CARDIOMETABOLIC RISK
Poor blood sugar regulation and unhealthy triglyceride and lipoprotein levels often present long before the diagnosis of type 2 Diabetes. SpectraCell's CardioMetabolic and Pre-Diabetes panels offer definitive diagnostic and clinically relevant evaluation to help define risk of atherosclerotic cardiovascular disease (ASCVD) and progression toward type 2 diabetes. These check points, along with an overall cardiometabolic risk score, help patients understand that not just one factor, but rather a constellation of risk factors, contribute to the genesis and progression toward poor blood sugar control and/or ASCVD. Results of testing allow doctors to know when guidance, educational referral, or treatment is necessary. Key components of the CardioMetabolic Risk Panel are listed below.

### METABOLIC RISK
- Insulin
- Glucose
- Hemoglobin A1c
- C-Peptide
- Adiponectin
- Metabolic Syndrome
- SpectraCell's unique CardioMetabolic Risk Score estimates a patient’s risk of developing diabetes and associated conditions

### CARDIOVASCULAR RISK
- Lipid Panel
  - Total Cholesterol
  - LDL & HDL Cholesterol
  - Triglycerides
  - Non-HD Cholesterol (calc)
- Lipoprotein Particle Numbers
  - VLDL Particles
  - Total LDL Particles
  - Non-HDL Particles (RLP, Small, dense LDL III & IV)
  - Total HDL Particles
  - Large, buoyant HDL 2b

### VASCULAR INFLAMMATION MARKERS
- ApoB 100
- Lp(a)
- C-Reactive Protein-hs
- Homocysteine

### PRE-DIABETES RISK

The Pre-Diabetes Biomarkers identify metabolic abnormalities that may progress into diabetes. Pre-diabetes is a condition where the body cannot efficiently metabolize foods, especially carbohydrates, resulting in impaired glycemic (blood sugar) control which may progress to diabetes when not properly treated or addressed through lifestyle changes.

**SpectraCell's CardioMetabolic Risk Score** is a way to estimate a patient's risk of developing diabetes and associated complications such as heart disease or stroke. The following tests have the largest impact on the cardiometabolic risk score: hemoglobin A1c, fasting blood sugar and metabolic syndrome traits. Other factors that significantly affect a pre-diabetic risk but that are not included in this report include weight, blood pressure (hypertension), smoking, inflammation and family history.

- **Glucose** – snapshot of blood sugar at time of blood draw
- **Insulin** – correlates to the efficiency with which a person can metabolize carbohydrates; high fasting levels indicate insulin resistance and possible pre-diabetes.
- **Hemoglobin A1c** – long term (2-3 months) marker of glycemic control; also considered a marker of accelerated aging
- **C-peptide** – a measure of endogenous insulin production; useful in distinguishing between type 1 and type 2 diabetes
- **Adiponectin** – a hormone that enzymatically controls metabolism; high levels beneficial and indicate efficient cellular energy production
- **Metabolic syndrome traits** – A diagnosis of metabolic syndrome is confirmed if any three of the following five traits exist in a patient: (1) high triglycerides (2) high glucose (3) low HDL (4) high blood pressure (5) high waist circumference

### Blood Test Levels for Diagnosis of Diabetes and Pre-diabetes

<table>
<thead>
<tr>
<th>Test</th>
<th>Diabetes</th>
<th>Pre-Diabetes</th>
<th>Normal</th>
</tr>
</thead>
<tbody>
<tr>
<td>HbA1c (percent)</td>
<td>6.5 or above</td>
<td>5.7 to 6.4</td>
<td>About 5</td>
</tr>
<tr>
<td>Fasting Plasma Glucose (mg/dL)</td>
<td>126 or above</td>
<td>100 to 125</td>
<td>99 or below</td>
</tr>
<tr>
<td>Oral Glucose Tolerance Test (mg/dL)</td>
<td>200 or above</td>
<td>140 to 199</td>
<td>139 or below</td>
</tr>
</tbody>
</table>

Definitions: mg = milligram, dL = deciliter
For all these tests, within the pre-diabetes range, the higher the test result, the greater the risk of diabetes.
LIPID PROFILE

Lipid Profile indicates whether a person’s cholesterol-carrying lipoproteins are predominantly healthy or atherogenic. The Lipoprotein Particle Profile is particularly useful in stratifying cardiometabolic risk in asymptomatic people. SpectraCell’s report segments the Lipid Profile into a standard Lipid Panel & the gold standard Lipoprotein Particle Numbers.

Lipid Panel
The basic Lipid Panel is a very general marker for cardiometabolic risk. This standard lipid panel is helpful when viewed in the context of other biomarkers, particularly lipoprotein particle numbers. Lowering LDL-cholesterol is currently the primary target of treatment. However, elevated triglycerides and low HDL-cholesterol are highly associated with metabolic syndrome, which negatively impacts a pre-diabetic risk score.

- **Standard lipid panel** – Total cholesterol, HDL, LDL – Useful when viewed in conjunction with more clinically accurate lipoprotein particle testing
- **Triglycerides** – Elevated triglycerides promote the formation of atherogenic small, dense LDL (indicates abnormal lipoprotein metabolism) and cause endothelial dysfunction; a strong inverse correlation exists between triglycerides and heart protective HDL

Lipoprotein Particle Numbers
Measuring cholesterol alone is insufficient for accurately assessing cardiometabolic risk. SpectraCell’s Lipoprotein Particle Profile (LPP™) is an advanced technology which accurately measures both the density and number of lipoprotein particles. This information reveals potential cardiovascular problems that are often missed when only using a standard lipid panel to assess risk.

- **Lipoprotein Particle Profile** – accurately measures the number and density of all lipoprotein particles; helpful in determining the best treatment since the most effective treatment option varies depending on which lipoprotein is elevated
- **VLDL, LDL and non-HDL Particles** – accurate number of lipoprotein particles stratified by density and type
- **Remnant Lipoprotein** – highly atherogenic; causes platelet aggregation and impairs vascular relaxation
- **Small Dense LDL** – highly atherogenic; these are more dangerous because their small size allows them to more easily penetrate and damage the endothelial wall of blood vessels, thus contributing to atherosclerosis
- **HDL2b** – lipoproteins that indicate how well HDL is clearing excess cholesterol

Knowing the precise information about a patient’s lipoprotein is a critical step in establishing an effective treatment program.

Why is it important to know lipoprotein particle numbers?

Cardiovascular risk increases with a higher LDL particle count. With a higher non-HDL lipoprotein count the probability of particle penetration of the arterial wall rises regardless of the total amount of cholesterol contained in each particle. On average, the typical LDL particles contain 50 percent cholesterol.

More than 20 percent of the population has cholesterol-depleted LDL, a condition in which a patient’s cholesterol may be “normal” but their lipoprotein particle number; and hence their actual risk, could be much higher than expected. This is especially common in persons whose triglycerides are high and HDL is low. In the population with a cholesterol-depleted LDL, there can be up to a 40 percent error in risk assessment.

*SpectraCell Laboratories’ LPP™ test provides physicians with the actual LDL particle count, allowing healthcare providers to accurately determine and diagnose cardiovascular risk in their practice.*
# Lipoprotein Particle Testing Therapeutic Guidelines

<table>
<thead>
<tr>
<th>Lipoprotein Abnormality</th>
<th>Lifestyle Changes (diet &amp; exercise)</th>
<th>Statins</th>
<th>Niacin</th>
<th>Fibrates</th>
<th>Oral Estrogens</th>
<th>Resins</th>
<th>Absorption Inhibitors</th>
<th>Omega-3's EPA &amp; DHA</th>
<th>Alcohol (moderate)</th>
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<tbody>
<tr>
<td>VLDL (Triglycerides)</td>
<td>♥</td>
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<td>♥</td>
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<td>x</td>
<td>♥</td>
<td>♥♥</td>
<td>♥</td>
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<tr>
<td>RLP (IDL)</td>
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<td>♥</td>
<td>♥</td>
<td>♥</td>
<td>x</td>
<td>x</td>
<td>♥</td>
<td>♥♥**</td>
<td>♥</td>
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<tr>
<td>LDL I &amp; II Buoyant</td>
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<td>♥</td>
<td>□</td>
<td>♥</td>
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<tr>
<td>LDL III - Dense</td>
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<td>♥</td>
<td>□</td>
<td>♥♥</td>
<td>♥</td>
<td>♥</td>
<td>□</td>
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<tr>
<td>LDL IV - or Lp(a)</td>
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<td>□</td>
<td>□</td>
<td>x**</td>
<td>□</td>
<td>□</td>
<td>□</td>
<td>□</td>
<td>□</td>
</tr>
<tr>
<td>HDL 2b - Buoyant</td>
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<td>□</td>
<td>♥</td>
<td>□</td>
<td>□</td>
<td>□</td>
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<td>♥</td>
</tr>
<tr>
<td>HDL 2a &amp; 3</td>
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<td>♥</td>
<td>□</td>
<td>□</td>
<td>□</td>
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</tbody>
</table>

*These guidelines provide some of the treatment options available to modify abnormal lipoprotein results determined by the LPP™ test.

**SpectraCell Laboratories observed response to treatment.

The National Cholesterol Education Program (NCEP) guidelines provide dosage information on the treatment options.

REFERENCES AVAILABLE ON REVERSE
Metabolic dysfunction is both a cause and result of inflammation, which accelerates progression to diabetes or cardiovascular disease if not addressed.

- **ApoB100** – a measure of all atherogenic lipoprotein particles in the bloodstream since every molecule of harmful LDL has exactly one, and only one ApoB100 attached to it
- **Lp(a)** – extremely atherogenic; inhibits the formation of plasmin, an enzyme that dissolves blood clots which explains its strong link to thrombosis (blood clots)
- **C-Reactive Protein** – an acute phase protein that occurs in response to inflammation; high CRP, regardless of cause, is strongly correlated to risk of sudden death from heart attack
- **Homocysteine** – a metabolic intermediate, this protein is dangerous at high levels because it is an indicator of poor methylation (detoxification) ability; acts as an arterial abrasive; high levels linked to diseases of “aging” including heart disease, stroke and dementia

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1. **Small, Dense LDL**
   - It is three times more atherogenic than buoyant LDL because they more easily penetrate the arterial endothelium.

2. **RLP (Remnant Lipoprotein)**
   - Is readily scavenged by macrophage cells without having to be oxidized (like other LDL) and becomes a major component of plaque.

3. **Lp(a)**
   - Are LDLs that are easily oxidized. Lp(a) is prothrombotic and very atherogenic.

4. **HDL Removes Excess Lipids**
   - HDL2b, which is formed from HDL3, is an indicator of how well HDL is clearing excess cholesterol from the body.

5. **LDL Oxidation**
   - Is when LDL is oxidized in the intima of the vessel wall and is scavenged by macrophage cells to form foam cells. The foam cells are the building blocks of plaque. Antioxidants, measured by Spectrox®, can retard LDL oxidation.
**Who Should Be Tested?**
The American Diabetic Association encourages those who are overweight or obese to be tested. However, people who are not overweight or obese should begin testing at age 45, and even more so if they have these risk factors:

- Being physically inactive
- Immediate family history of cardiovascular disease
- Gestational Diabetes – baby more than 9 lbs
- Blood pressure > 135/85 – or on treatment for hypertension
- HDL < 40 or tryglycerides > 150
- Polycystic Ovary Syndrome
- Insulin Resistance or Glucose Intolerance
- Ethnicity of African American, Alaska Native, American Indian, Asian American, Hispanic/Latino, Pacific Islander American

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**The Role of Nutrition**
Nutrition is the foundation upon which health exists. Conversely, nutritional deficiencies will inevitably compromise health, sometimes subtly and often dramatically. Too often dismissed, the link between micronutrient status and metabolic and cardiovascular health should not be underestimated.

Every metabolic step in our biochemistry requires vitamins and minerals to operate optimally. Building tissues, removing toxins, protecting cells — all metabolic reactions require enzymes, which themselves require co-enzymes and co-factors. Vitamins (B vitamins, folate, choline, etc) are the necessary coenzymes. Minerals (magnesium, zinc, copper, etc) are the necessary cofactors. Without the necessary micronutrients, metabolism is compromised and disease can develop.

In addition to their key role as coenzymes and cofactors, nutrients regulate gene expression, build hormones, remove rogue cells and enhance immunity. According to Dr. Bruce Ames, Professor of Biochemistry and Molecular Biology, University of California, Berkeley, his “triage theory” of nutrition suggests that low micronutrient intake may accelerate the degenerative diseases of aging such as cancer, heart disease and diabetes because our cells will allocate deficient nutrients to areas with immediate biological needs. When nutrition is not optimal, our bodies will adapt and sacrifice longer term metabolic health. Consequences include DNA breakage, reduced immunity, unchecked oxidative stress and metabolic dysfunction.

SpectraCell’s Micronutrient Test identifies exactly which nutrient deficiencies exist in a patient. The functional performance of over 35 vitamins, minerals, antioxidants, amino acids and metabolites is measured. As a result, differences in metabolism, age, genetics, illness or injury, absorption rate, prescription drug usage and lifestyle are automatically taken into consideration so a targeted and specific treatment plan can be developed for repletion.
**CardioMetabolic Report**

<table>
<thead>
<tr>
<th>Patient Name:</th>
<th>Doe, Jon</th>
<th>BMI:</th>
<th>33</th>
<th>Batch Number:</th>
<th>B0000</th>
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<td>Patient DOB:</td>
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<td>Gender:</td>
<td>M</td>
<td>Accession Number:</td>
<td>M00000</td>
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<td>Physician</td>
<td>John Doe, MD</td>
<td></td>
<td></td>
<td>Date Received:</td>
<td>10/31/2014</td>
</tr>
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<td></td>
<td></td>
<td></td>
<td></td>
<td>Report Date:</td>
<td>11/3/2014</td>
</tr>
</tbody>
</table>

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**CardioMetabolic Risk Score**

This score is a way to estimate your risk of developing diabetes and associated complications such as heart disease or stroke. It is based upon your test results in the pre-diabetes and lipoprotein profile sections of this report, which are indicators of your ability to metabolize food (glycemic control) and transport fats (lipoproteins) in your blood. The following tests have the largest impact on your pre-diabetes risk score: hemoglobin A1c, fasting blood sugar and metabolic syndrome traits. Factors that significantly affect your pre-diabetic risk but that are not included in this risk score include weight, blood pressure (hypertension), smoking, inflammation and family history.

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### Pre-Diabetes Risk Factors

<table>
<thead>
<tr>
<th>Test</th>
<th>Patient Results</th>
<th>Reference Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Insulin (µIU/mL)</td>
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<td></td>
</tr>
<tr>
<td>2.0</td>
<td>11.5</td>
<td>21.0</td>
</tr>
<tr>
<td>Glucose (mg/dL)</td>
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</tr>
<tr>
<td>30.0</td>
<td>73.0</td>
<td>115</td>
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<tr>
<td>Metabolic Syndrome Traits</td>
<td></td>
<td></td>
</tr>
<tr>
<td>0</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Hemoglobin A1c (%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.0</td>
<td>5.0</td>
<td>9.0</td>
</tr>
<tr>
<td>Adiponectin (µg/ml) *</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.0</td>
<td>19.5</td>
<td>31.0</td>
</tr>
<tr>
<td>C-Peptide (ng/mL)</td>
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</tr>
<tr>
<td>0.0</td>
<td>2.50</td>
<td>5.00</td>
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</table>

### Clinical Indications: Pre-Diabetes Biomarkers

These tests identify metabolic abnormalities that may progress into diabetes. Pre-diabetes is a condition where the body cannot efficiently metabolize foods, especially carbohydrates, resulting in impaired glycemic (blood sugar) control. Fasting glucose is a snapshot of blood sugar levels at the time your blood is collected. Hemoglobin A1C reflects your blood glucose levels over the prior three months. Prolonged elevated blood sugar will raise your hemoglobin A1C. Metabolic syndrome traits increase if you have any of the following: elevated triglycerides, low HDL or high small-dense LDL. Adiponectin is a beneficial hormone that promotes healthy metabolism of carbohydrates (sugars) and triglycerides (fats).

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### Lipid Panel (mg/dL)

<table>
<thead>
<tr>
<th>Test</th>
<th>Patient Results</th>
<th>Reference Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cholesterol (mg/dL)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>0</td>
<td>100</td>
<td>200</td>
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<tr>
<td>Triglycerides (mg/dL)</td>
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<td></td>
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<tr>
<td>0</td>
<td>75</td>
<td>150</td>
</tr>
<tr>
<td>HDL (mg/dL)</td>
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<td></td>
</tr>
<tr>
<td>80</td>
<td>80</td>
<td>40</td>
</tr>
<tr>
<td>LDL (mg/dL)</td>
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<td></td>
</tr>
<tr>
<td>0</td>
<td>65</td>
<td>130</td>
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<tr>
<td>Non-HDL Cholesterol (nmol/L)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>0</td>
<td>80</td>
<td>160</td>
</tr>
</tbody>
</table>

### Clinical Indications: Lipid Panel

The basic Lipid Panel is a very general marker for cardiometabolic risk. This lipid panel directly measures cholesterol, not lipoproteins (which carry cholesterol.) It is now recognized that measuring lipoproteins is a more accurate and precise way to evaluate your cardiometabolic risk than measuring cholesterol since cholesterol values are normal in over 50% of people who have a heart attack or stroke. But this standard lipid panel is helpful when viewed in the context of other biomarkers, particularly your lipoprotein particle numbers. Lowering LDL-cholesterol is currently the primary target of treatment. However, elevated triglycerides and low HDL-cholesterol are highly associated with metabolic syndrome, which negatively impacts your pre-diabetic risk score.
**Vascular Inflammation and Biomarkers**

These factors are important determinants of cardiometabolic risk, particularly with respect to vascular inflammation (health of blood vessels). Apo-B (apolipoprotein B100) is a measure of all atherogenic (harmful) lipoprotein particles in the blood. Lp(a) is an extremely atherogenic lipoprotein that is strongly linked to developing thrombosis (blood clots). C-reactive protein (CRP) is an indicator of inflammation throughout the body, including the cardiovascular system. Regardless of the cause, both physical and mental stressors, infections and low grade chronic inflammation can all raise CRP, which increases cardiometabolic risk. Finally, homocysteine is a harmful protein that indicates a person’s ability to methylate (detoxify) substances in the body. Elevated homocysteine is linked to thrombosis, thyroid dysfunction and Alzheimers disease (dementia).

**Clinical Indications: Vascular Inflammation and Biomarkers**

<table>
<thead>
<tr>
<th>Test</th>
<th>Patient Results</th>
<th>Reference Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>CRP-hs (mg/L)</td>
<td></td>
<td>3.79 &lt;3.00</td>
</tr>
<tr>
<td>Lipoprotein(a) (mg/dL)</td>
<td></td>
<td>22.1 6.0 - 29.9</td>
</tr>
<tr>
<td>Apolipoprotein B (mg/dL)</td>
<td></td>
<td>124 40 - 100</td>
</tr>
<tr>
<td>Homocysteine (umol/L)</td>
<td></td>
<td>11.9 &lt;11.0</td>
</tr>
</tbody>
</table>

**Lipoprotein Particle Numbers (nmol/L)**

It is now recognized that measuring cholesterol, which is carried by lipoproteins, is insufficient for accurately quantifying a person’s cardiometabolic risk. Lipoproteins are significant factors in causing heart disease and stroke and your lipoprotein particle numbers are clinically relevant. In particular, elevated small-dense LDL and RLP are the most strongly linked to heart attack and stroke. Conversely, large-buoyant HDL2b indicates how well HDL is clearing excess cholesterol from the body. This information reveals potential cardiovascular problems that are often missed when only using a standard lipid panel to assess risk.

**Clinical Indications: Lipoprotein Particle Numbers**

<table>
<thead>
<tr>
<th>Test</th>
<th>Patient Results</th>
<th>Reference Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>VLDL Particles (nmol/L)</td>
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<td>87 &lt;85</td>
</tr>
<tr>
<td>Total LDL Particles (nmol/L)</td>
<td></td>
<td>1282 &lt;900</td>
</tr>
<tr>
<td>Total HDL Particles (nmol/L)</td>
<td></td>
<td>7832 &gt;7000</td>
</tr>
<tr>
<td>Non-HDL Particles (nmol/L)</td>
<td></td>
<td>1369 &lt;1000</td>
</tr>
<tr>
<td>Remnant Lipoprotein (nmol/L)</td>
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<td>172 &lt;150</td>
</tr>
<tr>
<td>Dense LDL III (nmol/L)</td>
<td></td>
<td>481 &lt;300</td>
</tr>
<tr>
<td>Dense LDL IV (nmol/L)</td>
<td></td>
<td>104 &lt;100</td>
</tr>
<tr>
<td>Buoyant HDL 2b (nmol/L)</td>
<td></td>
<td>2017 &gt;1500</td>
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</tbody>
</table>

**Comments:** See Micronutrient Test report for additional vitamin, mineral, antioxidant and other micronutrients contributing to pre-diabetes risk and lipid risk factors.

* For research use only
### CardioMetabolic Report

**Patient Name:** Doe, Jon  
**BMI:** 33  
**Batch Number:** B0000  
**Patient DOB:** 5/10/1946  
**Gender:** M  
**Accession Number:** M0000  
**Physician:** John Doe, MD  
**Date Received:** 10/31/2014  
**Report Date:** 11/3/2014

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#### CardioMetabolic Risk Score

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<th>Test Component</th>
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<th>Reference Range</th>
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<td>Glucose (mg/dL)</td>
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<td>Hemoglobin A1c (%)</td>
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<td>Adiponectin (ug/ml) *</td>
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<td>C-Peptide (ng/mL)</td>
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<td>Triglycerides (mg/dL)</td>
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<td>HDL (mg/dL)</td>
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<td>LDL (mg/dL)</td>
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<td>VLDL Particles (nmol/L)</td>
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<td>40 - 100</td>
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<tr>
<td>Homocysteine (umol/L)</td>
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<td>11.9</td>
<td>&lt;11.0</td>
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* For research use only
### Lipoprotein Particle Numbers (nmol/L)

<table>
<thead>
<tr>
<th>Particle Type</th>
<th>Value</th>
<th>Reference Value</th>
<th>Alert (Notes Page 5)</th>
</tr>
</thead>
<tbody>
<tr>
<td>VLDL Particles</td>
<td>67</td>
<td>&lt;85</td>
<td>Borderline High (12)</td>
</tr>
<tr>
<td>Total LDL Particles</td>
<td>1202</td>
<td>&lt;900</td>
<td>Very High (13)</td>
</tr>
<tr>
<td>Non-HDL Particles</td>
<td>1369</td>
<td>&lt;1000</td>
<td>High (19)</td>
</tr>
<tr>
<td>RLP (Remnant Lipoprotein)</td>
<td>172</td>
<td>&lt;150</td>
<td>Borderline High (14)</td>
</tr>
<tr>
<td>Small-Dense LDL III</td>
<td>481</td>
<td>&lt;300</td>
<td>High (15)</td>
</tr>
<tr>
<td>Small-Dense LDL IV &amp; HDL 2b</td>
<td>104</td>
<td>&lt;100</td>
<td>Borderline High (16)</td>
</tr>
<tr>
<td>Total HDL Particles</td>
<td>7832</td>
<td>&gt;7000</td>
<td>Borderline-M, Low-F (17)</td>
</tr>
<tr>
<td>Large Buoyant HDL 2b</td>
<td>2017</td>
<td>&gt;1500</td>
<td></td>
</tr>
</tbody>
</table>

### Biomarkers and Risk Factors

<table>
<thead>
<tr>
<th>Biomarker</th>
<th>Value</th>
<th>Reference Value</th>
<th>Alert (Notes Page 5)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Apo B-100 (mg/dL)</td>
<td>124</td>
<td>40 - 100</td>
<td>High (20)</td>
</tr>
<tr>
<td>Lp(a) (mg/dL)</td>
<td>22.1</td>
<td>6.0 - 29.9</td>
<td></td>
</tr>
<tr>
<td>Metabolic Syndrome Traits</td>
<td>1</td>
<td>Zero</td>
<td>Possible (8)</td>
</tr>
<tr>
<td>C-Reactive Protein-hs (mg/L)</td>
<td><strong>3.3</strong></td>
<td>&lt;3.0</td>
<td>High (9)</td>
</tr>
<tr>
<td>Insulin (uU/mL)</td>
<td>7.7</td>
<td>2.0 - 21.0</td>
<td></td>
</tr>
<tr>
<td>Homocysteine (umol/L)</td>
<td>11.9</td>
<td>&lt;11.0</td>
<td>Borderline High (11)</td>
</tr>
</tbody>
</table>

### Lipid Panel (mg/dL)

<table>
<thead>
<tr>
<th>Lipid Type</th>
<th>Value</th>
<th>Reference Value</th>
<th>Alert (Notes Page 5)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Cholesterol</td>
<td>228</td>
<td>&lt;200</td>
<td>Borderline High (1)</td>
</tr>
<tr>
<td>LDL-Cholesterol</td>
<td><strong>160</strong></td>
<td>40 - 130</td>
<td>Very High (2)</td>
</tr>
<tr>
<td>HDL-Cholesterol</td>
<td>48</td>
<td>&gt;40</td>
<td>Borderline (3)</td>
</tr>
<tr>
<td>Triglycerides</td>
<td>116</td>
<td>30 - 150</td>
<td></td>
</tr>
<tr>
<td>Non-HDL-Chol (calc)</td>
<td>152</td>
<td>&lt;160</td>
<td>High (5)</td>
</tr>
</tbody>
</table>

1. Reference Value for Blacks is 50.0 mg/dL
2. Reference Value for Insulin has changed on 2-20-14

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The Role of Nutrition in Diabetes

**Vitamin B12**
Deficiency common in diabetics because metformin depletes B12.1,2

**Chromium**
Helps insulin attach to cell’s receptors increasing glucose uptake into cell; Deficiency can cause insulin resistance; Supplementation trials show dose-dependent benefits for type II diabetics.3,7,8

**Biotin**
Stimulates glucose-induced insulin secretion in pancreatic B-cells; High dose biotin can improve glycemic control in diabetics.21,24,25

**Magnesium**
Deficiency reduces insulin sensitivity; Low magnesium exacerbates foot ulcers in diabetics.21,22

**Zinc**
Needed in the synthesis, storage and secretion of insulin; Protects pancreatic B-cells from damage; Affects the expression of genes linked to diabetes.29,30

**Lipoic Acid**
Enhances glucose uptake in skeletal muscle tissue; Improves glucose tolerance in type 2 diabetics; Very effective treatment for diabetic neuropathy.26,27,28

**Glutathione & Cysteine**
Glutathione-containing enzymes protect B-cells which are particularly sensitive to oxidative stress; Type 2 diabetics have abnormal antioxidant status; Supplementation with the glutathione precursor cysteine restores antioxidant status.31,24,25

**Vitamin B3**
Preserves B-cell function in type I diabetics; Part of GTF (glucose tolerance factor) which facilitates insulin binding.3,4,5

**Vitamin D**
Lowers risk of type 1 and 2 diabetes; Supresses inflammation of pancreatic B-cells; Vitamin D receptor gene linked to diabetes.6,7,8

**Vitamin B6**
Preserves B-cell function in type 1 diabetics; Part of GTF (glucose tolerance factor) which facilitates insulin binding.3,4,5

**Vitamin E**
Confers protection against diabetes by protecting pancreatic B-cells from oxidative stress induced damage; May prevent progression of type 1 diabetes.6,8

**Vitamin C**
Lowers glycosylated hemoglobin (HbA1c) and fasting and post-meal glucose levels and in type 2 diabetics.10,11,12

**Inositol**
Evidence suggests that inositol may be effective in treating diabetic neuropathy.13,14

**Carnitine**
Reduces and even prevents pain from diabetic neuropathy; Improves insulin sensitivity by increasing glucose uptake and storage.15,16,17,18

**Glutamine**
Stimulates a hormone called GLP-1 (glucagon-like peptide 1) that regulates insulin secretion after meals; Improves insulin signaling and sensitivity.19,20

**Coenzyme Q10**
Reduces and even prevents pain from diabetic neuropathy; Improves insulin sensitivity by increasing glucose uptake and storage.15,16,17,18

**Vitamin B12**
Because metformin depletes B12.1,2

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**The Role of Nutrition in Dyslipidemia**

**Manganese**
Cofactor to an antioxidant (superoxide dismutase) that repairs damage to blood vessels caused by oxidized LDL (low density lipoprotein).

**Magnesium**
Deficiency causes pro-atherogenic (heart-disease causing) changes in lipoprotein metabolism; Protects LDL (low density lipoprotein) from being oxidized.

**Vitamin C**
Protects LDL from oxidation, thus making it less "sticky" and prone to atherosclerosis (clogging of arteries); Prevents white blood cells (monocytes) and oxidized LDL from sticking to blood vessel wall; Lowers Lp(a) in some people.

**Vitamin D**
Suppresses foam cell formation thus reducing risk of lipid-related arterial blockages; Deficiency linked to dyslipidemia.

**Zinc**
Suboptimal zinc raises dangerous lipoproteins that promote vascular inflammation and arterial plaque formation; Cellular zinc controls the gene that makes heart-protective HDL (high density lipoprotein). Cellular zinc controls the gene that makes heart-protective HDL (high density lipoprotein).

**Selenium**
Prevents post-prandial (after a meal) changes in lipoproteins that make them susceptible to oxidation and thus harmful.

**Copper**
Several copper-dependent enzymes affect lipoprotein metabolism; Deficiency contributes to fatty buildup in arteries caused by dyslipidemia.

**Coenzyme Q10**
It is well established that statins, often prescribed for dyslipidemia, deplete CoQ10; Lowers Lp(a).

**Chromium**
Specifically improves the dyslipidemia that accompanies insulin resistance; May increase HDL; Synergistic effect with niacin (B3) for dyslipidemia.

**Choline**
Regulates HDL metabolism; Part of the enzyme lecithin-cholesterol acyltransferase that has a major impact on lipoprotein metabolism.

**Inositol**
Decreases small, dense LDL especially in patients with metabolic syndrome; Lowers triglycerides.

**Lipoic Acid**
Improves lipid profile by reducing small, dense LDL (dangerous type); Protects vascular lining from oxidized cholesterol.

**Vitamin B3**
Niacin (B3) effectively lowers the highly atherogenic Lp(a) by decreasing its rate of synthesis in the liver.

**Vitamin B5**
Favorably alters low density lipoprotein metabolism and reduces triglycerides; Full benefit of lipid lowering effects may not be seen for up to four months.

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The Role of Nutrition in Inflammation

**Selenium**
- Subclinical deficiency negatively alters genes that regulate the inflammatory response.
- Deficiency promotes vascular inflammation.

**Copper**
- Deficiency lowers enzyme activity (such as superoxide dismutase) that fights inflammation.
- Lowers damaging isoprostanes, a by-product of inflammation.

**Zinc**
- Inflammation raises demand for zinc.
- Pro-inflammatory chemicals (cytokines) dose dependently decrease in response to zinc repletion.

**Vitamin A**
- Regulates the cellular immune response to inflammatory signals.
- Deficiency increases the severity of chronic inflammation.
- Zinc depletion lowers vitamin A status.

**Vitamin B6**
- Riboflavin (B2) helps minimize pain associated with inflammation.
- Detoxifies homocysteine, an amino acid that indirectly causes inflammation in various tissues.

**Coenzyme Q10**
- Decreases several inflammatory markers (CRP and IL-6) in supplementation trials.
- Affects genes that control response to inflammatory stress.

**Selenium**
- Cofactor to the powerful antioxidant superoxide dismutase that fights inflammation within cells.

**Magnesium**
- Deficiency activates pro-inflammatory chemicals called cytokines.
- Deficiency will also kick start a damaging immune response by activating cells called leukocytes and macrophages.

**Glutathione**
- Repairs damage to cells caused by inflammation.
- Regulates the production of pro-inflammatory cytokines.
- Recycles vitamins C and E.

**Cysteine**
- Protects organs such as blood vessels, brain and liver from inflammatory damage.
- Precursor to glutathione production.
- Supplementation with N-acetyl cysteine raises glutathione.

**Vitamin C**
- Inversely related to C-reactive protein.
- Increases glutathione.

**Copper**
- Deficiency lowers enzyme activity (such as superoxide dismutase) that fights inflammation.
- Lowers damaging isoprostanes, a by-product of inflammation.

**Vitamin B6**
- Low B6 status is linked to high levels of CRP and systemic inflammation.

**Vitamin B2**
- Amino acid that indirectly causes inflammation.

**Coenzyme Q10**
- Decreases several inflammatory markers (CRP and IL-6) in supplementation trials.
- Affects genes that control response to inflammatory stress.

**Glutamine**
- Decreases cytokine production.
- Invokes an anti-inflammatory response.
- Precursor to glutathione.

**Lipoic Acid**
- Neutralizes free radicals caused by uncontrolled inflammation in both water and lipid phases of the cell.
- Protects endothelial cells from inflammation.
- Regenerates other antioxidants such as vitamin E, C and glutathione.

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