HOW TO WORK WITH YOUR DOCTOR

TO GET WHAT YOU NEED

THE BLOOD SUGAR SOLUTION

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Table of Contents

Introduction:

Why You Need This Guide

Though there is much you can do to treat yourself for diabesity, working with a doctor experienced in a comprehensive approach to treating this problem is essential. Having a good relationship with a primary care physician and undergoing regular evaluations is critical in monitoring your treatment. However, there is one problem. The vast majority of physicians practicing today are not familiar with the methods I outlined in *The Blood Sugar Solution.* Some may not take a truly comprehensive approach to diagnosis and treatment of diabesity or be aware of or order the appropriate panel of tests. Others may not test you at all unless you have progressed down the path of disease. And *most* doctors interpret tests quite differently than I do, taking a "wait and see approach," which can be dangerous.

Getting an Annual Physical Examination

You will need to have a regular physical examination so your doctor can monitor important potential complications related to diabesity, including elevated blood pressure, cataracts, early nerve damage, kidney dysfunction, joint damage, as well as indications of heart disease and dementia. I also **strongly** encourage you to work with a doctor to get a basic, baseline set of tests that can help you understand more precisely how severe your imbalances are and exactly what is going on inside your body, and provide a way of tracking your progress and improvement.

Special Note: Blood Pressure

Blood pressure is a simple but indirect measure of insulin resistance. In fact, insulin resistance causes 50 percent of all high blood pressure. Ideal blood pressure is less than 115/75. Over 140/90 is significantly elevated. The other major undiagnosed cause of high blood pressure is sleep apnea. Properly treating insulin resistance and sleep apnea will often result in a "cure" of high blood pressure or hypertension.

In addition to having an annual physical examination and getting the right tests from your primary care physician, you should have an annual ophthalmologic (eye) exam to check for early signs of eye damage that can lead to blindness. Diabetic foot exams are also critical because the loss of sensation may lead to injury and ulcers, which can lead to amputations. These are not typically complications of insulin resistance, but must be monitored in diabetics.

As you now know, treating diabesity early and intensively is essential if you want to halt or reverse its progress. Getting your physician to assist you in this process by providing you with the correct tests and assessments is critical.

That is why I have developed this guide. In it you will find:

- A complete list of tests I recommend for the assessment of diabesity and related conditions, including indications on how to properly read those tests
- Testing and additional medical treatments that are available for imbalances in the 7 steps
- A letter you can give your doctor that outlines the principles of Functional medicine and why this approach is essential in the treatment of diabesity

If you cannot get your primary care physician to cooperate in your treatment the way you want, you may need to consider looking for another doctor. However, it is my hope that with the tools in this guide you can work with your doctor to get the assistance you need. Good health care is a team effort between patient and doctor. I hope you can find someone you can work with to help you reverse your diabesity. (See the Resources section of *The Blood Sugar Solution* for information on how to find a practitioner of Functional or integrative medicine.)

Tests for Diabesity:

Looking for Causes and Seeing the Effects

Let's start by reviewing a list of tests and treatment options that are available to you when you work with a doctor. Understanding what tests to ask for will help you advocate for yourself in your doctor's office and the broader medical setting.

To do the tests recommended here and get the care you need, you will most likely have to find an experienced practitioner of Functional or integrative medicine. Most conventional doctors simply will not give you these tests. I offer some recommendations on places to find practitioners of functional and integrative medicine in the Resources section of *The Blood Sugar Solution.*

You can also visit our team at **The UltraWellness Center** in Lenox, Mass. Please see our website for more information (www.ultrawellnesscenter.com) or call us at (413) 637-9991. Physician visits must be done in person. Nutrition consultations can be done by phone. We also offer two discounted special month-long healing programs: **Achieving UltraWellness** and **Achieving an UltraMind.** These can be done in person or through phone consultations.

Most tests I recommend in my practice are available through conventional large commercial labs such as Quest Diagnostics or LabCorp. Other tests are available through small specialty labs that specialize in metabolic, immune, nutritional, or functional testing. After each test discussed below, I have given recommendations on which lab or labs to use to obtain the test.

There is still great controversy in conventional medicine circles about the utility of these laboratory tests, but I have used them with great success for more than 20 years on thousands of patients to help me navigate this new medical territory. Rather than provide "on or off" types of diagnoses—you have this or you don't—they provide a picture of where you are on the continuum from optimal health to full-blown disease.

Many of these tests identify disturbances in function, not pathology. In other words, you might not have anemia from lack of folate, but you might have any number of important pathways that are jammed because you don't have enough folate for you and that may lead to cancer, dementia, depression, heart disease, or birth defects.

The tests I recommend often help me identify patterns and guide me in choosing the best therapies to help my patients achieve optimal health. I think they can help you and your doctor in the same way.

While extensive testing isn't always necessary, basic testing can be **very** helpful in homing in on specific imbalances in your biochemistry that are creating problems for you.

A number of laboratory tests may be useful in helping you identify your degree of insulin resistance, the severity of your diabesity, its complications, underlying causes, or contributing factors. I have divided these into two groups. The Basic Diabesity Tests help assesses the presence and severity of diabesity. The Additional Tests for Diabesity help determine the degree of dysfunction or problems that result from or contribute to diabesity, including inflammation, kidney and liver function, thyroid and sex hormone function, or nutritional deficiencies. In Chapter 17 on specialized testing for the underlying causes of diabesity, I will review the tests that help identify the underlying causes of diabesity, based on imbalances in the 7 key systems in the body. These tests help uncover specific nutrient deficiencies, food allergies, pesticide or heavy metal exposure, gut dysfunction, and more.

These Basic and Advanced tests are ALL readily available from any doctor or laboratory, and they are important for screening for, evaluating, and monitoring diabesity. Most are available from Quest Diagnostics or LabCorp. If you have never had them done, do them all. If you have had recent tests, you can do these yearly or more often as recommended by your doctor to evaluate your progress. During the first year or two I recommend repeating these tests every four to six months.

The specialty tests need to be selected based on consultation with a Functional or integrative physician, and need to be monitored and evaluated less frequently based on your individual needs and condition.

Testing Laboratories

Quest Diagnostics
http://www.questdiagnostics.com/
A resource for most conventional laboratory testing needs.

LabCorp
https://www.labcorp.com/wps/portal/
A resource for most conventional laboratory testing needs.

LipoScience
http://www.liposcience.com/
Innovative nuclear medicine spectroscopy for the assessment of lipid particle size and improved accuracy in assessing cardiovascular risk factors.

Doctor's Data
http://www.doctorsdata.com/home.asp
Experts in testing for heavy metal toxicity and other nutritional and metabolic disorders.

Metametrix
http://www.metametrix.com
Leaders in nutritional and metabolic testing.

Genova Diagnostics
http://www.gdx.net/
Leaders in nutritional and metabolic testing and genetic testing of SNP—single-nucleotide polymorphisms—to help identify disease predispositions that can be modified with lifestyle interventions.

Immunolabs
http://www.immunolabs.com/patients/
IgG food sensitivity testing.

Prometheus Labs
http://www.prometheuslabs.com/
Leaders in testing for gluten-related disease.

DiagnosTechs
http://www.diagnostechs.com
Testing for adrenal stress hormones.

IGeneX
http://igenex.com/Website/
Specialized testing for detecting chronic infections such as Lyme disease with PCR technology.

Melisa
http://www.melisa.org/laboratories.php
Testing for the toxic immunological effects of mercury and other heavy metals.

Basic Diabesity Testing: To Diagnose Presence of Diabesity

- Insulin response test—fasting, 1-hour, and 2-hour glucose and insulin levels after a 75-gram glucose load. Hemoglobin A1c (abnormal is > 5.5% of total hemoglobin).
- NMR lipid profile—particle size and number of LDL, HDL, and triglycerides. You should have fewer than 1,000 total LDL particles and fewer than 500 small LDL particles (the dense, dangerous type). This test is performed by Liposcience, but can be ordered through LabCorp, a laboratory testing company. Total cholesterol/HDL ratio. Abnormal is greater than 3.Triglyceride/HDL ratio (Abnormal is > 4)
- Total cholesterol/HDL ratio (> 3)

Additional Tests for Diabesity: To Assess Severity of Complications of Diabesity

- High-sensitivity C-reactive protein (abnormal > 1.0 mg/liter) — to assess inflammation.
- Fibrinogen (abnormal > 350 mg/deciliter) — to assess clotting risk and thick blood.
- Lipoprotein (a) (abnormal > 30 nmol/L) — to assess treatable genetic cholesterol marker.
- Uric acid (abnormal > 7.0 mg/dl) — to assess gout risk caused by diabesity.
- Liver function tests (elevated AST, ALT, GGT are abnormal) — to assess fatty liver.
- Kidney function tests (BUN (abnormal > 20 mg/dl), creatinine (abnormal< 1.2 mg/dl)) — to assess kidney function.
- Microalbumin (abnormal > 20 mg/dl) — to assess protein in urine, an early marker for damage to kidneys.
- 25 OH vitamin D (abnormal < 45–60 ng/dl) — for vitamin D status
- Homocysteine (abnormal > 8.0 micromoles/liter) — a sensitive marker for folic acid deficiency.
- Ferritin (abnormal > 200 ng/ml) — to assess inflammation and iron status.
- Thyroid hormones (TSH, free T3, free T4, TPO antibodies)*
- Sex hormones (male and female)* DHEAS, estradiol, progesterone, free testosterone, and sex hormone binding globulin) — to assess sex hormones.

* See Step #2 in Chapter 9 for thyroid and sex hormone testing information.

Explanation of Basic Testing for Diabesity

Blood Glucose: Is Measuring Your Blood Sugar Helpful?

Historically, diabetes was diagnosed when one's fasting blood sugar level was higher than 140 mg/dl. Now we recognize diabetes complications happen at much lower blood sugar levels. That's why the cutoff was recently lowered to 126 mg/dl. In the past, a blood sugar level higher than 110 mg/dl was considered glucose intolerance; now it is 100 mg/dl. Why do we keep moving the goal posts? Because we are learning that what we thought was normal was not really normal. You still get sick at what were previously considered normal blood sugar levels. The real question is: What is the optimal level of blood sugar? It turns out it is much lower than we thought.

A remarkable study published in *The Journal of the American Medical Association* found that anybody with a blood sugar level higher than 87 mg/dl had an increased risk for type 2 diabetes.[i] This study was done in young healthy men in the military. It was startling, because it found the lowest risk for diabetes is a blood sugar level of lower than 81 mg/dl. I believe we will see that any blood sugar level between 80 mg/dl and 100 mg/dl signals a problem and an increased risk for diabetes and insulin resistance.

The "normals" we typically have in medicine may not be "normal." They may be normal for a sick population. If 65 percent of Americans are overweight, then the "normal" weight for Americans is fat! The increasing loads of dietary sugars and the spikes of insulin they produce increase your risk of cardiovascular disease even if you don't have diabetes. You can even have a perfectly "normal" blood sugar level and still be at risk.

That is why the insulin response test described below is so critical to diagnosing diabesity. The only problem is that most doctors do not know how to do or interpret this test. Even with a normal fasting blood sugar level, if your insulin is high, you can have many of the problems and complications associated with diabetes, particularly heart disease, stroke, dementia, and cancer.

Therefore, we must look at the basic laboratory tests in more detail with a new light in order to identify how to interpret them most effectively.

Insulin Response Test

Most physicians perform a glucose tolerance test to evaluate diabetes. However, by the time your blood sugar goes up in the typical glucose tolerance test, you are far down the continuum of disease and insulin resistance and are already in big trouble. The conventional oral glucose tolerance test, or OGTT, will often miss many, many cases of sugar or insulin problems.

There are six stages of diabesity or insulin resistance. Most doctors only act when people reach the fifth stage. The Blood Sugar Solution provides a plan of action right from the first stage.

1. The first stage of insulin resistance is high spiking levels of insulin 30 minutes, one hour, and two hours after the introduction of a sugar load. Your blood sugar may stay completely normal in these time frames.
2. The second stage is elevated levels of fasting insulin with a perfectly normal blood sugar level while fasting *and* after a glucose challenge test.
3. The third stage is the elevation of blood sugar and insulin after the glucose drink at 30 minutes, one hour, or two hours.
4. The fourth stage is an elevation of your fasting blood sugar level higher than 90 or 100 mg/dl and elevation of fasting insulin.
5. The fifth stage is the elevation of your blood sugar level higher than 126 mg/dl.
6. The sixth stage is decreasing insulin levels and pancreatic burnout with increasing levels of blood sugar.

> *The insulin response test is probably the single most important test in all medicine to learn your risk of diabesity, heart disease, cancer, dementia, and premature death. It is cheap, easy, and any lab can do it, yet it is almost never done.*

The test I recommend is a two-hour glucose tolerance test, with measurements of insulin and blood sugar checked after taking a 75-gm load of sugar (the equivalent of two sodas). You first measure fasting glucose and fasting insulin levels. Then you take the sugar drink and measure glucose AND insulin 30 minutes, one hour, and two hours later.

Recent studies have identified fasting and the 30-minute insulin and glucose test as a sensitive alternative to the two-hour test to diagnose insulin resistance. Some people have a delayed insulin response, but the 30-minute test can be a quick way to do the test for most people.

There are no agreed upon "normals" for these tests, but after doing more than 5,000 of them over 15 years, I can share with you what I think is optimal and ideal.

Blood Sugar Levels

- Fasting blood sugar should be less than 80 mg/dl.
- Thirty-minute, one-hour, and two-hour glucose should not rise above 110 mg/dl; some say 120 mg/dl.

Insulin Levels

- Fasting insulin should be between 2 and 5 mIU/dl; anything greater than 10 mIU/dl is significantly elevated.
- Thirty-minute, one-hour and two-hour insulin levels should be less than 25 mIU/dl to 30 mIU/dl. Anything higher than 30 mIU/dl indicates some degree of insulin resistance.

The insulin response test is the most sensitive test available to identify insulin resistance and diabesity very early on and highlights the need for more aggressive approaches to treatment and care. It can also be useful in patients with diagnosed diabetes to see if they are still capable of producing insulin or if they have burnt out their pancreas. This can influence treatment recommendations. In some cases even a burnt-out pancreas can recover and diabetes can be reversed. For some, after decades of beating up their bodies with a toxic diet and lack of exercise, it may not be possible to reverse diabetes completely. But we can effectively treat everyone and prevent further complications with a comprehensive approach.

Hemoglobin A1c

Checking just one blood sugar reading doesn't tell you much about your overall blood sugar control. There is a test called *hemoglobin A1c,* or *glycosylated hemoglobin,* that can tell you if your overall blood sugar has been high over the previous six weeks. This test is used in monitoring diabetics but has now been proposed as a better way of diagnosing diabetes than just a random fasting blood sugar test.

Even in the face of normal fasting blood sugar your hemoglobin A1c can be high, because it measures your average sugar, including the effects of all the food you eat throughout the day. I use it to screen for overall blood sugar balance. Ideally it should be less than 5.5 percent of total hemoglobin. Anything higher than 6.0 is considered diabetes. Higher than 7.0 is considered poorly controlled diabetes.

Blood Cholesterol Testing

Conventional treatment for cholesterol focuses only on lowering LDL cholesterol with statins. We measure and treat LDL because it is what we have the best drugs treat, not because it is the most important marker of your risk of heart disease. In fact your LDL cholesterol is a very bad predictor of your risk of heart disease when compared with the total cholesterol-to-HDL ratio. And this is not as good a predictor as the triglyceride-to-HDL ratio (which incidentally is the best way to check for insulin resistance other than the insulin response test).

In fact, according to a paper published in *Circulation,* the most powerful test to predict your risk of a heart attack is the ratio of your triglycerides to HDL. If the ratio is high, then your risk for a heart attack increases 16-fold—or 1,600 percent![ii] This is because triglycerides go up and HDL or good cholesterol goes down with diabesity.

Very often patients with diabesity have normal LDL and total cholesterol, but very high triglycerides and very low HDL. For example, it is not uncommon to see patients with triglycerides of 300 mg/dl and HDL of 30 mg/dl. This is much more of a concern to me than someone with total cholesterol of 300 mg/dl and LDL of 140 mg/dl but triglycerides of 60 and HDL of 80. So assessing triglycerides and HDL is critical.

Optimal Cholesterol Levels

- Total cholesterol < 180 mg/dl
- LDL cholesterol < 70 mg/dl
- HDL cholesterol > 60 mg/dl
- Triglycerides < 100 mg/dl
- Total cholesterol/HDL ratio < 3.0
- Triglyceride to HDL ratio < 4

Unfortunately, the old way of testing cholesterol can lead to deceptive conclusions. You may have a totally normal total and LDL cholesterol but be at very high risk of a heart attack because it is the wrong type of cholesterol. In fact, more than 50 percent of people who show up in the emergency room with heart attacks have normal cholesterol. But they have small cholesterol particles, which are caused by insulin resistance. Let's look a little more deeply at the question of how to properly measure cholesterol.

Specialized Cholesterol Testing: Size Matters

Newer tests look at not only the total amount of cholesterol, but also the actual size of the cholesterol particles as well as the total number of cholesterol particles. In my view this is the only test for cholesterol that should be performed. Using older versions of cholesterol testing leads to practicing medicine with blinders on. It is outdated, misleading, and often leads to harmful prescriptions for medication when not indicated. It can also provide a false sense of security when your cholesterol numbers are normal but the type of cholesterol you have is the small, dangerous kind.

The newer cholesterol test I recommend is called *nuclear magnetic resonance spectroscopy,* or *NMR lipid testing.* It is performed by a laboratory called LipoScience. LabCorp will also send blood to that lab for analysis when asked. This test is a much more sensitive, more precise indicator of your risk of heart disease than the total cholesterol or LDL cholesterol numbers you get from a regular blood test.

Studies have found that people who have a cholesterol level of 300 mg/dl but have very large cholesterol particles have very little risk of cardiovascular disease. On the other hand, people with a "normal" cholesterol level—such as 150 mg/dl—but very small and numerous LDL and HDL cholesterol particles have an extremely high risk of heart disease.

But what causes these small dangerous cholesterol particles? It is the sugar and refined carbohydrates in our diet. Insulin resistance causes these small cholesterol particles to form, and taking statins won't fix the problem. The NMR test for cholesterol is one of the most essential tests in evaluating the degree of insulin resistance and cardiovascular risk. Smaller particles are dangerous. They act like BB pellets, damaging arteries and putting your health at greater risk. Light, fluffy beach ball–like cholesterol particles, on the other hand, are harmless and bounce off arteries regardless of the overall LDL cholesterol number.

Optimal NMR Tests

- Total LDL particles < 1000 nmol/L
- Total small LDL particles < 600 nmol/L
- LDL size > 21 nm
- HDL size > 9 mmol/L
- VLDL < 0.1 nmol/L

Additional Tests for Diabesity

Measuring the insulin response test and the NMR lipid test will quickly help to determine your level of diabesity. They are the most important, but other tests that measure cardiovascular risk are also important in filling in the picture of just how severe a problem you have and what to do about it. You should also get the following tests:

- **High-sensitivity C-reactive protein** (less than 1.0 mg/L is ideal): This is the best measure of hidden inflammation in the body.
- **Fibrinogen** (less than 350 mg/dl is ideal): This is a clotting factor in the blood that increases with inflammation and insulin resistance.
- **Lipoprotein (a)** is a genetically inherited lipoprotein marker that increases the risk of cardiovascular disease but can be treated. Less than 30 nmol/L is ideal.
- **Uric acid** (less than 7.0 mg/dl is ideal): This is a byproduct of protein metabolism that causes gout and an increase in insulin resistance.
- **Homocysteine** (less than 8.0 mol/L is ideal): This is a sensitive marker for folic acid deficiency.
- **Ferritin** (less than 200 ng/ml is ideal): This is a measure of excess iron stores that increases with inflammation and insulin resistance.
- **Liver function tests** (elevated AST, ALT, GGT): These tests identify the death of liver cells, most often caused by elevated insulin resistance because of a fatty liver.
- **Kidney function tests** (BUN, creatinine, and microalbumin): Used to identify early damage to kidneys, which can occur even without full-blown diabetes.
- **25 OH vitamin D** (45-60 ng/dl is ideal): Vitamin D deficiency is an important predisposing factor to diabesity.
- **Thyroid hormones** (TSH, free T3, free T4, TPO antibodies): Low thyroid function worsens and often occurs with diabesity.
- **Sex hormones** (male and female): These hormones are often altered by diabesity and are important to monitor and treat.

Inflammation: Cause and Effect in Diabesity

Among the tests above, the two most important are C-reactive protein, which measures inflammation, and liver function, which measures liver damage from inflammation, something that is very common with insulin resistance. C-reactive protein is significantly elevated in most people with diabesity. As the diabesity gets better the inflammation goes down.

Fatty Liver: Toxicity in Diabesity

One of the major complications of diabesity is *fatty liver,* also known as *nonalcoholic steatohepatitis.* It affects up to 70 million Americans and is the number one cause of liver damage in this country. Think about it—you can get hepatitis from eating too much sugar and too many flour products! The French delicacy *fois gras* (which means "fatty liver" in French) is made by force-feeding ducks starchy carbohydrates (corn), which turns to sugar. The sugar is what turns to fat in our livers, creating problems with detoxification, which leads to a further increased load of toxins in our bodies, creating more disease in a vicious cycle. That is why it is important to measure liver function with AST, ALT, and GGT tests and treat the liver to reverse this problem.

Kidney Function: Early Signs of Damage

Early signs of kidney damage are important to evaluate. The best way to do this is through a *microalbumin* test, which measures small amounts of protein in the urine. You also should measure BUN and creatinine as overall indicators of kidney function.

Optimal Levels

- Microalbumin: <2 0 mg/dl
- BUN: < 20 mg/dl
- Creatinine: < 1.2 mg/dl

Vitamin D: A Key Factor in Promoting Diabesity

Get tested for 25 OH vitamin D. The current ranges for normal are 25–137 nmol/L or 10–55 ng/ml. These are fine if you don't want to get rickets, but not enough for optimal health. The

range should be 100–160 nmol/L or 40–65 ng/ml. In the future, we may even raise this "optimal" level further. In fact, I like my patients to be between 60–80 ng/ml.

Monitor your vitamin D status until you are in the optimal range. If you are taking high doses (5,000 to 10,000 IU a day), your doctor must check your calcium, phosphorous, and parathyroid hormone levels every three months.

Hormonal Imbalances: Common in Diabesity

Thyroid Dysfunction

People with diabesity often have problems with thyroid function, and it is often undiagnosed. I recommend checking TSH, free T3, free T4, and thyroid peroxidase antibodies as the baseline tests to assess thyroid function. For more information on thyroid function testing, see *The UltraThyroid Solution* at: www.bloodsugarsolution.com/ultrathyroid

Make sure you get the following tests:

- TSH (ideal range is between 1 and 2): This is a measure of the pituitary hormone that controls the thyroid.
- Free T3 and free T4: These are a measure of the circulating thyroid hormones.
    - The normal level of free T4 is usually between 0.9 and 1.8 ng/dl.
    - The normal level of free T3 is considered to be between 240 and 450 pg/dl, depending on the laboratory measurements. However, the reference ranges for laboratory tests are often based on "normal populations." (Remember "normal" means the average of population, not necessarily the ideal.)
- TPO (thyroid peroxidase) and antithyroglobulin antibodies: These are autoimmune antibodies in the thyroid gland that interfere with its function. They should both be less than 20 IU/ml.

Sex Hormones

I recommend checking *free and total testosterone* in men, which is often low in insulin resistance and diabetes. This leads to muscle loss, fatigue, loss of motivation, low sex drive, and impotence.

I also recommend checking *DHEA-S* measurement of adrenal function as well as total and *free testosterone and estrogen and progesterone*, FSH (follicle stimulating hormone), and

LH (luteinizing hormone) between days 18 and 23 of the menstrual cycle for premenopausal women and anytime for postmenopausal women. These are very helpful in identifying imbalances of hormones, which are common in diabesity. Women often have increased levels of testosterone and DHEA-S and a ratio of LH/FSH (luteinizing hormone to follicle stimulating hormone) of > 3:1.

Optimal Levels of Hormones

Men:

- Total testosterone: > 500 ng/dl
- Free testosterone: > 20 pg/dl

Women

- Free testosterone: < 0.5 to 5 pg/dl
- DHEA-S: < 200 mg/dl
- LH/FSH ratio: < 3:1
- Estradiol (depends on age and time of cycle)
- Progesterone (depends on age and time of cycle)

Getting these tests will help you understand the nature and severity of your health risks associated with diabesity. Work with your doctor to get them all done so you both know what you are dealing with. It will inform your treatment, and they offer a good measure for how much you heal using *The Blood Sugar Solution.*

Specialized Testing for the Underlying Causes of Diabesity

Identify Imbalances in the 7 Steps

In addition to the basic evaluation outlined in the previous chapter, a number of other tests can be helpful in identifying the underlying causes of diabesity and monitoring its effects and improvement with treatment. These tests may be needed depending on how you score on the "7 Steps Quiz" in your *Six-Week Action Guide.*

If your score qualified you for medical care in any one of the 7 steps, you should start the Basic or Medical Care plan and add on any additional self-care steps that are recommended in Part II of *The Blood Sugar Solution.*

After the first six weeks of the program have been completed, retake the self-assessment in *The Six-Week Action Plan* for any of the steps in which you had a severe imbalance. Many of you may no longer show a severe imbalance after you have completed the first six weeks of the plan; however, if you do, please seek out the assistance of a practitioner of integrative or Functional medicine and work through the tests and treatments in this chapter and the one that follows.

In this chapter I want to focus on the testing available for imbalances in the 7 steps specifically. Then, in the next chapter we will discuss some medical treatment options you can pursue with your physician.

The tests I recommend include tests for nutritional status, hormonal balance, food sensitivities or allergies, gluten sensitivity, digestive imbalances, toxins including petrochemicals and heavy metals, mitochondrial function and oxidative stress, and the effects of stress on your body. First let me provide you with a simple list of the most important tests you need, and then we will discuss each of them in more detail below.

Overview of Important Testing for Imbalances in the 7 Steps

Step #1: Boost Your Nutrition: Nutritional Testing

- Magnesium Quiz
- RBC minerals (including chromium and vanadium)
- Vitamin D Quiz
- EssentialOmega-3 Fatty Acids testing
- OAT or organic acid testing

Step #2: Regulate Your Hormones

- Thyroid Quiz: TSH, free T3, free T4, TPO antibodies
- Sex Hormone Imbalance Quiz
    - Male: total and free testosterone
    - Female: FSH, LH, estradiol, progesterone, free testosterone, DHEA-S

Step #3: Reduce Inflammation

- Gluten allergy/celiac disease testing (all these tests help identify various forms of allergy or sensitivity to gluten or wheat)
    - IgA antigliadin antibodies
    - IgG antigliadin antibodies
    - IgA antiendomysial antibodies
    - Tissue transglutaminase antibody (IgA, and IgG in questionable cases)
    - Total IgA antibodies
- IgG food sensitivity (special antibody tests against common foods)
- Elimination/provocation: This is simply removing potentially allergic foods like gluten and dairy for two weeks, then reintroducing them and monitoring how you feel. My book *The UltraSimple Diet* describes a comprehensive elimination diet in great detail.
- Testing for hidden infections: This specialized testing needs to be ordered by a trained physician of functional or integrative medicine.

Step #4: Improve Your Digestion

- Gut immunology: EPX and calprotectin stool analysis
- Digestion Quiz
- Gut ecology and digestive stool analysis
- Urine organic acid dysbiosis analysis

Step #5: Maximize Detoxification

- Provoked urine toxic element test: Levels of heavy metals (mercury, lead, arsenic, antimony, etc.)
- Toxity Quiz
- Blood levels of PCBs, solvents, pesticides, and heavy metals
- Urine organic acid or OAT testing for detoxification

Step #6: Enhance Energy Metabolism

- Urine organic acid (OAT) testing for mitochondrial function
- Energy Metabolism QuizUrinary 8 OHDG for Oxidative Stress or Rusting QuizLipid peroxides
- VO2 max: cardiometabolic stress testing

Step #7: Soothe Your Mind

- Stress and Adrenal Fatigue Quiz

Now let's look at all these tests in a little more detail. For each step I will outline the name of the tests I recommend and labs where they can be ordered. I will also provide details about what the test is and how it is useful in examining the optimal levels your doctor should be looking for with you.

Step #1: Boost Your Nutrition: Nutritional Testing

There are common nutrient deficiencies that promote the development of diabesity. The most important to assess are chromium, magnesium, vitamin D, and essential fatty acids. People with diabesity often have magnesium, chromium, and vitamin D deficiency.

Essential fatty acids (omega-3 fats) are critical in normal blood sugar control and insulin function. And more than 90 percent of Americans are omega-3 fat deficient. Simply supplementing with omega-3 fats improves blood sugar control, reduces triglycerides and improves HDL, and lowers inflammation. However, there can be unusual fatty acid problems that specific tests may be helpful in uncovering.

Here are the tests I recommend to assess problems with any of these nutrient levels:

Magnesium Testing

Quest Diagnostics, LabCorp, Metametrix, or Genova Diagnostics

Serum magnesium is most often used but is rarely helpful. Levels of less than 2.0 can be significant.

Red blood cell magnesium is more accurate (nl 4–6), but if you have symptoms of magnesium deficiency, the best way to know if the addition of magnesium to your diet will help is to try taking it and seeing how you feel.

Red Blood Cell Minerals

Metametrix or Genova Diagnostics

Mineral status is a critical part of nutritional health. This can identify deficiencies or imbalances in many minerals including chromium and vanadium.

Essential Omega-3 Fatty Acid Testing

Metametrix or Genova Diagnostics

It may be useful to test red blood cell fatty acid levels to look for the proper balance of fats, especially low levels of omega-3 fats and high levels of omega-6 fats. This test can identify essential fatty acid deficiencies as well as excesses of inflammatory fats and trans fats.

OAT (Organic Acid Test): Urine Organic Acids

Metametrix or Genova Diagnostics

Organic acids are byproducts of metabolism. They are helpful as a general nutritional and metabolic screening test. They help identify vitamin B deficiencies, including biotin, which is important in diabesity, as well as problems with fat, carbohydrate, and energy metabolism. They also help with oxidative stress, the gut, detoxification, and even

neurotransmitter function. This is probably the single best-advanced test for evaluating diabesity because it covers so many problems with the 7 steps.

Step #2: Regulate Your Hormones

These tests are all included in the basic testing for diabesity because hormones are so important. I include a little more explanation here.

Testing for Thyroid Dysfunction (Part of Basic Testing for Diabesity)

Quest Diagnostics, LabCorp, or Genova Diagnostics

There is no one perfect way, no one symptom or test result, that will properly diagnose low thyroid function or hypothyroidism. The key is to look at your symptoms and your blood tests, and then decide.

Doctors typically diagnose thyroid problems by testing your TSH levels and sometimes your free T4 level. But some doctors and researchers have brought the normal levels of those tests into question.

The diagnosis of "subclinical" hypothyroidism depends on having a thyroid-stimulating hormone (TSH) level higher than 5 mIU/L and lower than 10 mIU/L. But new guidelines from the American College of Endocrinologists suggest that anything higher than 3 mIU/L is abnormal. This number is an improvement but still may miss many people who have normal tests and a malfunctioning thyroid system.

To get a complete picture, I recommend looking at a wider range of function:

- TSH (ideal is between 1 and 2 mIU/L).
- Testing for free T4 (ideal level is 1–1.4 ng/dl) AND free T3 (ideal level is 300–400 pg/dl), which are the inactive and the active hormones.
- Thyroid antibodies (TPO) or autoimmune thyroid antibodies. Most doctors don't check this UNLESS the TSH is high. This is a big mistake. Many people have autoimmunity against their thyroids, which makes it function poorly, but still have "normal" TSH. That's why I think this should be part of routine screening.
- Basal normal body temperature is 98.6 degrees F. This is measured with a special basal body thermometer you can obtain at a pharmacy. Check your temperature before getting out of bed in the morning. If you are a menstruating woman, check it

only between the first and third days of your menstrual cycle (the first day is the first day of bleeding).

Testing for Sex Hormone Imbalances (Part of the Basic Tests for Diabesity)

Testing for sex hormone imbalances in women is tricky because levels change throughout the menstrual cycle. Postmenopausal testing is easier. The best time to test for hormones in premenopausal women is anywhere between days 18 and 23 of the menstrual cycle. For postmenopausal women, anytime is fine. Hormone testing is essential to monitor the effects of bio-identical hormone replacement.

Women's Hormone Testing (Blood)

Quest Diagnostics, LabCorp, or Genova Diagnostics

1. FSH (follicle stimulating hormone)
2. LH (luteinizing hormone)
3. Estradiol
4. Progesterone
5. SHBG (sex hormone binding globulin)
6. Free testosterone
7. DHEA-S

Men's Hormone Testing

Quest Diagnostics, LabCorp, or Genova Diagnostics

1. Free testosterone
2. Total testosterone

Note that saliva testing is an accurate, noninvasive way of measuring sex hormone levels and can be used to measure variations over time by measuring at different times of the menstrual cycle.

Step #3: Reduce Inflammation: Find the Causes of Inflammation

Gluten testing and food sensitivity or IgG testing can be very helpful in identifying sources of inflammation from your diet. Selective use of IgG food sensitivity testing can identify low-grade food allergies and sensitivities. Eliminating food sensitivities that cause inflammation can reduce systemic inflammation and its effects on insulin and blood sugar. Here are the tests I recommend.

Gluten Allergy/Celiac Disease Testing

LabCorp or Quest Diagnostics

Each of these tests helps identify various forms of allergy or sensitivity to gluten or wheat. Remember, gluten sensitivity exists all the way along the continuum from mild sensitivity to full-blown celiac disease. I recommend that anyone with any level of antibodies or autoimmune reaction to gluten do a six-week, 100 percent gluten elimination. Stopping and then reintroducing it is the ONLY way to really know how gluten affects you:

- IgA antigliadin antibodies
- IgG antigliadin antibodies
- IgA antiendomysial antibodies
- Tissue transglutaminase antibody (IgA, and IgG in questionable cases)
- Total IgA antibodies
- HLA DQ2 and DQ8 genotyping for celiac disease (used occasionally)

IgG Food Sensitivity (Special Antibodies Tests against Food)

Immuno Laboratories or Genova Diagnostics

While still controversial, well-controlled studies have shown that these tests are helpful in identifying problem foods. Removing these foods helps inflammatory problems. I have found these tests to be imperfect though helpful guides in locating trouble foods.

Elimination/Provocation

This is simply the process of removing potentially allergic foods like gluten and dairy from your diet for two weeks, then reintroducing them and monitoring how you feel. *The Blood Sugar Solution* has a six-week gluten and dairy elimination and provocation test built into it. My book and home study course, *The UltraSimple Diet,* describes a more comprehensive elimination diet if you need it.

Special Side Effects

Following a short-term comprehensive elimination diet often leads to extraordinary side effects including relief from many health problems such as arthritis, autoimmune diseases, migraines, fatigue, allergies, irritable bowel syndrome, and much more.

Hidden Infections

Quest Diagnostics, LabCorp, Medical Diagnostic Laboratories, or IGeneX Labs

You can have a chronic, smoldering infection that leads to an activation of your immune system and promotes system-wide inflammation. If inflammation persists despite changing your diet and lifestyle, taking supplements, and addressing food allergies and insulin resistance, then you may have a hidden infection. There are many tests that identify hidden infections.

Step #4: Improve Your Digestion: Digestive Functioning Tests

Occasionally if there is systemic inflammation and you have ruled everything else out, the gut can be a source of hidden problems.

General Gut Health, Bacterial Balance, and Parasite Testing: Stool Analysis for Dysbiosis

Metametrix, Genova Diagnostics, or Doctor's Data

Many chemical markers in the stool can be analyzed to give a picture of the ecosystem. Markers for digestion, absorption, acid-alkaline balance, as well as cultures of various bacteria, yeasts, or parasites can often pinpoint the sources of inflammation and be linked to many diseases. Some conventional labs do test for parasites but are often not experienced and miss many infections. Newer tests even assess the DNA of microbes in the gut through PCR testing of the entire gut ecosystem and can identify the balance of good and bad bugs in the gut.

PCR Stool Testing for Gut Ecology

Metametrix

This test is an innovative way to identify hard-to-find bacteria, yeasts, parasites, and worms, which can trigger systemic inflammation.

Urine Organic Acid Test (OAT) for Bacterial and Yeast Metabolites

Metametrix or Genova Diagnostics

Organic acids are metabolites in the urine that can give clues to nutritional status, but the organic acid test is often used to look at unusual chemicals that come from the gut, such as

bacteria, yeasts, or parasites. The test can be helpful in identifying problems and tracking treatment, but even a negative test doesn't rule out significant imbalances in the gut. Currently we can measure only some of the activity, not all of it.

Step #5: Maximize Detoxification: Identifying Hidden Toxins

A number of tests are available that can assess petrochemicals and heavy metals as well as their effects on our detoxification system. There are also tests to assess our genetic detoxification capacity.

The most important test is a *urine toxic element test*. This is a simple test that measures stored heavy metals in the body. It is done by orally taking a chelating agent such as DMSA or DMPS, followed by a six-hour urine collection.

This test measures the total body load of heavy metals. Measuring simple blood tests or an unprovoked urine test doesn't reflect total body burden. Using these methods will not give you a clear assessment of the amounts of metals in your body. Most doctors just check blood levels, and if they are fine they think everything is fine. Nothing could be further from the truth. The metals are cleared from the blood in 30 to 90 days after exposure, and while some are eliminated in stool and urine, many get stored in your tissues and organs, including the liver, kidney, and brain. The provoked urine test is the only clinically available measurement of your total body heavy-metal burden.

There are also newer tests available to measure the levels of solvents, PCBs, and pesticides in the blood. This can help uncover ongoing exposures to chemicals and diagnose toxin-induced diabesity. Here is what I recommend.

Heavy-Metal Testing Overview

These tests can be critical in identifying heavy-metal poisoning. If you are concerned about heavy metals, you should find a doctor of Functional medicine and have these tests performed. If you have many amalgam fillings, regularly consume seafood, get flu vaccines, or live in an area close to coal-burning industrial plants or medical incinerators, then you should be tested for mercury and other heavy metals.

Chelation Challenge

Doctor's Data or Genova Diagnostics

The chelation challenge test is often better than any other test at identifying the levels of heavy metals. An FDA-approved chemical chelation agent called DMSA (challenge dose is 30 mg/kg) can be used to mobilize the metals that are found in a 24-hour urine sample that is collected and sent to the lab. DMPS, sold over the counter in Germany and used widely in Europe and Russia, is another well-used chelating agent that can be used for testing or treatment. The challenge dose is 250 mg for children and 500 mg for adults. It is not FDA approved but is legally available from compounding pharmacies in the United States.

Whole Blood or Red Blood Cell Heavy-Metal Levels: Lead, Mercury, Arsenic, Etc.

Quest Diagnostics, LabCorp, Doctor's Data, Metametrix, or Genova Diagnostics

Even though this is the test used by conventional doctors to screen for metals, it is ONLY accurate in picking up very recent exposure (the last 120 days) because most of the toxic metals are cleared quickly from your bloodstream and are stored in your tissues and bones for decades.

Urinary Organic Acids

Metametrix or Genova Diagnostics

Specific compounds can be measured, including sulfates, pyroglutamate, orotate, and others, that can give clues to problems with detoxification pathways. This can be useful for anyone scoring high on the detoxification quiz.

Chemical Testing

I rarely perform chemical tests because I assume nearly everyone has some degree of chemical toxicity. Body burden studies have been done through the Environmental Working Group (www.ewg.org) and the Centers for Disease Control and Prevention (www.cdc.gov/exposurereport) and have found hundreds of chemicals in everyone. For more serious or acute exposures, certain tests that identify chemicals can be helpful. For example, blood levels of PCBs, solvents, and pesticides can be tested. You can order these tests through Metametrix.

Step #6: Enhance Energy Metabolism: Identifying Loss of Energy and Oxidative Stress

We can test for mitochondrial function and oxidative stress, which is very important in diabesity. We can identify the effectiveness of fat and carbohydrate metabolism and

cellular energy production as well as important markers of free radical or oxidative stress damage. Here is what I recommend.

Specialty Testing for Mitochondrial Function

While the tests above cover many general factors that affect your energy production, such as toxins, allergens, infections, poor diet, and nutritional deficiencies, the following tests focus specifically on mitochondrial function and can be important in cases where this is a potential problem. The most important test is the organic acids test (OAT).

Urine Organic Acids Test

Metametrix or Genova Diagnostics

The body produces many byproducts of metabolism. We can measure these in the urine after the body excretes them. The tests can identify metabolic weak spots or deficiencies. They are a great way to look at the function of mitochondria. With them, we can see how fats and carbohydrates are processed through the mitochondria, and even how well the mitochondria make energy.

If there are steps in your energy production system that are not functioning properly, we can identify the steps and the exact nutrient, cofactor, or amino acid necessary to correct the problem.

For example, if you have trouble getting fats into your cells for energy, we know you may need more carnitine, an amino acid that transports fats into the cells. Then we can prescribe carnitine to help overcome the problem.
This is an overnight urine test.

Cardiometabolic Stress Testing: VO2max

This is a special cardiac stress test that measures how much oxygen you can consume or burn per minute. It is directly related to your mitochondrial function and your fitness level. The lower the level, the higher your risk of death. People with diabesity have much lower capacity to burn oxygen and calories in their mitochondria and have much lower levels of V02max, which can be corrected with interval training and mitochondrial nutrient support. This test is often only available from specialists in exercise physiology, although I think it is an excellent way to learn about the mitochondria and monitor fitness levels and improvement in function.

Oxidative Stress Testing: Damaged DNA Byproducts

Metametrix or Genova Diagnostics

This tests for 8 OHDG or 8-hydroxy-2-deoxyguanosine found in the urine. It is usually done by specialized labs. Testing indicates the presence of oxidized or damaged DNA, which is closely connected to neurologic diseases.

Oxidative Stress Testing: Lipid Peroxide Assays in Urine or Serum or TBARS

Metametrix or Genova Diagnostics

This provides indicators of rancid or oxidized fat in the body, especially the fats from our cell membranes. It is an excellent indicator of oxidative stress.

Step #7: Soothe Your Mind

Here are the tests I recommend you discuss with your doctor to assess your stress level.

An Adrenal Stress Index

DiagnosTechs or Genova Diagnostics

This is a measure of four separate saliva tests for cortisol done at four different times of the day. A number of labs perform this test, which helps you identify if your stress response is still functioning normally, if you are on overdrive, or if you are burned out. Each finding may require different treatment.

Heart Rate Variability

When you are stressed, your body and brain are less resilient, flexible, and complex. They get stuck in rigid patterns of function, behavior, and mood. One of the best ways to measure this is the "flexibility" of your heart rate.

A small device hooked up to a computer can record very minute changes in your heartbeat from second to second. The more complex and variable your heart rate, the healthier your autonomic nervous system, which controls both the stress response and the pause button. Heart rate variability is something you can change almost instantly by changing your breathing or thinking. And it can even be measured at home using a simple software program and sensors for your fingers.

There are two products I recommend that are wonderfully effective:

- Healing Rhythms by Wild Divine
- emWave by HeartMath

Now that we have covered the tests you need, in the next chapter we will review some of the medical treatments available to help you rebalance these key systems in your body.

Medical Care for the 7 Steps

Once you have procured the necessary tests to identify imbalances in the 7 key systems in your body, the next step is to pursue medical treatment options that will help you rebalance these steps. In this chapter I will review some of the options available. Note that for each step I have only chosen a few of the most important and effective treatments available. Many other options exist. Discuss the possibilities with a practitioner of Functional or integrative medicine.

Step #1: Boost Your Nutrition

One of the foundational concepts of Functional and systems medicine is **biochemical individuality.** We are all different with slightly different needs and imbalances. Nutritional testing helps to identify weak or trouble spots in your biochemistry and fix them as needed. Your physician can further customize your treatment based on nutritional testing. Here are a few things that are particularly important in diabesity:

- Testing for amino acids and neurotransmitters can help identify your particular imbalances more accurately.
- Further customization of amino acid therapy is possible based on testing and your symptoms.
- Testing for omega-3 fats, vitamin D, magnesium, zinc, chromium, and selenium can be helpful in identifying the need for additional supplementation.
- Testing for methylation problems with homocysteine and methylmalonic acid is often very helpful in optimizing doses of folate, B12, and B6.

Step #2: Regulate Your Hormones

Choosing the Right Thyroid Hormone Replacement

Ultimately, to properly balance a thyroid that is severely out of balance, you will need to go on some type of thyroid hormone replacement therapy. There are certain things you can do by altering your diet and your lifestyle, but if your thyroid isn't functioning properly you may need to have some additional thyroid hormones to supplement its output. Knowing

what's available and what to ask about can empower you to make better decisions about your health.

A combination of experience, testing, and trial and error is necessary to get it just right. However, I have found that the majority of my patients benefit from a combination hormone treatment including T4 and T3.

Synthroid, the most commonly prescribed thyroid hormone, is just T4, the inactive hormone. Most doctors assume that the body will convert it to T3 and all will be well. Unfortunately, pesticides, stress, mercury, infections, allergies, and selenium deficiencies can block that process. Since 100 percent of us have stored pesticides in our bodies, we will all likely have some problem with Synthroid.

The most common treatment I use is Armour thyroid

Armour thyroid is a whole combination of thyroid hormones including T4, T3, and T2[iii] (a little known product of thyroid metabolism that actually may be very important). There are other ways of obtaining combinations of T4 and T3, including compounded desiccated porcine thyroid (like Armour) or compounded bio-identical T4 and T3. I sometimes even use combinations of prescription T4, such as Levoxyl or Synthroid, along with prescription T3 called Cytomel.
Armour is a prescription drug made from desiccated or dried porcine thyroid. It contains the full spectrum of thyroid hormones including T4, T3, and T2. It seems paradoxical that taking a pig hormone can make your brain better, but it does. The right dose ranges from 15 to 180 mg, depending on the person.

Many doctors still hold the outdated belief that the preparation is unstable and the dosages difficult to monitor. That was true with the old preparation of Armour, not the new one. (See www.armourthyroid.com for more information). It has been increasingly difficult to obtain Armour thyroid, but it may become more widely available in time. It is my preferred treatment for thyroid dysfunction. It is the best treatment for about 80 percent of my patients. The rest need some combination of prescription or compounded thyroid.

Sometimes the only way to find out if you have a thyroid problem is a short trial of something like Armour thyroid or equivalent for three months. If you feel better; your symptoms disappear; your mood, memory, and behavior improve; and you have more energy and lose weight (assuming this a problem for you, which it is for many people with a thyroid

deficiency), it's the right choice. Occasionally, further customization of thyroid hormones is necessary using various combinations of T4 and T3 in prescription or compounded forms.

Once started it doesn't have to be taken for life (a common misperception). Sometimes, once all the factors that disturb your thyroid have been corrected, you may be able to reduce or discontinue the dose.

As with any treatment, always work with an experienced physician in using medications for your thyroid. Careful monitoring is essential. Taking too much thyroid hormone, or taking it if you don't need it, can lead to undesirable side effects including anxiety, insomnia, palpitations, and, over the long term, bone loss.

WARNING

If your adrenal glands are burned out from long-term stress, treating the thyroid without supporting the adrenal glands through relaxation and adaptogenic herbs (such as ginseng, rhodiola, or Siberian ginseng) can actually make people feel worse. Your Functional or integrative medicine practitioner will know how to balance your adrenal glands before treating your thyroid with medication.

Bio-Identical Hormone Replacement

Occasionally, despite lifestyle therapies, diet, exercise, stress reduction, nutrient supplementation, and herbs, sex hormone therapy may be the answer.

A physician knowledgeable and experienced with bio-identical hormone therapy must prescribe them. The ONLY hormones that should be used are ones that are identical to those made by your body. They have very specific actions when they bind to their hormone receptors on your cells. Synthetic or animal hormones typically have unwanted side effects and dangers.

For menopause your doctor may try:

- Topical combinations of estradiol, estriol, progesterone, and testosterone, which are prepared by compounding pharmacies
- My approach is to use the lowest dose possible to relieve symptoms, to use only bio-identical hormones and to use them topically (vaginal, skin, under the tongue)
- Oral hormones should be used with as low a dose as possible and only when topical hormones are not effective
- DHEA supplementation, which can be helpful sometimes

For severe cases of PMS not improved by diet, lifestyle, or supplements, your doctor may try:

- Topical, natural, bio-identical progesterone in the last two weeks of the menstrual cycle; the usual dose is ½ tsp (20–40 mg) applied at night to thin skin areas of your body during the last two weeks of the menstrual cycle

For men's hormone balance your doctor may use:

- Testosterone—topical is ideal after measurement of your hormone levels and with ongoing monitoring of testosterone and PSA levels
- DHEA supplementation

Step #3: Reduce Inflammation

Once testing has been completed, specific treatments for infections or more aggressive treatments for autoimmunity and allergies may be needed. Discuss this possibility with your doctor.

The most important triggers of inflammation are our diet, hidden allergens and gluten, hidden infections, digestive imbalances, environmental toxins, and stress. Each of these has specific treatments.

Cleaning up your diet and following *The Blood Sugar Solution* will take care of most of the dietary causes of inflammation. A more comprehensive gluten and food allergy elimination diet, which I describe in my book *The UltraSimple Diet* (www.bloodsugarsolution.com/ultrasimple-diet) and the associated home study course called *Kick-Start Your Metabolism in 7 Days: The UltraSimple Plan to Quickly and Safely Lose Up to 10 Pounds* (www.bloodsugarsolution.com/ultrasimple-challenge) is sometimes necessary.

Intensive gut healing (see Step #4) is also very important in addressing one of the most important sources of systemic inflammation.

Sometimes finding and treating low-level toxins such as mercury and lead can be essential in reducing inflammation.

Occasionally, odd hidden infections, including hidden dental infections in old root canals or hidden viral or bacterial or tick-borne infections, can be a source of chronic inflammation. These need to be "hunted down" and treated on an individual basis.

Finally, learning to find the pause button and reduce the effects of chronic stress can cool the fires of inflammation for many.

Each person is unique, and many need specific treatments for the cause of inflammation that include the use of antimicrobials like antibiotics or antifungals and chelating agents. An experienced practitioner of Functional or integrative medicine will recommend these treatments as needed. The key thing to remember is that it often takes persistence and diligence to find the source of the inflammation and treat it directly. But with time this can be done and is remarkably more effective than anti-inflammatory medications such as steroids, Advil-like medications, or immunosuppressive or immune-blocking medications. And with much fewer side effects.

Step #4: Improve Your Digestion

Very often some simple dietary changes and supplements can help overcome years of digestive problems. However, this is an area in which it is often helpful to have some testing and to work with a doctor of Functional medicine who knows how to address work with digestive problems.

The healing process takes four main steps, which have to be done in the right order for you to get the best results. This is often referred to as the **4 R program:**

- **Remove** any offending factors, including potential food allergens; overgrowth of bacteria, yeast, parasites, and worms; and toxins, such as heavy metals.
- **Replace** missing or weakened enzymes, digestive acids, and fiber or prebiotics in order to help fertilize the healthy bacteria.
- **Re-inoculate** with probiotics or beneficial bacteria.
- **Repair** the intestinal lining with healing nutrients.

Eliminating allergens and taking enzymes, prebiotics, probiotics, and healing nutrients can be done without medical care, EXCEPT if you have a significant overgrowth of bacteria in your small intestine, yeast overgrowth, infestation with parasites or worms, or heavy-metal toxicity. Testing is often needed to identify these problems. Then medication is often needed for adequate treatment. Sometimes herbs can be helpful in reducing the bad bugs.

So you can try working to fix your gut on your own, but if things don't improve, it may be time for testing and medication with your doctor's help.

Remember, if you are standing on a tack, it takes a lot of aspirin to feel better. If you have too much bacteria, yeast, or a parasite, you can eliminate all the foods you like or add all the healthy bacteria, but it may be an uphill battle unless you fully address any imbalances or infections with bugs in the gut.

Special Note: Treating Bugs

Bugs that affect the gut come in four main varieties:

- Bacteria
- Yeast
- Parasites
- Worms

Each type of bug needs a different treatment. Testing can identify which bug or bugs are a problem for you.

Herbal therapies can often be helpful, but most of the time a short course of curative medication is necessary and is dramatically effective.

Guidance from a trained practitioner is often necessary to test for and treat these problems.

Step #5: Maximize Detoxification

In a medically supervised detoxification program, many nutrients, herbs, and phytonutrients may be used, including alpha lipoic acid, NAC, milk thistle (which are already part of *The Blood Sugar Solution*), bioactive whey protein, and amino acids such as taurine, glycine, glutamine, calcium-D-glucarate, and methionine. Detoxification is a powerful method of healing when applied carefully and intelligently. It is one of the most powerful tools to restore optimal health and may, in fact, be a major target in the future treatment of diabetes as we learn more about the impact of toxins on our weight and metabolism.

Special Note: Detoxifying from Heavy Metals

Detoxifying from heavy metals is an important step on the road to health for many and needs to be done with an experienced and qualified health care practitioner.

Aside from addressing hidden food allergens and helping people balance their blood sugar and consume a whole-foods diet, one of the most powerful ways to correct many chronic health problems is a medically supervised heavy-metal detoxification program. Proper testing, preparation, and care are needed in order to achieve safe and effective heavy-metal detoxification. Below you will find the steps I often recommend to prepare my patients for heavy-metal detoxification. I will also outline the options available for treatment.

I want to reinforce that this **must** be done with a qualified health care practitioner.

Below I describe the most important steps to help prepare you for safe metal removal. Once you have improved your health and optimized your detoxification system, you can begin working to remove metals from your body through various approaches including safe amalgam or silver-filling removal (see www.iaomt.org) and the use of chelating agents such as DMSA, which is a prescription medication designed and approved for lead removal in children, but also effective against mercury and many other toxic metals.

While there needs to be more research done in this area, the current body of evidence, my experience, and the experience of thousands of other doctors and patients make it clear to me that this can be a critical part of the process of healing for chronic illnesses, including diabesity.

To read an excellent consensus position paper on heavy-metal detoxification called "Defeat Autism Now!" that was developed by a group involved with autism treatment, go to www.autism.com/triggers/vaccine/heavymetals.pdf.

Recognize that there is much controversy in this area as well as many opinions on the best way to detoxify from heavy metals. I humbly offer my hard-won and personal observations and knowledge on how to do this safely and effectively.

Getting Ready for Detoxification

These are the general guidelines I use with my patients that I recommend you follow with your doctor. They should generally be done in collaboration with your health care provider and may take a few months.

- First, optimize your gut function by eliminating common food allergens and taking probiotics and enzymes for one to two months before detoxifying.

- Optimize your nutritional status for detoxification using healthy fats (omega-3 fats, olive oil, and flax oil); the amino acids noted above (which boost your liver's detoxification capacity); and minerals, particularly zinc and selenium (which help your body detoxify metals).
- Enhance your liver's detoxification pathways—especially the sulfation and methylation pathways—by taking folate, B12, and B6; eating foods that contain sulfur, such as broccoli, collards, kale, daikon radish, garlic, onions, and omega-3 eggs; and supplements such as alpha lipoic acid and N-acetylcysteine.
- Use herbal support for heavy-metal detoxification, including alginate, cilantro, garlic, and milk thistle.
- Start sauna therapy and make sure that you take adequate electrolyte and mineral replacements to prevent dehydration and mineral loss from the perspiration.
- Optimize elimination routes for metals through your urine, stool, and perspiration by drinking plenty of clean pure water, eating a diet high in plant fibers, and taking daily saunas for 30 minutes.

Once you have prepared for the process of detoxification using the steps above, you can then begin detoxifying from heavy metals by using chelating agents. However, you must work with an experienced physician to do this.

Step #6: Enhance Energy Metabolism

Once testing has been completed, your doctor may recommend additional supplements for helping support your mitochondrial function including creatine, coenzyme Q10, carnitine, alpha lipoic acid, NADH, magnesium, B vitamins such as riboflavin or niacin, NAC, sulfate, and reduced glutathione. Resveratrol derivatives or extracts are also powerful mitochondrial energy boosters and are in drug development now (Sirtris was just purchased by Pfizer). Note that many of these supplements are already built into *The Blood Sugar Solution.*

Your doctor may also prescribe additional energy-boosting treatments and exercises such as interval training. If you haven't already begun interval training, now is the time. It's an excellent way to boost your energy metabolism.

Step #7: Soothe Your Mind

Occasionally, hormonal treatment with DHEA or low-dose cortisone or additional herbal therapies can be helpful if you have adrenal burnout. Acupuncture and traditional Chinese medicine are also very powerful in helping restore the adrenal system balance and correct the effects of chronic stress.

But ultimately, finding your "pause button" is up to you. Focused practice of deep relaxation and restorative self-care in the form of meditation, yoga, breathing practices, or qigong, as well as things such as massage, hot baths, saunas, journaling, and engaging in regular rhythmic living with consistent times of waking, eating, and sleeping are very helpful in restoring our natural biological rhythms and righting the hormonal chaos of chronic stress.

By using the self-care strategies in *The Blood Sugar Solution* and the tests and medical treatments outlined in this guide, you and your doctor should be able to isolate and treat the underlying imbalances in your physiology that are driving your illness. Once you do, you will begin to experience what it is like to be vibrantly healthy. Good luck!

Letter and Other Information for Your Doctor

It is important that you form a partnership with your doctor. The old model of medicine was "the doctor knows best". Trust the doctor and take this pill. In the past when there wasn't much doctors could do for patients besides give them hope and an aspirin that was probably the best way to engage the healing response. The biology of belief is very powerful. But today, with medical knowledge exploding and with increasing specialization, you have to be the CEO of your own body and health. But you also need expert advice and help. You can ask questions, inquire about new tests or treatments, ask about research, and be fully engaged in your care. That is how you can best create health for yourself. Remember, your doctor is trained in disease and illness, not health and wellness. Treating a symptom is different than treating your whole system. You are responsible for your whole system. *The Blood Sugar Solution* provides you with the knowledge and tools you need to heal your whole system, but you may need your doctor's help.

With that in mind I compiled the materials in this chapter to help you better communicate with your doctor. It includes:

- A letter you can copy and give your doctor that outlines the principles of *The Blood Sugar Solution*
- A quick-reference list of diabesity tests
- An editorial I wrote that will help them better understand the Functional medicine model of treating diabetes
- A complete list of medical references from *The Blood Sugar Solution*

In order to best partner with your doctor to get the tests and treatments outlined in *The Blood Sugar Solution* and in this guide, try photocopying these materials and giving them to your physician. I hope it helps convince your medical practitioner to join in the revolution that is happening in medicine today.

Dear Doctor:

In my practice, I have found the diagnosis and treatment of diabesity (the continuum of insulin resistance from metabolic syndrome to diabetes) to be one of the more rewarding aspects of patient care. Diabetes and metabolic syndrome combined affected well over 100 million Americans and close to 1 billion people worldwide. According to research published in *Diabetes Care* in December 2009, the diabetic population will rise to 44.1 million in 2034, from 23.7 million now, with medical spending increasing to $336 billion from $113 billion.

Double the patients, triple the cost. Clearly what we are doing to treat this pandemic is not adequate. Early diagnosis and comprehensive treatment is necessary to stem this tsunami of disease and its social and economic burden. Insulin resistance is also a major underlying process that contributes not only to diabetes, but also to most cardiovascular disease, dementia and most common cancers.

The phenomena of insulin resistance and diabetes emerges from the interaction of genetic predispositions and environmental insults—our highly-refined, processed, high-sugar, low-fiber, high-fat diet; our sedentary lifestyle; chronic stress; and, increasingly, environmental toxins.

Over the last few decades the mechanisms of explaining how these gene-environment interactions lead to disease have become clear. Our toxic diet, lifestyle, and environment trigger secondary phenomenon of nutritional deficiencies, inflammation, oxidative stress, mitochondrial dysfunction, digestive imbalances, hormonal dysfunction (thyroid and sex hormone) and effects of environmental toxins such as persistent organic pollutants and heavy metals on metabolism.

These underlying mechanisms lead to the clinical phenomena we treat: hyperglycemia, hypertension, hyperlipidemia, and coagulopathy. However, these "numbers" are simply **risk factors**, clinical indicators that are downstream from the **real causes**. And treating risk factors alone will not address the underlying systemic causes that drive insulin resistance. We need to move beyond risk factor management to treatment of the causes of the disease.

The real causes are our 21st century diet, sedentary lifestyle, chronic stress, and environmental toxins. Addressing these upstream causes in a comprehensive and systematic program will correct the mechanisms (inflammation, oxidative stress, mitochondrial dysfunction, etc.), which in turn will resolve the risk factors that we treat—hyperglycemic, hypertension, and hyperlipidemia. What we do now is often more akin to

mopping up the floor while the faucet runs and the sink continues to overflow. We need to turn off the faucet.

That is why I prepared a home study course on diabesity for my patients and consumers based on 20 years of practice treating thousands of patients with diabesity. I hope you receive this letter in the spirit of inquiry and cooperation that I believe is needed for patients and physicians to find the best possible treatment for each person.

Your patient has read my report and home study course on diabesity—the continuum of metabolic syndrome and diabetes. My approach is based on the science of functional medicine, a systems biology approach to dealing with chronic illness that attempts to assess the underlying network of causes and factors that promote disease as well as incorporating strategies to optimize and enhance normal gene expression, biochemistry, and physiology.

The key things that I have identified from my practice and research include the following:

1. Metabolic syndrome and diabetes are best approached through comprehensive lifestyle and environmental change. The data supports this approach as more effective than medication or surgery.
2. Specific tests can help in the early assessment and diagnosis of metabolic syndrome, as well as assess the severity of metabolic syndrome and diabetes. Some of these tests may be familiar, while others are not. Lipid particle size, for example, is a critical part of assessment of the dyslipidemia associated with metabolic syndrome.
3. Monitoring a basic panel of tests is necessary, as well as some additional tests that assess the secondary phenomena associated with insulin resistance such as fatty liver, inflammation, thyroid dysfunction, androgen deficiency in men, and androgen excess and PCOS in women.
4. Treatment of metabolic syndrome and diabetes with a low glycemic load, high-fiber, nutrient-dense, plant-based diet; regular exercise; stress management tools; reduction of exposure to environmental toxins; and selective research-based nutritional supplementation such as omega-3 fatty acids can more effectively treat the disease than medication and often even reverse the pathology. This can reduce overall medical expenses, care, and morbidity and mortality.

My home study course entitled *The Blood Sugar Solution* provides patients with all the tools they need for self-care to implement the lifestyle changes needed to address this epidemic. However, I have encouraged them to partner with their physician for testing, monitoring of

their care, and adjustment of medications as needed as they become healthier. As a practicing physician, I know that most of us neither have the time, nor often the training to teach our patients about sustainable behavioral and lifestyle change. I work closely with a nutritionist, but most do not have that luxury. This home study course, I hope, can be an adjunct to your practice and allow you to provide your patients a comprehensive approach to change that addresses the causes of their metabolic syndrome and diabetes.

With that in mind I have provided here what I hope are some useful tools, references and resources:

1. A list of the basic tests and interpretation that I use in my practice to monitor patients with metabolic syndrome and diabetes. I hope you will find them helpful and useful in monitoring your patients.
2. An editorial I published in 2006 entitled *Diabetes: Asking the Right Questions* explaining some of the science behind this approach.
3. An extensive list of references documenting everything I have said or recommended in this letter and the home study course.

Thank you for taking the time to review this letter. I encourage you to consider this perspective in your practice. I would like to offer this home study course as a support for your patient care.

If you would like further information on the field of Functional medicine and more detail about how to address our burden of chronic disease using a systems approach, I encourage you to read the *Textbook of Functional Medicine.* For further resources and training including the Certification Program in Functional Medicine, please visit www.functionalmedicine.org.

Sincerely,

Mark Hyman, MD

Diabesity Testing for Health Professionals

To Diagnose Presence of Diabesity

- **Insulin Response Test**
  Fasting, 1-hour, and 2-hour glucose and insulin levels after a 75-gram glucose load. It's like a glucose tolerance test but measures both glucose and insulin. Your blood sugar can be normal but your insulin can be sky high. Fasting insulin should be < 5 IU/dl and 1– and 2–hour levels less than 30 IU/dl. Fasting blood sugar should be < 90 mg/dl and 1– and 2–hour less than 120 mg/dl.

  Demand this test.

  It is the most important indicator of the presence and severity of diabesity, but it is rarely done in medical practices today. That is why diabesity is not diagnosed in 90 percent of the people who have it. An alternative is to measure just fasting and 30 minutes post-glucose- load glucose and insulin levels. If you have already been diagnosed with diabetes, you don't need to do the 2–hour glucose-load test.

- **Hemaglobin A1c**
  This test measures the average of the last six weeks of blood sugar. Abnormal is > 5.5% of total hemoglobin.

- **NMR lipid profile**
  This test determines the particle size and number of LDL, HDL, and triglycerides. Small, dense particles are dangerous and an indicator of diabesity, even if your overall cholesterol is normal with or without medication. You should have fewer than 1,000 total LDL particles and fewer than 500 small LDL particles (the dense, dangerous type). This test is performed by LipoScience, but can be ordered through LabCorp, a laboratory testing company.

- **Lipid panel**
  This panel shows total cholesterol (ideal < 180 mg/dl), LDL (ideal < 70 mg/dl), HDL cholesterol (ideal > 60 mg/dl), and triglycerides (ideal < 100 mg/dl). Triglyceride/HDL ratio. Abnormal is greater than 4. Total cholesterol /HDL ratio. Abnormal is greater than 3.

Additional Tests for Diabesity

To Assess Severity of Complications of Diabesity

- **High-sensitivity C-reactive protein** (abnormal > 1.0 mg/liter) — to assess inflammation.
- **Fibrinogen** (abnormal > 350 mg/deciliter) — to assess clotting risk and thick blood.
- **Lipoprotein (a)** (abnormal > 30 nmol/L) — to assess treatable genetic cholesterol marker.
- **Uric acid** (abnormal > 7.0 mg/dl) — to assess gout risk caused by diabesity.
- **Homocysteine** (abnormal > 8.0 micromoles/liter) — a sensitive marker for folate deficiency.
- **Ferritin** (abnormal > 200 ng/ml) — to assess inflammation and iron status.
- **Liver function tests** (elevated AST, ALT, GGT are abnormal) — to assess fatty liver.
- **Kidney function tests** (BUN abnormal > 20 mg/dl, creatinine abnormal > 1.2 mg/dl) — to assess kidney function.
- **Microalbumin** (abnormal > 20 mg/dl) — to assess protein in urine, an early marker for damage to kidneys.
- **25 OH vitamin D** (abnormal <45-60 ng/dl) 50-80 ng/dl — for vitamin D status.
- **Thyroid hormones** (abnormal TSH, free T3, free T4, TPO antibodies) — to assess thyroid function.
- **Sex hormones** (male - total and free testosterone; and female – FSH, LH, DHEA-S, estradiol, progesterone, free testosterone, and sex hormone binding globulin) — to assess sex hormones.

Optimal Blood Sugar Levels

- Fasting blood sugar should be less than 80 mg/dL
- Thirty-minute, one-hour and two-hour glucose should not rise above 110 mg/dL, some say 120 mg/dL

Optimal Insulin Levels

- Fasting insulin should be between 2 IU/dL and 5, anything greater than 10 IU/dL is significantly elevated.

- Thirty-minute and one-hour and two-hour should be less than 25 IU/dL to 30 IU/dL. Anything higher than 30 IU/dL indicates some degree of insulin resistance.

Optimal Cholesterol Levels

- Total cholesterol < 180 mg/dL
- LDL cholesterol < 70 mg/dL
- HDL cholesterol > 60 mg/dL
- Triglycerides < 100 mg/dL
- Total cholesterol/HDL ratio < 3.0
- Triglyceride to HDL ratio < 4

Optimal NMR Tests (Nuclear Magnetic Resonance Lipid Particle Size)

Available from LabCorp or LipoScience

- Total LDL particles < 1000 nmol/L
- Total small LDL particles < 500 nmol/L
- LDL size > 21 nm
- HDL size > 9 nm/L
- VLDL < 0.1 nm/L

Renal Function Optimal Levels

- Microalbumin: Less than 20 mg/dL
- BUN: Less than 20 mg/dL
- Creatinine: Less than 1.2 mg/dL

Hormonal Imbalances: Common in Diabesity

Thyroid Dysfunction

People with diabesity often have problems with thyroid function, and it is often undiagnosed. I recommend checking TSH, free T3, free T4, thyroid peroxidase antibodies, baseline test to assess thyroid function.

- Ultrasensitive TSH (ideal range is between 1 and 2): This is a measure of the pituitary hormone that controls the thyroid.
- Free T3 and free T4: These are a measure of the circulating thyroid hormones.
    - The normal level of free T4 is usually between 0.9 and 1.8 ng/dl.

    - The level of free T3 that is normal is considered to be between 240 and 450 pg/ml, depending on the laboratory measurements. However, the reference ranges for laboratory tests are often based on "normal populations." (Remember "normal" means the average of population, not necessarily the ideal.)
- TPO (thyroid peroxidase) and antithyroglobulin antibodies: Autoimmune antibodies in the thyroid gland that interfere with its function. These should both be less than 20 IU/mL.

Optimal Levels of Sex Hormones

Men:

- Total testosterone: Greater than 500 nanograms/dL
- Free Testosterone Greater than 20 picograms/dL

Women

- Free testosterone: Less than 0.5 to 5.0 picograms/dL
- DHEA-S: <200 mg/dL
- LH/FSH ratio: < 3:1
- Estradiol (depends on age and time of cycle)
- Progesterone (depends on age and time of cycle)

DIABETES—ASKING THE RIGHT QUESTIONS

Mark A. Hyman, MD

Mark A. Hyman, MD, is the editor-in-chief of *Alternative Therapies in Health and Medicine*. *(Altern Ther Health Med.* 2006; 12(5):10-13.)

It ain't what you don't know that gets you into trouble. It's what you know for sure that just ain't so.

—Mark Twain

In science, as in life, we receive answers to only the questions we ask. How is this true in the explosive increase in diabetes worldwide? How might diabetes be a model for a new way to diagnosis and treat chronic complex illnesses? Unfortunately, we are married to definitions and risk factors and not exploring more fruitful lines of inquiry. We are mired in asking the wrong questions, much like the religious sages of the middle ages who wondered how many angels could dance on the head of a pin. What is the correct definition of diabetes or insulin resistance or metabolic syndrome or pre-diabetes? Should we be excited by the latest drug therapy or gene discovery in diabetes? What about CAM therapies? Should we be assessing old or new therapies as "green drugs" to control blood sugar or lipids? Are these useful questions or simply distractions from the more important question of how to deal with diabetes from a cultural, social, political, etiologic, and comprehensive systemic, biological perspective?

Does asking the wrong questions distract from the larger notion of discovering the causes of disturbances in the dynamic continuum of our metabolic equilibrium and their remediation? Does asking the wrong questions deflect from inquiry into the critical processes of restoring self-regulation to our complex biology? I would argue that the answer to these questions is yes.

Understanding that illness has purpose and that disease is generally rooted in the body's attempt to correct underlying imbalances or dysfunction, we can seek to not alter, block, or interfere with normal metabolic processes, but to learn how to enhance, facilitate, and promote normal function. Symptoms are clues to deeper molecular, metabolic, and psycho-spiritual problems. They are welcome signposts guiding us to the imbalances, dysfunction and causes of illness. Symptoms are not enemies to be silenced, but friends that can orient us in the maze of metabolic accommodations resulting from the collision of genes, environment, and lifestyle we call disease.

So how do we reorient ourselves to more effectively address the biggest worldwide epidemic threatening our species, an epidemic that threatens our children and shortens our life expectancy for the first time in history?[1] One billion people worldwide are overweight; 300 million are obese. One in 3 children born today will have type 2 diabetes in their lifetime. The rates of diabetes are increasing exponentially, both in developed countries and in developing worlds. In 1985, an estimated 30 million people worldwide had diabetes. In 2000, 150 million were "afflicted." It is estimated that by 2025, 350 million will have diabetes.[2] The World Health Organization (WHO) estimates that 2.5% to 15% of annual health budgets are spent on diabetes-related illnesses.[3] Despite advances in diagnosis and pharmacologic therapies, the crisis continues unabated.

Perhaps we are thinking about the problem in old ways, and we need to reorient from treating the disease of diabetes and focus on the underlying metabolic dysfunctions that arise from lifestyle choices and cultural habits that destine a pharmacological approach for failure. Treating a patient who does not exercise; eats a nutrient-poor diet that includes white flour, refined sugars, and trans fatty acids, and that is low in fiber, omega 3 fatty acids, and phytonutrients; and who does not sleep enough with the latest peroxisome proliferator-activated receptor (PPAR) agonist or statin can be likened to pushing an enormous boulder up a mountain.

The diabetic constellation of hypertension, dysglycemia, dyslipidemia, visceral obesity, inflammation, oxidative stress, mitochondrial dysfunction, and coagulopathy is the tip of a much larger iceberg.[4] While we may have to temporarily lower elevations in blood pressure, lipids or glucose, this cannot be our long-term strategy. We can chip away at the tip of the iceberg or dive deep to find the proximal causes rooted in our way of living, eating, sleeping, and moving our bodies, in the way we have left the source of the natural conditions that sustain life. Our ancestors did not need scientists, nutritionists, the media, or diet books to tell us what to eat to sustain human life. Unfortunately, we now need these things because we are lost in the supermarket forest, unsure of what items to hunt and gather to nourish our bodies appropriately.

We study each symptom or manifestation of disease in isolation, sometimes seeking to combine treatments in a new "polypill"[5] (statin, beta-blocker, ACE inhibitor, aspirin, folate) that can reduce the burden of disease. This approach fails to recognize that thousands of variables and dynamic alterations in disease come from a very few original causes—this principle is the foundation of biological or functional medicine. The "poly-

meal" (wild salmon, wine, dark chocolate, almonds, fruits, vegetables, and garlic) might be a more effective and sensible solution with greater benefit.[6]

The simplicity of this perspective is founded in 2 guiding clinical notions. First, find and remove or correct the obstructions to normal biological function (and they are few—genes, dietary inputs, toxins, infections, allergens, and stress). Second, provide the more natural conditions (necessarily unique to each individual) for proper biologic and psycho-spiritual functioning (they are also few—quality protein, fat, carbohydrates, vitamins, minerals, phytonutrients, conditionally essential nutrients, water, air, sleep, rhythm, love, community).[7] The name or definition of disease and the treatment of disease become less important than correcting the internal milieu that gave rise to symptoms. We cannot escape the exigencies of being born into the animal world, dependent on nature and each other in order to thrive.

SIDETRACKED BY THE NAME

A recent pair of editorials in the American Journal of Clinical Nutrition argued the merits and limitations of the various definitions of metabolic syndrome, a precursor to diabetes, and a significant disease risk factor unto itself. Gerald Reaven, the physician who first coined the term "Syndrome X," later called "metabolic syndrome," believes that while this appellation is useful in research, the concept has no clinical utility.[8] It distracts, he says, from the more important task of identifying and treating each risk factor separately and aggressively—control the blood pressure, the lipid profile, the inflammation, the coagulopathy, and the glucose metabolism—and applies equally to metabolic syndrome or diabetes.

The World Health Organization, the Adult Treatment Plan III (ATP III), and the International Diabetes Federation all have different definitions of metabolic syndrome, including with varying importance abnormal fasting or post glucose load glucose, high-density lipoprotein (HDL) and triglyceride levels, blood pressure, and obesity or waist circumference. While this homogenization of definitions may have academic utility, it is not particularly helpful in working with the single patient in a clinical setting. The problem with names and labels is that they abort the thinking process. They abort thinking about the state of a person's individual constitution—their unique genetic constellation interacting with their nutritional, immune, endocrine, or overall metabolic state—what has been referred to as the biological terrain or internal milieu. That terrain might be a better starting part for clinical disease management than attempting to match a patient to an existing or new International Classification of Diseases (ICD-10) definition. Many patients will not fit into the box of diagnosis. Some may have normal lipids or glucose but severe hyperinsulinemia, or central obesity, but normal glucose metabolism. They also may have different precipitating causes from dietary indiscretions to inflammatory or toxic etiologies layered upon a sea of genetic variation.

Grundy, in an accompanying editorial, makes the argument for an understanding that recognizes the interaction of all aspects of the "syndrome" —dyslipidemia, dysglycemia, hypertension, visceral obesity, inflammation, and coagulopathy—as a unifying principle that can help in early pattern recognition of metabolic derangement. Grundy reminds us that, "Whereas single-disorder organizations and sub-specialties may find it difficult to embrace risk-factor clustering as a new prevention paradigm, its reality makes a move in this direction virtually inevitable."[9] Perhaps treating the risk factors is less important than treating the patterns they form at their root.

Taken in isolation, any study—whether basic science or translational clinical research—provides a limited guide for clinical care. Yet when considered together, patterns, themes, principles, and guiding concepts emerge. The National Institutes of Health (NIH) New Roadmap initiative recognizes the importance of systems thinking, patterns, and networks of function in disease and health. And the NIH is supporting basic research in this area. Yet the gap between basic sciences, epidemiology, and clinical care is vast because our approach to chronic conditions like diabetes is focused on treating downstream effects, and not a comprehensive view of the causes and their remediation. If the disease is primarily a lifestyle, nutritional, and metabolic disorder, why do we seek new drugs or employ outdated dietary recommendations from organizations such as the American Diabetes Association, which ignores the reality that the content of food is equally important as the calories?

BEYOND THE NAME: SEARCHING FOR MEANING AND ORDER IN CHAOS

So what do we know about the causes of diabetes or metabolic syndrome? What do we know about the various factors that influence its expression? And what do we know about the ways to influence genes and metabolism that reorganizes the abnormal patterns of function that appear clinically—the hyperinsulinemia, dyslipidemia, inflammation, oxidative stress, mitochondrial dysfunction, coagulopathy, hypertension, and central obesity? Is there a way of thinking and treating the patient in the clinic that addresses all of these problems simultaneously without addressing any one of them individually or directly? The answer, I believe, is yes.

I propose that diabetes is a clinical model for a problem that is endemic to clinical medicine—treating the symptoms, not the cause—and that understanding how to improve the biological terrain; optimize nutrient status; improve gene expression through specific nutrients and phytonutrients; and regulate immunity and metabolism via lifestyle interventions such as diet, exercise, stress management, and adequate sleep collectively can have a much greater impact than any pharmacologic treatment.

What does the evidence indicate might play a role in the development of insulin resistance, metabolic syndrome, and type 2 diabetes? A key epidemiological study by Willett et al assessed the collective effects of an improved dietary pattern (low glycemic load, high cereal fiber,[10] high polyunsaturated and monounsaturated[11] fatty acids, low trans fats); moderate to vigorous exercise 30 minutes per day; no current smoking; and the consumption of half an alcoholic beverage per day. It was esti-

mated that in the 84,941 women followed in the study, 91% of all diabetes could be prevented.[12]

There are hundreds more genes that help us adapt to starvation than to excess calories. Learning to influence gene regulation and expression through dietary, lifestyle, and environmental influences on PPAR and nuclear factor kappa binding (NFkB) and other key receptors and transcription factors is critical.

Over 35% of our calories come from 2 engineered foods foreign to human genes and biology—the genetically novel epic monocultures of corn and soybeans that infuse nearly all industrial foods produced through commercial agriculture or food processing.[13] These industrial foods have untoward effects on human physiology and metabolism. They alter and become our cellular structure. Eating whole foods, native in design and beneficial to gene expression and cellular functioning is more sensible (and scientifically sound), than forming our cells and tissues of recently developed material that is biologically questionable.

The information in food and the science of nutrigenomics[14] is a more useful guiding paradigm in the treatment of disease than understanding food as simply a source of energy, with all calories being equal in their metabolic effects. The research points in quite a different direction.

The quality and source of fat, carbohydrate, and protein qualitatively and quantitatively influences all the biological systems involved in insulin resistance and type 2 diabetes. Plant-based whole-food dietary patterns can prevent or even reverse underlying pathologies and metabolic dysfunction.[15] Dietary fatty acid composition also plays a critical role—eliminating trans and saturated fats and increasing omega 3 and monounsaturated fats improves all parameters of diabetes and metabolic syndrome—the hyperinsulinemia, dyslipidemia, inflammation, oxidative stress, mitochondrial dysfunction, coagulopathy, hypertension, and central obesity.[16] Carbohydrate quality is equally important—low-glycemic-load and -index carbohydrates with a high fiber content have similar benefit.[17] Adequate protein nutrition also plays a role in glucose metabolism and can improve skeletal muscle function and reduce post-prandial lipids, insulin, and glucose and grehlin secretions.[18] Elimination of red meat from the diet improves microalbuminuria and fatty acid profiles in people with diabetes.[19]

Dietary fiber has salutary effects on weight, lipids, and glucose metabolism and is equivalent to sulfonylureas in lowering glycated hemoglobin.[20] Micronutrients such as chromium, zinc, magnesium, biotin, vitamin D, the B vitamins, and antioxidants also might play a key role in modulating the various components of metabolic syndrome.[21] Conditionally essential nutrients such as lipoic acid, coenzyme Q10, and carnitine also play a physiologic role in metabolic syndrome.[22] Phytonutrients such as the carotenoids,[23] almonds,[24] soy, and phytoestrogens[25] influence gene expression, favoring insulin sensitivity, and reduction in lipids, oxidative stress, inflammation and coagulopathy.

Other key lifestyle factors affect our metabolic equilibrium as well. Exercise alters skeletal muscle metabolism and improves glucose uptake, reduces low-density lipoprotein, raises HDL, lowers blood pressure, and reduces inflammation and oxidative stress.[26] Autonomic dysfunction with sympathetic over-activity exacerbates insulin resistance and lipid and glucose metabolism and promotes central obesity.[27] Therefore, techniques to enhance parasympathetic and reduce sympathetic activity, such as yoga or meditation, can have protective or even therapeutic benefit in metabolic syndrome and diabetes.

While these therapies may have a small or limited benefit when studied in isolation, when taken together to approximate the more natural conditions, foods, and activities with which we evolved, they can dramatically help prevent and treat the sentinel disease that is a central cause of the accelerating epidemic of degenerative diseases including cardiovascular, neurodegenerative, and neoplastic conditions that afflict our aging population and our children. Disease is not a natural consequence of life to be accepted, but a reflection of the loss of the natural and evolutionary conditions necessary for self-regulation and healing. It is the body's best attempt to restore balance given a difficult set of circumstances. Learning to restore our capacity for self-regulation and metabolic equilibrium is the hope of the next generation of medical scientists and practitioners.

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Preface

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