Cholesterol

"Not as simple as avoiding eggs and red meat"

High cholesterol is a serious health problem that affects about fifty million Americans. Hyperlipidemia refers to increased levels of lipids (fats) in the blood, including cholesterol and triglycerides. Why do we care about Hyperlipidemia? Although hyperlipidemia does not cause you to feel bad, it can significantly increase your risk for stroke and in developing coronary heart disease, latter in life. People with coronary disease develop thickened or hardened arteries in the heart muscle. This can cause chest pain, a heart attack, or both. It is for these reasons that screening for hyperlipidemia and appropriate treatment is highly recommended.

A lot of people don't take the risks of high cholesterol very seriously. After all, one out of six people have high cholesterol. A staggering 50% of Americans have levels above the suggested limit. Could something so common really be a serious health risk? Unfortunately, yes. Cholesterol is a direct contributor to cardiovascular disease, which can lead to strokes and heart attacks. The World Health Organization estimates that almost 20% of all strokes and over 50% of all heart attacks can be linked to high cholesterol. However, it is also important to realize that high cholesterol all by itself does not ***cause*** coronary artery disease all by itself, it ***contributes*** to a cascade of things that leads to coronary artery disease. Genetics, diet, smoking, hypertension, diabetes, weight, inflammation, activity level and more are also contributing factors that predispose coronary heart disease. The more factors you can control for, the less likely you are to suffer from coronary artery disease in the future.

How does Cholesterol lead to disease?

Everyone has cholesterol in his or her blood. But if your levels of the bad forms of cholesterol are too high, the excess can accumulate on the walls of your arteries with other substances to form plaque, which can narrow and clog the artery like a drain. It can also lead to arteriosclerosis, or hardening of the arteries, which turns the normally flexible tissue into more brittle.

Plaques can form anywhere. If they form in the carotid artery in the neck, it's carotid artery disease. When they form in the coronary arteries -- which supply the heart muscle with blood -- it's called coronary artery disease. Like any organ, the heart needs a good supply of blood to work. If it doesn't get that blood, you could get angina, which causes a squeezing pain in the chest and other symptoms.

There are other risks associated with high cholesterol. If these plaques break open, they can form a clot. If a clot lodges in an artery and completely chokes off the blood supply, the cells don't get the nutrients and oxygen they need and die. If a clot gets to the brain and blocks blood flow, it can cause a stroke. If a clot lodges in the coronary arteries, it can cause a heart attack. It can accumulate in the liver and cause Fatty Liver Disease, or trigger Pancreatitis. Recent studies also have even shown an association with increased severity of post-menopausal hot flashes and high cholesterol.

High cholesterol risks are usually not immediate. The damage accumulates over years and decades -- high cholesterol in your 20s and 30s can take its toll in your 50s and 60s. Because the effects take time, many people don't feel a real urgency in addressing it, as there are no immediate symptoms. This lack of immediate consequence contributes to many people ignoring treatment or lifestyle changes necessary to address this problem.

Having high cholesterol may not hurt you today or tomorrow, but if you ignore it now, it can greatly impact your quality of life in the future.

Cholesterol Isn't All Bad

While too much of certain kinds of cholesterol can be harmful, just the right amount of it does a lot of important work in the body. In recent years, cholesterol and fat intake has gotten such a bad rap that most people don't know the good it does.

Cholesterol performs three main functions:

1. It helps make the outer coating of cells.
2. It makes up the bile acids that work to digest food in the intestine.
3. It allows the body to make Vitamin D and hormones, like estrogen in women and testosterone in men.

Without cholesterol, none of these functions would take place, and without these functions, we wouldn't exist. Cholesterol is so important to the body that we make it ourselves—Mother Nature doesn't leave it up to humans to get whatever they need from diet alone. So even if you ate a completely cholesterol-free diet, your body would make the approximately 1,000 mg it needs to function properly.

What is Cholesterol?

Cholesterol is a type of fat, or lipid. If you held cholesterol in your hand, you would describe a waxy substance that resembles whitish-yellow candle scrapings. Cholesterol is absorbed in the gut, and then flows through the body via your bloodstream, but this is not a simple process. Because lipids are oil-based and blood is water-based, they don't mix. If cholesterol were dumped directly into your bloodstream, it would congeal into dysfunctional globs. To get around this problem, the body packages cholesterol and other fats into small protein-covered particles called lipoproteins that do mix easily with blood. The proteins used are known as apolipoproteins.

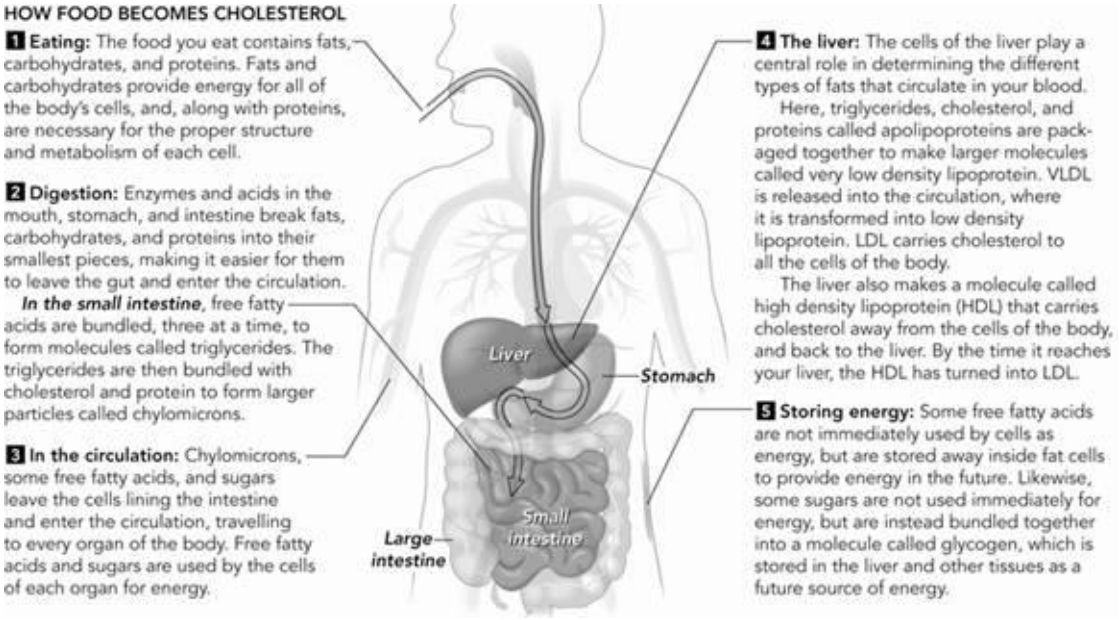
The fat in these particles is made up of cholesterol and triglycerides and a third material called phospholipid, which helps make the whole particle stick together. Triglycerides are a particular type of fat that have three fatty acids attached to an alcohol called glycerol—hence the name. They compose about 90 percent of the fat in the food you eat. The body needs triglycerides for energy, but as with cholesterol, too much is bad for the arteries and the heart.

Where does Cholesterol come from?

Your body makes cholesterol. Your blood cholesterol level is determined by the sum of how much cholesterol your body makes and how much you take in from food, minus how much your body uses up or excretes. High cholesterol can result from a problem in any of the variables in that equation—your body may produce more cholesterol than it needs due to a genetic predisposition, you may be getting too much from your diet, or you may not excrete cholesterol in your bile efficiently. The fact that Americans have higher blood cholesterol levels than citizens of the Far East or Africa could be due to differences in genetic factors, but most evidence suggests that our higher cholesterol levels are largely a product of our diet.

For most people—especially those with high cholesterol—the liver and other cells aren't the body's only sources of cholesterol. Our society's typical high saturated fat diet also packs a powerful cholesterol punch. How can cholesterol from a hamburger and French fries eventually make its way to your heart's arteries? As you eat food with cholesterol, your intestines go through a complex process of breaking down fat molecules and building them into new molecules that the body can use.

FIGURE 1.2 How Food Becomes Cholesterol



Lipoproteins

The two main types of lipoproteins important in a discussion on heart disease are low-density lipoproteins (LDL) and high-density lipoproteins (HDL). Though the names sound the same, these two particles are as different as night and day. The differences stem from their densities, which are a reflection of the ratio of protein to lipid; particles with more fat and less protein have a lower density than their high-protein, low-fat counterparts. There are countless other lipoproteins, some of which we are just beginning to understand, but in order to get a basic understanding of how cholesterol affects your body and how the food you eat affects your cholesterol levels, LDL and HDL are the ones to start with.

Low-Density Lipoproteins (LDL)

The LDL cholesterol (sometimes called "bad cholesterol") is a more accurate predictor of coronary disease than total cholesterol. In the average person, 60 to 70 percent of cholesterol is carried in LDL particles. LDL particles act as ferries, taking cholesterol to the parts of the body that need it at any given time. Unfortunately, if you have too much LDL in the bloodstream, it deposits the cholesterol into the arteries, which can cause blockages and lead to heart attacks. That's why people refer to LDL as the "bad" cholesterol. The good news is that most people can decrease their LDL if they address the kinds and quantities of fats they are consuming and adopt healthier lifestyles.

LDL targets differ, depending on your underlying risk of heart disease. Most people should aim for an LDL level below 130. If you have other risk factors for heart disease, your target LDL may be below 100. If you are at very high risk of heart disease, you may need to aim for an LDL level below 70. In general, the lower your LDL cholesterol level is the better.

Other Risk Factors for Cardiovascular Disease:

In addition to high bad cholesterol, there are a number of other factors that increase the risk of coronary disease and its complications.

Adult Treatment Panel III or ATP III has summarized the current recommendations for the management of high cholesterol. ATP III guidelines are based upon epidemiologic observations that showed a graded relationship between the total cholesterol concentration and coronary risk. They are influenced by the absence or presence of preexisting CHD. A meta-analysis of 38 trials found that for every 10 percent reduction in serum cholesterol, CHD mortality was reduced by 15% and total mortality risk by 11%. The ATP III risk assessment tool is based on the LDL fraction and are influenced by coexistence of CHD or equivalents and cardiac risk factors.

The following are coronary disease-risk equivalents:

- Symptomatic carotid artery disease such as stroke or transient ischemia attack.
- Peripheral arterial disease: claudication
- Diabetes Mellitus, type 1 and 2
- Abdominal aortic aneurysm

Major CHD risk factors other than LDL include:

- Cigarette smoking
- Hypertension: blood pressure ≥140/90 or use of blood pressure medication
- Low HDL-cholesterol: <40 in men, <50 in women
- Family history of coronary disease at a young age in a first degree relative (parents and siblings). In males: first degree relatives <55 years; in females: relative <65 years
- Age: Increasing risk of coronary disease with increasing age (Men >45, Women >55)

HDL >60 counts as a "negative" risk: its presence removes one risk factor from the total count.

Other factors that increase the risk of coronary disease include:

- Obesity: Central Obesity or "apple" body type greater than "pear" body type
- Stress: elevated cortisol and adrenalin levels
- Sedentary Lifestyle or physical inactivity
- Impaired fasting glucose
- Inflammation: Diseases that causes chronic inflammation such as Celiac and Rheumatoid arthritis is linked to increased CAD. C-reactive therapy can be used as a marker.
- Gender: Men have a higher risk of coronary disease than women at every age

If you have a CHD equivalent, or two or more CHD risk factors other than LDL, the 10-year risk of CHD is assessed using the ATP III modification of the Framingham risk tables available as online calculators @: hp2010.nhlbihin.net/atpiii/calculator.asp?usertype=prof. Risk not necessary in people without CHD who have 0 to 1 risk factors as their 10-year risk of CHD is <10%.

The last step in risk assessment is to determine the risk category that establishes the LDL goal, when to initiate therapeutic lifestyle changes, and when to consider drug therapy.

- Low CV risk (0-1 risk factors):
    - Lifestyle treatment for LDL >140
    - Rx Medication for LDL >190
- Moderate CV risk (2+ risk factors and Framingham Score <20%):

    - If CRP low, lifestyle treatment for LDL >130, Rx med for LDL >160
    - If CRP high, lifestyle treatment for LDL >100, Rx med for LDL >130
- High CV risk (CHD or risk Equivalent or Framingham Score >20%):
    - Lifestyle treatment for LDL >80, Rx med for LDL >100
- Very High CV risk (Cardiovascular event—Heart attack or stenting):
    - Lifestyle treatment for LDL >70, Rx med for LDL >80

Typically, I recommend always pursuing diet and lifestyle changes first, but this does depend on the motivation of the individual to follow through with these changes and the level of risk for that individual. We will not get into the details of Rx cholesterol medications this lecture, as all of you merely being present for this lecture show motivation that I encourage you to in turn apply to healthy choices. When lifestyle and dietary changes fail to alter your cholesterol levels below satisfactory goals based on your individual risks, I would encourage you to discuss Rx options with your Primary Care Physician. It can take 3-12 months depending on the individual circumstances for diet and lifestyle changes to take affect on your lipid panel. I would encourage close monitoring of your progress.

High-Density Lipoproteins (HDL)

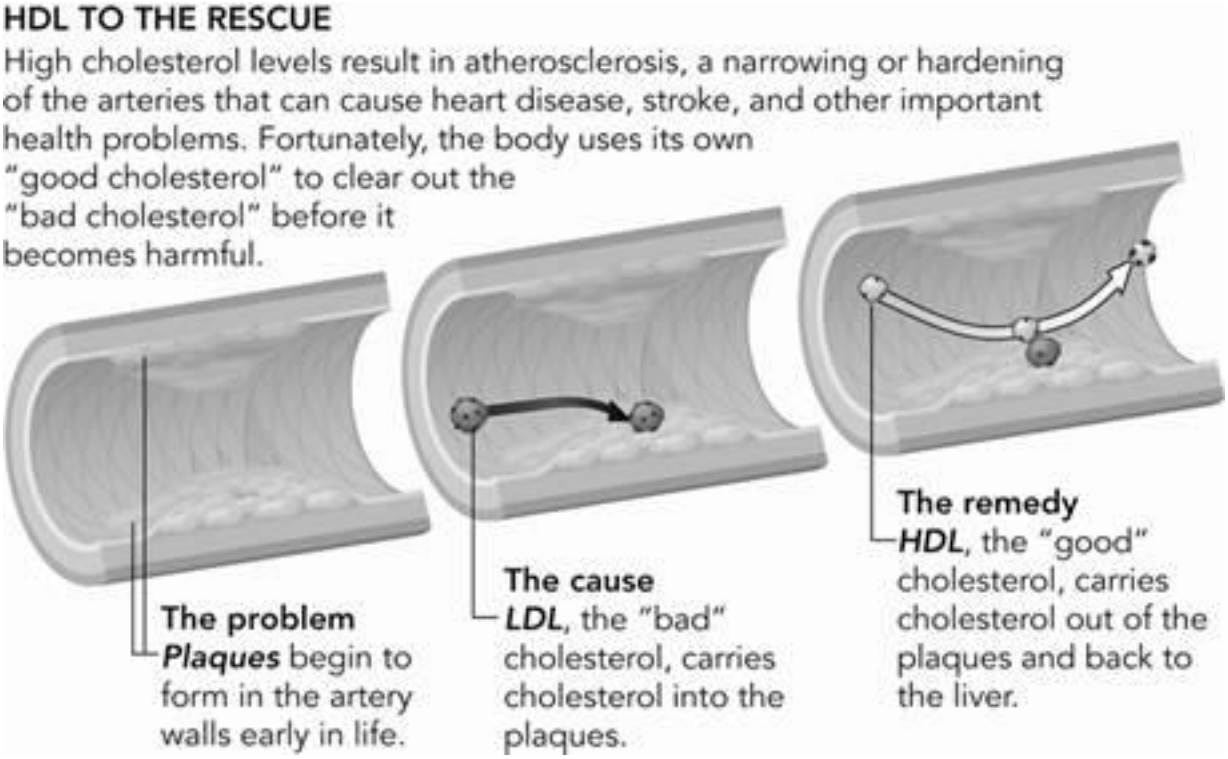
HDL is basically the opposite of LDL. Instead of having a lot of fat, HDL has a lot of protein. Instead of ferrying cholesterol around the body, HDL acts as a vacuum cleaner sucking up as much excess cholesterol as it can. It picks up extra cholesterol from the cells and tissues and takes it back to the liver, which takes the cholesterol out of the particle and either uses it to make bile or recycles it. This action is thought to explain why high levels of HDL are associated with low risk for heart disease. HDL also contains antioxidant molecules that may prevent LDL from being changed into a lipoprotein that is even more likely to cause heart disease. HDL also has been shown to protect against inflammation.

Lifestyle changes affect HDL levels—exercise can increase, while obesity and smoking lower. As for diet, in general, the high-fat diets have a tendency to raise HDL as well as LDL, while low-fat diets tend to lower. However, by carefully choosing the right foods, you can eat a diet that lowers LDL while raising HDL.

HDL targets are >40 for men, and >50 for women. HDL above 60 confers extra cardiovascular protection. HDL above 75 has been associated with 'Longevity Syndrome' in average living 5 (men) and 7 (women) years longer, and relative freedom from coronary heart disease! If you have HDL cholesterol greater than 60, I suggest ignoring your 'Total Cholesterol' number and instead calculating your 'Non-HDL Cholesterol', or your 'HDL-Total Cholesterol Ratio' (as explained below in the next section). When your HDL is high, it provides protective value, yet inflates your 'Total Cholesterol' thus giving an inaccurate picture of your true risks, whereas these modified calculations take the HDL benefits into consideration and provide more accurate representation.

LIPID and CARE trials found that for a 10 mg/dL in HDL, the event rate decreased by 29% in those with LDL <125 compared to 10% in those with LDL cholesterol >125. So just because your LDL cholesterol is well controlled does not mean you can ignore your HDL!

High triglyceride levels, physical inactivity, being overweight, obese, smoking, high sugar carbohydrate intakes, type two diabetes, inflammatory conditions, some medications as well as genetic factors can contribute to low HDL cholesterol levels.



Total cholesterol

A high total cholesterol level can increase your risk of coronary disease. However, decisions about when to treat high cholesterol are usually based upon the level of LDL or HDL cholesterol, rather than the level of total cholesterol.

- A total cholesterol level of less than 200 mg/dL (5.17 mmol/L) is **normal**.
- A total cholesterol level of 200 to 239 mg/dL (5.17 to 6.18 mmol/L) is **borderline high**.
- A total cholesterol level greater than or equal to 240 mg/dL (6.21 mmol/L) is **high**.

The total cholesterol, in my opinion is for many a poor representation of your overall cardiovascular risks as it includes your HDL (good cholesterol). Individuals who have low HDL are at high risk for CV, but will deflate their total cholesterol number making it look not as high. Same is true for individuals with high HDL, this number inflates the total cholesterol but is known to be cardio protective! For these reasons, I encourage you to look past this number and look at the breakdown components of your cholesterol. Other approaches that give a more accurate representation include your total to HDL ratio and your Non-HDL cholesterol.

Total to HDL cholesterol ratio: This has been suggested to have a greater predictive value than the serum total cholesterol or LDL cholesterol level for future artery plaque formation potential. The number is obtained by dividing the total cholesterol value by the value of the HDL cholesterol. (High ratios indicate higher risks of heart attacks low ratios indicate lower risk).

High total cholesterol and low HDL cholesterol increases the ratio, and is undesirable. Conversely, high HDL cholesterol and low total cholesterol lowers the ratio, and is desirable. An average ratio would be about 4.5. Ideally we want to be better than average if we can. Thus the best ratio would be 2 or 3, or less than 4.

- Among men, a ratio of 6.4 or more identified a group at 2-14% greater risk than predicted by total cholesterol or LDL.
- Among women, a ratio of 5.6 or more identified a group at 25-45% greater risk than predicted by total cholesterol or LDL.

Non-HDL cholesterol: Defined as the difference between the total cholesterol and HDL. It is helpful to know your non-HDL cholesterol because your level of non-HDL may predict your risk of cardiovascular disease even better than your LDL "bad" cholesterol. That's because your non-HDL number tells you all the bad cholesterol circulating in your blood – not just your LDL cholesterol but your VLDL cholesterol levels as well. Both LDL and VLDL particles are artery-clogging "bad" lipids. When you subtract the "good" cholesterol (HDL) from your total cholesterol, you are left with all the "bad" cholesterol.

The goal for non-HDL cholesterol in this circumstance is a concentration that is no more than 30 mg/dL higher than that for LDL. Other goals are that the non-HDL be no more than 120 for prevention and no more than 100 for regression, or reversal, of atherosclerotic lesions in those with established coronary artery disease or those at very high risk, such as diabetics or those with evidence of severely clogged arteries, including people who have had a heart attack or have angina or claudication (difficulty/pain in walking due to insufficient blood supply to the legs and feet). For individuals with Triglycerides that are so high that LDL cannot be measured directly the Non-HDL cholesterol can be used to risk stratify.

Triglycerides

High triglyceride levels are also associated with an increased risk of coronary disease. High TG's generally mean lower HDL and are frequently associated with diabetes, insulin resistance, obesity, high blood pressure, smoking, and genetic disorders. Triglyceride levels are divided as follows:

- Normal - less than 150 mg/dL (1.69 mmol/L)
- Borderline high - 150 to 199 mg/dL (1.69 to 2.25 mmol/L)
- High - 200 to 499 mg/dL (2.25 to 5.63 mmol/L)
- Very high - greater than 500 mg/dL (5.65 mmol/L)

Treatment for elevated triglycerides is usually centered on decreasing insulin desensitization by cutting down sugars (Ex: deserts, sweets, juice, pastries, soda) and simple carbohydrates (bread, pasta, cereal, crackers, pastries, potato, rice) in the diet. Niacin supplementation also can be particularly affective for reduction in Triglycerides.

When should you have your Cholesterol checked?

Many expert groups have guidelines for cholesterol screening. The guidelines differ in their recommendations about when to start screening, frequency of testing, and when to stop.

- Lipid screening should start earlier for those who have increased risks. These include individuals with diabetes, hypertension, overweight, or with a family history of heart disease. Some suggest starting a screening panel in mid 30's, others in mid 20's.
- The American Academy of Pediatrics (AAP) recently endorsed recommendations that call for checking LDL (bad) cholesterol levels in all kids between the ages of 9 and 11.
- Lipid screening should definitely start at age 45 for both men and women, most agree here.
- Screening should include total cholesterol, LDL, triglycerides, and HDL-cholesterol levels and are measured most accurately after fasting 12 hours.

- The optimal time interval between screenings is uncertain; reasonable options include every five years, with a shorter interval for those with high cardiovascular risk or elevated lipid levels and longer intervals for low-risk individuals with low or normal levels.
- There is no recommendation to stop screening at a particular age.
- Screening may be appropriate in older people who have never been screened, although screening a second or third time is less important in older people because lipid levels are less likely to increase after age 65.

High Cholesterol Treatment

Lipid levels can be lowered with lifestyle changes, medications, or a combination of these approaches. In certain cases, a clinician will recommend a trial of lifestyle changes before recommending a medication.

Lifestyle changes — All patients with high LDL or Triglyceride cholesterol should try to make some changes in their day-to-day habits, by addressing their diet, losing weight (if overweight or obese), decreasing stress, avoiding inflammation, adequate sleep, smoking cessation, and exercise. Refer to first lecture on "Wellness—back to the basics" for further details.

Nutritional supplements—If you're worried about your cholesterol and have already started exercising and eating healthier foods, you might wonder if adding a cholesterol-lowering supplement to your diet can help reduce your numbers. Below is a summary of common supplements to combat high cholesterol, some with good evidence to support their use and others with limited to no conclusive evidence.

Omega 3 fatty acids (fish oil) — These essential fatty acids have a favorable effect on cholesterol. Supplement sources include fish oil capsules, flaxseed and flax seed oil. Omega-3 fatty acids decrease the rate at which the liver produces LDL cholesterol and triglycerides. They have an anti-inflammatory effect in the body, decrease the growth of plaque in the arteries, and aid in thinning blood. I recommend eating at least two servings of fish a week. The highest levels of omega-3 fatty acids are in: Mackerel, Lake trout, Herring, Sardines, Albacore tuna, Salmon, and Halibut. You should bake or grill the fish to avoid adding unhealthy fats. If you don't like fish, you can also get small amounts of omega-3 fatty acids from foods like ground flaxseed or canola oil. You can take an omega-3 or fish oil supplement to get some of the same benefits 1200-2000mg, but you won't get other nutrients in fish, like selenium.

Olive oil-- Olive oil contains a potent mix of antioxidants that can lower your "bad" (LDL) cholesterol but leave your "good" (HDL) cholesterol untouched. The FDA recommends using about 2 T (23 grams) of olive oil a day in place of other fats in your diet to get its heart-healthy benefits. To add olive oil to your diet, you can saute vegetables in it, add it to a marinade, or mix it with vinegar as a salad dressing. You can also use olive oil as a substitute for butter when basting meat or as a dip for bread. Olive oil is high in calories, so don't over do it. The cholesterol-lowering effects of olive oil are even greater if you choose extra-virgin olive oil, meaning the oil is less processed and contains more heart-healthy antioxidants. But keep in mind that "light" olive oils are usually more processed than extra-virgin or virgin olive oils and are lighter in color, not fat or calories.

Soy protein — Soy protein contains isoflavones, which mimic the action of estrogen. A diet high in soy protein can slightly lower levels of total cholesterol, LDL cholesterol, and triglycerides, and raise levels of HDL cholesterol. However, normal protein should not be replaced with soy protein or isoflavone supplements in an effort to lower cholesterol levels. Soy foods and food products (eg, tofu, soy butter, edamame, some soy burgers, etc.) are likely to have beneficial effects on lipids and cardiovascular

health because they are low in saturated fats and high in unsaturated fats. No more than 25g daily is necessary. The controversial effects of exogenous estrogen ingestion, however in many peoples opinion, tends to make me recommend against using soy as a tool to lower cholesterol.

Garlic — A large trial showed that garlic is not effective in lowering cholesterol. In this study, participants with an elevated LDL took one of several types of garlic extract (raw, powdered, aged) or a placebo (inactive pill) six days per week for six months. At the end of the study, the LDL levels were not improved in the garlic group compared to the group that took the placebo. While garlic has been shown to help with high blood pressure and hold other health benefits, garlic does not appear to be affective in lowering cholesterol.

Plant Stanols and Sterols — Plant stanols and sterols may act by blocking the absorption of cholesterol in the intestine. They are naturally found in some fruits, vegetables, vegetable oils, nuts, seeds, and legumes. They are also available in commercially prepared products such as margarine (Promise Active™ and Benecol®), orange juice (Minute Maid Premium Heart Wise®), rice milk (Rice Dream Heart Wise™), as well as dietary supplements (Benecol SoftGels® and Cholest-Off®). You don't need more than 2g daily. Despite lowering cholesterol levels, there are no studies demonstrating a reduced risk of coronary heart disease in people who consume supplemental plant stanols and sterols. There is some evidence that these supplements might actually increase risk.

Soluble fiber—Soluble fiber helps to reduce LDL cholesterol. Two servings per day or 5-10g or more a day should be sufficient. Good sources of soluble fiber include oats and oat bran, barley, almost any kind of bean, apples, pears, prunes, eggplant, and okra. Aim for 10 grams of soluble fiber per day. Eating 1 1/2 cups of cooked oatmeal provides 6 grams of fiber.

Vitamin D-- In a recent journal of "Circulation", the researching team reports that vitamin D regulates signaling pathways linked both to uptake and to clearance of cholesterol in macrophages. The process that leads to LDL oxidation that in turn stimulates atherosclerosis becomes accelerated when a person is deficient in vitamin D. Thus supplementing with vitamin D to maintain adequate levels (30-150, goal >50) is recommended. The FDA recommends 800 IU daily, this may be enough for Florida or San Diego however in the Northwest I recommend 2000 IU daily to maintain adequate levels.

Artichoke Extract—Inconclusive evidence exists, however claims of LDL and total cholesterol lowering have been suggested.

Green Tea-- Has been shown to make mild shifts in lowering LDL and is also known to have other health benefits from the tannins that are rich in antioxidants including appetite suppression.

Walnuts, almonds, and other nuts-- Walnuts, almonds and other nuts can reduce blood cholesterol. Rich in polyunsaturated fatty acids, walnuts also help keep blood vessels healthy. According to the FDA, eating a handful (1.5 ounces, or 42.5 grams) a day of most nuts, such as almonds, hazelnuts, pecans, pine nuts, pistachio nuts and walnuts, may reduce your risk of heart disease. Just make sure the nuts you eat aren't salted or coated with sugar. All nuts are high in calories, so a handful will do.

Red Yeast Rice—There is evidence that red yeast rice can help lower your LDL cholesterol. However, the FDA has warned that red yeast rice products could contain a naturally occurring form of the prescription medication known as lovastatin. Lovastatin in the red yeast rice products in question is potentially dangerous because there's no way for you to know what level or quality of lovastatin might be in red yeast rice, and liver enzymes should me monitored while taking this supplement.

Red yeast rice is the product of yeast (*Monascus purpureus*) grown on rice, and is served as a dietary staple in some Asian countries. The use of red yeast rice in China was first documented in the Tang Dynasty in 800 A.D. A detailed description of its manufacture is found in the ancient Chinese

pharmacopoeia, Ben Cao Gang Mu-Dan Shi Bu Yi, published during the Ming Dynasty (1368-1644). In this text, red yeast rice is proposed to be a mild aid for gastric problems (indigestion, diarrhea), blood circulation, and spleen and stomach health.

Niacin—Shown to help increase HDL and decrease Triglycerides. In fact Niacin is so affective that prescription versions have been made to use in lipid lowering treatment. The OTC supplements are not FDA regulated, and thus do have varying bioavailability and dosing depending on the brand. A common burden of Niacin that causes many to discontinue its use is flushing. Flushing is not an allergic reaction, but rather vasodilation of the peripheral arteries. Taking an aspirin or high fiber snack 20-30 min prior to taking the Niacin can help to reduce flushing. Typically it is a bit of a hump to get over, but once your body becomes accustomed to it the side effects of flushing resolves. I recommend starting at 500mg and gradually titrating the dose as tolerated up to 2000mg a day. Non-flush forms typically have decreased efficacy in cholesterol lowering, but can be tried if regular Niacin can not be tolerated.

Medications — There are many medications available to help lower elevated levels of LDL cholesterol and triglycerides, but only a few for increasing HDL cholesterol. Each category of medication targets a specific lipid and varies in how it works, how effective it is, and how much it costs. Your healthcare provider will recommend a medication or combination of medications based on blood lipid levels and other individual factors.

If risks are high, medications may be suggested to be started immediately always in coordination with lifestyle and diet modifications. If risks are low to moderate, conservative approaches and trials with supplements, diet, and lifestyle should be considered first for those who are motivated and proactive. For some, despite best efforts and clean diets and lifestyle, medications are still necessary.

Statins — Statins are the most powerful drugs for lowering LDL cholesterol and are the most effective drug for prevention of coronary heart disease, heart attack, stroke, and death. Statins include lovastatin, pravastatin, simvastatin, fluvastatin, atorvastatin, and rosuvastatin. These medications decrease the body's synthesis of cholesterol and can reduce LDL levels by as much as 20 to 60 percent. In addition, statins can lower triglycerides and slightly raise HDL cholesterol levels.

Ezetimibe — Ezetimibe (Zetia®) impairs the body's ability to absorb cholesterol from food as well as cholesterol that the body produces internally. It lowers LDL levels when used alone. It has relatively few side effects when used alone. However, there are no studies that demonstrate better outcomes in patients who take ezetimibe, either alone or in combination with other cholesterol-lowering medications. Further study is needed before ezetimibe is recommended as a first-line treatment. This is why this medication is reserved only for individuals who can not tolerate Statin therapy.

Bile acid sequestrants — The bile acid sequestrants include cholestyramine, colestipol, and colesevelam. These medications bind (combine with) bile acids in the intestine, reducing the amount of cholesterol absorbed from foods. Bile acid sequestrants may be recommended to treat mild to moderately elevated LDL cholesterol levels. However, side effects can be bothersome and limiting, and may include nausea, bloating, cramping, and liver injury. Taking psyllium (a fiber supplement, such as Metamucil®) can sometimes reduce the dose required and the side effects.

Bile acid sequestrants can interact with some medications, including as digoxin (Lanoxin®) and warfarin (Coumadin®), and with the absorption of fat-soluble vitamins (including vitamins A, D, K, and E). Taking these medications at different times of day can solve these problems in some cases.

Nicotinic acid (Niacin) — Nicotinic acid is a vitamin that is available in immediate-release, sustained-release, and extended-release formulations. Nicotinic acid may be recommended for people with elevated cholesterol levels and some types of familial hyperlipidemia.

- Side effects — Nicotinic acid has several possible side effects, including flushing (when the face or body turns red and becomes warm), itching, nausea, and numbness and tingling. This is not an allergic reaction, rather it causes the vessels in the skin to dilate and a rush of blood to the surface of the skin. This medication can also be hard on the liver; patients who use it require regular monitoring of liver function, and those with liver disease should avoid this medication. For those with gout, Niacin should be avoided as it can increase uric acid levels.

Taking nicotinic acid with fiber rich food and taking aspirin (325 to 650 mg) 30 minutes before can decrease the side effects. Side effects often improve after 7 to 10 days.

Fibrates — Fibrate medications (gemfibrozil, fenofibrate and fenofibric acid) can lower triglyceride levels and raise HDL cholesterol levels . Fibrates have been associated with muscle toxicity (causing muscle pain or weakness), especially when used by people with kidney insufficiency or when used in combination with a statin medication. Fenofibrate/fenofibric acid (Tricor®, Triglide®, Trilipex®) are less likely to interact with statins than gemfibrozil, and are safer in people who must use both medications.

Diets

Low fat diet vs Paleo diet

Which diet is the best diet for high cholesterol? Historically, low fat diets have been recommended for both elevated cholesterol and heart disease. However, more recently we are realizing that it is not as simple as avoiding eggs and red meat. In large trials comparing different diets, results several very different diets are all somewhat similar. This is a story of no clear winners when discussing cholesterol lowering alone. Extremely low fat diets, vegetarian, low carbohydrate diets such as the Atkins, and diets rich in good fats such as the Mediterranean diet all finish similarly with cholesterol comparisons.

So what is the best diet? What have we learned from each of the diets that have been studied in depth? Here is a summary of what I have read, and my take: We know that decreasing saturated and bad fats help to lower cholesterol from AHA (American Heart Association) recommended low fat diets. But when these diets were compared to a diet focusing on getting known cholesterol-reducing foods such as nuts, soluble fiber, olive oil the latter was more affective at cholesterol lowering (several studies showing ~3% vs ~13% reduction). Diets such as the Mediterranean diet or Portfolio diet rich in olive oil and nuts helps to reduce cholesterol due to increased healthy fats and Omega 3 content. Low carbohydrate diets such as the Atkins diet, help reduce cholesterol by reducing insulin secretion and metabolic syndrome. Vegetarian diets rich in fruits, vegetables, and Soy help reduce cholesterol due to its high soluble fiber and soy content. We also know that high inflammation with many chronic illnesses increases cortisol and affects cholesterol processing. Likewise, processed and foods exposed

to high heat cooking (fried) denatures proteins and fats that increases bad cholesterol and plaque build up.

So lets put this all together…… A diet rich in nutrient dense foods and soluble fiber such as fruits and vegetables; low in commonly pro-inflammatory foods such as wheat and dairy; low in simple carbohydrates such as sugars and refined grains; high in healthy fats and Omega 3's (nuts, grass fed and wild red meat, olive oil, cage free eggs); low in preservatives, high heat degradation, and processing—what does this sound like? Sounds awfully familiar, and very similar to Paleo! Unfortunately large controlled studies have not yet been done, but Paleo is gaining momentum. We hope to have statistics and good evidence based medicine in the near future so that this way of life can be better excepted within the medical community and mainstream public.

We must also consider the importance of how our diets affect our hormonal access, gut, energy levels, nutritional content, and inflammation. For many, the Paleo diet can achieve not only cholesterol lowering but also overall health benefits of all the above. Every individual is different, and our diets should reflect this. There is not a one size fits all. Some may do fine with whole grains or dairy without inflammatory or gut issues, but many don't. Some can eat endless eggs, bacon, and trans-fats found in store bought cookies and processed foods without consequences on their cholesterol, and others who have a genetic predisposition to high cholesterol may have to dial these foods rich in saturated fats down.

Avoid fried high temperature cooked and heavily processed foods

With all the focus on LDL cholesterol, a lesser known form of cholesterol called oxycholesterol may pose the biggest heart health threat, says Chinese scientist. Scientist from the Chinese University of Hong Kong identified fried and processed food as the main sources of Oxycholesterol in the diet. Their work demonstrated that oxycholesterol boosts total cholesterol levels and promotes atherosclerosis more than non-oxidized cholesterol. "Foods of animal origins contain cholesterol, which is stable at room temperature. However, it is susceptible to oxidation during heating, particularly, long frying and high temperature." Oxycholesterol is also produced from oxidized oils, particularly the trans-fatty acids and partially-hydrogenated vegetable oils.

Sticking with Treatment

Sometimes healthy lifestyle choices, including supplements and other cholesterol-lowering products, aren't enough. If your doctor prescribes medication to reduce your cholesterol, take it as directed while you continue to focus on a healthy lifestyle. As always, if you decide to take an herbal supplement, be sure to tell your doctor. The herbal supplement you take may interact with other medications you take.

The treatment of high cholesterol and/or triglycerides is a lifelong process. Although medications can rapidly lower your levels, it often takes 6 to 12 months before the effects of lifestyle modifications are noticeable. Once you have an effective treatment plan and you begin to see results, it is important to stick with the plan. Stopping treatment usually allows lipid levels to rise again.