

Blood Glucose after Transplant: Why It Matters

Celebrating a Second Chance at Life Survivorship Symposium

April 29 – May 5, 2023



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Learning Objectives

To understand:

1. Normal blood glucose levels
2. Health consequences of having blood glucose levels that are too low or too high
3. How hematopoietic stem cell transplant (HCT) can affect blood glucose levels
4. Steps HCT recipients and their healthcare providers can take to detect and manage blood glucose levels

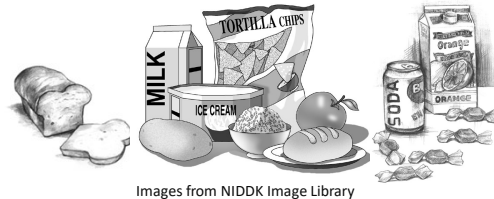
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What is Glucose?

- Glucose is a type of sugar that is commonly found in food
- Our bodies make glucose from “carbohydrate”
- Carbohydrates, fat and protein are three major nutrients our bodies need

Nutrition Facts

Serving Size 1 cup (228g)	
Servings Per Container 2	
Amount Per Serving	
Calories 250	Calories from Fat 110
% Daily Value*	
Total Fat 12g	18%
Saturated Fat 3g	15%
Trans Fat 3g	
Cholesterol 30mg	10%
Sodium 470mg	20%
Total Carbohydrate 31g	10%
Dietary Fiber 0g	0%
Sugars 5g	
Protein 5g	
Vitamin A	4%
Vitamin C	2%
Calcium	20%
Iron	4%
<small>* Percent Daily Values are based on a 2,000 calorie diet. Your Daily Values may be higher or lower depending on your calorie needs.</small>	
	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

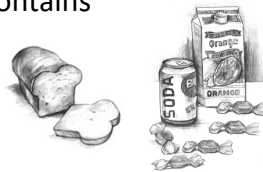


Images from NIDDK Image Library

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Why do our Bodies Need Glucose?

When we eat food that contains carbohydrate or sugar...



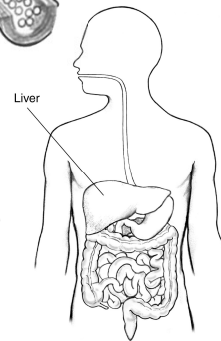
...the glucose level in our blood stream increases.



This **is important** as it provides energy to organs, such as our brain and muscles....



... we also store the glucose in our liver to use when we are fasting.



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How do our Keep Glucose Levels Normal?

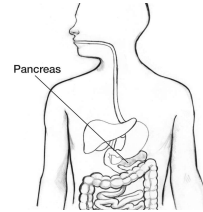
1. When we Eat



2. Blood Glucose Increases



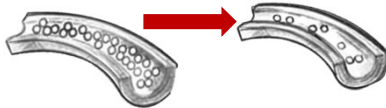
3. Our Pancreas makes Insulin



4. Insulin Helps Our Muscles and Fat Take Up Glucose from the Blood



5. Blood Glucose Returns to Normal

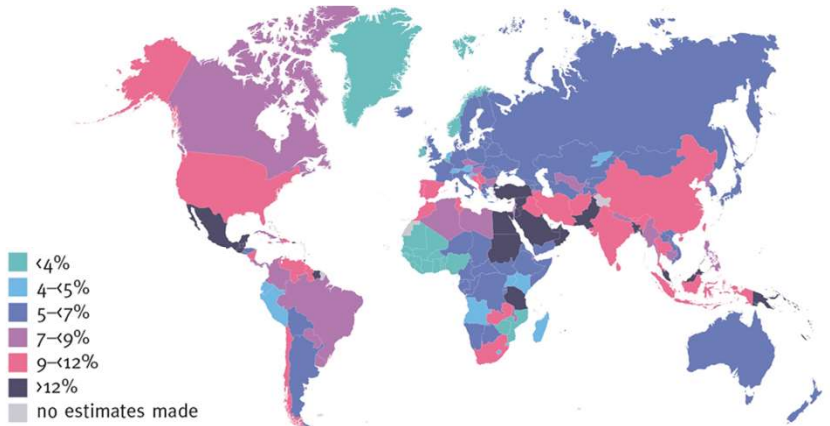


If we do not make enough insulin or our body does not respond normally to insulin, blood glucose levels increase = "Diabetes"

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Is High Glucose (Diabetes) Common?

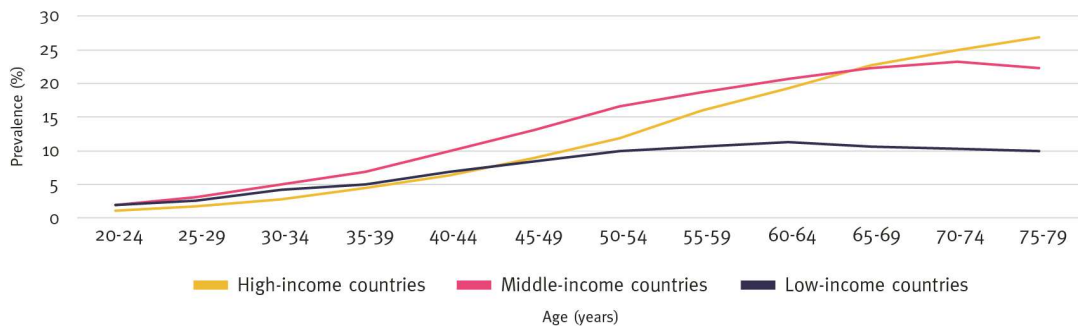
Estimated Percent of People with Diabetes in 2021



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Diabetes is More Common as We Get Older

Percent of People with Diabetes by Age Group



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What Happens if Glucose Levels are Too High?

Short Term:

- ↑ Urination
- ↑ Thirst
- ↑ Appetite
- ↓ Weight
- Blurred Vision
- ↓ Energy
- Confusion / Coma


Long Term:

- Vision Loss
- Kidney Damage
- Numbness in Feet
- **Problems with Circulation:**
 - Heart
 - Brain
 - Legs

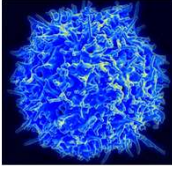
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How Can High Glucose Affect Stem Cell Transplant Recipients?


↑ Time in Hospital




↑ Graft vs Host Disease



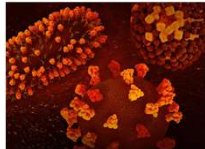
↓ Life Expectancy



↑ Kidney Damage



↑ Infections




JM Olausson et al. Oncol Nurs Forum 2014;41(5):E302-312.
Images from NIDDK Image Library and NIAID Flickr Gallery

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Long Term Heart Disease Risk after HCT

Individual Risk Factors




Age
Sex
Race/Ethnicity
Family History

Treatment Factors




Chemotherapy
Radiation

HCT




Conditioning Treatment

GVHD



Inflammation Treatment

Accelerated Heart Disease



NIH HCT Late Effects Initiative 2017

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How Can HCT Increase Blood Glucose?

Conditioning
Treatment before
HCT



HCT



Intravenous
(Parenteral)
Nutrition

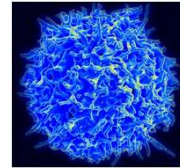


Immunosuppressive
Treatment



Corticosteroids
Tacrolimus
Cyclosporin
Sirolimus

Inflammation
after HCT



Infection
GVHD
Corticosteroids

These factors can either reduce insulin production or decrease our body's ability to respond to insulin, leading to high blood glucose levels.

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Other Factors Increase the Risk of High Glucose

- Age
- First-degree relative (sister, brother, parent) with diabetes
- Race / Ethnicity

- Being overweight or obese by body mass index (BMI)*
- Previously having diabetes while pregnant
- Having or previously having polycystic ovarian syndrome
- Having HIV

- Physical inactivity

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*Calculating Body Mass Index (BMI)



1. Measure height



2. Measure weight

3a. Calculate body mass index: $\text{Weight (kg)} / [\text{Height (m)}^2]$

3b. Use online calculator: nhlbi.nih.gov/health/educational/lose_wt/BMI/bmicalc.htm

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*What the Body Mass Index (BMI) Numbers Mean

- Underweight = Less than 18.5
- Normal weight = 18.5–24.9
- Overweight = 25–29.9
- Obesity = 30 or greater

Having a BMI in the overweight or obese range, increases our risk of certain conditions such as diabetes.

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*Very Important Caveats

1. The BMI ranges are different for people from Asian-Pacific regions:

Underweight	<18.5
Normal	18.5–22.9
Overweight	23–24.9
Obese	≥25

2. Many people with normal BMI may have high glucose

3. Waist circumference measurements may be a better indicator, but are not frequently done in clinical practice

How Can We Tell if We Have High Glucose?

- Symptoms of High Glucose
- Blood Tests with High Blood Glucose

What are Normal and High Blood Glucose Levels?

- Fasting Glucose (at least 8 hours):

Normal	Borderline (Pre-diabetes)	High Glucose (Diabetes)
<100mg/dL Or <5.6mmol/L	100-125mg/dL Or 5.6-6.9mmol/L	≥126 mg/dL Or 7.0 mmol/L

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How Else Can We Diagnose High Blood Glucose?

1. Two Hour Glucose Tolerance Test

Normal	Borderline (Pre-diabetes)	High Glucose (Diabetes)
<140mg/dL Or 7.8 mmol/L	140-199mg/dL Or 7.8-11.0mmol/L	≥200mg/dL Or ≥11.1mmol/L

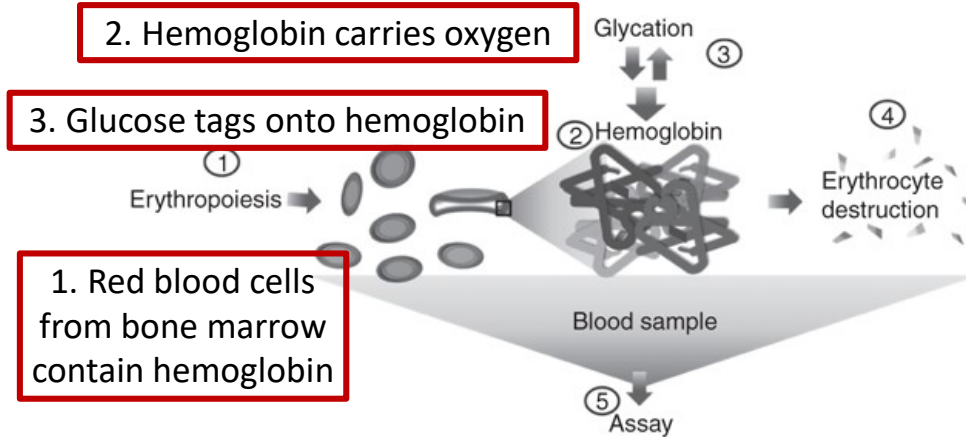
2. Hemoglobin A1c (HbA1c)**

Normal	Borderline (Pre-diabetes)	High Glucose (Diabetes)
<5.7% Or <39mmol/L	5.7-6.4% Or 39-47 mmol/mol	≥6.5% Or ≥48 mmol/mol

3. Symptoms of high glucose and random glucose ≥200mg/dL (11.1mmol/L)

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**A Note About Hemoglobin A1c (HbA1c) Test



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What Happens if Glucose Levels Are Too Low?

Symptoms:

- Hungry
- Sweating or pale, cold and clammy
- Anxious or irritable
- Heart racing
- Weakness / Tingling
- Confusion / Seizures / Coma

How to Know if These Symptoms are from Low Glucose

- Check glucose with symptoms
- $<70\text{mg/dL}$ ($<4\text{mmol/L}$)

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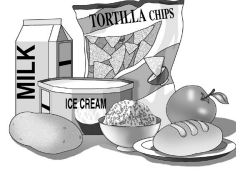
How Can HCT Lead to Low Blood Glucose?



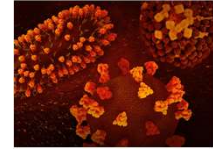
Reducing or stopping corticosteroids leads to low cortisol levels



Continuing blood glucose-lowering medications when corticosteroids or other HCT related medications are reduced



Loss of appetite or fasting while taking glucose lowering medications



Infections can sometimes lead to low blood glucose

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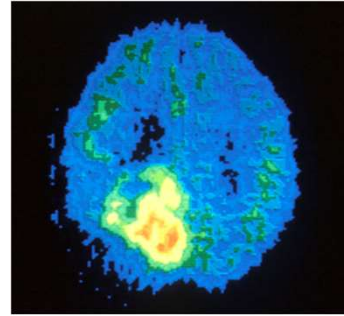
Treating High Blood Glucose

- Nutrition:
 - Avoid concentrated sweets / sugars
 - Balance food intake
- Physical Activity:
 - 30 minutes a day, 5 days a week



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Glucose and Cancer



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Medication to Treat High Blood Glucose

- There are many medications available to treat high blood glucose
- It is important that the doctor who is treating your blood glucose knows that you had a stem cell transplant, and all of the medications that you are taking
- Tell the doctor helping you to take care of your blood glucose about all of your symptoms
- Ideally, your oncology doctor and diabetes doctors should be able to communicate with each other easily

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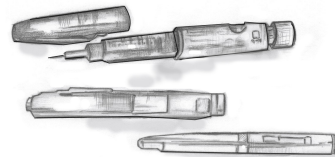
Diabetes Medication and Side Effects

- Every medication potentially has side effects
- There are a growing number of diabetes medications, but many of these medications were not studied in people who previously had a stem cell transplant
- Sometimes we treat people with insulin after transplant as it can quickly lower blood glucose
 - Doses can be adjusted easily
 - It does not typically cause side effects other than lowering blood glucose ***

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*** A Note About Insulin

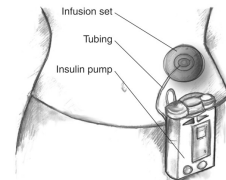
Insulin can come as...
Pens



Vials and syringes..



Or Insulin pumps



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*** Another Note about Insulin

- Insulin makes your blood glucose go down with few other side effects, so can work very well
- However, **there are different types of insulin**, so you should ask your doctor how your insulin works
- **Insulin can make your blood glucose go too low**, which can be dangerous

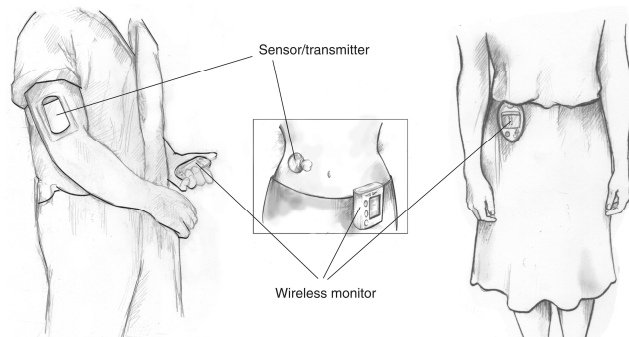
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Monitoring Your Blood Glucose

Fingerstick monitoring



Fingerstick free: Continuous glucose monitors



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Finally, Supplements and Herbs to Treat Blood Glucose

- Many of our current prescribed medications originally came from herbs, animals flowers, or other natural sources
 - Metformin came from French lilac
 - Other diabetes medications were discovered in the saliva of a reptile!
 - Cyclosporin came from a fungus!!
 - Tacrolimus from a bacteria!!!
- However, currently FDA approved medications are regulated regarding consistency, dose, and quality, while herbal medications and supplements are not
- We have a lot to learn about medicines, but talk with your doctor regarding the safety of any herbs (including herbal teas), or supplements you are taking or considering taking

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In Conclusion

- High blood glucose can cause short-term and long-term issues after transplant
- Know the symptoms of low and high blood glucose
- Ask about the right treatment for you to reduce your risk of short- and long-term complications related to high blood glucose
- Thank you!

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QUESTIONS?



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