.0\%$

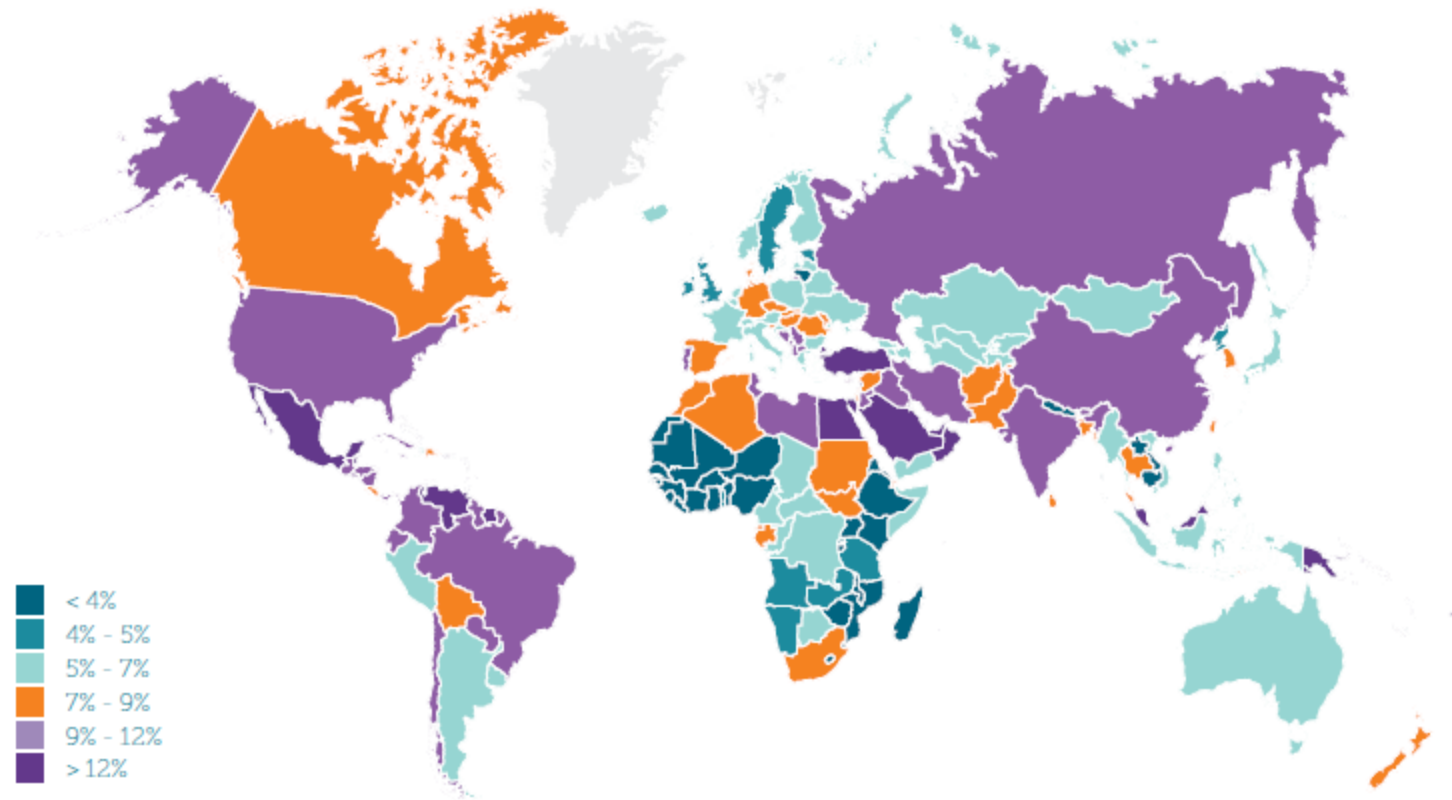
# Diagnosed Diabetes



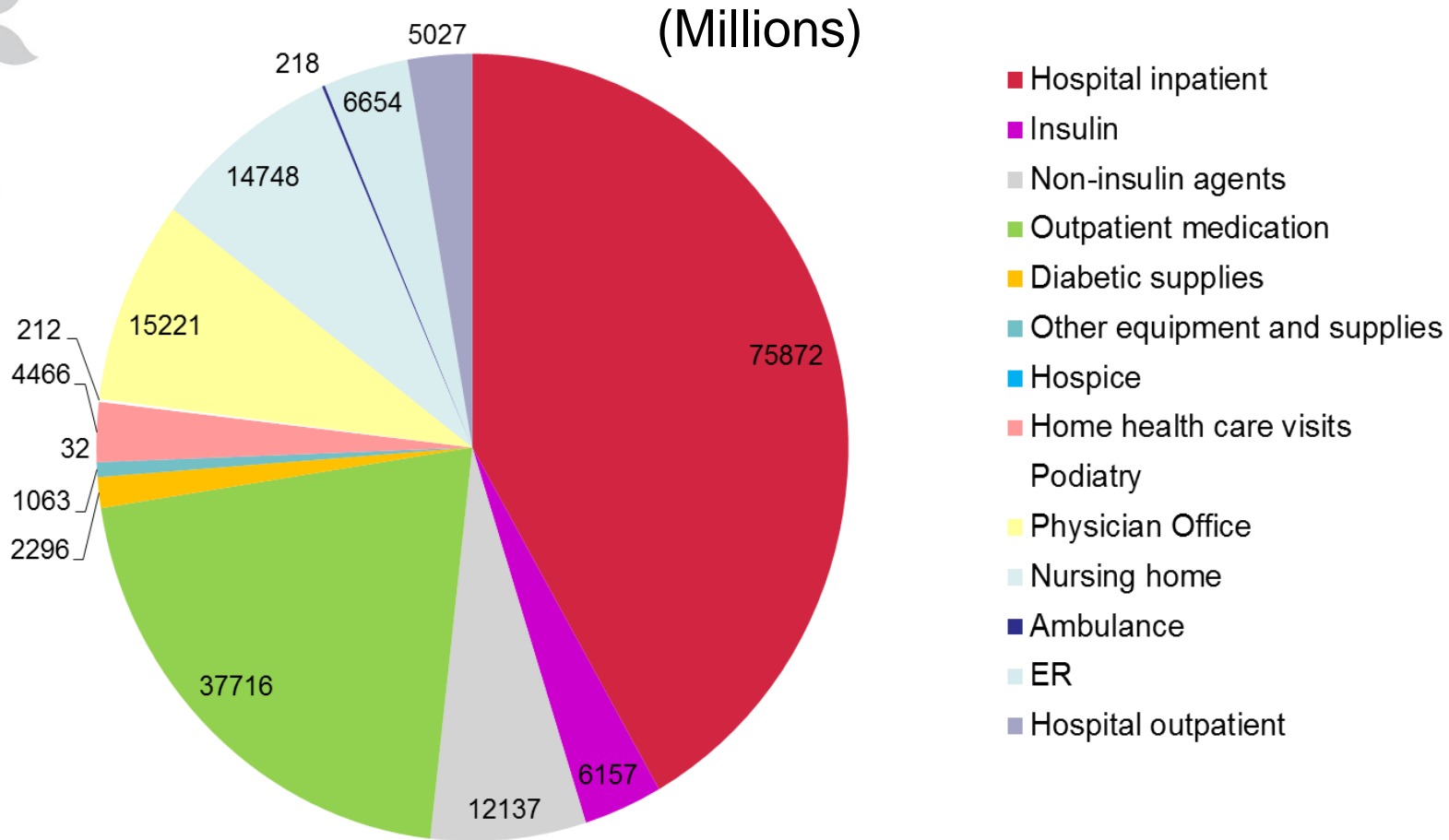
Franklin County: 9.9%



**Map 3.1** Estimated age-adjusted prevalence of diabetes in adults (20-79), 2015



# Costs Due to Diabetes in 2012



\$176 billion (direct medical costs)

\$ 69 billion (reduced productivity)

**\$245 BILLION (41% increase from 2007)**

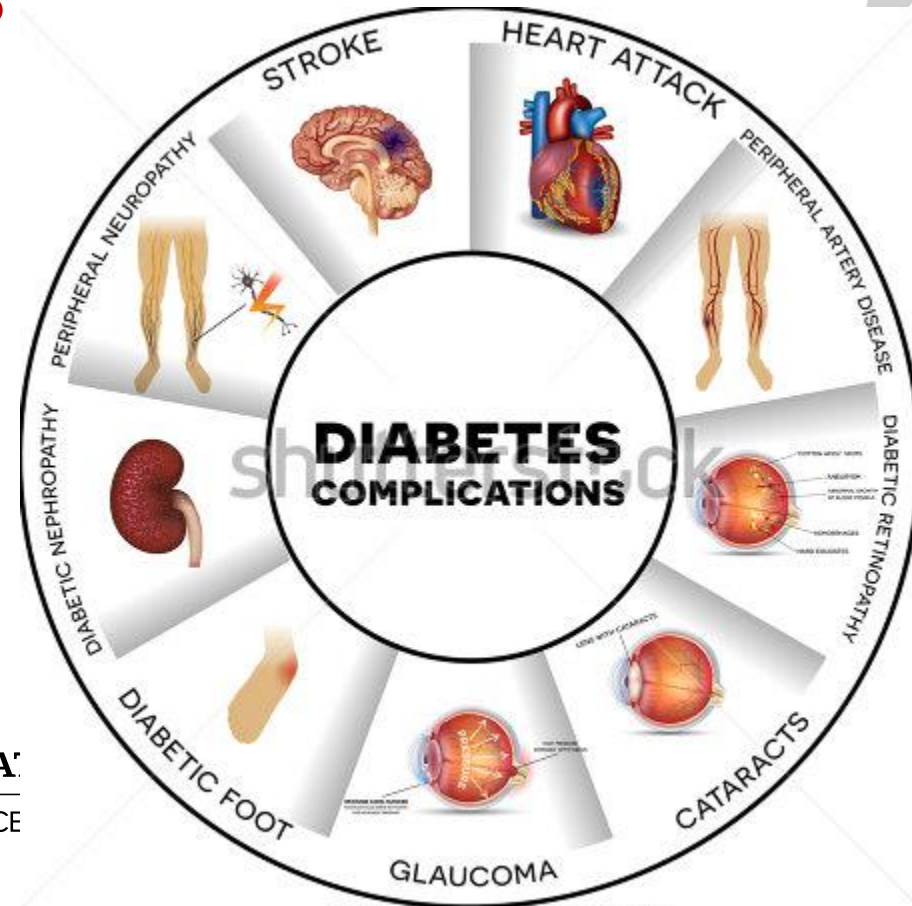
ADA. Diabetes Care 2013; 36:1033



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# The Toll of Diabetes

- 7<sup>th</sup> leading cause of death in the U.S.
  - Heart attack and stroke account for 65% of deaths
- Leading cause of new blindness in adults
- Leading cause of renal failure
- Leading cause of non-traumatic lower limb amputations



www.shutterstock.com · 341076317

[www.diabetes.org](http://www.diabetes.org)



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# AT THE HEART OF DIABETES

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Diabetes &  
Heart Disease  
By The #s

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## U.S. DIABETES PATIENTS HAVE:

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**2-3x**

increased risk  
for heart disease



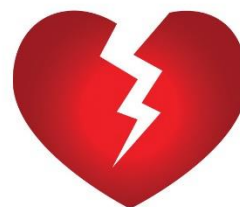
**30%**

of coronary stents  
implanted in 2011



**280,000**

heart attacks  
annually



**2-4x**

higher heart disease  
morbidity and mortality rates



**60%**

chance of dying  
from heart disease

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# Link between Diabetes, Heart Disease, and Stroke

- Conditions that increase the chance for heart disease or stroke
  - Overweight or obese
  - High blood pressure
  - High cholesterol
  - Family history of heart disease
  - smoking



# Who should be tested for diabetes?

>45 years old

**Or**

## RISK FACTORS

(1 or more)

- Obesity/acanthosis
- CVD
- High risk ethnicity
- 1<sup>st</sup> degree relative with DM
- Gestational DM or baby > 9#
- HTN
- HDL (Good Cholesterol) < 35
- TG > 250 mg/dl
- Polycystic ovarian disease

***Repeat screen every 3 years***

# ARE YOU AT RISK FOR TYPE 2 DIABETES?



## Diabetes Risk Test

- 1 How old are you?**  
Less than 40 years (0 points)  
40—49 years (1 point)  
50—59 years (2 points)  
60 years or older (3 points)
- 2 Are you a man or a woman?**  
Man (1 point) Woman (0 points)
- 3 If you are a woman, have you ever been diagnosed with gestational diabetes?**  
Yes (1 point) No (0 points)
- 4 Do you have a mother, father, sister, or brother with diabetes?**  
Yes (1 point) No (0 points)
- 5 Have you ever been diagnosed with high blood pressure?**  
Yes (1 point) No (0 points)
- 6 Are you physically active?**  
Yes (0 points) No (1 point)
- 7 What is your weight status?**  
(see chart at right)

Write your score  
in the box.








Add up  
your score.

### If you scored 5 or higher:

You are at Increased risk for having type 2 diabetes. However, only your doctor can tell for sure if you do have type 2 diabetes or prediabetes (a condition that precedes type 2 diabetes in which blood glucose levels are higher than normal). Talk to your doctor to see if additional testing is needed.

Type 2 diabetes is more common in African Americans, Hispanics/Latinos, American Indians, and Asian Americans and Pacific Islanders.

For more information, visit us at  
[www.diabetes.org](http://www.diabetes.org) or call 1-800-DIABETES

Visit us on Facebook  
[Facebook.com/AmericanDiabetesAssociation](https://www.facebook.com/AmericanDiabetesAssociation)



Height	Weight (lbs.)		
4' 10"	119-142	143-190	191+
4' 11"	124-147	148-197	198+
5' 0"	128-152	153-203	204+
5' 1"	132-157	158-210	211+
5' 2"	136-163	164-217	218+
5' 3"	141-168	169-224	225+
5' 4"	145-173	174-231	232+
5' 5"	150-179	180-239	240+
5' 6"	155-185	186-246	247+
5' 7"	159-190	191-254	255+
5' 8"	164-196	197-261	262+
5' 9"	169-202	203-269	270+
5' 10"	174-208	209-277	278+
5' 11"	179-214	215-285	286+
6' 0"	184-220	221-293	294+
6' 1"	189-226	227-301	302+
6' 2"	194-232	233-310	311+
6' 3"	200-239	240-318	319+
6' 4"	205-245	246-327	328+
	(1 Point)	(2 Points)	(3 Points)
You weigh less than the amount in the left column (0 points)			

Adapted from Bang et al., Ann Intern Med 151:775-783, 2009.  
Original algorithm was validated without gestational diabetes as part of the model.

### Lower Your Risk

The good news is that you can manage your risk for type 2 diabetes. Small steps make a big difference and can help you live a longer, healthier life.

If you are at high risk, your first step is to see your doctor to see if additional testing is needed.

Visit [diabetes.org](http://diabetes.org) or call 1-800-DIABETES for information, tips on getting started, and ideas for simple, small steps you can take to help lower your risk.

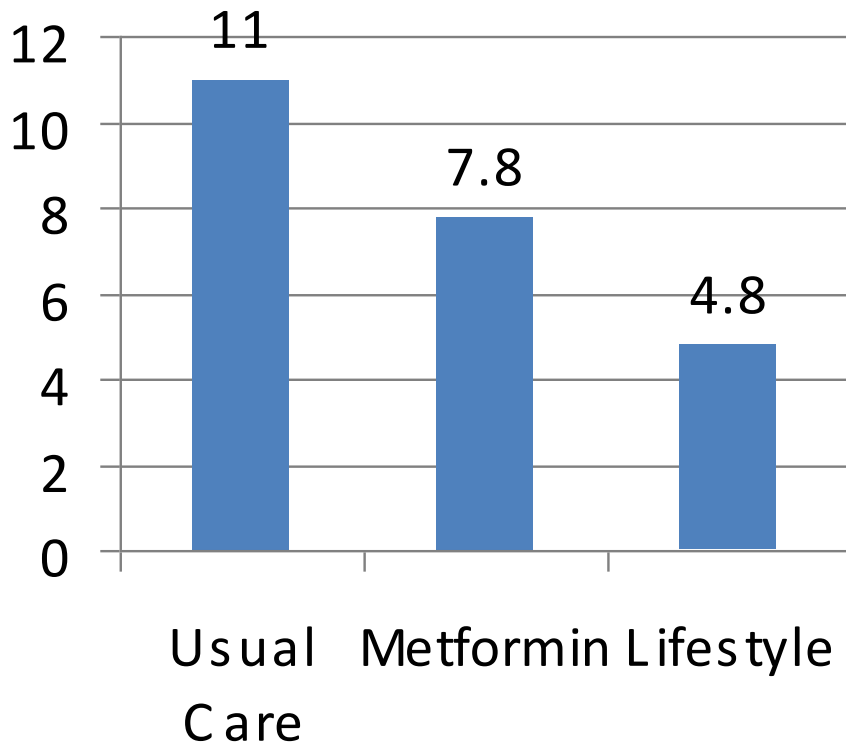
<http://www.diabetes.org/diabetes-basics/prevention/diabetes-risk-test/>



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# Diabetes Prevention Program

## % of Patients developing Diabetes



3200 Adults with Prediabetes  
Follow-up 2.8 years

*Intensive* lifestyle changes prevent progression from prediabetes to diabetes:

- 7% weight reduction
- Low-calorie, low fat diet
- Exercise 150 min/week
- Frequent contact with educators

N Engl J Med. 2002 Feb 7;346(6):393-403.



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# Weight loss

- The cornerstone of management for T2DM
- The goal is modest weight loss (5-7%): improves blood sugars and other risk factors for complications

Weight in Pounds

	120	130	140	150	160	170	180	190	200	210	220	230	240	250
4'6"	29	31	34	36	39	41	43	46	48	51	53	56	58	60
4'8"	27	29	31	34	36	38	40	43	45	47	49	52	54	56
4'10"	25	27	29	31	34	36	38	40	42	44	46	48	50	52
5'0"	23	25	27	29	31	33	35	37	39	41	43	45	47	49
5'2"	22	24	26	27	29	31	33	35	37	38	40	42	44	46
5'4"	21	22	24	26	28	29	31	33	34	36	38	40	41	43
5'6"	19	21	23	24	26	27	29	31	32	34	36	37	39	40
5'8"	18	20	21	23	24	26	27	29	30	32	34	35	37	38
5'10"	17	19	20	22	23	24	26	27	29	30	32	33	35	36
6'0"	16	18	19	20	22	23	24	26	27	28	30	31	33	34
6'2"	15	17	18	19	21	22	23	24	26	27	28	30	31	32
6'4"	15	16	17	18	20	21	22	23	24	26	27	28	29	30
6'6"	14	15	16	17	19	20	21	22	23	24	25	27	28	29
6'8"	13	14	15	17	18	19	20	21	22	23	24	25	26	28

Underweight
Healthy Weight
Overweight
Obese

Body mass  
index  
calculation



# Do low carb diets work?

- The most effective diet is the one that *you* can continue long-term
- High-protein, low-carb diets
  - Improved sugars
  - But may also increase LDL cholesterol (the bad stuff)
- Carbs:
  - the total amount is important
  - Avoid refined sugars



Fat Matters, Carbs Count, but Calories are King!

(Allan Borushek)

ADA. Diabetes Care 31 (Suppl 1):S61-S78



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# Learn to Read Nutrition Labels

1. Start here

2. Check the total calories per serving

3. Limit these nutrients

4. Get enough of these nutrients

Nutrition Facts			
Serving Size 2/3 cup (55g)			
Servings Per Container About 8			
Amount Per Serving			
<b>Calories</b> 230		Calories from Fat 72	
			% Daily Value*
<b>Total Fat</b> 8g			<b>12%</b>
Saturated Fat 1g			<b>5%</b>
Trans Fat 0g			
<b>Cholesterol</b> 0mg			<b>0%</b>
<b>Sodium</b> 160mg			<b>7%</b>
<b>Total Carbohydrate</b> 37g			<b>12%</b>
Dietary Fiber 4g			<b>16%</b>
Sugars 1g			
<b>Protein</b> 3g			
Vitamin A			10%
Vitamin C			8%
Calcium			20%
Iron			45%
* Percent Daily Values are based on a 2,000 calorie diet. Your daily value may be higher or lower depending on your calorie needs.			
	Calories:	2,000	2,500
Total Fat	Less than	65g	80g
Sat Fat	Less than	20g	25g
Cholesterol	Less than	300mg	300mg
Sodium	Less than	2,400mg	2,400mg
Total Carbohydrate		300g	375g
Dietary Fiber		25g	30g

5. Quick Guide for % Daily Value: 5% or less is low and 20% or more is high

1. Eat plenty of fruits and vegetables.
2. Choose whole-grain foods (like whole wheat bread, oatmeal, brown rice), a good source of fiber.
3. Eat fish, especially oily fish (like salmon, trout, herring), twice a week.
4. Limit saturated and *trans* fats.
5. Limit red meat and choose lean meats and skinless poultry.
6. Choose low-fat dairy products, such as skim milk or low-fat yogurt.
7. Limit beverages and foods with added sugars.
8. Learn about sodium and the common foods that have too much of it.

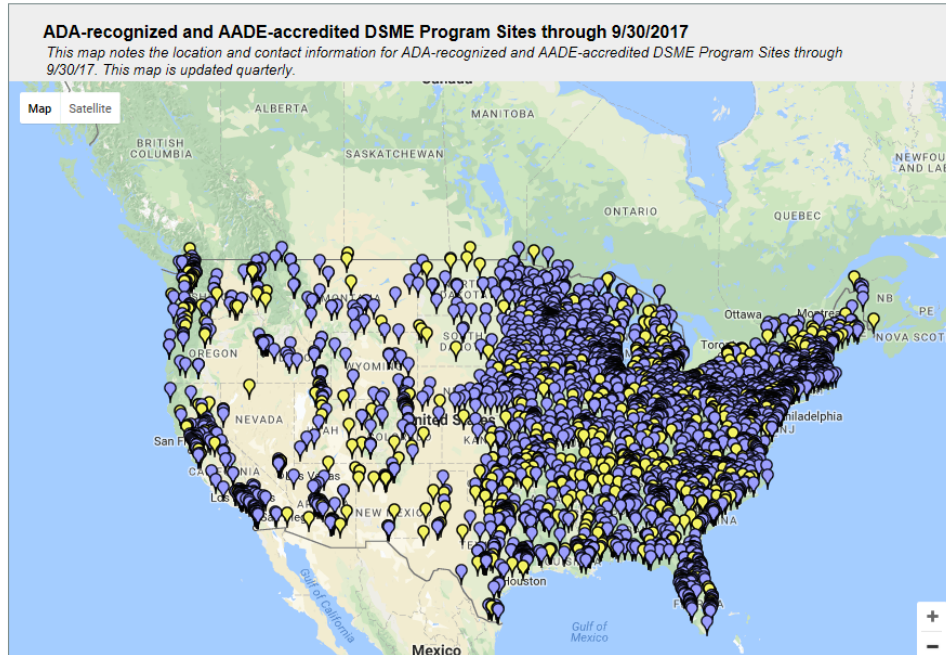
# Does this mean I can't eat treats?

- If you *must* splurge
  - Portion control
  - Substitute one carb for another
  - Take an extra walk
  - Learn to count carbs and adjust your medication



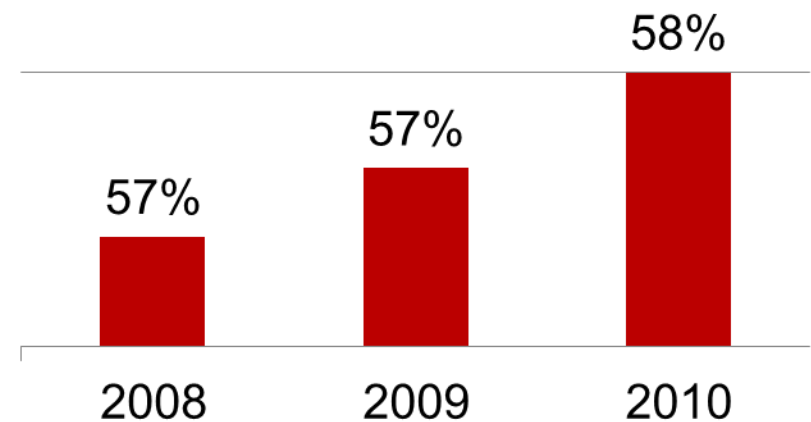


*But I already know what I need to do...*



Learn diabetes *self*-management  
Certified diabetes education programs

**% of adults with diabetes  
reporting they have EVER had  
formal diabetes education**



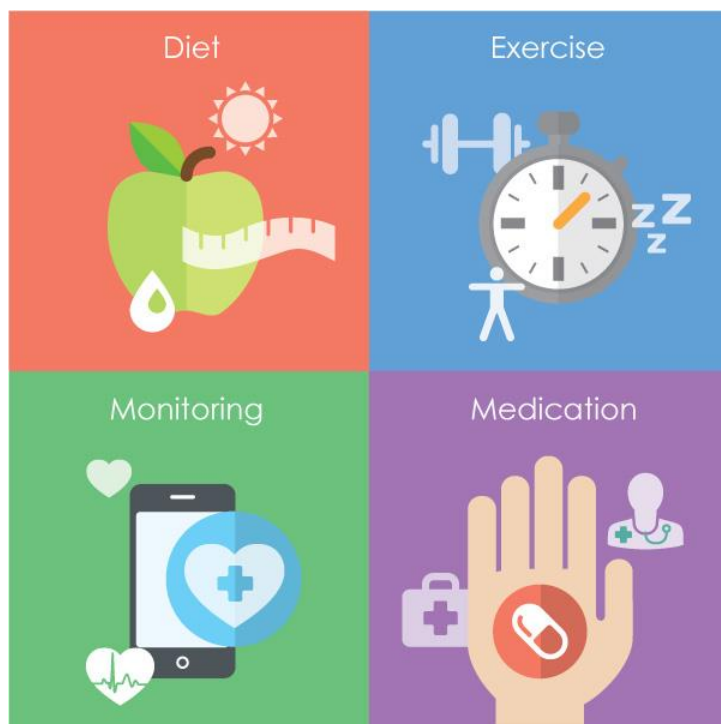
Healthy People 2020 data



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# *But I already know what I need to do...*

Learn how to take control of your diabetes with diabetes self-management education



- Is this a good sugar?
- What do I do if I'm high?
- What do I do if I'm low?
- What should I do if I'm sick?
- Should I eat that?
- How do I take this medicine?
- What kind of exercise can I do?
- How can I prevent complications?
- And many more...



# Exercise

- Minimum 30 min/day
- Important for keeping weight off.
- Most weight loss results from ↓ calories
- Benefit in reducing sugars beyond that produced by weight reduction alone.





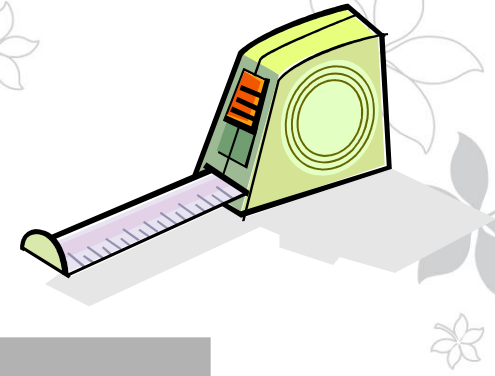
# So you want to start an exercise program...

- Talk to your doctor to make sure it is safe
- You may need an exercise stress test
- See your doctor if you experience chest pain or discomfort, shortness of breath or racing heart



# Where should my sugars be?

## Measuring Success



	ADA <sup>1</sup>
<b>A1C</b>	<b>&lt;7%</b>
<b>Fasting/premeal glucose</b>	<b>90-130</b>
<b>Postmeal glucose</b>	<b>&lt;180 (peak)</b>

Goals should be individualized

1. ADA Clinical Practice Recommendations. Diabetes Care 2015



# What does my A1c mean?

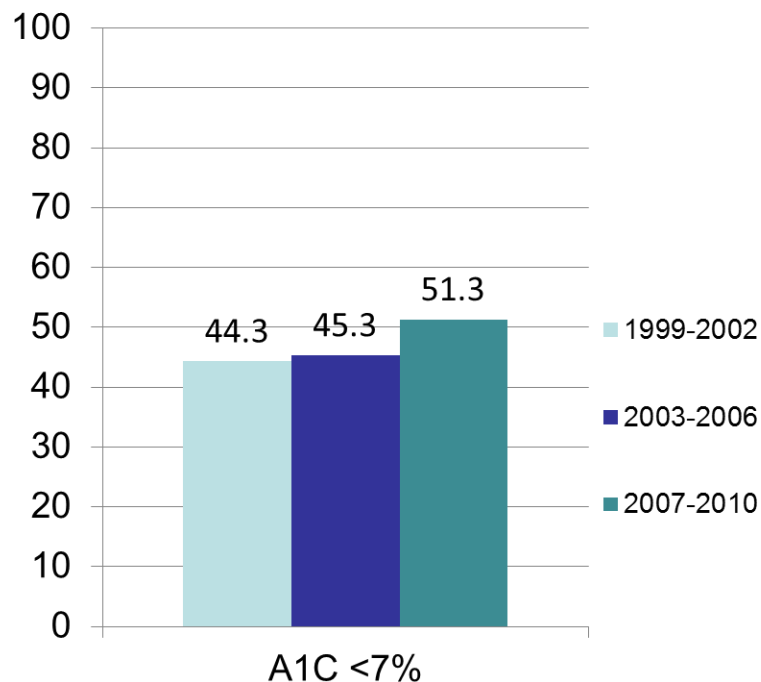
A1c %	3 Month Average Blood sugar
4.0	65
4.5	83
5.0	100
5.5	118
6.0	135
6.5	153
7.0	170
<b>7.5</b>	<b>187</b>
<b>8.0</b>	<b>204</b>
<b>8.5</b>	<b>222</b>
<b>9.0</b>	<b>240</b>
<b>9.5</b>	<b>258</b>
<b>10.0</b>	<b>275</b>
<b>10.5</b>	<b>293</b>
<b>11.0</b>	<b>310</b>
<b>11.5</b>	<b>328</b>
<b>12.0</b>	<b>345</b>

DIABETES CARE, VOLUME 25, NUMBER 2, FEBRUARY 2002



# Prevalence of HbA1c <7% among people with diabetes

*NHANES Data*



Ali et al. N Engl J Med. 2013;368(17):1613-24





## How often should I check?

- Depends upon medications used
  - Insulin: 3+ times/day
  - Oral Hypoglycemics: 1+ time/day

But it only improves glucose control if you use  
the information!





# Can you find the pattern?

9/1/15	8:00	114
	12:00	214
9/2/15	7:00	85
	6:30	174
	9:00	210
9/3/15	6:30	121
	11:30	229
	7:00	72
9/4/15	7:00	112
	5:30	181
	9:00	145
9/5/15	12:00	281
	7:00	142
9/6/15	7:00	89
	11:30	210
9/7/15	6:30	121

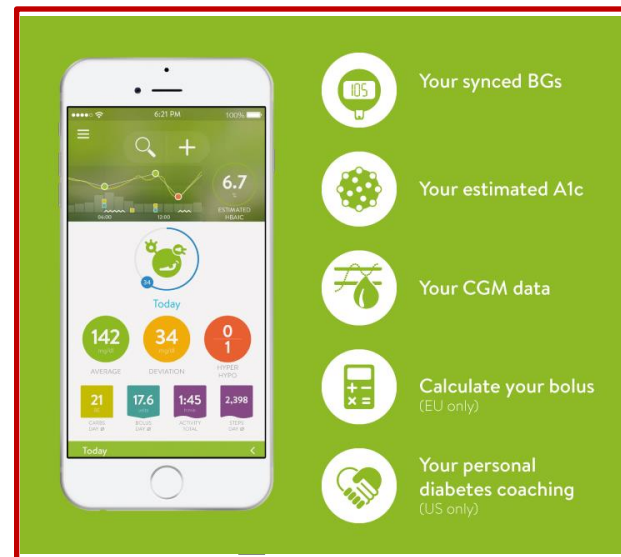
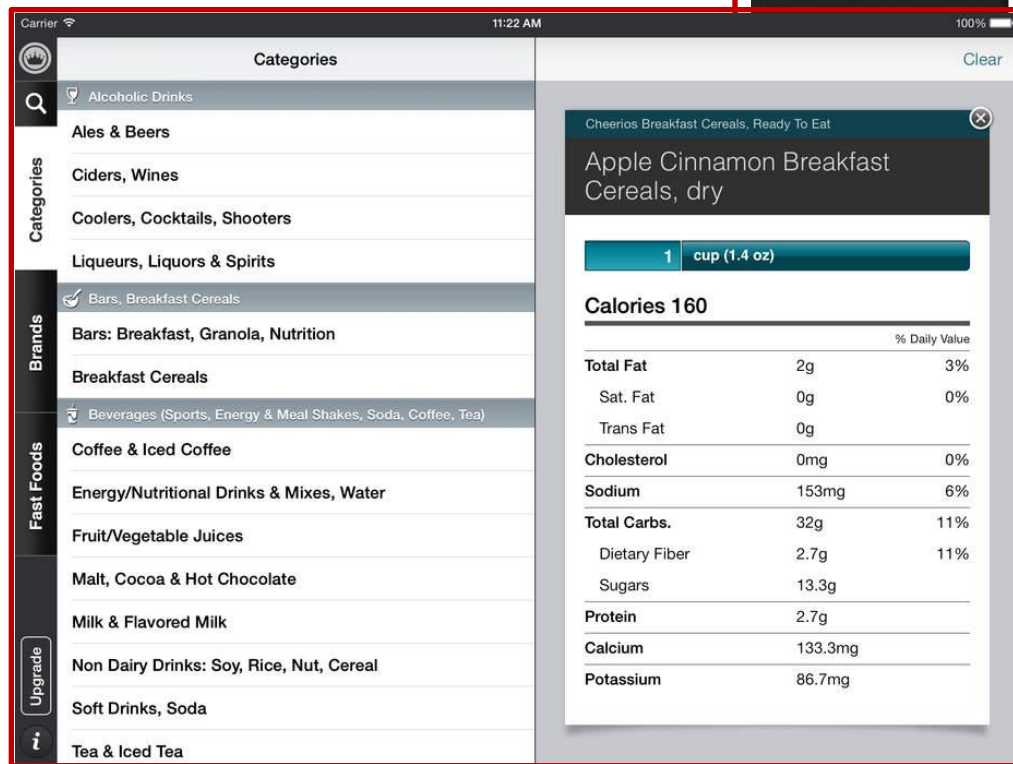
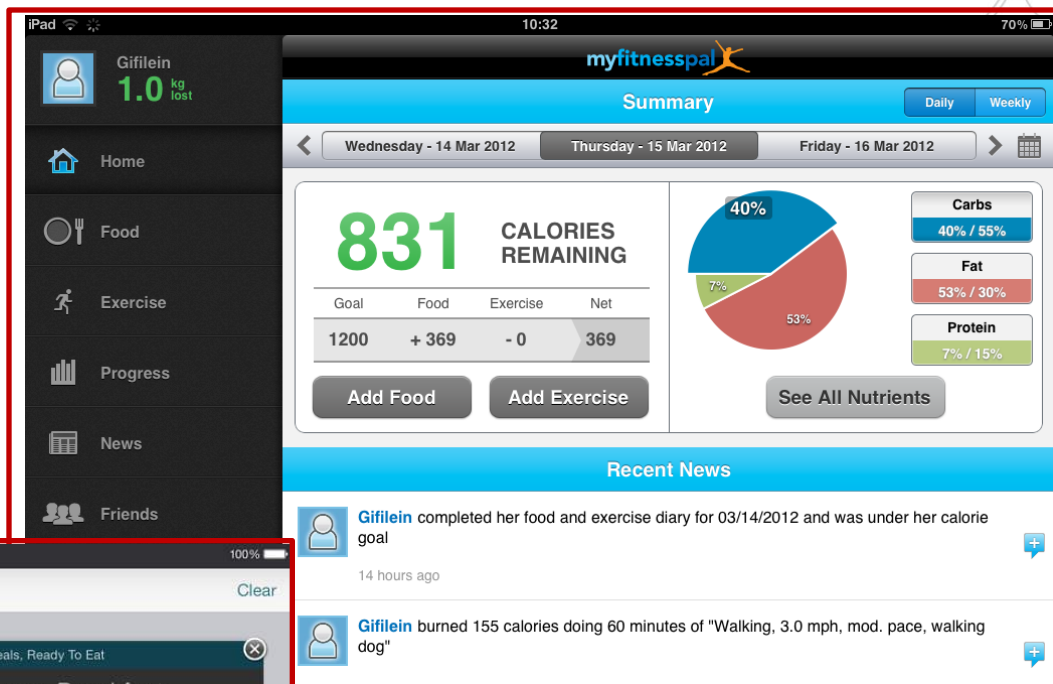
	Breakfast			Lunch			Dinner			Bedtime		Night
	before	insulin	after	before	insulin	after	before	insulin	after	before	insulin	
Day	time			time			time			time		time
Mon 11-15	8:00	10	128	1:00	12	172	1:00	15	198	2:00	221	
Tue 16	9:00	10	160	1:00	13	170	1:00	15	206	2:00	21	
Wed 17	12:00	10	158	1:00	13	165	1:00	15	181	2:00	222	
Thu 18	8:00	10	94	1:00	12	189	1:00	15	72	2:00	222	
Fri 19	11:00	11	95	1:00	12	212	1:00	16	188	2:00	222	69
Sat 20	13:00	16	148	1:00	13	184	1:00	15	280	2:00	224	
Sun 21	10:00	10	96	1:00	12	210	1:00	16	200	2:00	224	



# Connecting and Downloading



# Apps



# Apps

- Diabetes
- Diet
- Lifestyle
- Exercise

App Name	Device Compatibility	Ratings	Cost (iOS, Android)	Features
Dlife	iOS	No Rating	Free	Gives a range of advice on Type I Diabetes. And give reminders to check blood sugar.
Glucose Buddy	iOS, Android	4.4	Free, Free	Glucose Buddy is a data storage utility for people with diabetes.
MySugr	iOS, Android	4.8	Free, Free	mySugr Logbook is a charming, sometimes outspoken diabetes manager that focuses on making your diabetes data useful in everyday life.
Meal Memory	iOS	No Rating	\$1.99	Logging a meal is as simple as taking a picture. Now with Apple Health integration, Meal Memory can import your blood sugar readings and link them to your meals automatically.
MyDiabetes	iOS, Android	No Rating	\$0.99	App manages your Blood Glucose, Blood Pressure, Food, Exercise, Water intake and Medication all in one simple-to-use application.
Calorie King	iOS, Android	3.6	Free, Free	Contains over 70,000 foods 260 fast food chains and restaurants.
Figwee	iOS	3.5	\$1.99	visual, using over 28,000 photos of meticulously weighed portions. Use a slider to adjust how much is in the bowl, on the plate, or in the glass,
Fooducate	iOS, Android	4.5	Free, Free	Products are awarded a nutrition grade of A, B, C, or D by an automatic algorithm
Go Meals	iOS, Android	3	Free, Free	GoMeals includes tools for eating healthy, staying active, and tracking your blood glucose levels. food tracker, activity tracker, glucose tracker, and restaurant locator.
HealthyOut	iOS, Android	4.4	Free, Free	Find healthy meals from local restaurants in your area. Filters by Cuisine, ingredients, type of dish, low carb, and by dietary restriction like vegan, vegetarian, and etc.
My FitnessPal	iOS, Android	4.7	Free, Free	The largest food database (over 5,000,000 foods) and amazingly fast and easy food and exercise entry. Can connect with 50+ other apps and tracks goals and reports them.
SPARKPEOPLE	iOS, Android	4	Free, Free	This app brings the fitness tracking and calorie counting tools, exercise demos, reporting, and the detailed food database
Daily Workouts	iOS, Android	4.8	Free, Free	Daily Workouts FREE is a 10 to 30 minute daily workout routine for men and women that steps you through some of the best exercises you can do in the comfort of your own home No internet required to do the workouts.
Run Keeper	iOS, Android	4.4	Free, Free	With Runkeeper, turn your phone into a GPS tracker or track your runs without your phone with our Apple Watch app.

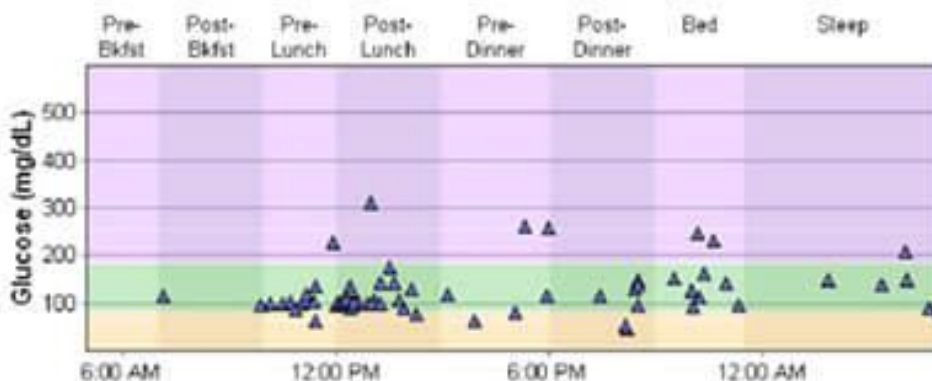




test bgmeter  
 Patient ID: 12345  
 Date of Birth: Not Specified

Date Range: 7/20/2010 - 8/2/2010

## Two Week Glucose Summary with Logbook



Glucose Target Ranges

Low Within High

Glucose Readings

Manual (BG) Glucose (BG) • Glucose (CM)

Glucose Statistics	Breakfast		Lunch		Dinner		Bed & Sleep	
(mg/dL)	5:01 AM-7:00 AM-10:00 AM		10:01 AM-12:00 PM-3:00 PM		3:01 PM-6:00 PM-9:00 PM		9:01 PM-11:30 PM-5:00 AM	
	Pre	Post	Pre	Post	Pre	Post	Bed	Sleep
# Readings		2	11	28	6	7	9	8
Highest	N/A	116	226	311	262	147	246	209
Lowest	N/A	97	62	77	62	47	92	78
Average		107	112	115	149	103	151	124
Standard Deviation	N/A	N/A	39.8	42.4	80.5	37.4	52.3	42.1
Within %	N/A	100%	82%	92%	33%	71%	78%	76%



# CGM: continuous glucose monitoring

- Eras of glucose measurement



- Tiny filament inserted just under the skin samples glucose levels every 5 minutes
- Now able to **replace** frequent glucose checks!



# So many drugs...

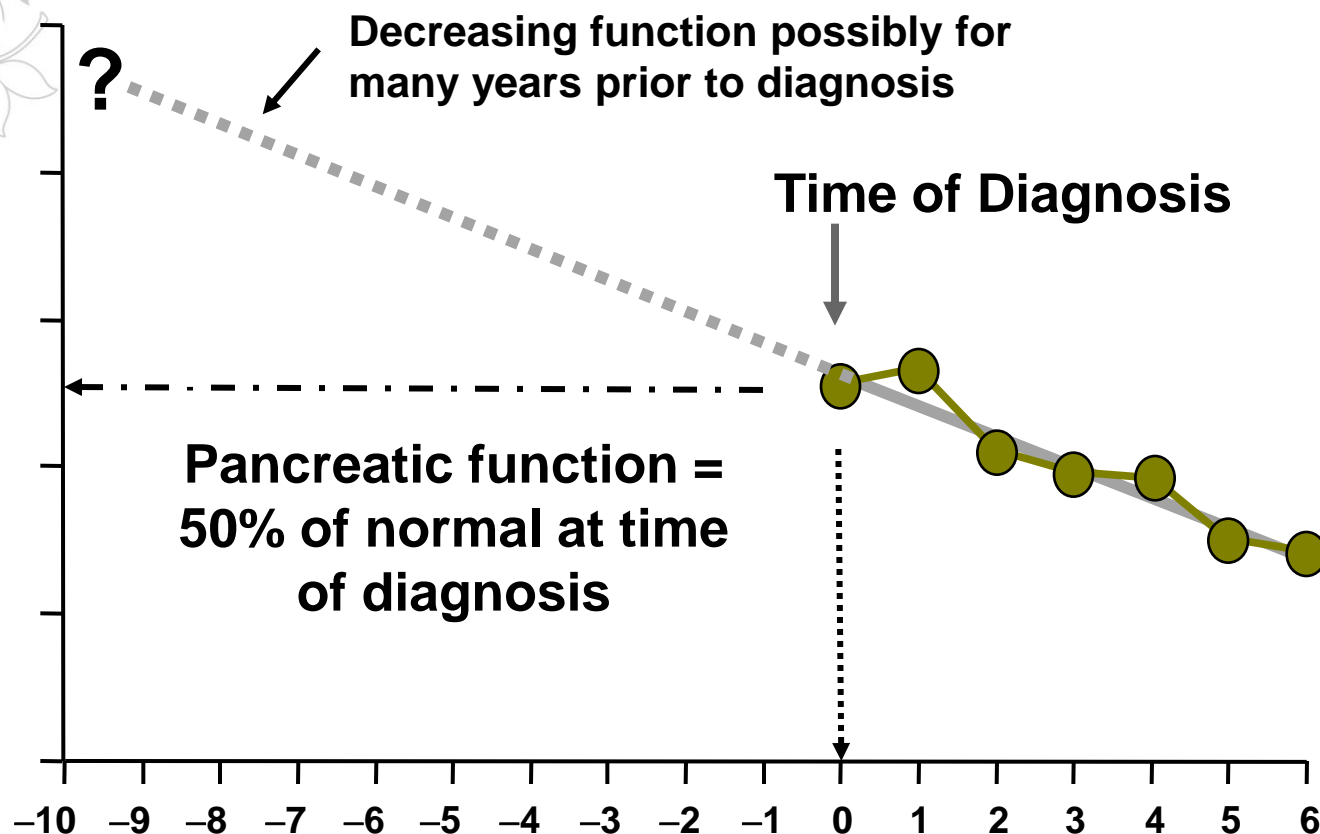
In general, treatment has to be tailored to fit you

- Effectiveness
- Safety
- Hypoglycemia
- Cost
- Weight gain



# But it worked for me before!

## *Declining Pancreas Function in T2DM*







## Long-term safety

- The FDA requires all new diabetes drugs to demonstrate long-term safety to the heart

- Requires very large trials ~10,000 patients
- Patients usually have known vascular disease
- Typically 3-5 years



# The first diabetes drug to demonstrate reduced cardiac events

*The NEW ENGLAND JOURNAL of MEDICINE*

ORIGINAL ARTICLE

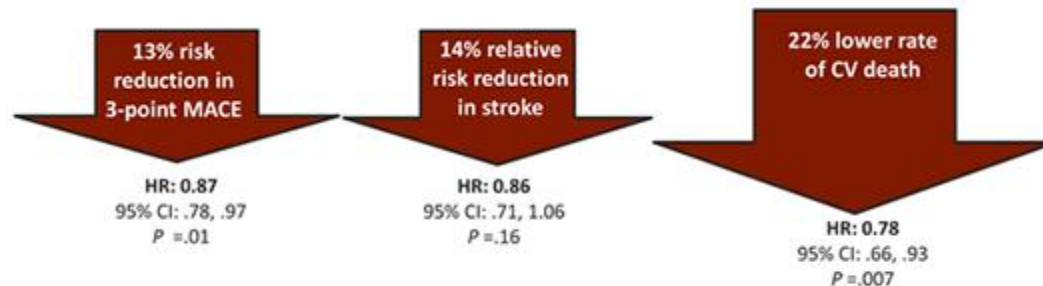
## Empagliflozin, Cardiovascular Outcomes, and Mortality in Type 2 Diabetes

“...significantly lower rates of **death from cardiovascular causes** (3.7%, vs. 5.9% in the placebo group; 38% relative risk reduction), **hospitalization for heart failure** (2.7% and 4.1%, respectively; 35% relative risk reduction), and **death from any cause** (5.7% and 8.3%, respectively; 32% relative risk reduction).”

ORIGINAL ARTICLE

## Liraglutide and Cardiovascular Outcomes in Type 2 Diabetes

Steven P. Marso, M.D., Gilbert H. Daniels, M.D., Kirstine Brown-Frandsen, M.D., Peter Kristensen, M.D., E.M.B.A., Johannes F.E. Mann, M.D., Michael A. Nauck, M.D., Steven E. Nissen, M.D., Stuart Pocock, Ph.D., Neil R. Poulter, F.Med.Sci., Lasse S. Ravn, M.D., Ph.D., William M. Steinberg, M.D., Mette Stockner, M.D., Bernard Zinman, M.D., Richard M. Bergenstal, M.D., and John B. Buse, M.D., Ph.D., for the LEADER Steering Committee on behalf of the LEADER Trial Investigators\*



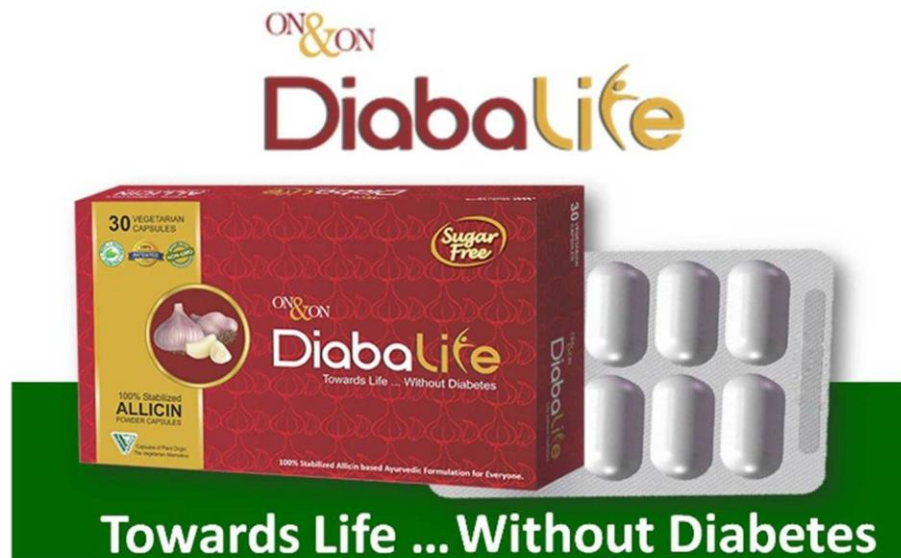
Marso SP, et al. *N Engl J Med*. 2016. [Epub ahead of print]

- 9340 adults with type 2 diabetes and high risk for heart and vascular disease
- Duration: 3.8 years



# Should I take this supplement?

- Supplements are not regulated by the FDA
  - Not required to vigorously study safety or effectiveness
  - Contents may not be consistent with the label
- “Natural” does not necessarily mean “safe”



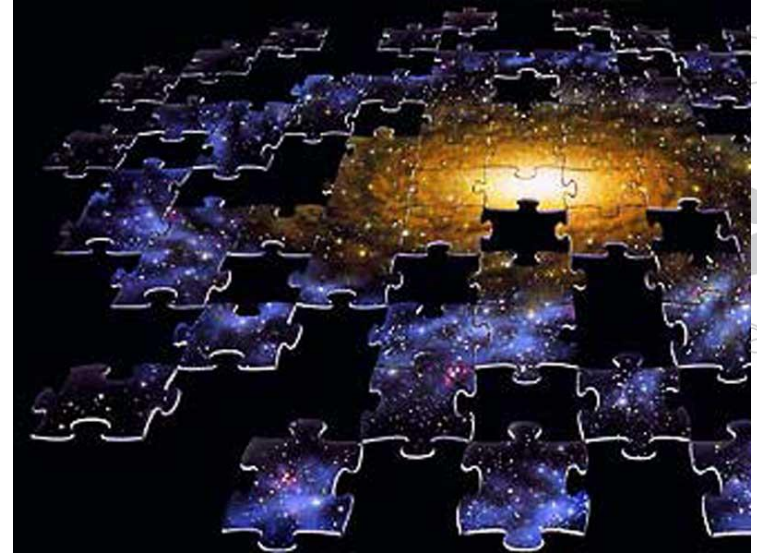
- (1) A medicine which is CURING diabetes 100%.....
- (2) Its going to work on both types of diabetes.....
- (3) Let us make India free from diabetes.....
- (4) Contact me for purchase the product...

(M)8128746329



THE OHIO STATE UNIVERSITY  
WEXNER MEDICAL CENTER

# Global Treatment of T2DM



- **Glucose control is only one of the pieces of the puzzle for diabetes**
- **Aggressive therapy is necessary for**
  - Blood pressure
  - Cholesterol
- **Aggressive multiple risk factor interventions prevent complications**



# KEY TESTS/EXAMS

**Hemoglobin A1c**

**Quarterly if treatment change**

**At least twice/yr if stable**

**Dilated eye exam**

**Yearly**

**Foot exam**

**Yearly (at risk often)**

**Lipid profile**

**1-2 years**

**Urine Microalbumin**

**Yearly**

**Blood pressure**

**Each visit**

**Weight**

**Each visit**

**GYN/family planning**

**Each visit**



# Common Diabetes Myths

- There is no diabetes in my family, so I don't have to worry
- I developed diabetes because I eat too much sugar
- If I get diabetes I can never eat any sugar
- I can tell my sugar is high so I don't need to check it
- I don't have to worry because my doctor said I have "borderline diabetes"
- Metformin causes kidney damage
- Insulin causes complications
- I have seen the effects of diabetes on my family so there is nothing I can do about it
- I don't need to do anything about my diabetes because I plan to lose weight.



# When to see a specialist

- There are 25 million people with diabetes and only 3000 Endocrinologists!
- Most primary care providers are very capable of managing early diabetes, and many have dedicated programs or teams
- Diabetes self-management education programs
- Reasons for referral:
  - Uncontrolled despite working closely with your doctor
  - Special devices (insulin pumps and continuous glucose monitors)
  - Severe hypoglycemia





# Conclusions

- Diabetes places a substantial clinical and economic burden on the U.S.
- Lifestyle changes, as part of a multi-pronged approach, can prevent or delay DM and prevent complications
- Glucose lowering therapy should be individualized and goal-directed

