Insulin and disease

Centenarian studies

There are three major centenarian studies going on around the world. They are trying to find the variable that would confer longevity among this group of people who live to be 100 years old. Why do centenarians become centenarians? Why are they so lucky? Is it because they have low cholesterol, exercise a lot and live a healthy, clean life?

Well, the oldest person ever recorded was Jean Calumet of France who died last year at 122 years of age. She smoked all of her life and drank.

What researchers are finding from these major centenarian studies is that there is hardly anything in common among these people. They have high cholesterol and low cholesterol, some exercise and some don't, some smoke, some don't. Some are nasty as can be, some nice and calm and some are ornery.

But, they all have relatively low sugar for their age, and they all have low triglycerides for their age.

And, they all have relatively low insulin.

A Common Cause

Insulin is the common denominator in everything I've just talked about. They way to treat cardiovascular disease and the way I treated my stepfather, the way I treated the high risk cancer patient, and the osteoporosis and high blood pressure. The way to treat virtually all of the so-called chronic diseases of aging is to treat insulin itself.

The other major avenue of research in aging has to do with genetic studies of so-called lower organisms. We know the genetics involved. We've got the entire genes mapped out of several species of yeast and worms now. We think of life span as being fixed, sort of.

Humans tend to have an average life span of 76 years, and the maximum lifespan was this French lady at 122 years. In humans we feel this length of time is relatively fixed, but in lower forms of life it is very plastic. Lifespan is strictly a variable depending on the environment. Other species can live two weeks, two years or sometimes 20 years depending on what they want themselves to do, which depends very much on the environment.

If there is a lot of food around they are going to reproduce quickly and die quickly, if not they will just bide their time until conditions are better. We know now that the variability in lifespan is regulated by insulin.

Often it is thought that insulin's role is strictly to lower blood sugar. I once had a patient list off about eight drugs she was on and not even mention insulin. Insulin is not treated as a drug. In fact, in some places you don't even need a prescription, you can just get it over the counter, it's treated like candy.

Insulin is found in even single-celled organisms and has been around for several billion years. Its purpose, in some organisms, is to regulate lifespan. The way genetics works is that genes are not replaced, they are built upon. We have the same genes as everything that came before us--we just have more of them.

We have added books to our genetic library, but our base is the same. What we are finding is that we can use insulin to regulate lifespan too.

Aging is a Disease

If there is a single marker for lifespan, as they are finding in the centenarian studies, it is insulin, specifically insulin sensitivity.

How sensitive are your cells to insulin? When they are not sensitive, the insulin levels go up. Who has heard of the term insulin resistance?

Insulin resistance is the basis of all of the chronic diseases of aging, because the disease itself is actually aging.

We know now that aging is a disease. The other case studies that I mentioned, cardiovascular disease, osteoporosis, obesity, diabetes, cancer, all the so-called chronic diseases of aging and auto-immune diseases, those are symptoms.

If you have a cold and you go to the doctor, you have a runny nose. I did Ear, Nose and Throat (ENT) for 10 years so I know what the common treatment for that is, a decongestant. I can't tell you how many patients I saw who had been given Sudafed by their family doctors for a cold who then came to see me afterward because of a really bad sinus infection.

What happens when you treat the symptom of a runny nose from a cold and you take a decongestant? Well, it certainly decongests you by shutting off the mucus, but why do you have the mucus? It's because your body is trying to clean and wash out the membranes. What else is in mucus? Secretory IgA, a very strong antibody to kill the virus. If there is no mucus, there is no secretory IgA.

Decongestants also constrict blood vessels, the little capillaries, or arterioles, that go to those capillaries, and the cilia, the little hair-like projections that beat to push mucus along to create a stream. They get paralyzed because they don't have blood flow, so there is no more ciliary movement.

What happens if you dam a stream and create a pond?

In days you've got larvae growing, but if the stream is moving, you are fine. You need a constant stream of mucus to get rid of and prevent an infection. I am going into this in some detail because in almost all cases, if you treat a symptom you are going to make the disease worse. The symptom is there as your body's attempt to heal itself.

Now, the medical profession is continually segregating more and more symptoms into diseases--they call the symptoms diseases. Using ENT for example, a patient will walk out of the office with a diagnosis of Rhinitis, which is inflammation of the nose. Is there a reason why that patient has inflammation of the nose? I think so. Wouldn't that underlying cause be the disease as opposed to the descriptive term of Rhinitis or Pharyngitis?

Someone can have the same virus and have Rhinitis, Pharyngitis or Sinusitis. They can have all sorts of "itis's," which is a descriptive term for inflammation. That is what the code will be, and that is what the disease will be. So they treat what they think is the disease, but which actually is just a symptom.

The same thing happens with cholesterol. If you have high cholesterol it is called hypercholesterolemia. Hypercholesterolemia has become the code for the disease when it is only the symptom. So doctors treat that symptom, and what are they doing to the heart? Messing it up.

What you have to do if you are going to treat any disease is get to the root of the disease. If you keep pulling a dandelion out by its leaves, you are not going to get very far. But the problem is that we don't know what the root is.

The root is known in many other areas of science, but the problem is that medicine really isn't a science; it is a business (but I don't want to get into that, we could talk for hours).

You really need to look at the root of what is causing the problem. We can use that cold as a further example.

Why does that person have a cold?

If he saw the doctor, the doctor might tell him to take an antibiotic along with the decongestant. You see this all the time because the doctor wants to get rid of the patient. In almost all cases of an upper respiratory infection, it is a virus, and the antibiotic is going to do worse than nothing, because it is going to kill the bacterial flora in the gut and impair the immune system, making the immune system worse.

The patient might see someone else more knowledgeable who will say, "No, you caught a virus, don't do anything, go home and sleep, let your body heal itself." That's better. You might see someone else who would ask why you caught a virus without being out there trying to hunt for viruses with a net. We are breathing viruses every day; right now we are breathing viruses, cold viruses and rhinoviruses.

So why doesn't everybody catch a cold tomorrow?

The Chinese will tell you that it is because the milieu has to be right, if the Chinese were to quote the French. Your body has to be receptive to that virus--only if your immune system is depressed will it allow that virus to take hold.

So maybe a depressed immune system is the disease. You can be given a bunch of vitamin C because your immune system is depressed and it is likely that the person has a vitamin C deficiency. That's where most of us are at right now, where we would recommend a bunch of vitamin C to try to pick up the immune system.

But why is the vitamin C not working? Vitamin C is made in almost all living mammals except humans and a couple of other species. Vitamin C is made directly from glucose and actually has a similar structure; they compete for one another.

It has been known for many decades that sugar depresses the immune system. It was only in the 70s that they found out that vitamin C was needed by white blood cells so that they could phagocytize bacteria and viruses. White blood cells require a fifty times higher concentration, at least inside the cell as outside, so they have to accumulate vitamin C.

There is something called a phagocytic index, which tells you how rapidly a particular macrophage or lymphocyte can gobble up a virus, bacteria or cancer cell. In the 70s Linus Pauling knew that white blood cells needed a high dose of vitamin C and that is when he came up with his theory that you need high doses of vitamin C to combat the common cold.

But if we know that vitamin C and glucose have similar chemical structure, what happens when sugar levels go up? They compete for one another upon entering the cells. And the thing that mediates the entry of vitamin C into the cells is the same thing that mediates the entry of glucose into the cells. If there is more glucose around then less vitamin C will be allowed into the cell, and it doesn't take much glucose to have this effect. A blood sugar value of 120 reduces the phagocytic index 75 percent.

Here we are getting a little bit further down into the roots of disease. It doesn't matter what disease you are talking about, whether you are talking about a common cold or cardiovascular disease, osteoporosis or cancer, the root is always going to be at the molecular and cellular level, and I will tell you that insulin is going to have its hand in it, if not totally control it.

What is the purpose of insulin?

As I mentioned earlier, in some organisms it is to control their lifespan. What is the purpose of insulin in humans? Your doctor will say that it's to lower blood sugar, but I will tell you right now that that is a trivial side effect. Insulin's evolutionary purpose as is known right now, we are looking at other possibilities, is to store excess nutrients.

We come from a time of feast and famine when if we couldn't store the excess energy during times of feasting, we would not be here because all of our ancestors encountered famine. We are only here because our ancestors were able to store nutrients, which they were able to do because they were able to elevate their insulin in response to any elevation in energy that the organism encountered.

When your body notices that sugar is elevated, it is a sign that you've got more than you need; you're not burning it so it is accumulating in your blood. So insulin will be released to take that sugar and store it. How does it store it? Glycogen?

Your body stores very little glycogen at any one time. All the glycogen stored in your liver and muscle wouldn't last you through one active day. Once you fill up your glycogen stores that sugar is stored as saturated fat, 98 percent of which is palmitic acid.

So the idea of the medical profession recommending a high complex-carbohydrate, low-saturated-fat diet is an absolute oxymoron. A high-complex-carbohydrate diet is nothing but a high-glucose diet, or a high-sugar diet. Your body is just going to store it as saturated fat, and the body makes it into saturated fat quite readily.

Insulin's Other Roles

Insulin doesn't just store carbohydrates, by the way. Somebody mentioned that it is an anabolic hormone, and it absolutely is. Body builders are injecting themselves with insulin because it builds muscle and stores protein.

Magnesium

A less known fact is that insulin also stores magnesium. But if your cells become resistant to insulin, you can't store magnesium so you lose it through urination.

Intracellular magnesium relaxes muscles. What happens when you can't store magnesium because the cell is resistant? You lose magnesium and your blood vessels constrict.

This causes an increase in blood pressure and a reduction in energy since intracellular magnesium is required for all energy producing reactions that take place in the cell.

But most importantly, magnesium is also necessary for the action of insulin and the manufacture of insulin. When you raise your insulin, you lose magnesium, and the cells become even more insulin resistant. Blood vessels constrict and glucose and insulin can't get to the tissues, which makes them more insulin resistant, so the insulin levels go up and you lose more magnesium. This is the vicious cycle that begins even before you were born.

Insulin sensitivity starts to be determined the moment the sperm combines with the egg. If a pregnant woman eats a high-carbohydrate diet, which turns into sugar, animal studies have shown that the fetus will become more insulin resistant.

Worse yet, researchers have used sophisticated measurements and found that if that fetus happens to be a female, the eggs of that fetus are more insulin resistant. Does that mean it is genetic? No, you can be born with something and it doesn't mean that it is genetic. Diabetes is not a genetic disease as such. You can have a genetic predisposition, but it should be an extremely rare disease.

Sodium Retention: Congestive Heart Failure

We mentioned high blood pressure; if your magnesium levels go down or your blood vessels constrict you get high blood pressure. Insulin also causes the retention of sodium, which causes the retention of fluid, which causes high blood pressure and fluid retention: congestive heart failure.

One of the strongest stimulants of the sympathetic nervous system is a high level of insulin. What does all of this do to the heart? Not very good things.

There was a solid study done a couple of years ago that showed that heart attacks are two to three times more likely to happen after a high-carbohydrate meal and are specifically NOT likely after a high-fat meal.

Why is that?

Because the immediate effects of raising your blood sugar from a high-carbohydrate meal is a raise in insulin. This immediately triggers the sympathetic nervous system, which will cause arterial spasm, or constriction of the arteries. If you anyone is prone to a heart attack, this is when they are going to get it.

Blood Lipids

Insulin mediates blood lipids. For that patient mentioned earlier who had a triglyceride level of 2200, one of the easiest things we can do is lower triglyceride levels. It is so simple. There was just an article in the Journal of the American Medical Association (JAMA) saying that the medical profession doesn't know how to reduce triglycerides dietarily, that drugs still need to be used.

This is so ridiculous because you will find that it is the easiest thing to do. There is an almost direct correlation between triglyceride levels and insulin levels, though in some people more than others.

The gentleman who had a triglyceride level of 2200 while on all the drugs only had an insulin level of 14.7. That is only slightly elevated, but it doesn't take much in some people. All we had to do was get his insulin level down to 8 initially and then it went down to six and that got his triglycerides down to under 200.

The way you control blood lipids is by controlling insulin.

LDL cholesterol comes in several fractions, and it is the small, dense LDL that plays the largest role in initiating plaque, as it's the most oxidizable, and it’s the most able to actually fit through the small cracks in the endothelium. And this is the cholesterol that insulin actually raises the most. When I say insulin, I should say insulin resistance. It is insulin resistance that is causing this.

Cells become insulin resistant because they are trying to protect themselves from the toxic effects of high insulin. They down regulate their receptor activity and number of receptors so that they don't have to listen to that noxious stimuli all the time. It is like having this loud, disgusting music played and you want to turn the volume down.

You might think of insulin resistance as similar to sitting in a smelly room and pretty soon you don't smell it anymore because you get desensitized.

You can think about it, it’s not that you are not thinking about it anymore. But if you walk out of the room and then come back in, the smell is back, which means you get resensitized.

If your cells are exposed to insulin at all, they get a little bit more resistant to it. So the pancreas just puts out more insulin. I saw a patient today whose blood sugar was 102 and her insulin was 90! She wasn't sure if she was fasting or not, but I've seen other patients where their blood sugar was under 100 and their fasting insulin has been over 90.

That is a fasting insulin. I'm not sure how many people are familiar with seeing fasting insulins, but if I drank all the glucose I could possibly drink my insulin would never go above probably 40. So she was extremely insulin resistant.

What was happening was that she was controlling her blood sugar. Statistically she was not diabetic or even impaired glucose tolerant. Her glucose is supposedly totally normal. But her cells aren't listening to insulin; she just has an exceptionally strong pancreas.

Her islet cells that produce insulin are extremely strong and are able to compensate for that insulin resistance by producing thirty times more insulin than what my fasting insulin is. And just by mass action her pancreas is yelling so loud that her cells are able to listen, but they are not going to listen forever. Her pancreas is not going to be able keep up that production forever.

Once her production of insulin starts slowing down, or her resistance goes up any more, then her blood sugar goes up and she becomes a diabetic. For many years, decades before that, her insulin levels have been elevated but have never been checked.

That insulin resistance is associated with the hyperinsulinemia that produces all of the so-called chronic diseases of aging, or at least contributes to them. As far as we know in many venues of science, this is the main cause of aging in virtually all life.

Insulin is that important.

So controlling insulin sensitivity is extremely important.

Insulin and Cardiovascular Disease

Insulin is a so-called mytogenic hormone. It stimulates cell proliferation and cell division. If all of the cells were to become resistant to insulin we wouldn't have that much of a problem, but all of the cells don't become resistant.

Some cells are incapable of becoming very resistant. The liver becomes resistant first, then the muscle tissue, then the fat. When the liver becomes resistant it suppresses the production of sugar.

The sugar floating around in your body at any one time is the result of two things, the sugar that you have eaten and how much sugar your liver has made. When you wake up in the morning it is more of a reflection of how much sugar your liver has made. If your liver is listening to insulin properly it won't make much sugar in the middle of the night. If your liver is resistant, those brakes are lifted and your liver starts making a bunch of sugar, so you wake up with a bunch of sugar.

The next tissue to become resistant is the muscle tissue. What is the action of insulin in muscles? It allows your muscles to burn sugar for one thing. So if your muscles become resistant to insulin it can't burn that sugar that was just manufactured by the liver. So the liver is producing too much, the muscles can't burn it, and this raises your blood sugar.

Well the fat cells become resistant, but not for a while as it takes them longer. So for a while your fat cells retain their sensitivity.

What is the action of insulin on your fat cells? To store that fat. It takes sugar and it stores it as fat. So until your fat cells become resistant you get fat. As people become more and more insulin resistant, their weight goes up and up.

But eventually they plateau. They might plateau at 300 pounds, 220 pounds, 150 pounds, but they will eventually plateau as the fat cells protect themselves and become insulin resistant.

As all these major tissues, your liver, muscles and fat, become resistant your pancreas is putting out more insulin to compensate, so you are hyperinsulinemic and you've got insulin floating around all the time, 90 units or more.

But there are certain tissues that aren't becoming resistant such as your endothelium; the lining of the arteries doesn’t become resistant very readily, so all that insulin is affecting the lining of your arteries.

If you drip insulin into the femoral artery of a dog, there was a Dr. Cruz who did this in the early 70s by accident, the artery will become almost totally occluded with plaque after about three months.

The contra lateral side was totally clear, just contact of insulin in the artery caused it to fill up with plaque. That has been known since the 70s and has been repeated in chickens and in dogs; it is really a well-known fact that insulin floating around in the blood causes a plaque build-up. They didn't know why, but we know that insulin causes endothelial proliferation. This is the first step as it causes a tumor, an endothelial tumor.

Insulin also causes the blood to clot too readily and causes the conversion of macrophages into foam cells, which are the cells that accumulate the fatty deposits. Every step of the way, insulin is causing cardiovascular disease. It fills the body with plaque, it constricts the arteries, it stimulates the sympathetic nervous system, it increases platelet adhesiveness and coaguability of the blood.

Insulin is a part of any known cause of cardiovascular disease. It influences nitric oxide synthase; you produce less nitric oxide in the endothelium. We know that helps mediate vasodilatation and constriction, i.e. angina.

I mentioned that insulin increases cellular proliferation, what does that do to cancer? It increases it. And there are some pretty strong studies that show that one of the strongest correlations to breast and colon cancers are levels of insulin.

Hyperinsulinemia causes the excretion of magnesium in the urine. What other big mineral does it cause the excretion of? Calcium. People walking around with hyperinsulinemia can take all the calcium they want by mouth and it's all going to go out in their urine.

Insulin-like Growth Factors (IgFs)

Insulin is one of the first hormones that any organism ever developed, and as I mentioned in genetics, things are built upon what was there before. So all the other hormones we have in our body were actually built upon insulin. In other words, insulin controls growth hormone.

The pituitary produces growth hormone, and then it goes to the liver and the liver produces what are called IgF 1 thru 4, there are probably more. What does IgF stand for? Insulin-like growth factor. They are the active ingredients. Growth hormone has some small effects on its own, but the major growth factors are the IgFs that then circulate throughout the body.

Why are they called IgF's or insulin-like growth factors? Because they have an almost identical molecular structure to insulin. When I said that insulin promotes cellular proliferation, it is because it cross-reacts with IgF receptors. So somewhere in the evolutionary tree, IgFs diverged from insulin. Insulin can work very well by itself; it doesn't need growth hormone, but growth hormone can't do anything without insulin.

Thyroid

The thyroid produces mostly T4. T4 goes to mostly to the liver and is converted to T3. We are getting the idea that insulin controls a lot of what goes on in the liver, and the liver is the primary organ that becomes insulin resistant.

When the liver can no longer listen to insulin, you can't convert T4 to T3 very well. In people who are hyperinsulinemic with a thyroid hormone that comes back totally normal, it is important to measure their T3. Just as often as not, their free T3 will be low, but get their insulin down and it comes back up.

Insulin helps control sex hormones estrogen, progesterone, and testosterone as well. Insulin helps control the manufacture of cholesterol and where do all the sex hormones come from? All the stearic hormones are originally derived from cholesterol, so that's one way. Dr Nestler from the University of Virginia who has spent the last eight years doing multiple studies to show that DHEA levels are directly correlated with insulin levels, or I should say insulin resistance.

The more insulin resistant you are, the lower your DHEA levels. He firmly believes, and has a lot of studies to back it up, that the decline in DHEA is strictly due to the increase in insulin resistance with age. If you reduce the insulin resistance, the DHEA rises.

And how are these sex hormones carried around the body? Something called sex hormone binding globulins. The more that is bound, the less free, active hormone you have. Sex hormone binding globulin is controlled by what? Insulin. There is not a hormone in the body that insulin doesn't affect, if not directly control.

Osteoporosis

You take a bunch of calcium. The medical profession just assumes that it has a homing device and it knows to go into your bone. What happens if you have high levels of insulin and you take a bunch of calcium? Number one, most of it is just going to go out in your urine. You would be lucky if that were the case because that part that doesn't does not have the instructions to go to your bone because the anabolic hormones aren't working.

This is first of all because of insulin, then because of the IGFs from growth hormone, also testosterone and progesterone. They are all controlled by insulin and when they are insulin resistant they can't listen to any of the anabolic hormones. Your body doesn't know how to build tissue anymore so while some of the calcium may end up in your bone, a good deal of it will end up everywhere else--leading to metastatic calcifications, including in your arteries.

Diseases are a result of a lack of communication. There are certain things that your cells need to be healthy. If you learn nothing else today, you should know that everything is at the cellular and molecular level and we are nothing but a community of cells. We are a commune of cells; a metropolis of cells that have been given instructions to cooperate.

When you have a large number of cells, like we have ten trillion or so, there must be proper communication so that there will be proper division of labor. You can take most any cell in your body, put it in a petrie dish and under the right conditions it can live all on its own. They each have a life of their own.

You can manipulate the genetics of a cell, and we've now made a blood cell into a nerve cell. Pretty soon we are going to be able to take any cell we want and make it into any other cell, because every cell in your body has the identical genetics, all derived from that egg and that sperm that came together. Why is one cell different from another? Because they are reading different parts of the same library.

You can influence which part of that genetic library that every cell reads by the environment of that cell. The environment of that cell is going to be very much dictated by hormones and what you eat. Eating is just internalizing the external environment. That is what you have circulation for, to bring that external environment to each and every one of those cells that is inside of you.

I hope that by now you have gotten the idea that high insulin resistance is not very good for you. So now let's talk about what causes insulin resistance.

What Causes Insulin Resistance?

Any time your cell is exposed to insulin it is going to become more insulin resistant. That is inevitable; we cannot stop that, but the rate we can control. An inevitable sign of aging is an increase in insulin resistance.

That rate is the variable. If you can slow down that rate, you can become a centenarian, a healthy one. You can slow the rate of aging. Not even just the rate of disease, but the actual rate of aging itself can be modulated by insulin. We talked about some of the lower animals and there is some pretty good evidence that even in humans we still retain the capacity to control lifespan at least partially. We should be living to be 130 to 140 years old routinely.

Let's talk about carbohydrates. We talk about simple and complex carbohydrates, this is totally irrelevant, it means absolutely nothing. Carbohydrates are fiber or non-fiber. Few things in life are as clear-cut as this. Fiber is good for you, and a non-fiber carb is bad for you. You can bank on that.

There is not a whole lot of middle ground. If you have a carbohydrate that is not a fiber it is going to be turned into a sugar, whether it be glucose or not. It may be fructose and won't necessarily raise your blood glucose. Fructose is worse for you then glucose so if you just go by blood sugar, which is just glucose, it doesn't mean that you are not raising your blood fructose, or your blood galactose which is the other half of lactose.

All of those sugars are as bad or worse for you than glucose. You can't just go by so-called blood sugar because we just don't measure blood fructose or blood galactose, but they are all bad for you.

Why are they bad? Well number one we know that it provokes insulin and every time you provoke insulin it exposes your body to more insulin and just like walking in a smelly room your body is going to become more resistant to insulin.

So every time you have a surge of sugar and you have a surge of insulin, you get more and more insulin resistant and risk all of the problems we've talked about.

Harmful Effects of Sugar

We know sugar increases insulin, but even by itself sugar is bad for you. You can divide aging into basically two major categories, one being genetic causes of aging. Cells have a limited capacity to divide, but normally we don’t reach that capacity. The more rapidly you make cells divide, the more rapidly they age.

One of the effects of insulin is to stimulate cellular proliferation and division. So we know that it increases the rate of aging of a cell population by that alone. But to get to the other category, our cells accumulate damage with age and we can’t help that.

When I say aging, I really am talking about something called senescence, or the damage associated with aging, but the common usage is the word aging. I can’t prevent you from being a day older tomorrow; that is aging. When we talk about aging we normally think about the damage that is associated with that day.

We have accumulated more damage during that day, which is called senescence. What causes that damage? There is often an example of test tubes in a laboratory. You don't think of test tubes as aging, yet if you mark test tubes with a little red dot and counted the number of test tubes there were at the end of the year with a little red dot left, there would hardly be any. Why? Because they have encountered damage; they've broken, so even though there is not aging they do have immortality rates. Aging is an increase in the rate of mortality.

In humans, the rate of mortality doubles every eight years.

That is really how you gauge the rate of aging. We found in animal studies that the rate of aging can be largely controlled by insulin, but the damage that accumulates during that aging is caused largely by sugar.

The two major causes of accumulated damage are oxygenation and glycation.

Oxidation

Whenever oxygen combines with something, it oxidizes. Oxygen is a very poisonous substance. Throughout most of the history of life on Earth there was no oxygen. Organisms had to develop very specific mechanisms of dealing with high levels of oxygen before there could ever be life with oxygen.

So we evolved very quickly, as plants arose and developed a very easy means of acquiring energy, they could just lay back and catch rays, they dealt with that oxygen with the carbon dioxide by spitting it out, so the oxygen in the atmosphere increased. All the other organisms then had to cope with that toxic oxygen. If they didn't have ways of dealing with it, they perished.

One of the earliest ways of dealing with all that oxygen was for the cells to huddle together so that at least the interior cells wouldn't be exposed as much. So, multi-celled organisms arose after oxygen did. Of course, with that came the need for cellular communication.

Glycation

Everyone knows that oxygen causes damage, but unfortunately the press has not been as kind to publicize glycation. Glycation is the same as oxidation except substitute the word glucose. When you glycate something you combine it with glucose. Glucose combines with anything else really; it's a very sticky molecule.

Just take sugar on your fingers. It's very sticky. It sticks specifically to proteins. So the glycation of proteins is extremely important. If it sticks around a while it produces what are called advanced glycated end products (A.G.E.s).

That acronym is not an accident. If you can turn over, or re-manufacture, the protein that's good, and it increases the rate of protein turnover if you are lucky. Glycation damages the protein to the extent that white blood cells will come around and gobble it up and get rid of it, so then you have to produce more, putting more of a strain on your ability to repair and maintain your body.

That is the best alternative; the worst alternative is when those proteins get glycated that can't turn over very rapidly, like collagen, or like a protein that makes up nerve tissue. These proteins cannot be gotten rid of, so the protein accumulates, and the A.G.E.s accumulate and continue to damage.

That includes the collagen that makes up the matrix of your arteries. A.G.E.s are so bad that we know that there are receptors for A.G.E.s, hundreds of receptors, for every macrophage. They are designed to try to get rid of those A.G.E.s, but what happens when a macrophage combines with an A.G.E. product?

It sets up an inflammatory reaction. You eat a diet that promotes elevated glucose, and you produce increased glycated proteins and A.G.E.s, you are increasing your rate of inflammation of any kind. You get down to the roots, including arthritis and headaches.

When you start putting people on a diet to remedy all of this, patients who used to have horrible headaches or shoulder pains don't have them anymore.

Glycated proteins make a person very pro-inflammatory, so we age and, at least partially, accumulate damage by oxidation. One of the most important types of tissues that oxygenate is the fatty component, the lipid, especially the poly-unsaturated fatty acids, and they turn rancid and glycate.

The term for glycation in the food industry is carmelization. It is used all the time to make caramel. So the way we age is that we turn rancid and we carmelize. It's very true, and that is what gets most of us. If that doesn't get us, then the genetic causes of aging will, because every cell in your body has genetic programs to commit suicide. There are various theories for why this is, one being that if they didn't, virtually every cell in your body would eventually turn cancerous.

Whether those so-called applopatic genes developed as a means to prevent cancer or not is open to speculation, but it is a good theory. We know that all cancer cells have turned off the mechanisms for applotosis, which is the medical term for chemical suicide. So we know that it plays a role.

Diet

Diet really becomes pretty simple. Carbohydrates we started talking about. You've got fiber and non-fiber and that's really clear-cut. Fiber is good, non-fiber is bad. Fibrous carbs like vegetables such as broccoli are great. What about a potato? A potato is a big lump of sugar. That's all it is. You chew a potato, what are you swallowing? Glucose. You may not remember, but you learned that in eighth grade, but the medical profession still hasn't learned that.

The Major Salivary Enzyme

The major salivary enzyme is amylase. It is used to break down amylase, which is just a tree of glucose molecules. What is a slice of bread? A slice of sugar. Does it have anything else good about it? Virtually nothing.

Somebody e-mailed me who had decided to do a little research. And there are over 50 essential nutrients to the human body. You know you need to breathe oxygen. It gives us life and it kills us. It’s the same thing with glucose. Certain tissues require some glucose. We wouldn't be here if there were no glucose, it gives us life and it kills us. We know that we have essential amino acids and we have essential fatty acids. They are essential for life, we better take them in as building blocks or we die.

So this person took all the essential nutrients that are known to man and plugged them into a computer data bank, and he asked the computer what are the top 10 foods that contain each nutrient that is required by the human body. Each of the 53 or 54, depending on who you talk to, essential nutrients that there are were plugged in, and did you know that grains did not come up in the top ten on any one?

What is the minimum daily requirement for carbohydrates?

ZERO.

The food pyramid is based on a totally irrelevant nutrient.

Why do we eat?

One reason we eat is for energy. That's half of the reason. The other essential reason (Not just for fun! Fun is a good one, but you won't have much fun if you eat too much) is to replace tissue and gather up building blocks for maintenance and repair.

Those are the two essential reasons that we need to eat. We need the building blocks and we need fuel, not the least of which is to have energy to obtain those building blocks and then to have energy to fuel those chemical reactions to use those building blocks.

The building blocks that are needed are proteins and fatty acids, not much in the way of carbohydrates. You can get all the carbohydrates you need from proteins and fats.

There are two kinds of fuel that your body can use with minor exceptions, sugar and fat. We mentioned earlier that the body is going to store excess energy as fat. Why does the body store it as fat? Because that is the body's desired fuel that will sustain you and allow you to live. The body can store only a little bit of sugar.

In an active day you would die if you had to rely 100 percent on sugar.

Why doesn't your body store more sugar if it is so needed? Sugar was never meant to be your primary energy source, it is meant to be your body's turbo charger.

Everybody right here, right now should be burning almost all fat with minor exceptions. Your brain will burn sugar, though it doesn't have to, by burning by-products of fat metabolism called ketones. That is what it has to burn when you fast for any length of time. It has been shown that if your brain was really good at burning ketones from fat that you can get enough sugar from eating 100 percent fat.

You can make a little bit of sugar out of the glycerol molecule of fat. Take two glycerol molecules and you have a molecule of glucose. Two triglycerides will give you a molecule of glucose. The brain can actually exist without a whole lot of sugar, contrary to popular belief. Glucose was meant to be fuel used in an emergency situation if you had to expend an extreme amount of energy, such as running from a saber tooth tiger.

It is a turbo charger, a very hot burning fuel. If you need fuel over and above what fat can provide, you will dig into your glycogen and burn sugar. But your primary energy source as we are here right now should be almost all fat.

What happens if you eat sugar?

Your body's main way of getting rid of sugar, because it is toxic, is to burn it. That which your body can't burn your body will get rid of by storing it as glycogen, and when that gets filled up your body stores it as fat. If you eat sugar your body will burn it and you stop burning fat.

Another major effect of insulin on fat is it prevents you from burning it. What happens when you are insulin resistant and you have a bunch of insulin floating around all the time? You wake up in the morning with an insulin level of 90.

And how much fat are you going to be burning? Virtually none. What are you going to burn if not fat? Sugar coming from your muscle. So you have all this fat that you've accumulated over the years that your body is very adept at adding to. Every time you have any excess energy you are going to store it as fat, but if you don't eat, where you would otherwise be able to burn it, you cannot. You will still burn sugar because that is all your body is capable of burning anymore.

Where does your body get the sugar?

Well you don't store much of it in the form of sugar so it will take it from your muscle. That's your body's major depot of sugar. You just eat up your muscle tissue. Any time you have excess you store it as fat and any time you are deficient you burn up your muscle.

So where do carbohydrates come in?

They don't. There is no essential need for carbohydrates. Why are we all eating carbohydrates? To keep the rate of aging up, we don't want to pay social security to everyone.

I didn't say you can't have any carbs, I said fiber is good. Vegetables are great; I want you to eat vegetables. The practical aspect of it is that you are going to get carbs, but there is no essential need. The traditional Eskimo subsists on almost no vegetables at all, but they get their vitamins from organ meats and things like eyeball, which are a delicacy, or were.

So, you don't really need it, but sure, vegetables are good for you and you should eat them. They are part of the diet that I would recommend, and that is where you'll get your vitamin C. I recommend Vitamin C supplements, I don't have anything against taking supplements, I use a lot of them.

Fruit is a mixed blessing. You can divide food on a continuum. There are some foods that I really can't say anything good about and the other end of the spectrum are foods that are totally essential, like omega-3 fatty acids for instance, which most people are very deficient in, and even those have a detriment because they are highly oxidizable, so you had better have the antioxidant capacity. So if you are going to supplement with cod liver oil you should supplement with Vitamin E too or it will actually do you more harm than good.

Most foods fall somewhere in the middle of the continuum. For example, with strawberries you are going to get a lot of sugar, but you are also going to get a food that is the second or third highest in antioxidant potential of any food known, the first being garlic, the second either being strawberries or blueberries. I will let some patients put strawberries in, let's say, a protein smoothie in the morning. But if they are a hard core diabetic, strawberries are out.

It doesn't take much, any type I diabetic who is not producing any insulin can tell you what foods do to their blood sugar. It doesn't take much. What is very surprising to these people once they really measure is what little carbohydrate it takes to cause your blood sugar to skyrocket.

One saltine cracker will take the blood sugar to over 100, and in many people it will cause the blood sugar to go to 150 for a variety of reasons, not just the sugar in it.

We only have one hormone that lowers sugar, and that's insulin. Its primary use was never to lower sugar. We've got a bunch of hormones that raise sugar, cortisone being one and growth hormone another, and epinephrine and glucagon.

Our primary evolutionary problem was to raise blood sugar to give your brain and your nerves enough as well as, primarily, red blood cells, which require glucose. So from an evolutionary sense if something is important we have redundant mechanisms. The fact that we only have one hormone that lowers sugar tells us that it was never something important in the past.

So you get this rush of sugar and your body panics, your pancreas panics and it stores, when it is healthy, insulin in these granules that is ready to be released. It lets these granules out and it pours out a bunch of insulin to deal with this onslaught of sugar and what does that do?

Well the pancreas generally overcompensates, and it causes your sugar to go down, and just as I mentioned, you have got a bunch of hormones then to raise your blood sugar, they are then released, including cortisone. The biggest stress on your body is eating a big glucose load.

Then epinephrine is released too, so it makes you nervous, and it also stimulates your brain to crave carbohydrates, to seek out some sugar. So you are craving carbohydrates, so you eat a bowl of cheerios or a big piece of fruit so that after your sugar goes low, and with the hormone release, your sugars go way up again, which causes your pancreas to release more insulin and then it goes way down.

Now you are in to this sinusoidal wave of blood sugar, which causes insulin resistance. Your body can't stand that for very long so you are constantly putting out cortisone.

Insulin Resistance

We hear a lot about insulin resistance, but stop and think a little bit, do you think our cells only become resistant to insulin? The more hormones your cells are exposed to, the more resistant they will become to almost any hormone. Certain cells more than others though, so there is a discrepancy. The problem with hormone resistance is that there is a dichotomy of resistance--all the cells don't become resistant at the same time.

And different hormones affect different cells, and the rate of hormone is different among different cells and this causes lots of problems with the feedback mechanisms. We know that one of the major areas of the body that becomes resistant to many feedback loops is the hypothalamus.

Hypothalamic resistance to feedback signals plays a very important role in aging and insulin resistance because the hypothalamus has receptors for insulin too. I mentioned that insulin stimulates sympathetic nervous system; it does so through the hypothalamus, which is the center of it all.

Can Insulin Sensitivity Be Restored?

Insulin sensitivity can be restored to its original state, well, perhaps not to its original state, but you can restore it to the state of about a 10-year-old.

One of my first experiences with this, I had a patient who literally had sugars over 300. He was taking over 200 units of insulin, and he was a bad cardiovascular patient, so I put him on a low-carbohydrate diet.

He was an exceptional case, after one month to six weeks he was totally off of insulin. He had been on over 200 units of insulin for 25 years. He was so insulin resistant, but one thing good about it is that when you lower that insulin, that insulin is having such little effect on him that you can massively lower the insulin and its not going to have much of an effect on his blood sugar. Two hundred units of insulin is not going to lower your sugar any more that 300 mg/deciliter.

You know that the insulin is not doing much, so we could rapidly take him off the insulin and he was actually cured of his diabetes in a matter of weeks. He became sensitive enough and was still producing a lot of insulin on his own. Then we were able to measure his own insulin. It was still elevated, and it took a long time, maybe six months or longer, to bring that insulin down.

It will probably never get to the point of the sensitivity of a 10-year-old, but yes, your number of insulin receptors increases and the activity of the receptors, the chemical reactions that occur beyond the receptor, occur more efficiently.

How to Increase Insulin Sensitivity

You can increase sensitivity by diet, which is one of the major reasons to take omega-3 oils. We think of circulation as that which flows through arteries and veins, and that is not a minor part of our circulation, but it might not even be the major part. The major part of circulation is what goes in and out of the cell.

The cell membrane is a fluid mosaic. The major part of our circulation is determined by what goes in and out. It doesn't make any difference what gets to that cell if it can't get into the cell. We know that one of the major ways that you can affect cellular circulation is by modulating the kinds of fatty acids that you eat. So you can increase receptor sensitivity by increasing the fluidity of the cell membrane, which means increasing the omega-3 content, because most people are very deficient.

They say that you are what you eat and that mostly pertains to fat because the fatty acids that you eat are the ones that will generally get incorporated into the cell membrane. The cell membranes are going to be a reflection of your dietary fat and that will determine the fluidity of your cell membrane. You can actually make them over fluid.

If you eat too much and you incorporate too many omega-3 oils then they will become highly oxidizable (so you have to eat Vitamin E and monounsaturates as well).

There was an interesting study pertaining to this where they had a breed of rat that was genetically susceptible to cancer. Researchers fed them a high-omega-3 diet, plus iron, without any extra Vitamin E and they were able to almost shrink down the tumors to nothing because tumors are rapidly dividing. This is like a form of chemotherapy, and the membranes that were being formed in these tumor cells were very high in omega-3 oils. The iron acted as a catalyst for that oxidation, and the cells were exploding from getting oxidized so rapidly. So omega-3 oils can be a double-edged sword. In fact, most food is a double-edged sword.

Like oxygen and glucose, food keeps us alive and kills us. Eating is the biggest stress we put on our body and that is why in caloric restriction experiments you can extend life as long as you maintain nutrition. This is the only proven way of actually reducing the rate of aging, not just the mortality rate but the actual rate of aging.

It has actually been shown by quite a number of papers that resistance training for insulin resistance is better than aerobic training. There are a variety of other reasons too. Resistance training is referring to muscular exercises. If you just do a bicep curl, you immediately increase the insulin sensitivity of your bicep. Just by exercising you are increasing the blood flow to that muscle, and one of the factors that determines insulin sensitivity is how blood can get there. It has been shown conclusively that resistance training will increase insulin sensitivity.

Protein’s Role

Now, back to the macronutrients. As I said before, you don't want very much in the way of non-fiber carbs, but fiber carbs are great. You are going to get some non-fiber carbs though. Even if you just eat broccoli you are going to get some non-fiber carbs. That is OK since for the most part you are getting something that is really pretty good for you.

Protein is an essential nutrient. You want to use it as a building block because your body requires protein to repair damage and replenish enzymes. All of the encoded instructions from your DNA are to encode for proteins. That is all the DNA encodes for. You need protein, but you want to use it as a building block. I don't believe in going over and above the protein that you need to use for maintenance, repair and building blocks.

I don't think you should be using protein as a primary fuel source, though your body can use protein very well as a fuel source. It is good to lose weight while using it as a fuel source because it is an inefficient fuel source. Protein is very thermogenic, meaning it produces a lot of heat, which means that less of it is going into stored energy and more is being dissipated--just like throwing a log into a fireplace. Your primary fuel should be coming from fat.

You can calculate the amount of protein a person requires or at least estimate it by their activity level. The book "Protein Power" actually went very well in to this. You have to calculate how much protein is required by activity level and lean body mass. There is still some gray area as to how many grams per kilogram of lean body mass, depending on the activity that person requires.

It can range anywhere from one to two grams of protein per kilogram of lean body mass, maybe even a little bit higher if someone is really active. You don't want to go under that amount for very long. It is better to go over than to go under that amount for very long.

If you can cure a diabetic of diabetes, you can do the same thing to a so-called non-diabetic person and still improve that person. I want to improve my insulin sensitivity just as much as I do my diabetics because insulin sensitivity is going to determine, for the most part, how long you are going to live and how healthy you are going to be. It determines the rate of aging more so than anything else we know right now.

Supplements

What about supplements such as Chromium?

All of my diabetics go on 1,000 mcg of chromium, some a little bit more if they are really big people. The amount is usually 500 mcg for a non-diabetic, though it depends on their insulin levels.

I use a lot of supplements. What you really want to do is to try to convert the person back into being an efficient burner of fat. Earlier we talked about when you are very insulin resistant and you are waking up in the morning with an insulin level that is elevated, you cannot burn fat but instead are burning sugar.

One of the reasons that sugar goes up so high is because that is what your cell is needing to burn, but if it is so insulin resistant it requires a blood sugar of 300 so that just by mass action some can get into the cell and be used as fuel. If you eliminate that need to burn sugar, you don't need such high levels of sugar even if you are insulin resistant.

You want to increase the ability of the cells in the body to burn fat and make that glucose burner into a fat burner. You want to make a gasoline-burning car into a diesel-burning car. Did anyone ever look at the molecular structure of diesel fuel in your spare time? It looks almost identical to a fatty acid. There is a company right now that can tell you how to alter vegetable oil to use in your Mercedes. It's just a matter of thinning it out a little bit. It is a very efficient fuel.

Triglycerides

You can look at other variables that will give you some idea too, such as triglycerides. If people are very sensitive to high levels of insulin, they come in with insulin levels of 14 and they have triglycerides of 1000. You would treat them just as you would if they had an insulin level of 50. It gives you some idea of the effect of the hyperinsulinemia on the body.

You can use triglycerides as a gauge, which I often do. The objective is to try to get the insulin level just as low as you possibly can. There is no limit. They classify diabetes now as a fasting blood sugar of 126 or higher. A few months ago it might have been 140. It is just an arbitrary number. Does that mean that someone with a blood sugar of 125 is non-diabetic and fine? If you have a blood sugar of 125 you are worse than if you had a blood sugar of 124--same with insulin. If you have a fasting insulin of 10, you are worse off than if you had an insulin of 9. You want to get it just as low as you can.

Does This Apply to Athletes?

With athletes, think about the effect of carbohydrate loading before an event. What happens if you eat a bowl of pasta before you have to run a marathon? What does that bowl of pasta do? It raises your insulin. What is the instruction of insulin to your body?

To store energy and not burn it. I see a fair amount of athletes and this is what I tell them, you want everybody, athletes especially, to be able to burn fat efficiently. So when they train, they are on a very low-carbohydrate diet. The night before their event, they can stock up on sugar and load their glycogen if they would like.

They are not going to become insulin resistant in one day. Just enough to make sure, it has been shown that if you eat a big carbohydrate meal that you will increase your glycogen stores, that is true and that is what you want. But you don't want to train that way because if you do you won't be able to burn fat, you can only burn sugar, and if you are an athlete you want to be able to burn both.

Few people have problems burning sugar if they are athletes, but they have lots of problems burning fat, so they hit the wall. And for certain events, like sprinting, it is less important, truthfully for their health it is very important to be able to burn fat, but a sprinter will go right into burning sugar. If you are a 50-yard dash person, whether you can burn fat or not is not going to make a huge difference in your final performance.

Beyond your athletic years, if you don't want to become a diabetic, and don't want to die of heart disease and don't want to age quickly, it is certainly not going to do you any harm to be able to burn fat efficiently in addition to sugar.

Vanadyl Sulfate

Vanadyl Sulfate is an insulin mimic, so that it can basically do what insulin does by a different mechanism. If it went through the same insulin receptors, then it wouldn't offer any benefit, but it doesn't, it actually has been shown to go through a different mechanism to lower blood sugar, so it spares insulin and then it can help improve insulin sensitivity. To really lower a person’s insulin, I give 25 mg 3 times a day temporarily.

Glutamine Powder

I also put people on glutamine powder. Glutamine can act as a brain fuel, so it helps eliminate carbohydrate cravings while they are in that transition period. I like to give it to them at night, and I tell them to use it whenever they feel they are craving carbohydrates. They can put several grams into a little water and drink it and it helps eliminate carbohydrate cravings between meals.

A high-protein diet will increase an acid load in the body, but not necessarily a high-fat diet. Vegetables and greens are alkalinizing, so if you are eating a lot of vegetables along with your protein it equalizes the acidifying effect of the protein. I don't recommend a high-protein diet; I recommend an adequate protein diet.

Fat in the Diet

I think you should be using fat as your primary energy source, and fat is kind of neutral when it comes to acidifying or alkalinizing. In general, over 50 percent of the calories should come from fat, but not from saturated fat. When we get to fat, the carbohydrates are clear-cut. No scientist out there is really going to dispute what I've said about carbohydrates.

There is the science behind it. You can't dispute it. There is a little bit of a dispute as to how much protein a person requires. When you get to fat, there is a big gray area as to which fat a person requires. We just have one name for fat, we call it fat or oil. Eskimos have dozens of names for snow and east Indians have dozens of names for curry. We should have dozens of names for fat because they do many different things. And how much of which fat to take is still open to a lot of investigation and controversy.

My take on fat is that if I am treating a patient who is generally hyperinsulinemic or overweight, I want them on a low-saturated-fat diet, because most of the fat they are storing is saturated fat. When their insulin goes down and they are able to start releasing triglycerides to burn as fat, what they are going to be releasing mostly is saturated fat. So you don't want them to take anymore orally. There is a ration of fatty acids that is desirable if you took them from the moment you were born, but we don't. We are dealing with an imbalance here that we are trying to correct as rapidly as we can.

Most of us here have enough saturated fat to last the rest of our life. Truthfully. Your cell membranes require a balance of saturated and poly-unsaturated fat, and it is that balance that determines the fluidity. As I mentioned, your cells can become over-fluid if they don't have any saturated fat.

Saturated fat is a hard fat. We can get the fats from foods to come mostly from nuts. Nuts are a great food because it is mostly mono-unsaturated. Your primary energy source ideally would come mostly from mono-unsaturated fat. It's a good compromise. It is not an essential fat, but it is a more fluid fat. Your body can utilize it very well as an energy source.

Grain-Fed Animals are not Healthy

Animal proteins are good for you, but not the ones that are fed grains.

Grain-fed animals are going to make saturated fat out of the grains. Saturated fat in nature occurs to a very tiny degree. In the wild there is very little saturated fat out there. If you talk about the Paleolithic diet, we didn't eat a saturated fat diet. Saturated fat diets are new to mankind. We manufactured a saturated fat diet by feeding animals grains. You can consider saturated fat to be second-generation carbohydrates. We eat the saturated fats that other animals produce from carbohydrates.

Zone was a good diet compared to the American diet. Is it an optimal diet? No. Is it optimal for what is known today about nutrition? It is not. Initially the author spoke about how it made no difference if you got your carbohydrate from candy or vegetables.

What he is doing now is changing his recipes so that the 40 percent carbohydrates are coming primarily from vegetables, and the carbohydrates are going way down because he knows that if they don't, it's not as good a diet.

I recommend 20 percent of calories from carbs, depending on the size of the person, 25 percent to 30 percent of calories from protein, and 60 percent to 65 percent from fat. You can get beef that is not grain-fed.

Insulin is Not the Only Cause of Disease

There are other considerations in disease, such as iron. We know that high iron levels are bad for you. If a person's ferritin is high, red meat is out for a while until the level goes down.

There is a great deal of difference between a non-grain-fed cow and a grain-fed cow.

Non-grain fed will have only 10 percent or less saturated fat. Grain-fed can have over 50 percent.

Also, a non-grain-fed cow will actually be high in omega-3 oils. Plants have a pretty high percentage of omega-3, and if you accumulate it by eating it all day, every day for most of your life, your fat gets a pretty high proportion of omega-3. I would try for 50 percent oleic fat, and the other fats would depend on the individual, but about 25 percent of the other two.

In a heavy diabetic I would probably go down on the saturated fat and go 60 percent oleic, and 1 to 1 on the omega-6 to 3 ratio--that would be therapeutic. The maintenance ratio would be about 2.5 to 1 for the omega-6 to 3 ratio. I would try to do most of this through diet. There are some practicalities involved. I would ask the person if they like fish and if they practically puke in front of me they are going on a tablespoon of cod liver oil, the best brand is made by Carlson, which doesn't taste fishy at all.

Most people end up going on a supplement of omega-3 oils because they are not going to eat enough fish to get an adequate amount. It is a little hard to get that much entirely from diet.

Sardines are a very good therapeutic food. They are baby fish so they haven't had time to accumulate a bunch of metal. They are smoked so they are not cooked and the oil is not spoiled in them. You have to eat the whole thing, not the boneless and skinless. You need to eat all the organs as they are high in vitamins and magnesium.

DNA Glycates

If people are worried about chromosomal damage from chromium, what they should really be worried about instead is high blood sugar. DNA repair enzymes glycate as well. Insulin is by far your biggest poison. They disproved that study that was against chromium many times. They showed that it only happens if you put cells in a petrie dish with chromium but in vivo studies prove otherwise. The lowering of insulin is going to be better than any possible detriment of any of the therapies you are using. Insulin is associated with cancer, everything.

Insulin should be tested on everybody repeatedly. It isn’t strictly because there haven't been drugs until recently that could effect insulin, so there is no way to make money off of it. Fasting insulin is one way to look at it, not necessarily the best way, but it is a way that everybody could get it done. Any family doctor can measure a fasting insulin.

There are other ways to measure insulin sensitivity that are more complex. We use intravenous insulin and watch how rapidly the blood sugar crashes in a fasting state in 15 minutes, and that assesses insulin sensitivity. Then you give them dextrose to make sure they don't crash any further. There are other ways that are utilized to directly assess insulin sensitivity, but you can get a pretty good idea just by doing a fasting insulin.

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