Hemoglobin A1c
The Key to Long Term Health In Diabetes

What is Hemoglobin A1c?
The hemoglobin A1c test, frequently abbreviated HbA1c is a simple lab test that shows your average blood sugar over the last two to three months. It's the best way to find out if your blood sugar is under control. All people with diabetes should have an HbA1c test at least twice a year.

How does it work?
Hemoglobin is an oxygen-carrying pigment-it's what makes red blood cells red. The hemoglobin A1c test measures the proportion of hemoglobin molecules in your red blood cells that have glucose attached to them (and thus are "glycated"). Once glycated, a hemoglobin molecule stays that way throughout the 3- to 4-month lifecycle of its red blood cell. Red blood cells are continually dying and being replaced, so at any given time they have a range of ages in your body. In a sense, your blood tells the history of your glucose level over the last few months. For example, if your levels were not in control three weeks ago, glycated hemoglobin will persist in the blood cells that were active at that time. If your blood sugar tends to go up at night, when you are less likely to self-monitor, your HbA1c test will indicate a higher average level of blood sugar than you found through self-monitoring.

How do I interpret the results?
The hemoglobin A1c goal for people diabetes is less than 7%. The findings of a major diabetes study, the Diabetes Control and Complications Trial (DCCT), showed that people who keep their HbA1c levels close to 7% have a much better chance of delaying or preventing complications that affect the eyes, kidneys, and nerves than people with an HbA1c at higher levels. The United Kingdom Prospective Diabetes Study (UKPDS), a 20-year study that involved more than 5000 people with Type 2 Diabetes, showed that intensive blood glucose control significantly reduces the risk of major diabetic eye disease and early kidney damage. In fact, at levels below 6%, the risk of these complications may be no different than the non-diabetic population! The study concluded that complications from diabetes should not be seen as a natural and expected outcome-good management of blood glucose and blood pressure can prevent or delay complications for many people.

A picture is worth a thousand words – what does it really mean
Your body makes every effort to lower you blood sugar when it is too high. One of the ways it does this is to allow sugar to attach to the cells of your body, thereby removing it from your circulation. While this might sound like a good idea, it’s actually the path to premature death.

When sugar attaches to the walls of your cells it is converted to sorbitol. This ultimately causes the cell to malfunction and die an early death. While your body can replenish destroyed cells, if too many are destroyed at once your body won’t be able to keep up with the damage and organ failure results. Think of it this way, your organs are like a forest. In every forest, trees die (body cells) and are replaced by new younger ones. When things are in balance, the rate of tree death equals new tree growth and the forest (your organs) remain healthy. Now, if loggers (diabetes) come into the forest and start cutting down trees rapidly, the new growth won’t keep up with the

loss and the forest (your organs) will die. Your body can keep up with a certain amount of cell death. This corresponds to an HbA1c of below 6%. Above this progressive organ failure develops**. The higher the HbA1c, the faster the destruction**. This is how blindness, kidney failure and nerve damage develop in diabetics. Even at HbA1c levels between 6-7% some slow progressive damage is occurring.

HbA1c Test Results (%) & Their Plasma Blood Glucose Equivalents (mg/dl)

HbA1c	**4.0**	**4.1**	**4.2**	**4.3**	**4.4**	**4.5**	**4.6**	**4.7**	**4.8**	**4.9**
Glucose	**65**	**69**	**72**	**76**	**79**	**83**	**86**	**90**	**93**	**97**
HbA1c	**5.0**	**5.1**	**5.2**	**5.3**	**5.4**	**5.5**	**5.6**	**5.7**	**5.8**	**5.9**
Glucose	**101**	**104**	**108**	**111**	**115**	**118**	**122**	**126**	**129**	**133**
HbA1c	**6.0**	**6.1**	**6.2**	**6.3**	**6.4**	**6.5**	**6.6**	**6.7**	**6.8**	**6.9**
Glucose	**136**	**140**	**143**	**147**	**151**	**154**	**158**	**161**	**165**	**168**
HbA1c	**7.0**	**7.1**	**7.2**	**7.3**	**7.4**	**7.5**	**7.6**	**7.7**	**7.8**	**7.9**
Glucose	**172**	**175**	**179**	**183**	**186**	**190**	**193**	**197**	**200**	**204**
HbA1c	**8.0**	**8.1**	**8.2**	**8.3**	**8.4**	**8.5**	**8.6**	**8.7**	**8.8**	**8.9**
Glucose	**207**	**211**	**215**	**218**	**222**	**225**	**229**	**232**	**236**	**240**
HbA1c	**9.0**	**9.1**	**9.2**	**9.3**	**9.4**	**9.5**	**9.6**	**9.7**	**9.8**	**9.9**
Glucose	**243**	**247**	**250**	**254**	**257**	**261**	**264**	**268**	**272**	**275**
HbA1c	**10.0**	**10.1**	**10.2**	**10.3**	**10.4**	**10.5**	**10.6**	**10.7**	**10.8**	**10.9**
Glucose	**279**	**282**	**286**	**289**	**293**	**297**	**300**	**304**	**307**	**311**
HbA1c	**11.0**	**11.1**	**11.2**	**11.3**	**11.4**	**11.5**	**11.6**	**11.7**	**11.8**	**11.9**
Glucose	**314**	**318**	**321**	**325**	**329**	**332**	**336**	**339**	**343**	**346**
HbA1c	**12.0**	**12.1**	**12.2**	**12.3**	**12.4**	**12.5**	**12.6**	**12.7**	**12.8**	**12.9**
Glucose	**350**	**353**	**357**	**361**	**364**	**368**	**371**	**375**	**378**	**382**
HbA1c	**13.0**	**13.1**	**13.2**	**13.3**	**13.4**	**13.5**	**13.6**	**13.7**	**13.8**	**13.9**
Glucose	**386**	**389**	**393**	**396**	**400**	**403**	**407**	**410**	**414**	**418**

Conversion: HbA1c = (Plasma Blood Glucose + 77.3) / 35.6; Plasma Blood Glucose = (HbA1c * 35.6) - 77.3

Source: Curt L. Rohlfing, BES, Hsiao-Mei Wiedmeyer, MS, Randie R. Little, PHD, Jack D. England, Alethea Tennill, MS and David E. Goldstein, MD "Defining the Relationship Between Plasma Glucose and HbA1c, Analysis of glucose profiles and HbA1c in the Diabetes Control and Complications Trial," *Diabetes Care* 25:275-278, 2002. Abstract