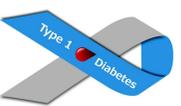




Using a Blood Test to Prevent Mortality in Undiagnosed Type 1 Diabetics

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Situation

Diabetic Ketoacidosis (DKA) is a life-threatening complication of Type 1 Diabetes that causes over 100,000 hospitalizations each year in the United States.

DKA is killing people without warning across the globe. Approximately 30% of people who die of Diabetic Ketoacidosis do not have a known history of diabetes.

Not only is DKA a medical emergency, but it is a financial burden on the patient, their family, and our healthcare system.

Here's the good news- DKA is preventable! Together, we can save the lives of our friends, family, and neighbors BEFORE this illness gets to them!

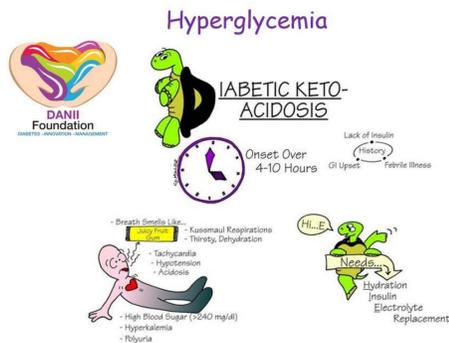


Fig 1. Signs and Symptoms of DKA. [Diabetic-Ketoacidosis.jpg \(939 x 658\) \(dani.org.au\)](#)

Background

Before you can understand DKA, you need to be familiar with diabetes.

- Type 1 Diabetes Mellitus is an autoimmune disease that targets the beta cells of your pancreas (that produce insulin).
- Eating too much sugar does not cause Type 1 Diabetes, and diabetics can eat sugar.
- There is no cure for Type 1 Diabetes. Insulin is NOT a cure.
- You can develop DKA as a Type 2 Diabetic, but it is rare.

What is DKA?

- Characterized by **high blood sugar** (hyperglycemia), **high bicarb level** and **low blood pH** (metabolic acidosis), **dehydration**, and the presence of **ketones** (a byproduct from the body using fats and muscle as an energy source instead of using the carbohydrates you eat).

What's the big deal?

- More and more people developing DKA do not know that they have diabetes.
- If you don't know you have diabetes, you cannot treat it. Therefore, you cannot prevent a complication such as DKA.
- People are losing their lives without being given a fighting chance.

Assessment

We know that people of all ages, races, and genders can develop Type 1 Diabetes and Diabetic Ketoacidosis. DKA is the leading cause of death in diabetics under the age of 24. We also know that blood glucose levels (and consequently, A1C levels) can be elevated before a person recognizes or even experiences symptoms.

For example, a normal blood glucose for a healthy person is 70-110 mg/dL. However, if a person is used to having a blood glucose level of 250 mg/dL, they would not feel symptoms of a high blood sugar. This person may not experience symptoms (needing to urinate more often, being more hungry than usual, and being more thirsty than usual) until their blood glucose levels are 300-400 mg/dL or higher. This puts them at great danger of developing DKA.

A1C (%)	x10.93 - 23.5	= mmol/mol
A1C (mmol/mol)	x0.0915 + 2.15	= %

Table 1 (above). Conversion of A1C as a percentage to mmol/mol. [Conversion of HbA1c values from % to mmol/mol \(soc-bdr.org\)](#)

A1C (%)	A1C (mmol/mol)	Est bg (mg/dL)
5.0	31.15	96.80
5.5	36.62	111.15
6.0	42.08	125.50
6.5	47.55	139.85
7	53.01	154.20
7.5	58.48	168.55
8	63.94	182.90
8.5	69.41	197.25
9	74.87	211.60
9.5	80.34	225.95
10	85.80	240.30

Table 2 (above). If you look at Figure 2, you will see that when diagnosed with Type 1 Diabetes, patients typically have an A1C much higher than is recommended. This figure also shows that those with DKA have a much higher A1C and estimated blood glucose at time of diagnosis. [Conversion of HbA1c values from % to mmol/mol \(soc-bdr.org\)](#)

What you need to know about A1C Testing:

- Also known as Hemoglobin A1C Test, Glycated Hemoglobin, or Glycosylated Hemoglobin
- Hemoglobin is a protein found in all red blood cells
- Shows what percentage of hemoglobin is coated in glucose (sugar) over approximately three months
- Can recheck every 90-120 days because that is the average lifespan of a red blood cell
- Often done by finger stick
- No need for fasting prior to test
- Get results within 10 minutes

Costs associated with DKA & A1C Tests:

- National bill for DKA in 2017 -- \$6.8 billion
- DKA represents more than \$1 of every \$4 spent on direct medical care for patients with Type 1 Diabetes
- DKA represents approximately \$1 of every \$2 on medical care for patients experiencing multiple occurrences of DKA
- Cost of hospitalization with DKA in 2017 -- \$30,836.19
- Cost of A1C Test -- \$19.10

	DKA patients in 2017	DKA cases per 10,000 admissions			P	Deaths among DKA patients	Deaths per 10,000 DKA patients admitted	P
		2003	2014	2017				
All cases	220,340	32.04	53.6	61.6		835	37.9	
Sex					<0.01			<0.01
Male	111,150 (50.4)	38.1	62.6	71.2		450 (53.9)	40.5	
Female	109,180 (49.6)	27.7	46.6	54.1		385 (46.1)	35.3	
Race					<0.01			<0.01
White	120,330 (56.5)	—	—	54.1		435 (53.7)	36.2	
Black	56,280 (26.4)	—	—	107.2		220 (27.2)	39.1	
Hispanic	26,205 (12.3)	—	—	61.2		95 (11.7)	36.3	
Age-group (years)					<0.01			<0.01
<1	55 (0.0)	0.2	0.14	0.13		—	—	
1-17	22,170 (10.1)	106.5	153.6	176.1		15 (1.8)	69.8	
18-44	117,540 (53.3)	67.65	117.9	137.2		175 (21.0)	14.9	
45-64	59,695 (27.1)	32.65	58.9	68.4		325 (38.9)	54.5	
65-84	19,150 (8.7)	6.54	13.67	18.7		235 (28.1)	122.7	
≥85	1,725 (0.8)	2.16	3.9	5.9		85 (10.2)	492.8	
Primary payer form					<0.01			<0.01
Medicare	45,970 (20.9)	12.5	27.1	31.7		390 (46.7)	84.9	
Medicaid	79,175 (36.0)	47.6	81.1	95.7		165 (19.8)	20.9	
Private insurance	61,025 (27.8)	32.3	49.9	58.4		150 (18.0)	24.6	

Data are n or n (%) unless otherwise indicated. Data for 2003 and 2014 from Desai et al. (1).

Figure 2. A breakdown of DKA prevalence in the United States by biological sex, race, age, and insurance. This shows us that DKA does not discriminate. A person of any age, race, or gender can have diabetes and may be a victim of DKA. [An Update on the Incidence and Burden of Diabetic Ketoacidosis in the U.S. | Diabetes Care \(diabetesjournals.org\)](#)

Recommendation

It is already recommended that school-aged children have a well child visit with their health care provider once a year.

At these visits, I would recommend that school-aged children get an A1C test to determine their risk for developing Type 1 Diabetes and/or Diabetic Ketoacidosis.

A1C tests can be done by a finger stick or blood draw. If a child is already due for blood work during their annual physical, they would be able to get this test done at the same time without an additional fingerstick or the need to give additional blood.

If the A1C comes back 6.5% or higher, additional testing would be needed to determine if a child has diabetes or DKA. If a child is not symptomatic or mildly symptomatic, a repeat A1C should be tested in 3 months. If a child is moderately symptomatic, a random glucose test should be done. If the blood sugar is 200 mg/dL or higher, a fasting blood glucose should be checked the next morning. If the fasting glucose is higher than 126 mg/dL, a diagnosis of diabetes is appropriate. If a child is severely symptomatic, they may need to be hospitalized for blood glucose testing and to determine if they are in DKA.

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