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MAYO CLINIC LABORATORIES

Test Definition: CRMP1

Cardiovascular Risk Marker Panel, Serum

Overview

Useful For

Assessment for risk of developing cardiovascular disease, major adverse cardiovascular events, or ischemic cerebrovascular events

Profile Information

Test Id	Reporting Name	Available Separately	Always Performed
CLDL1	Cholesterol, LDL, Calculated, S	No	Yes
NHDCH	Cholesterol, Non-HDL, Calculated, S	No	Yes
APOLB	Apolipoprotein B, S	Yes	Yes
HDCH	Cholesterol, HDL, S	Yes	Yes
CHOL	Cholesterol, Total, S	Yes	Yes
TRIG	Triglycerides, S	Yes	Yes
LIPA1	Lipoprotein(a), S	Yes	Yes
HSCRP	C-Reactive Protein, High Sens, S	Yes	Yes
CVINT	Interpretation	No	Yes
INTC1	Fasting (8 HR or more)	No	Yes

Method Name

LIPA1, HSCRP, APOLB: Immunoturbidimetry Assay
CHOL, TRIG, HDCH: Enzymatic Colorimetric
CLDL1, HNDCH: Calculation

NY State Available

Yes

Specimen

Specimen Type

Serum

Specimen Required

Patient Preparation:

Fasting: 12 hours, preferred but not required unless directed by the ordering provider.

Collection Container/Tube:

Preferred: Serum gel
Acceptable: Red top
Submission Container/Tube: Plastic vial
Specimen Volume: 2.5 mL
Collection Instructions: Centrifuge and aliquot serum into a plastic vial. Send refrigerated.

Forms

If not ordering electronically, complete, print, and send a Cardiovascular Test Request Form (T724) with the specimen.

Specimen Minimum Volume

1.25 mL

Reject Due To

Gross hemolysis	Reject
Gross lipemia	Reject
Gross icterus	Reject

Specimen Stability Information

Specimen Type	Temperature	Time	Special Container
Serum	Refrigerated (preferred)	7 days	
	Frozen	30 days	

Clinical & Interpretive

Clinical Information

Lipoprotein cholesterol measures are essential in managing risk for atherosclerotic cardiovascular disease (ASCVD). Atherosclerosis is defined by a buildup of plaque within arterial walls. ASCVD includes coronary heart disease, strokes, and peripheral artery disease. ASCVD develops over decades and is often asymptomatic until the patient experiences a life-threatening event such as a heart attack, stroke, or aneurysm.

Cholesterol is a lipid that is synthesized in most tissues and actively absorbed from the diet. There is a strong association between serum cholesterol concentrations and cardiovascular disease. Cholesterol is carried in the blood by lipoproteins. Some lipoproteins carry a stronger risk of cardiovascular disease while others are associated with reduced cardiovascular risk. Total cholesterol concentration includes the sum of all "good" and "bad" cholesterol. Therefore, total cholesterol is recommended to be interpreted in context of a lipid panel that includes high-density lipoprotein cholesterol (HDL-C) and triglyceride measures.

Low-density lipoprotein cholesterol (LDL-C) is the primary lipoprotein responsible for atherogenic plaque. Very low-density lipoprotein cholesterol (VLDL-C) is also atherogenic and the combination of LDL-C and VLDL-C is called non-HDL-C and often referred to as "bad" cholesterol. Serum total cholesterol, LDL-C and non-HDL-C are all directly associated with risk for ASCVD.

HDL-C is associated with lower risk of cardiovascular disease. Excess cholesterol is actively pumped into HDL to be carried in the blood circulation and cleared by the liver in a process known as reverse cholesterol transport. For these reasons, HDL-C is often referred to as "good" cholesterol.

Triglycerides are oily lipids carried in the blood by lipoproteins. Triglycerides are primarily carried by VLDL, chylomicrons and remnant lipoproteins. Recent evidence supports triglycerides as an independent risk factor for ASCVD. Several conditions are associated with increased plasma triglycerides, including obesity, pregnancy, physical inactivity, excess alcohol intake, kidney disease, and diabetes. Elevated triglycerides are often associated with reduced HDL-C, insulin resistance, hypertension, fatty liver disease, and increased waist circumference. In addition to cardiovascular risk, elevated triglycerides confer a risk for acute pancreatitis.

Apolipoprotein B (ApoB), high-sensitivity C-reactive protein (hsCRP), and lipoprotein (a) (Lp[a]) are serological risk factors endorsed by multiple international guidelines for use in cardiovascular disease risk assessment. Several recent guidelines have suggested that clinicians utilize ApoB, hsCRP, and Lp(a) in selected persons to augment risk classification, guide intensity of risk-reduction therapy, and modulate clinical judgment when making therapeutic decision.(1-3)

Reference Values

Age	2-17 years	> or =18 years
CALCULATED NON-HDL CHOLESTEROL (mg/dL)	** Acceptable: <120 Borderline High: 120-144 High: > or =145	* Desirable: <130 mg/dL Above Desirable: 130-159 mg/dL Borderline High: 160-189 mg/dL High: 190-219 mg/dL Very high: > or =220 mg/dL
CALCULATED LDL CHOLESTEROL (mg/dL)	** Acceptable: <110 Borderline High: 110-129 High: > or =130	*** Desirable: <100 Above Desirable: 100-129 Borderline High: 130-159 High: 160-189 Very high: > or =190
HDL CHOLESTEROL (mg/dL)	** Low: <40 Borderline Low: 40-45 Acceptable: > 45	*** Males: > or =40 Females: > or =50
TOTAL CHOLESTEROL (mg/dL)	** Acceptable: <170 Borderline High: 170-199 High: > or =200	* Desirable: < 200 Borderline High: 200 - 239 High: > or = 240
LIPOPROTEIN (a) (nmol/L)	Not established	< 75 nmol/L Values >= 75 nmol/L may suggest increased risk of coronary heart disease.
C-REACTIVE PROTEIN,	*	*

HIGH SENSITVITY	Lower risk: <2.0 mg/L Higher risk: >=2.0 mg/L Acute inflammation: >10.0 mg/L	Lower risk: <2.0 mg/L Higher risk: >=2.0 mg/L Acute inflammation: >10.0 mg/L
APOLIPOPROTEIN B(mg/dL)	Acceptable: <90 Borderline High: 90-109 High: > or =110	Desirable: <90 Above Desirable: 90-99 Borderline High: 100-119 High: 120-139 Very High: > or =140

Age	2-9 years	10-17 years	> or =18 years
TRIGLYCERIDES (mg/dL)	** Acceptable: <75 Borderline High: 75-99 High: > or =100	** Acceptable: <90 Borderline High: 90-129 High: > or =130	* Normal: <150 Borderline High: 150-199 High: 200-499 Very High: > or =500

*National Lipid Association 2014
**Expert Panel on Integrated Guidelines for Cardiovascular Health and Risk Reduction in Children and Adolescents
***National Cholesterol Education Program (NCEP)

Interpretation

Maintaining desirable concentrations of lipids lowers atherosclerotic cardiovascular disease risk. Establishing appropriate treatment strategies and lipid goals require that blood lipid values be considered in context with other risk factors including, age, sex, smoking status, and medical history of hypertension, diabetes, and cardiovascular disease.

Triglycerides results of 500 mg/dL or above are severely elevated increasing the risk of pancreatitis.
Triglycerides can be lowered by increasing physical activity, low-fat diet, weight loss and/or triglyceride lowering pharmaceuticals.

Low high-density lipoprotein cholesterol (HDL-C) is a risk factor for cardiovascular disease.
HDL-C can be increased by the same lifestyle changes that reduce risk for cardiovascular disease; physical activity, smoking cessation, and eating healthier. However, medications that specifically increase HDL levels have failed to reduce cardiovascular disease.
Extremely low HDL values (<20 mg/dL) may indicate liver disease or inherited dyslipidemia.

Low-density lipoprotein cholesterol results of 190 mg/dL or above in adults (> or =160 mg/dL in children) are severely elevated and may indicate familial hypercholesterolemia.

For non-HDL cholesterol results of 220 mg/dL or above, consider possible inherited hyperlipidemia.

Cautions

Consuming alcohol or fatty foods 24 hours prior to specimen collection can increase serum triglycerides.

Eating a meal 12 hours prior to specimen collection can increase serum triglycerides.

Calculated low-density lipoprotein cholesterol is not applicable when triglycerides are greater than 800 mg/dL.

Consider repeat measurement of lipids prior to initiating or changing lipid therapy.
Result can be falsely decreased in patients with elevated levels of N-acetyl-p-benzoquinone imine -a metabolite of acetaminophen, N-acetylcysteine , and metamizole.

Clinical Reference

1. Grundy SM, Stone NJ, Bailey AL, et al: 2018 AHA/ACC/AACVPR/AAPA/ABC/ACPM/ADA/AGS/APhA/ASPC/NLA/PCNA Guideline on the Management of Blood Cholesterol: A Report of the American College of Cardiology/American Heart Association Task Force on Clinical Practice Guidelines. Circulation. 2019 Jun 18;139(25):e1082-e1143
2. Jacobson TA, Ito MK, Maki KC, et al: National Lipid Association recommendations for patient-centered management of dyslipidemia: Part 1-executive summary. J Clin Lipidol. 2014 Sep-Oct;8(5):473-488. doi: 10.1016/j.jacl.2014.07.007
3. Expert Panel on Integrated Guidelines for Cardiovascular Health and Risk Reduction in Children and Adolescents; National Heart, Lung, and Blood Institute. Expert panel on integrated guidelines for cardiovascular health and risk reduction in children and adolescents: Summary report. Pediatrics. 2011 Dec;128 Suppl 5(Suppl 5):S213-S256. doi: 10.1542/peds.2009-2107C
4. Sampson M, Ling C, Sun Q, et al: A new equation for calculation of low-density lipoprotein cholesterol in patients with normolipidemia and/or hypertriglyceridemia. JAMA Cardiol. 2020 May 1;5(5):540-548

Performance

Method Description

The following calculations are performed in the laboratory information system, SCC Soft.
Non-high-density lipoprotein (HDL) cholesterol = Total cholesterol – HDL cholesterol
Low-density lipoprotein (LDL) cholesterol =

$$\frac{TC}{0.948} - \frac{HDLc}{0.971} - \left(\frac{TG}{8.56} + \frac{TG*nonHDLc}{2140} - \frac{TG(2)}{16{,}100}\right) - 9.44$$

TC = total cholesterol
HDLc = HDL cholesterol
TG = triglycerides

HDL Cholesterol:
Non-HDL lipoproteins such as LDL, very low-density lipoprotein (VLDL), and chylomicrons are combined with polyanions and a detergent forming a water-soluble complex. In this complex, the enzymatic reaction of cholesterol esterase (CHER) and cholesterol oxidase (CHOD) towards non-HDL lipoproteins is blocked. Finally, only HDL particles can react with CHER and CHOD. The concentration of HDL-cholesterol is determined enzymatically by CHER and CHOD. Cholesterol esters are broken down quantitatively into free cholesterol and fatty acids by CHER. In the presence of peroxidase, the hydrogen peroxide generated reacts with 4-amino-antipyrine and N-ethyl-N-(3-methylphenyl)-N'-succinylethylenediamine) to form a dye. The color intensity of this dye is directly proportional to the cholesterol concentration and is measured photometrically.(Package insert: HDL-Cholesterol Gen4. Roche Diagnostics; V 2.0, 08/2018)

Total Cholesterol:
Cholesterol esters are cleaved by the action of cholesterol esterase to yield free cholesterol and fatty acids. Cholesterol

oxidase then catalyzes the oxidation of cholesterol to cholest-4-en-3-one and hydrogen peroxide. In the presence of peroxidase, the hydrogen peroxide formed effects the oxidative coupling of phenol and 4-aminophenazone to form a red quinone-imine dye. The color intensity of the dye formed is directly proportional to the cholesterol concentration. It is determined by measuring the increase in absorbance.(Package insert: Cholesterol Gen2 Reagent. Roche Diagnostics; V 10.0, 03/2020)

Triglycerides:
This test uses a lipoprotein lipase from microorganisms for the rapid and complete hydrolysis of triglycerides to glycerol followed by oxidation to dihydroxyacetone phosphate and hydrogen peroxide. The hydrogen peroxide produced then reacts with 4-aminophenazone and 4-chlorophenol under the catalytic action of peroxidase to form a red dyestuff (Trinder endpoint reaction). The color intensity of the red dyestuff formed is directly proportional to the triglyceride concentration and can be measured photometrically.(Package insert: Triglycerides. Roche Diagnostics; V 9.0, 01/2020)

Lipoprotein (a):
This test is a particle enhanced immunoturbidimetric assay. Human lipoprotein (a)(Lp[a]) agglutinates with the latex particles coated with anti-Lp(a) antibodies.(Package insert: Lipoprotein (a) Gen.2 reagent. Roche Diagnostics; V 2.0, 01/2015)

C-Reactive Protein:
Particle-enhanced immunoturbidimetric assay. Human C-reactive protein (CRP) agglutinates with latex particles coated with monoclonal anti-CRP antibodies. The precipitate is determined turbidimetrically.(Package insert: Cardiac C-Reactive Protein (Latex) High Sensitive. Roche Diagnostics; V 12.0, 03/2019)

Apolipoprotein B:
Anti-apolipoprotein B antibodies react with the antigen in the sample to form antigen:antibody complexes, which, following agglutination, can be measured turbidimetrically.(Package insert: Tina-quant Apolipoprotein B, Roche Diagnostics; V 1.0 07/2020)

PDF Report
No

Day(s) Performed
Monday through Sunday

Report Available
1 to 2 days

Specimen Retention Time
7 days

Performing Laboratory Location
Mayo Clinic Laboratories - Rochester Main Campus

Fees & Codes

Fees

- Authorized users can sign in to Test Prices for detailed fee information.
- Clients without access to Test Prices can contact Customer Service 24 hours a day, seven days a week.
- Prospective clients should contact their account representative. For assistance, contact Customer Service.

Test Classification

This test has been modified from the manufacturer's instructions. Its performance characteristics were determined by Mayo Clinic in a manner consistent with CLIA requirements. This test has not been cleared or approved by the US Food and Drug Administration.

CPT Code Information

80061-Lipid panel (includes: HDL [CPT Code 83718], total cholesterol [CPT Code 82465], and triglycerides [CPT Code 84478])
83695-Lipoprotein (a)
86141-C-reactive protein; high sensitivity (hsCRP)
82172-Apolipoprotein B

LOINC® Information

Test ID	Test Order Name	Order LOINC® Value
CRMP1	Cardiovascular Risk Marker Panel, S	101642-7

Result ID	Test Result Name	Result LOINC® Value
CHOL	Cholesterol, Total, S	2093-3
HDCH	Cholesterol, HDL, S	2085-9
HSCRP	C-Reactive Protein, High Sens, S	30522-7
NHDCH	Cholesterol, Non-HDL, Calculated, S	43396-1
TRIG	Triglycerides, S	2571-8
CVINT	Interpretation	59462-2
APOLB	Apolipoprotein B, S	1884-6
LIPA1	Lipoprotein(a), S	43583-4
CLDL1	Cholesterol, LDL, Calculated, S	13457-7
INTC1	Fasting (8 HR or more)	87527-8