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 pre-diabetes 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

Metabolic Risk

- Insulin
- Glucose
- Hemoglobin A1C
- C-Peptide
- Adiponectin
- Metabolic Syndrome Traits
- SpectraCell's unique Pre-Diabetes 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

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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.

Blood Test Levels for Diagnosis of Diabetes and Pre-diabetes

	A1C (percent)	Fasting Plasma Glucose (mg/dL)	Oral Glucose Tolerance Test (mg/dL)
Diabetes	6.5 or above	126 or above	200 or above
Pre-Diabetes	5.7 to 6.4	100 to 125	140 to 199
Normal	About 5	99 or below	139 or below

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.

> "Studies have shown that most people diagnosed with pre-diabetes develop type 2 diabetes within 10 years, unless they change their lifestyle."

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 pre-diabetes 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 ezymatically 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

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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 contains 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.

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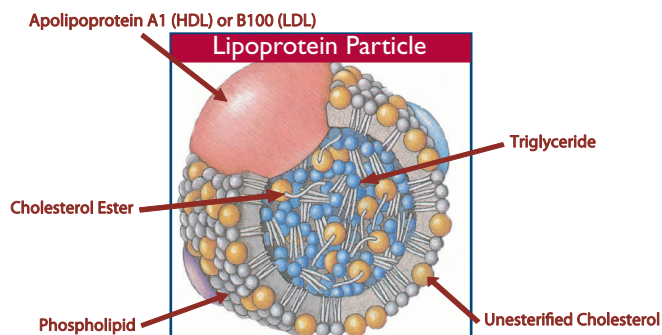
VASCULAR INFLAMMATION

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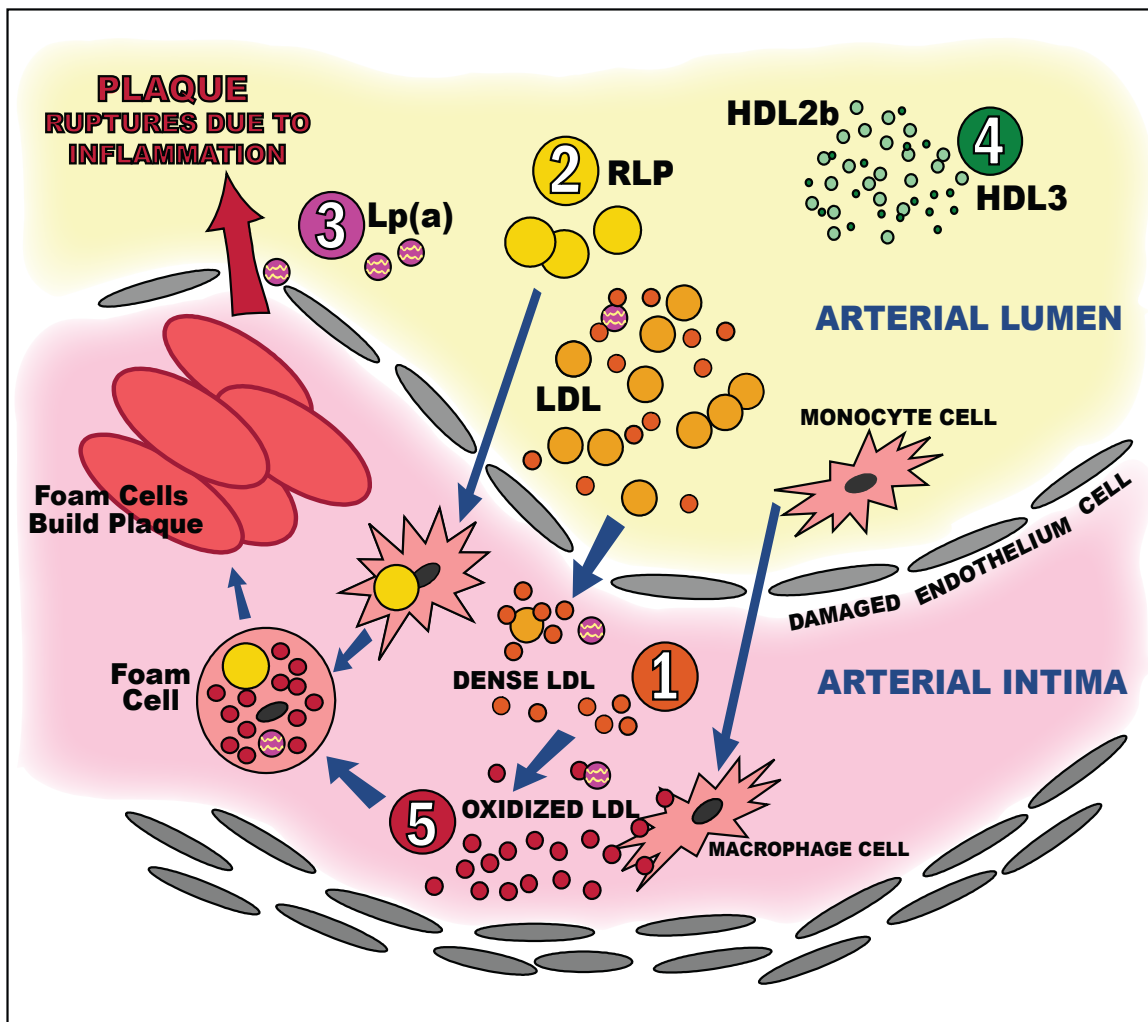
1. Small, Dense LDL
it is three times more atherogenic than buoyant LDL because they more easily penetrate the arterial endothelium.

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.

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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

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.

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