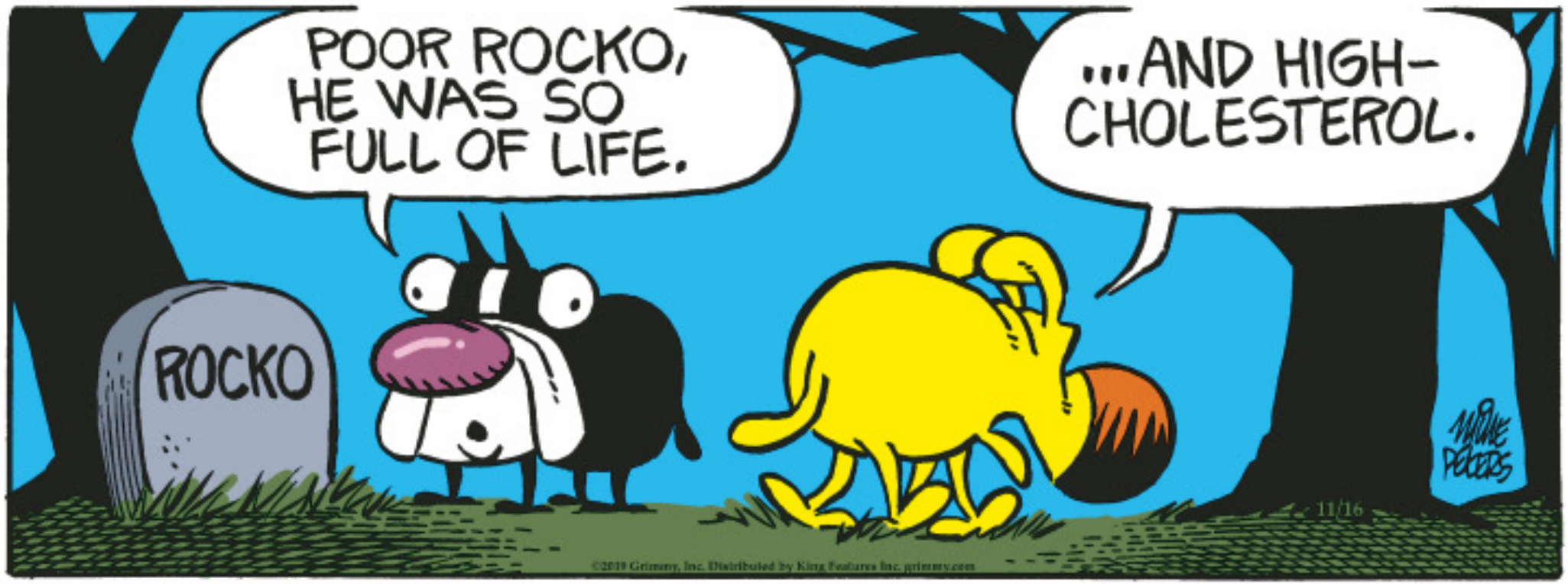
Managing Your Cholesterol

Robert Shapiro, MD, MS-CR, FACC
Boulder Heart
720-853-3032

Boulder Community Health


POOR ROCKO, HE WAS SO FULL OF LIFE.
...AND HIGH-CHOLESTEROL.
ROCKO
11/16
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Scope of the Problem

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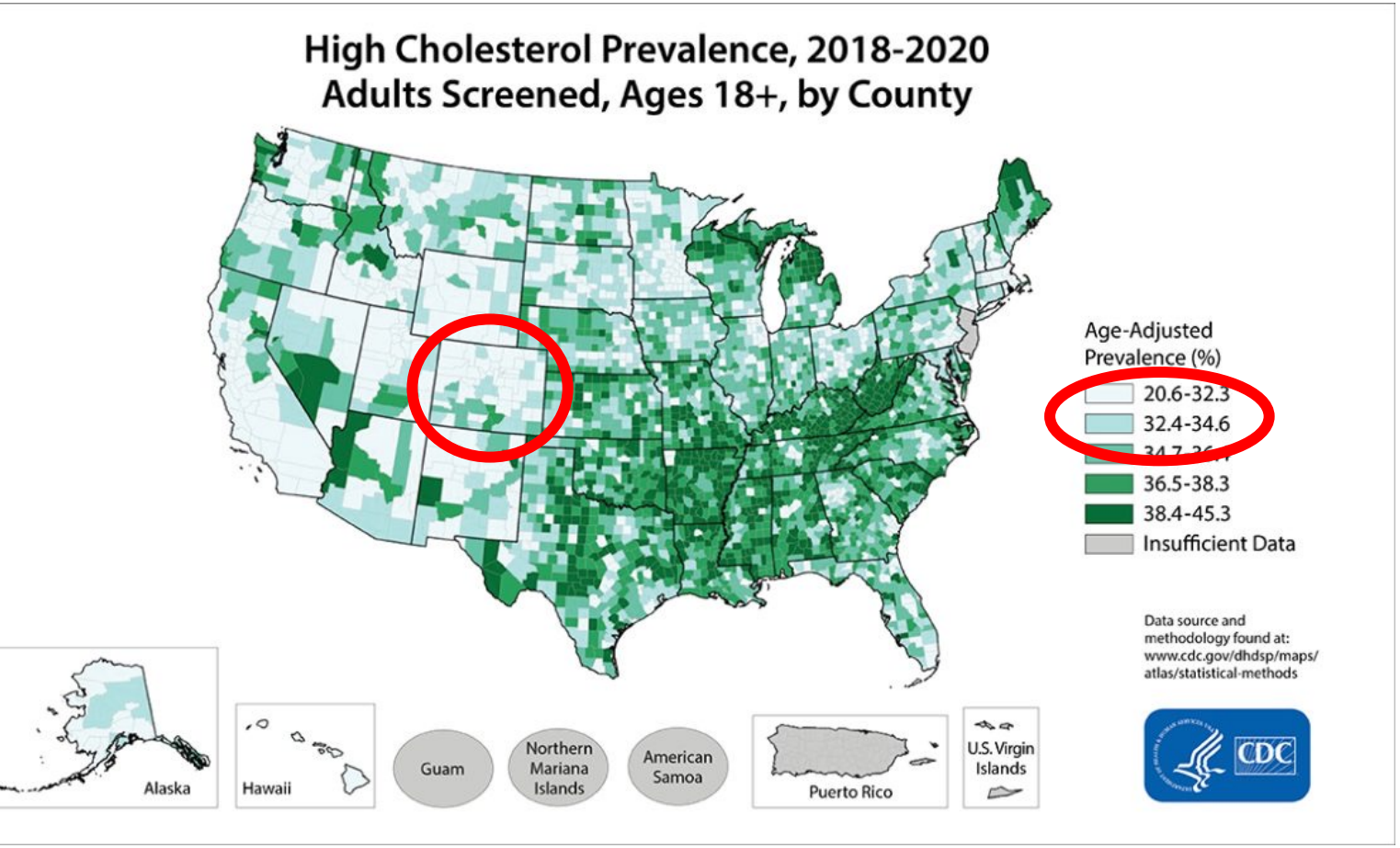


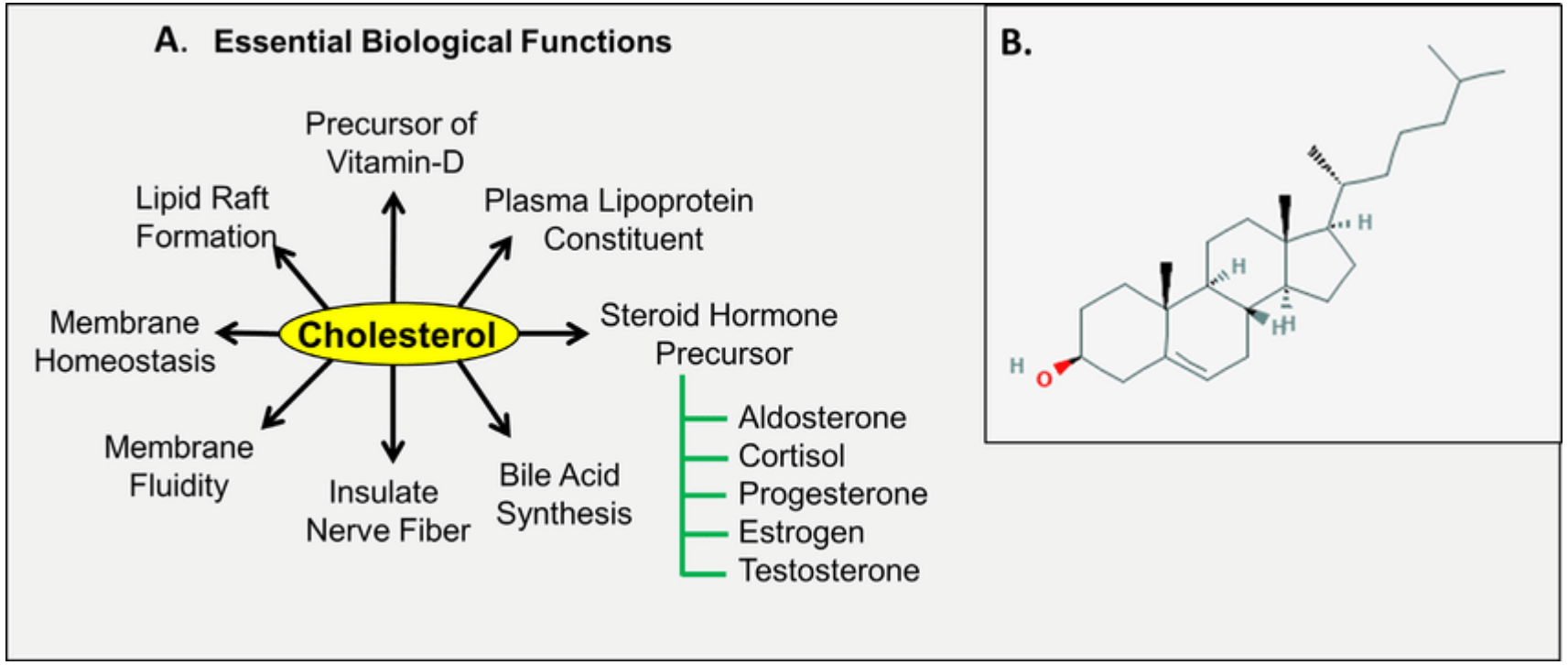
- 86 million American adults have high cholesterol.
- Only 47 million who could benefit from cholesterol medication take it. (54.5%)
- 33% of adults have not had their lipids checked in the last 5 years.

https://www.cdc.gov/cholesterol/facts.htm

What is Cholesterol?

Boulder Community Health

- Waxy substance produced in the liver to be used throughout the body.

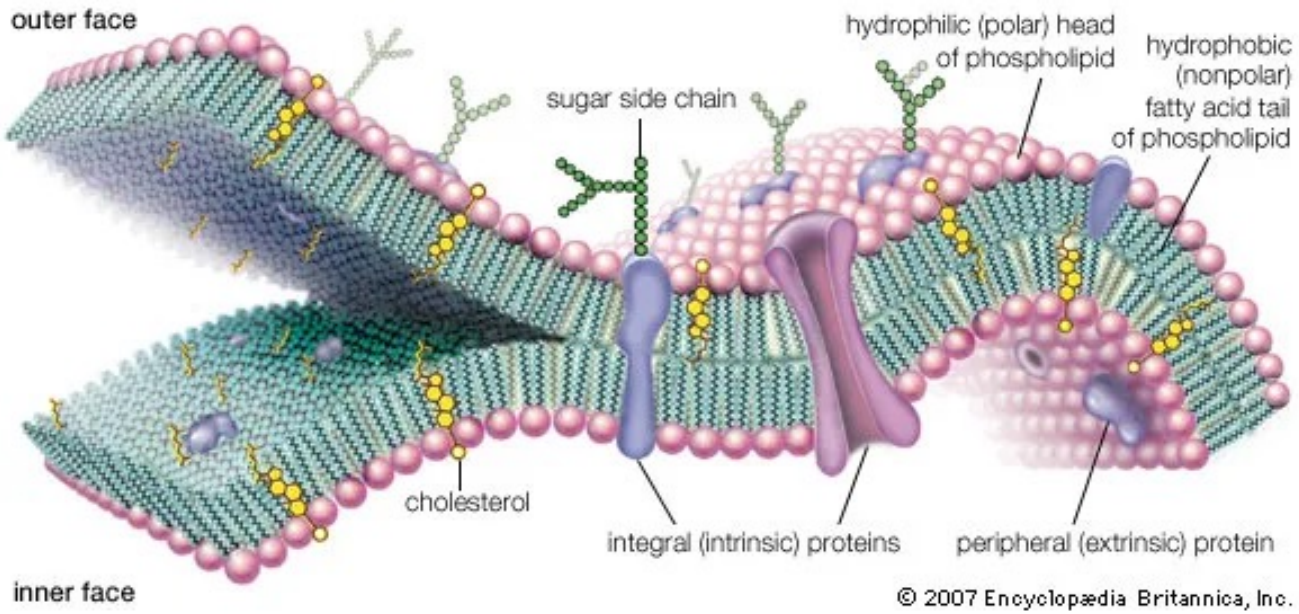


https://www.researchgate.net/figure/Structure-of-cholesterol-and-its-indispensable-biological-functions-A-Important_fig3_350224054

Normal Function of Cholesterol

Boulder Community Health

- Part of the cell membrane
- Membrane homeostasis
- Helps maintain the fluidity of the membrane

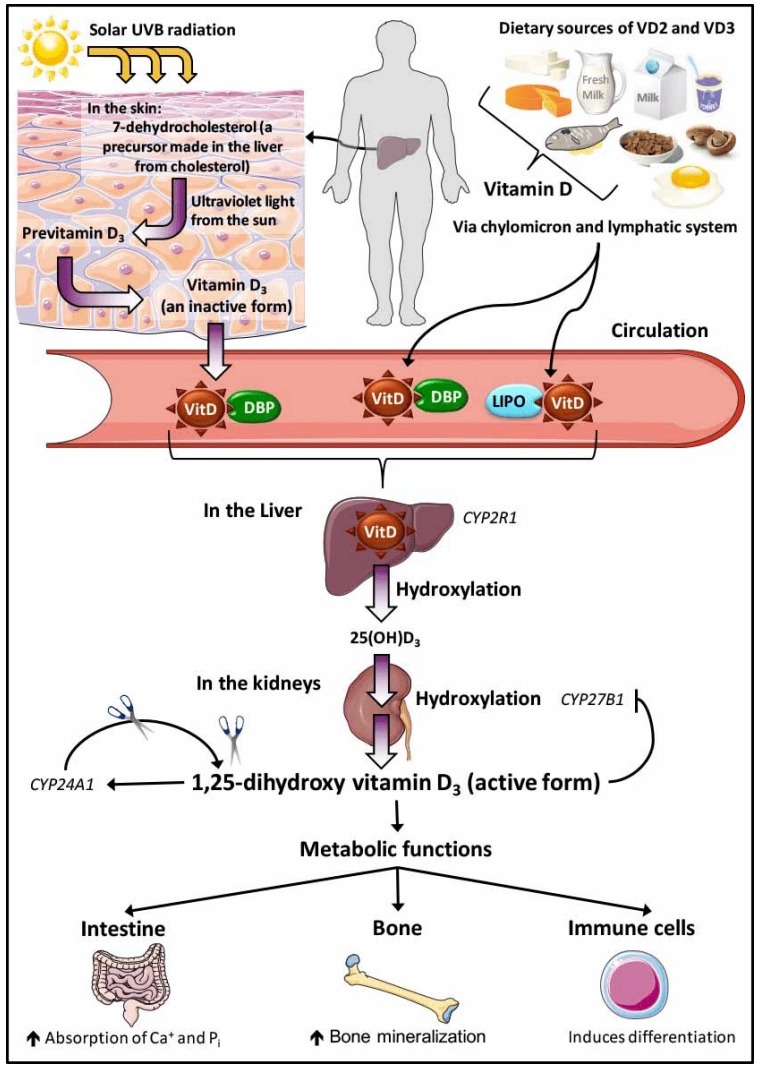


https://www.researchgate.net/figure/The-fluid-mosaic-model-The-membrane-is-composed-of-a-bilayer-structure-integral-and_fig1_292609006

Normal Function of Cholesterol

Boulder Community Health

- Vitamin D synthesis
  - Bone health
  - Absorption of calcium and phosphorus
  - Immune health



https://www.researchgate.net/figure/Basic-metabolism-of-vitamin-D-in-humans-Cholesterol-from-the-diet-undergoes-conversion_fig2_310458065

Normal Function of Cholesterol

Boulder Community Health

- Sex hormones
  - Progesterone
  - Testosterone
  - Estradiol
- Steroid hormones
  - Aldosterone
  - Cortisol

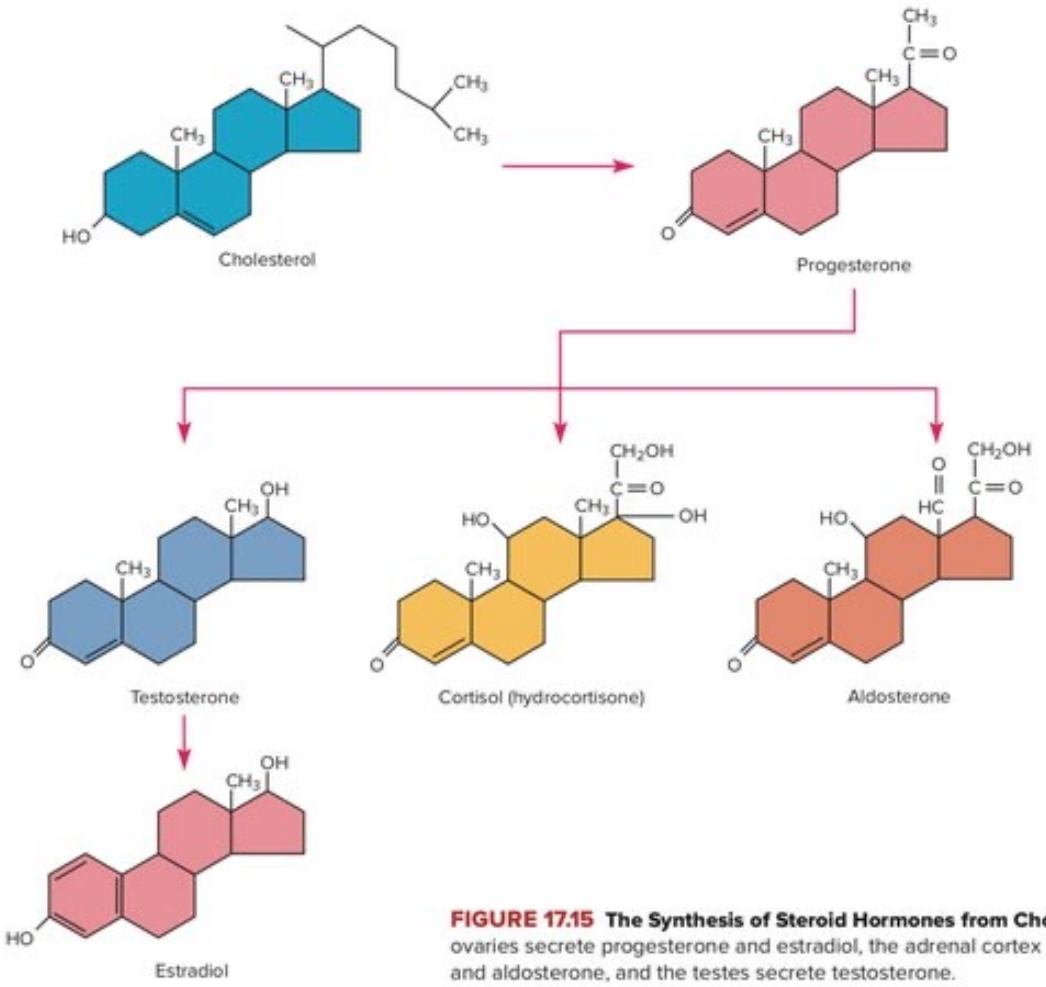


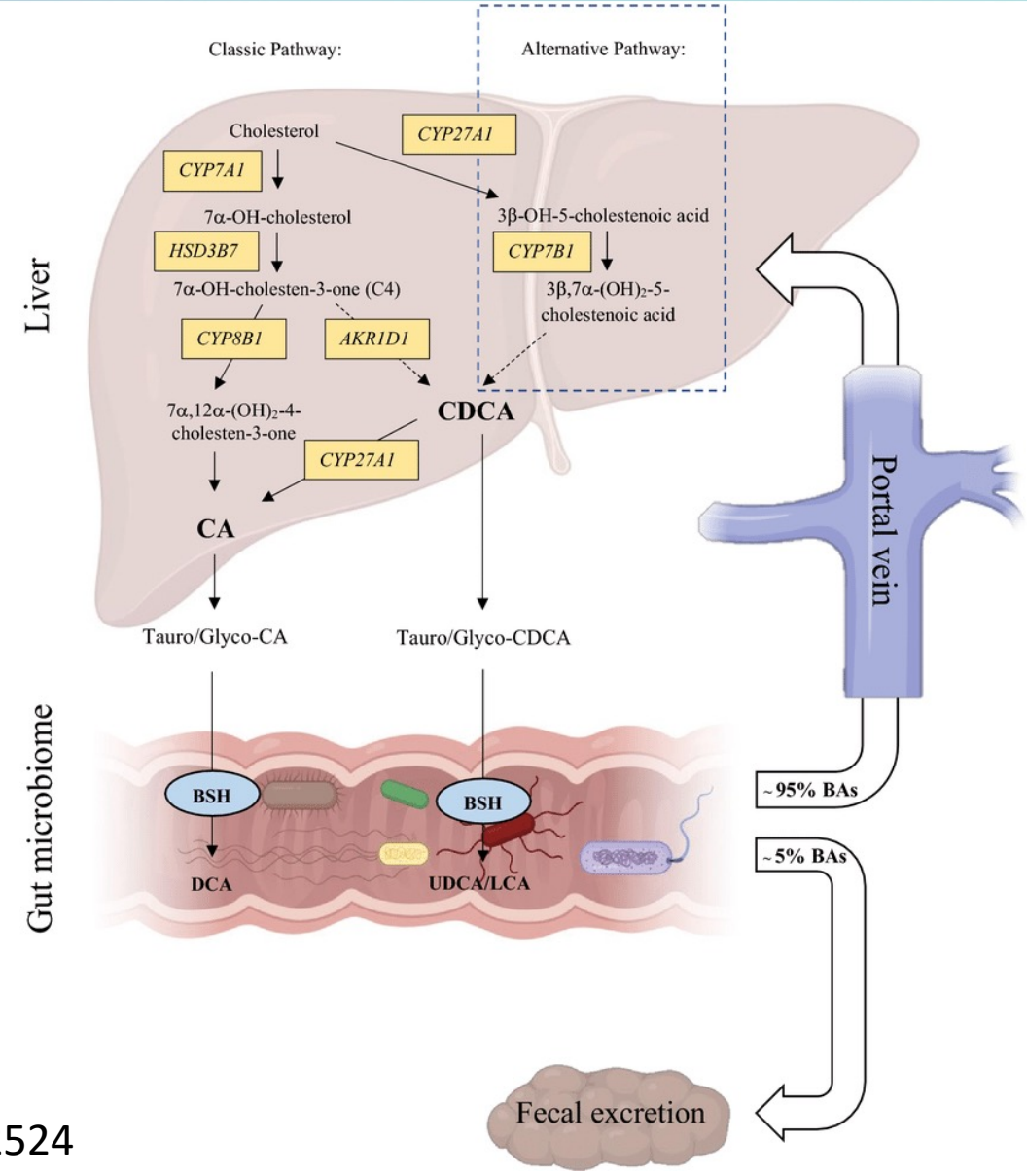
FIGURE 17.15 The Synthesis of Steroid Hormones from Cholesterol. The ovaries secrete progesterone and estradiol, the adrenal cortex secretes cortisol and aldosterone, and the testes secrete testosterone.

https://www.quora.com/Is-cholesterol-a-precursor-to-testosterone

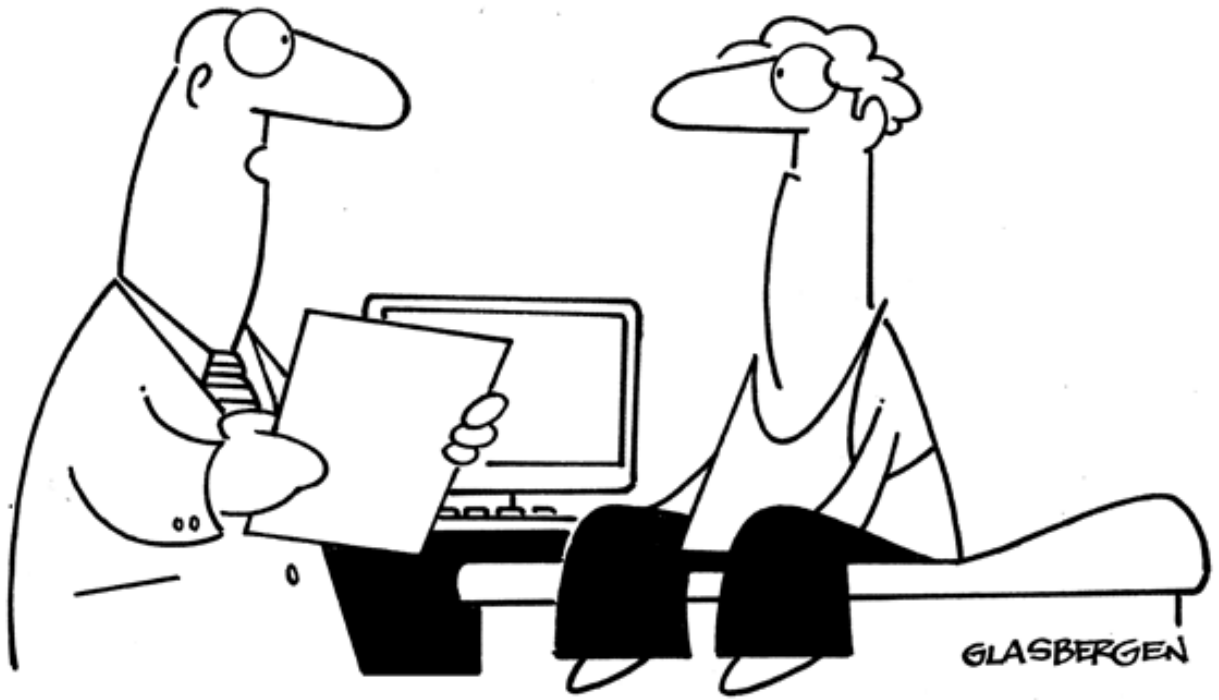
Normal Function of Cholesterol

Boulder Community Health

- Bile acid synthesis
  - 50% of daily cholesterol turnover
  - Emulsifier
  - Help with absorption of lipids and fat-soluble vitamins



https://www.researchgate.net/figure/The-principal-bile-acid-synthesis-pathways-in-humans-Hepatocytes-are-the-primary-site-of_fig1_344862524

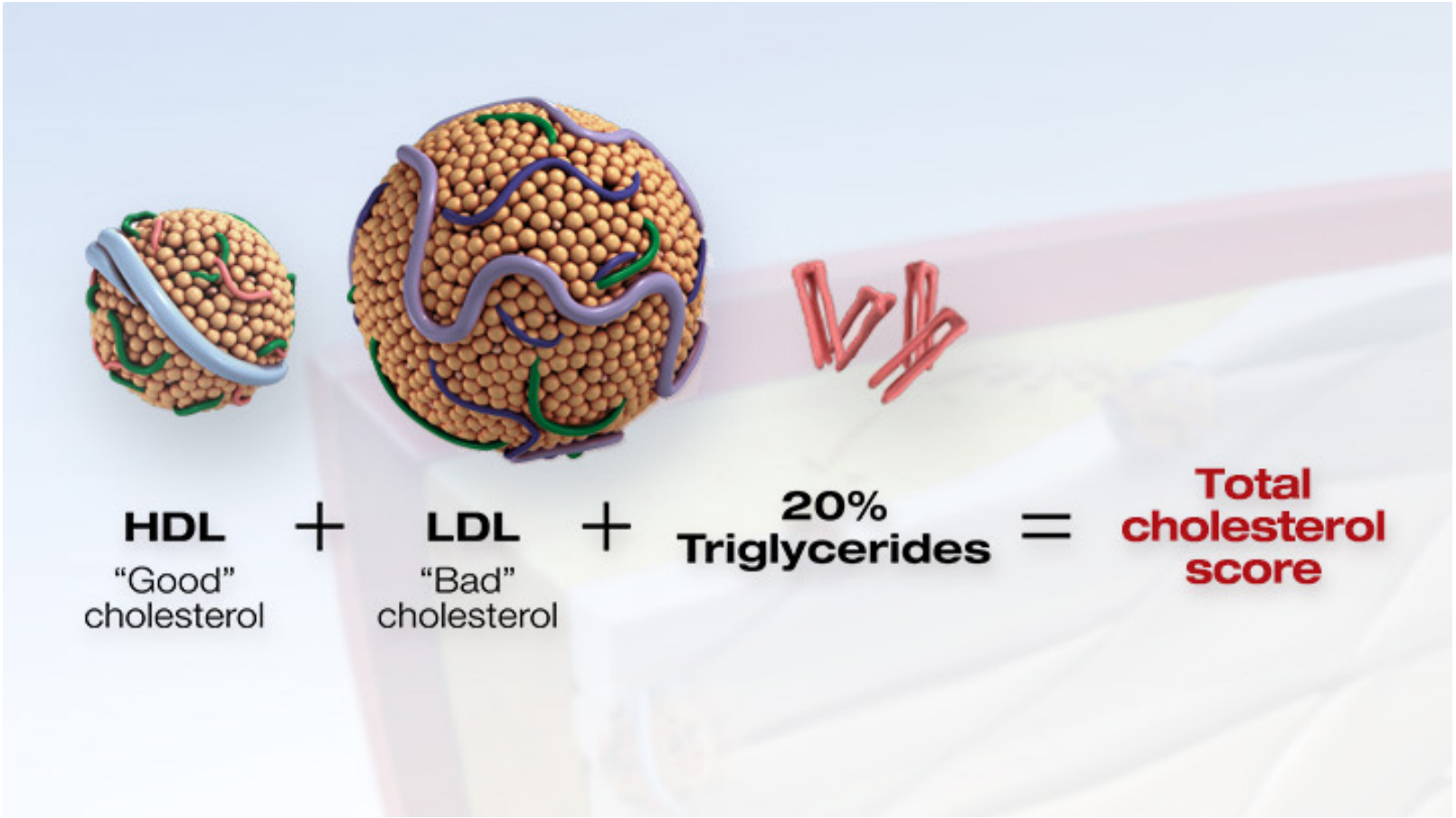


"Your good cholesterol is fine, but your bad cholesterol is plotting to hack into your computer, empty your bank account and steal your wife."

Basics of the Lipid Panel

Boulder Community Health

- Total cholesterol

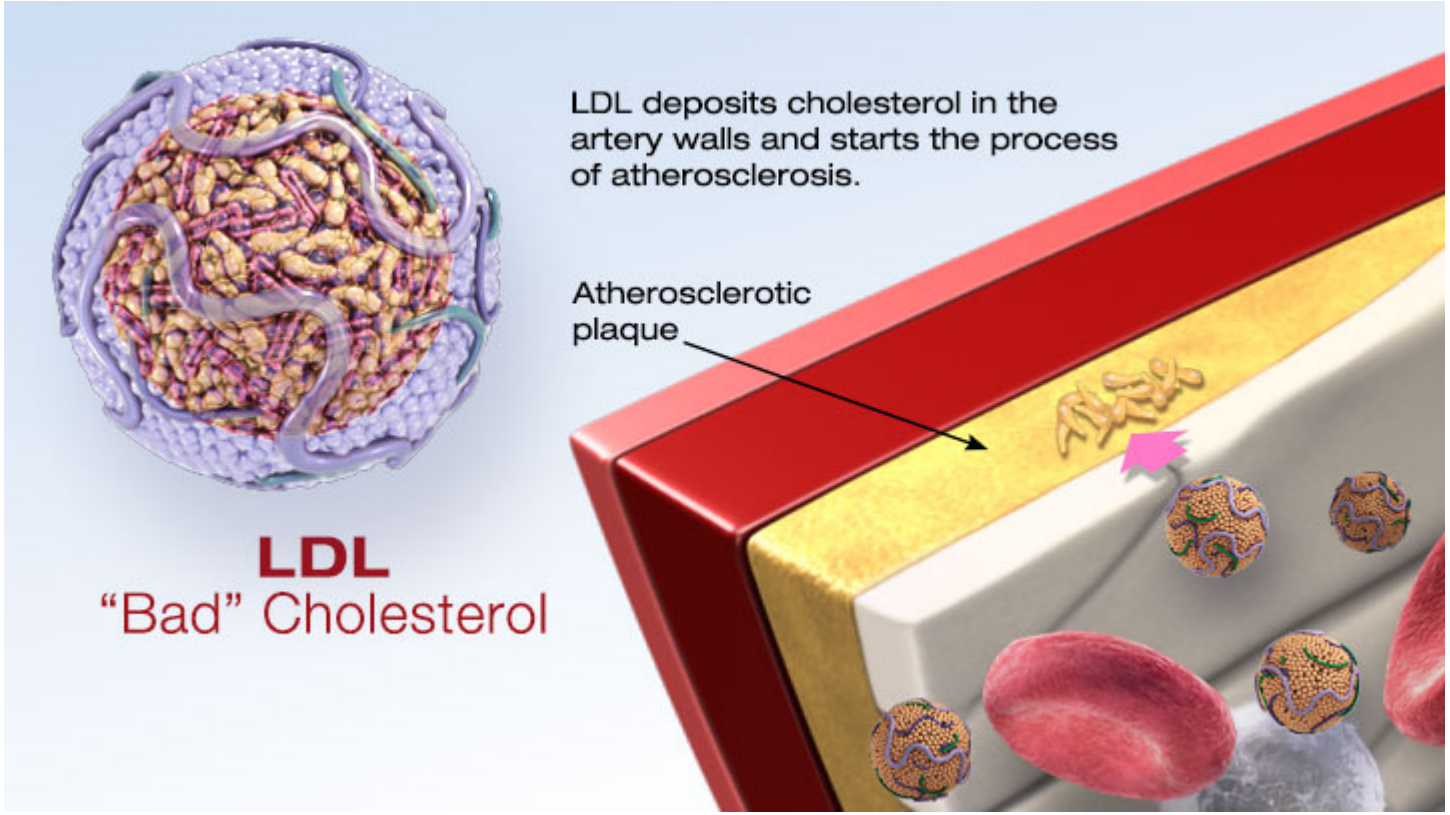


https://watchlearnlive.heart.org/index.php?moduleSelect=chlscr

Basics of the Lipid Panel

Boulder Community Health

- LDL
  - "Bad" cholesterol
  - Can stick into the walls of arteries causing atherosclerotic plaque
  - Over time, can have progressive blockage which can lead to symptoms, heart attack, stroke, etc.

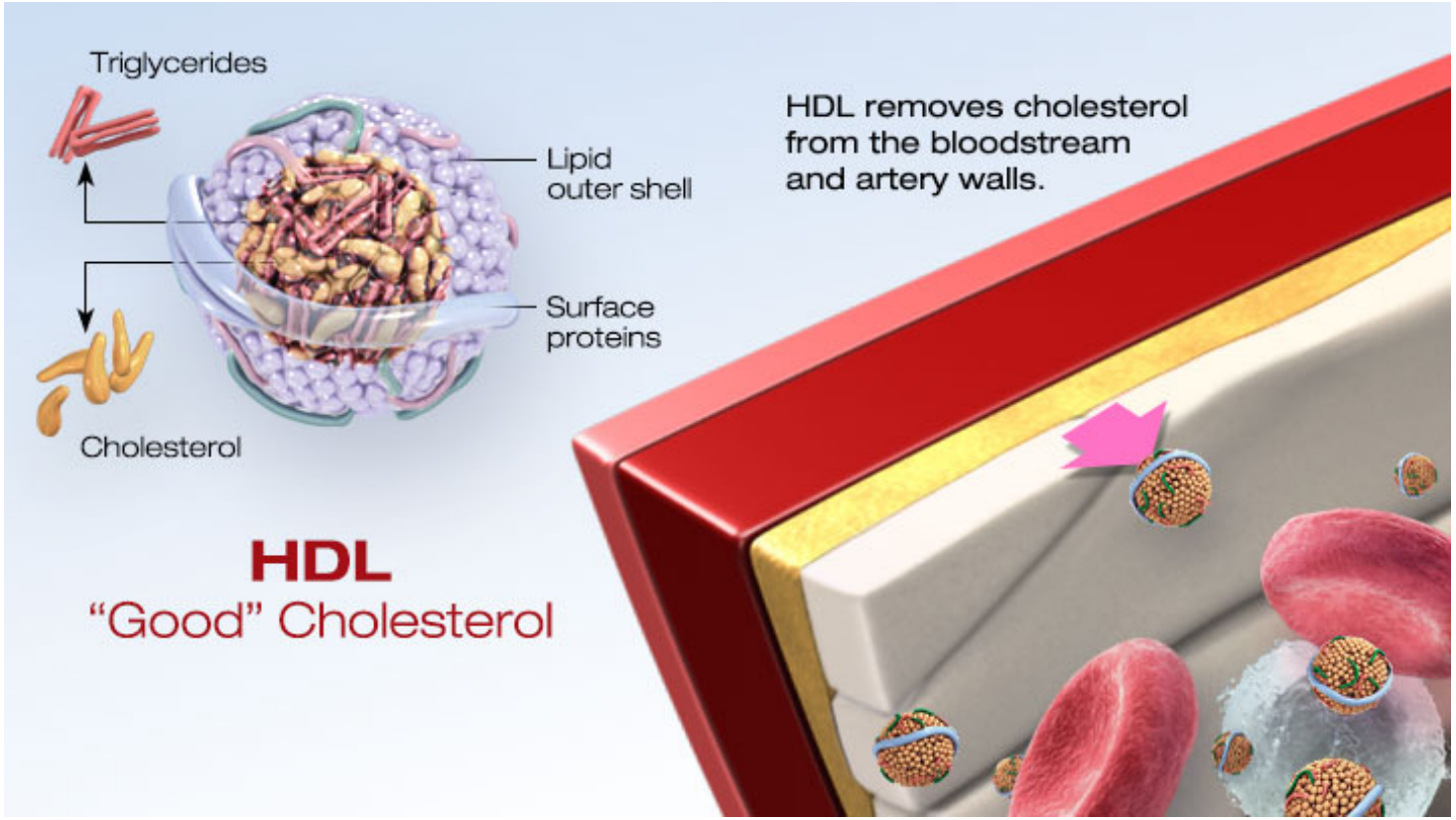


https://watchlearnlive.heart.org/index.php?moduleSelect=chlscr

Basics of the Lipid Panel

Boulder Community Health

- HDL
  - "Good" cholesterol
  - Works to bring cholesterol out of arteries and blood and back to the liver
  - High levels can be protective with regards to cardiovascular events
  - Too high of a level is also associated with increased events

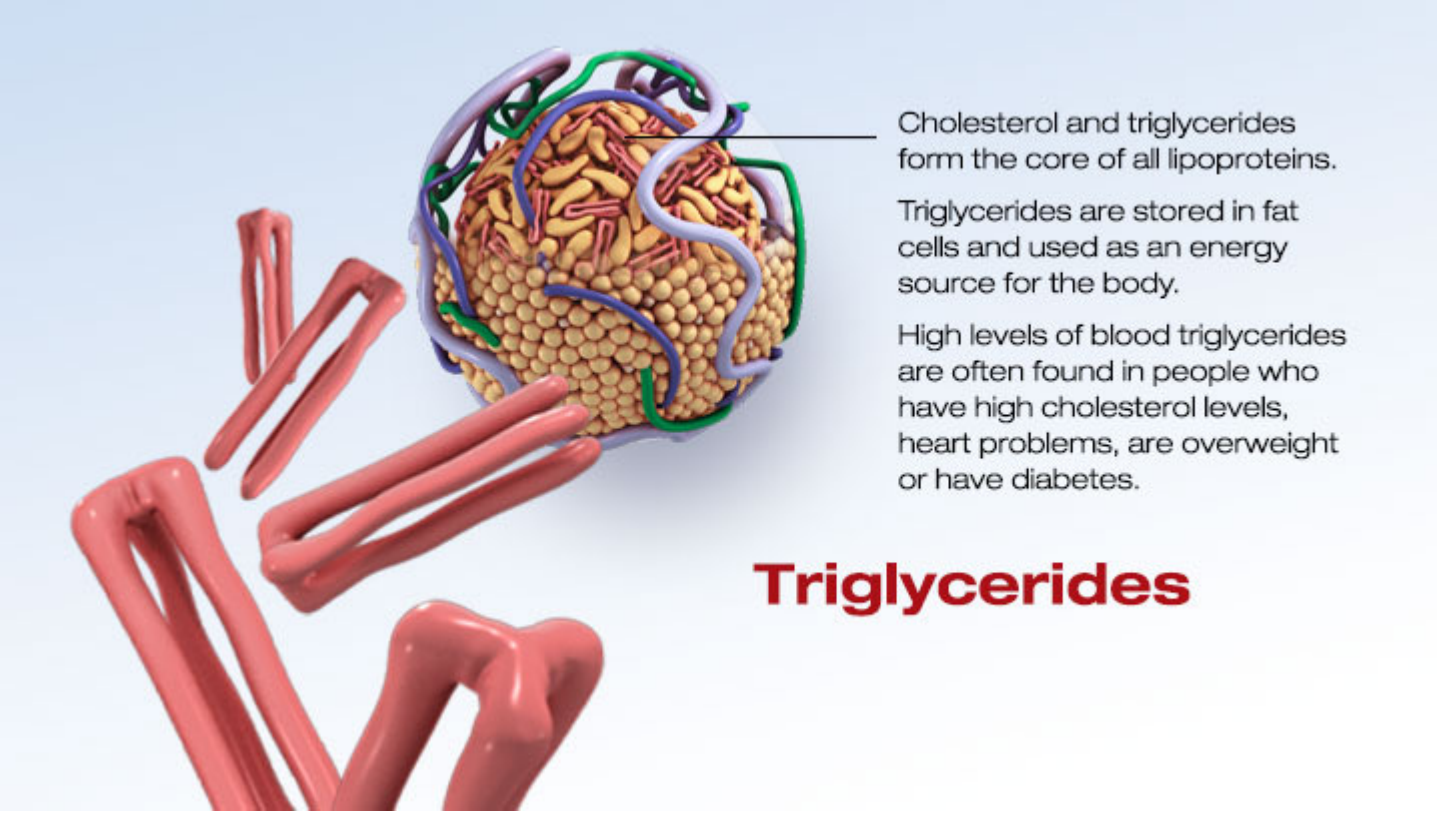


https://watchlearnlive.heart.org/index.php?moduleSelect=chlscr

Basics of the Lipid Panel

Boulder Community Health

- Triglycerides
  - Used for energy
  - High levels also associated with stroke/heart attack
  - Very high levels can cause pancreatitis
  - Most sensitive to diet
    - Sweets, simple carbohydrates, beer, etc.

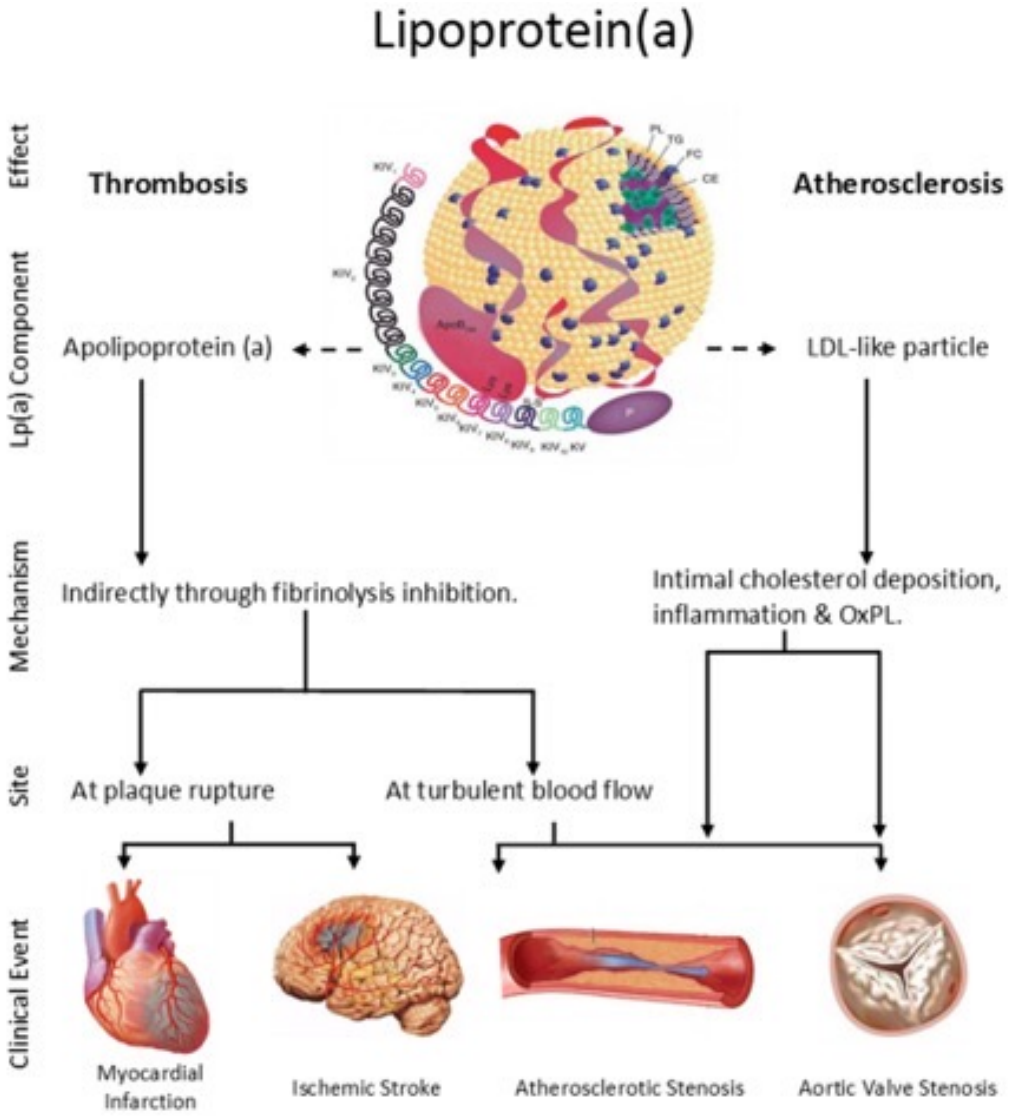


https://watchlearnlive.heart.org/index.php?moduleSelect=chlscr

Advanced Lipid Testing

Boulder Community Health

- Lipoprotein a [LP(a)]
  - Protein and fat on which cholesterol travels through blood (similar to LDL)
  - Can build up in arteries
  - Increased clotting
  - Inflammation
  - Can lead to narrowing of aortic valve

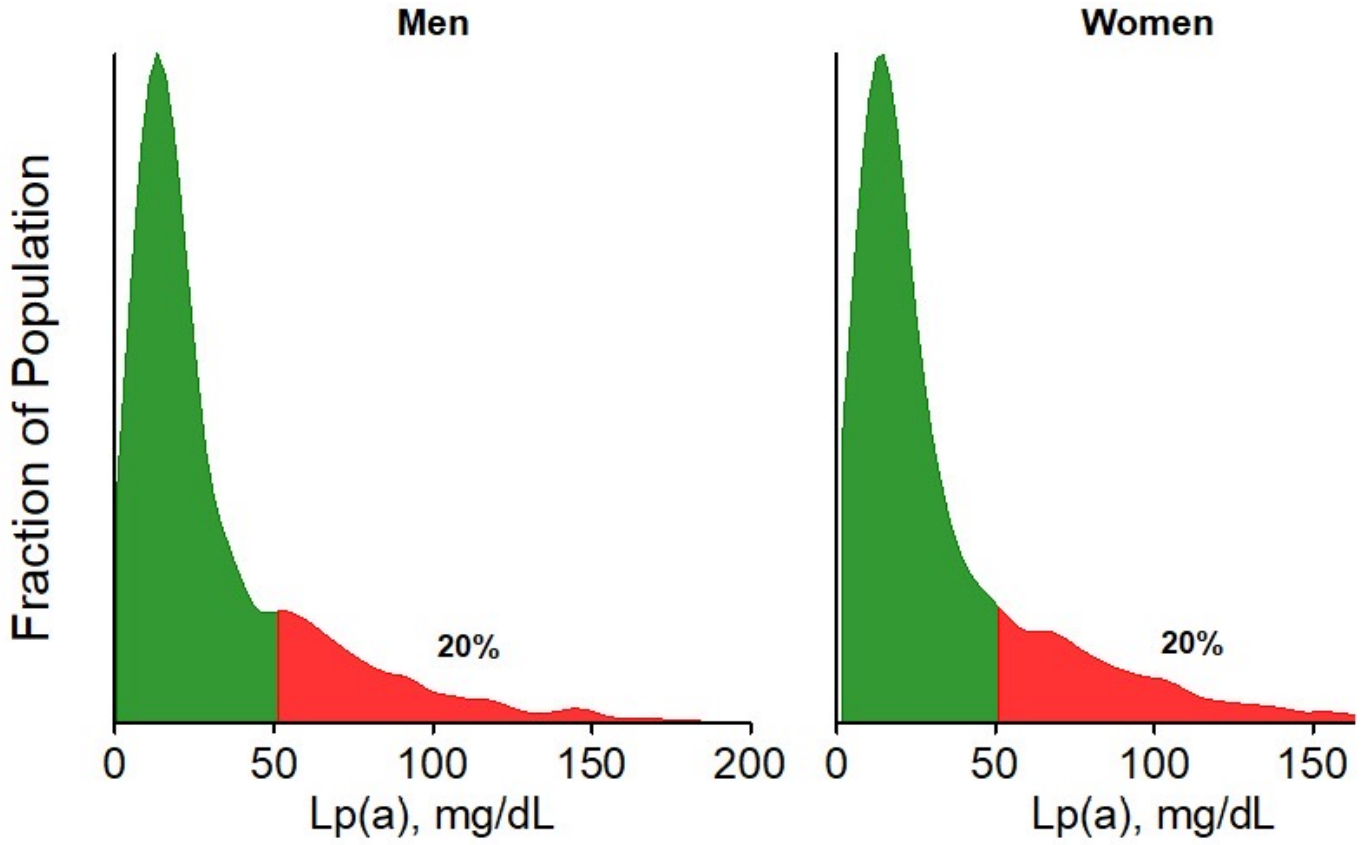


https://www.ncbi.nlm.nih.gov/books/NBK395570/

Advanced Lipid Testing

Boulder Community Health

- Lipoprotein a [LP(a)]
  - High levels run in families
  - Cannot be controlled by healthy eating and exercising
  - Apheresis for select high risk people
  - New therapies are being researched



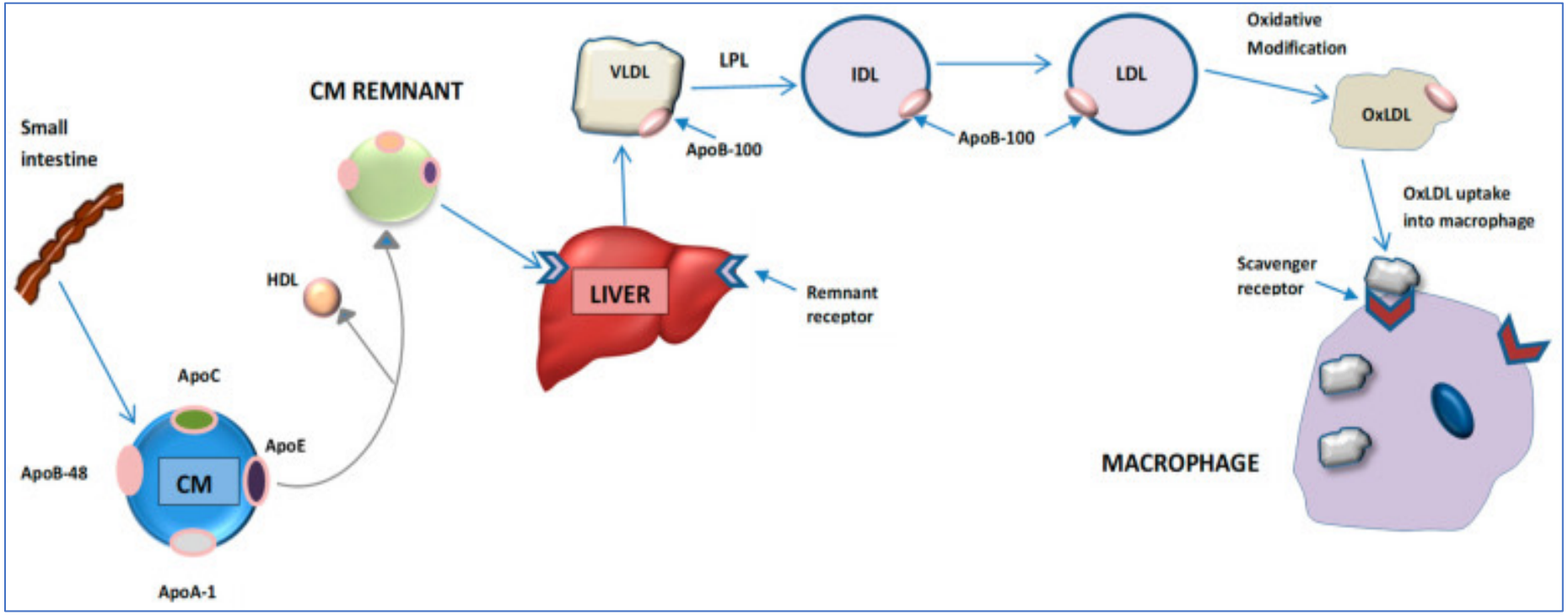
https://www.ncbi.nlm.nih.gov/books/NBK395570/

https://www.cdc.gov/genomics/disease/lipoprotein_a.htm

Advanced Lipid Testing

Boulder Community Health

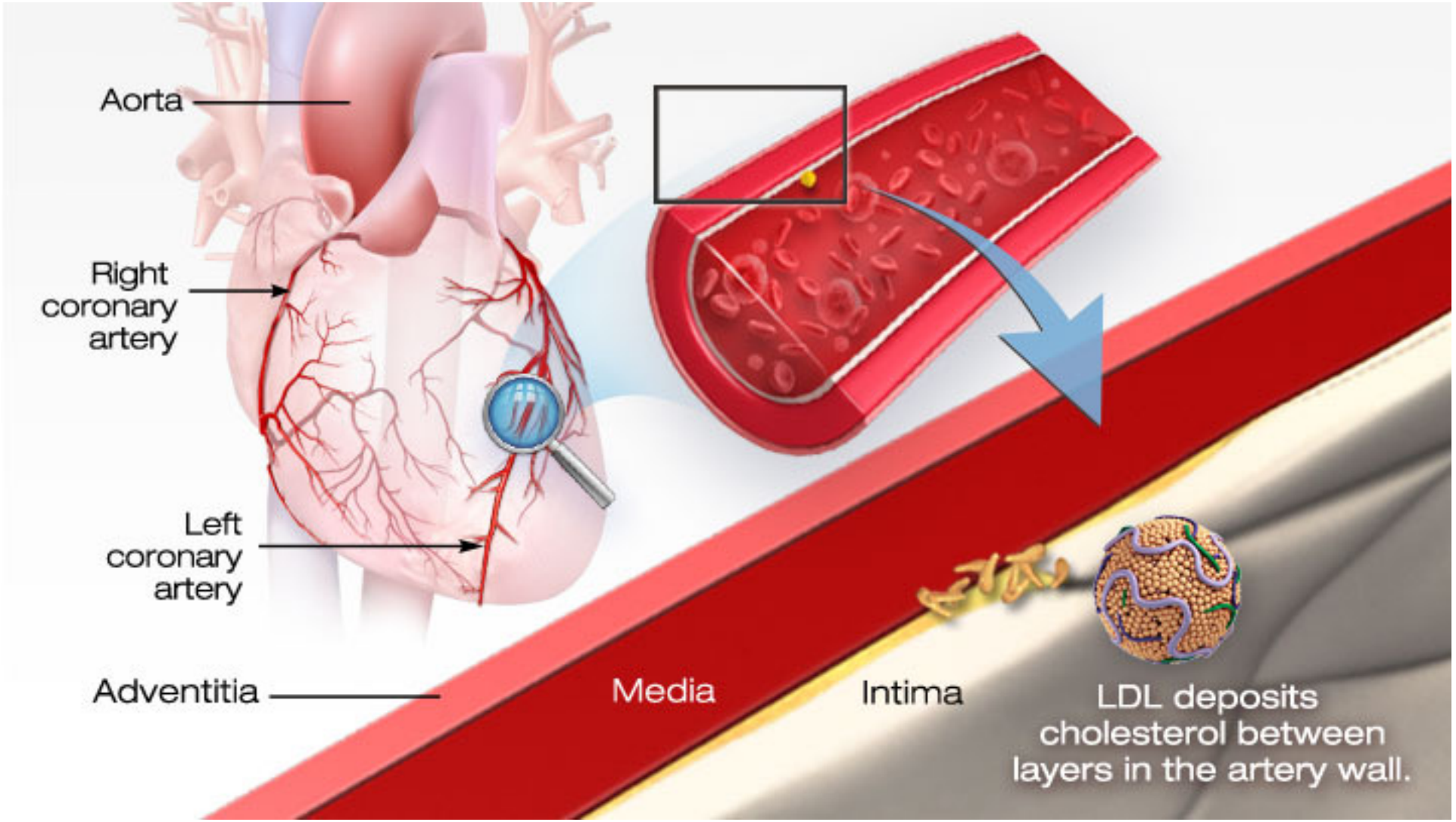
- Apolipoprotein B [apoB]
  - Critical structural protein of lipoproteins that cause plaque
  - Can be directly measured
  - Can be used to estimate cardiovascular risk



https://www.ncbi.nlm.nih.gov/pmc/articles/PMC8540246/

Why Worry About High Cholesterol?

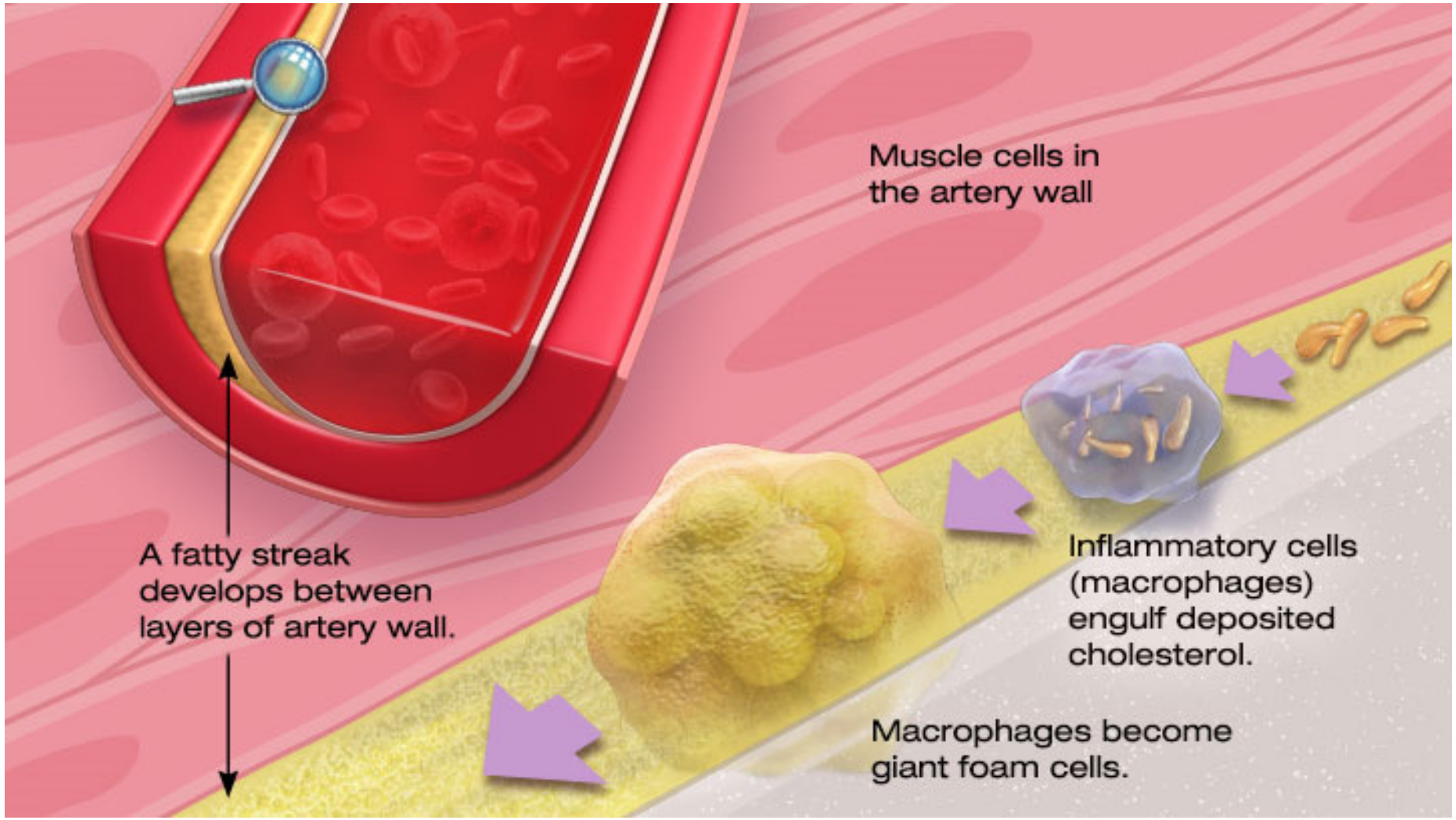
Boulder Community Health



https://watchlearnlive.heart.org/?moduleSelect=chlcad

Why Worry About High Cholesterol?

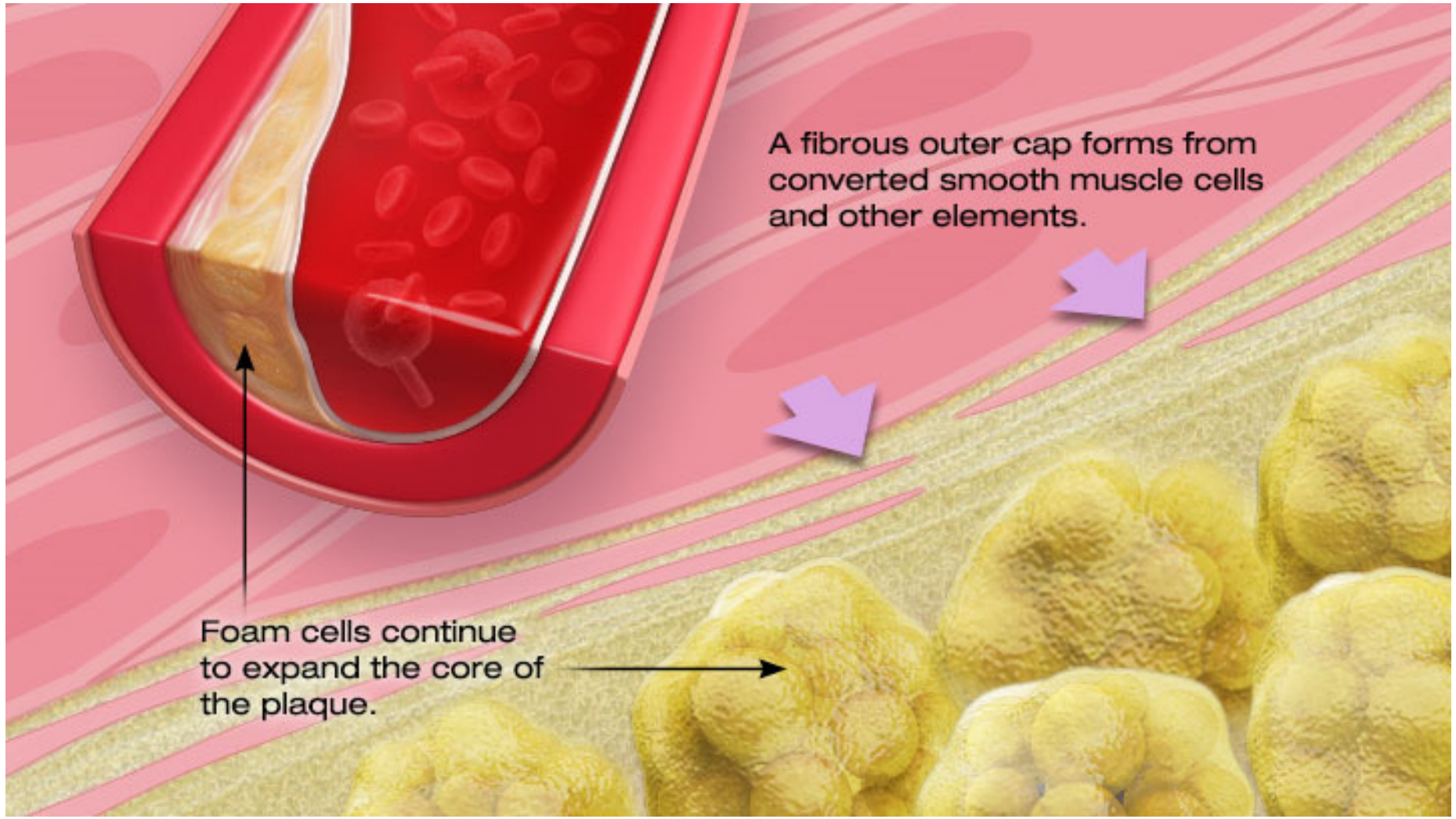
Boulder Community Health



https://watchlearnlive.heart.org/?moduleSelect=chlcad

Why Worry About High Cholesterol?

Boulder Community Health



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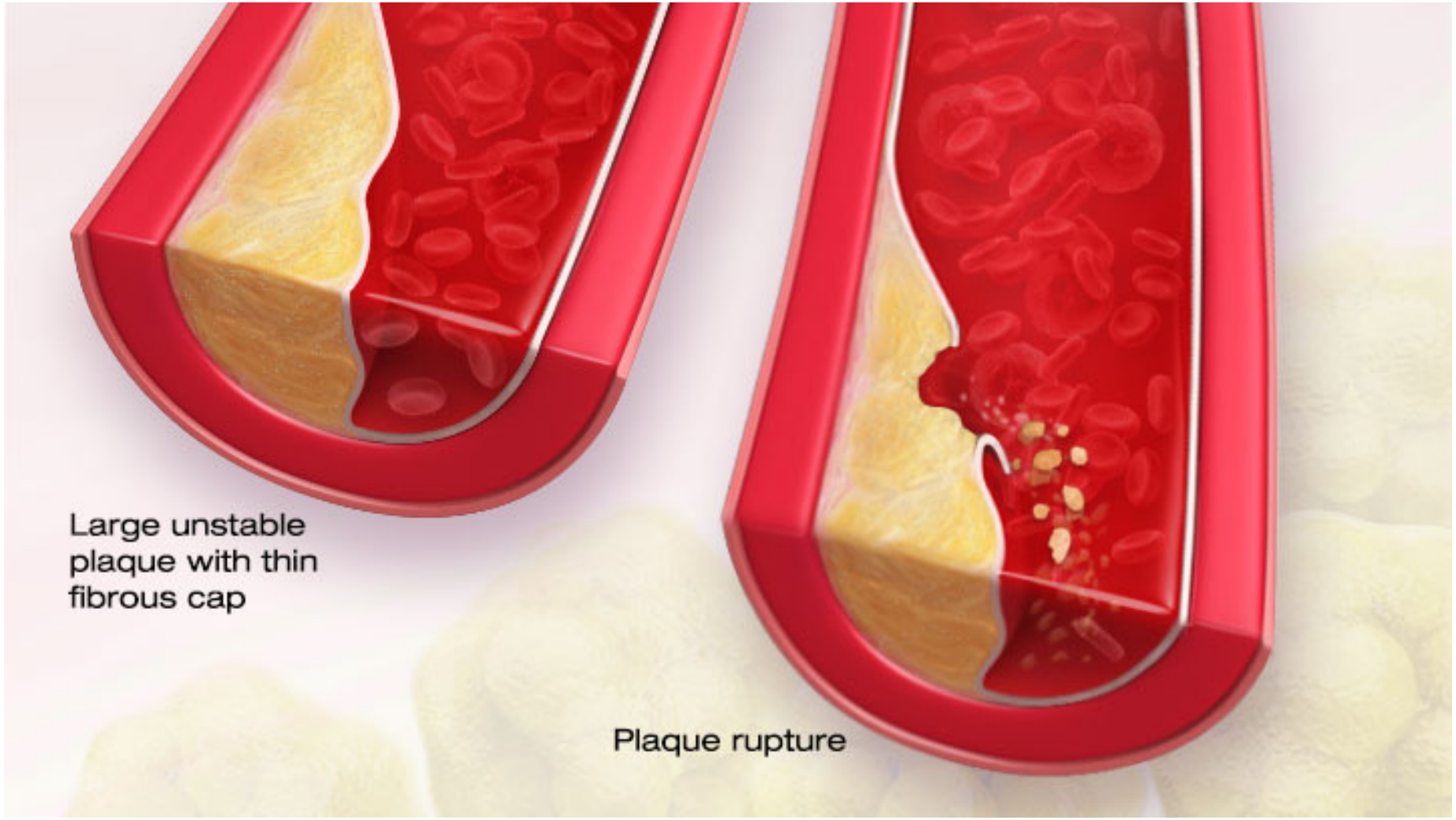
Why Worry About High Cholesterol?

Boulder Community Health



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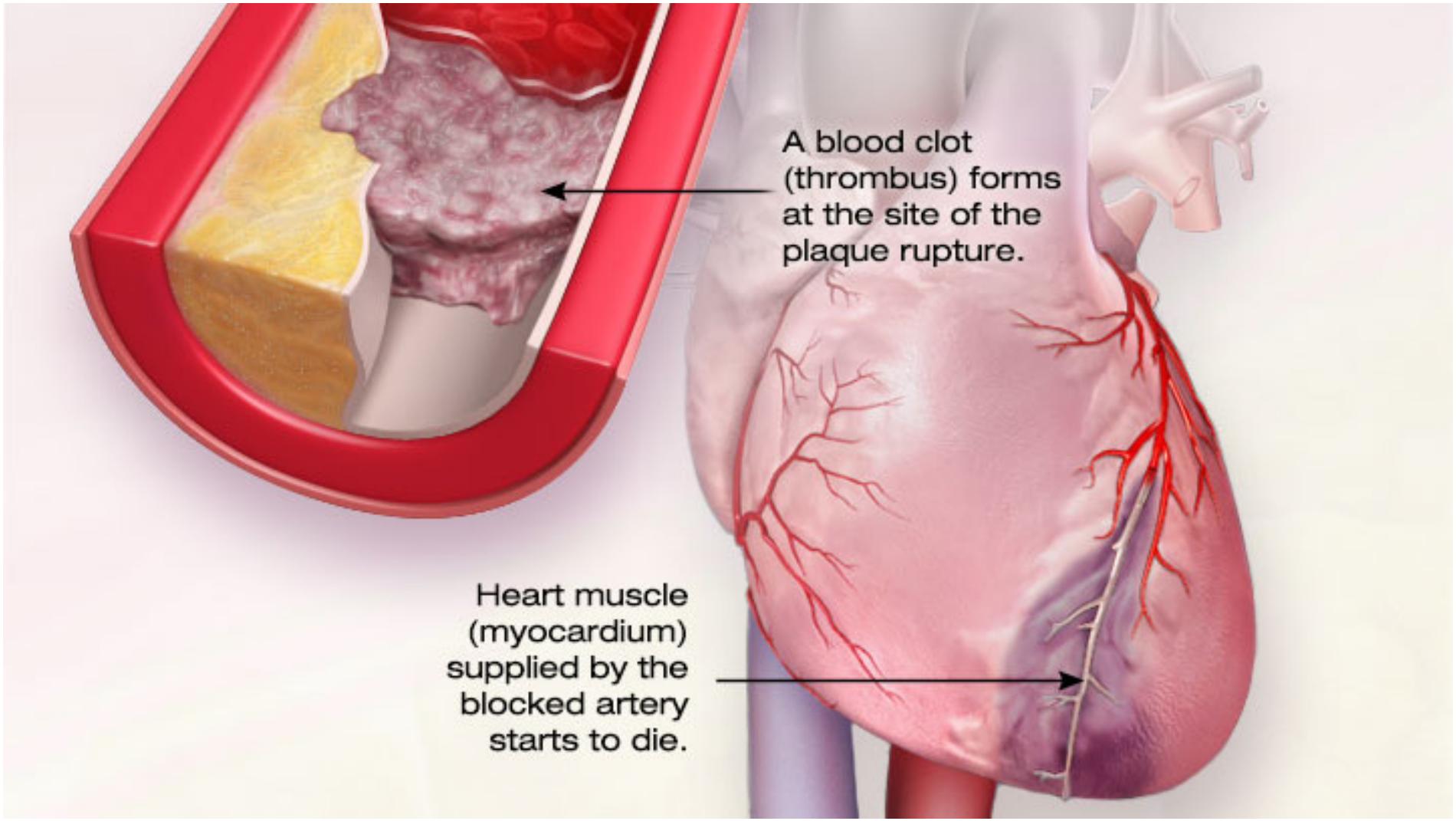
Why Worry About High Cholesterol?

Boulder Community Health

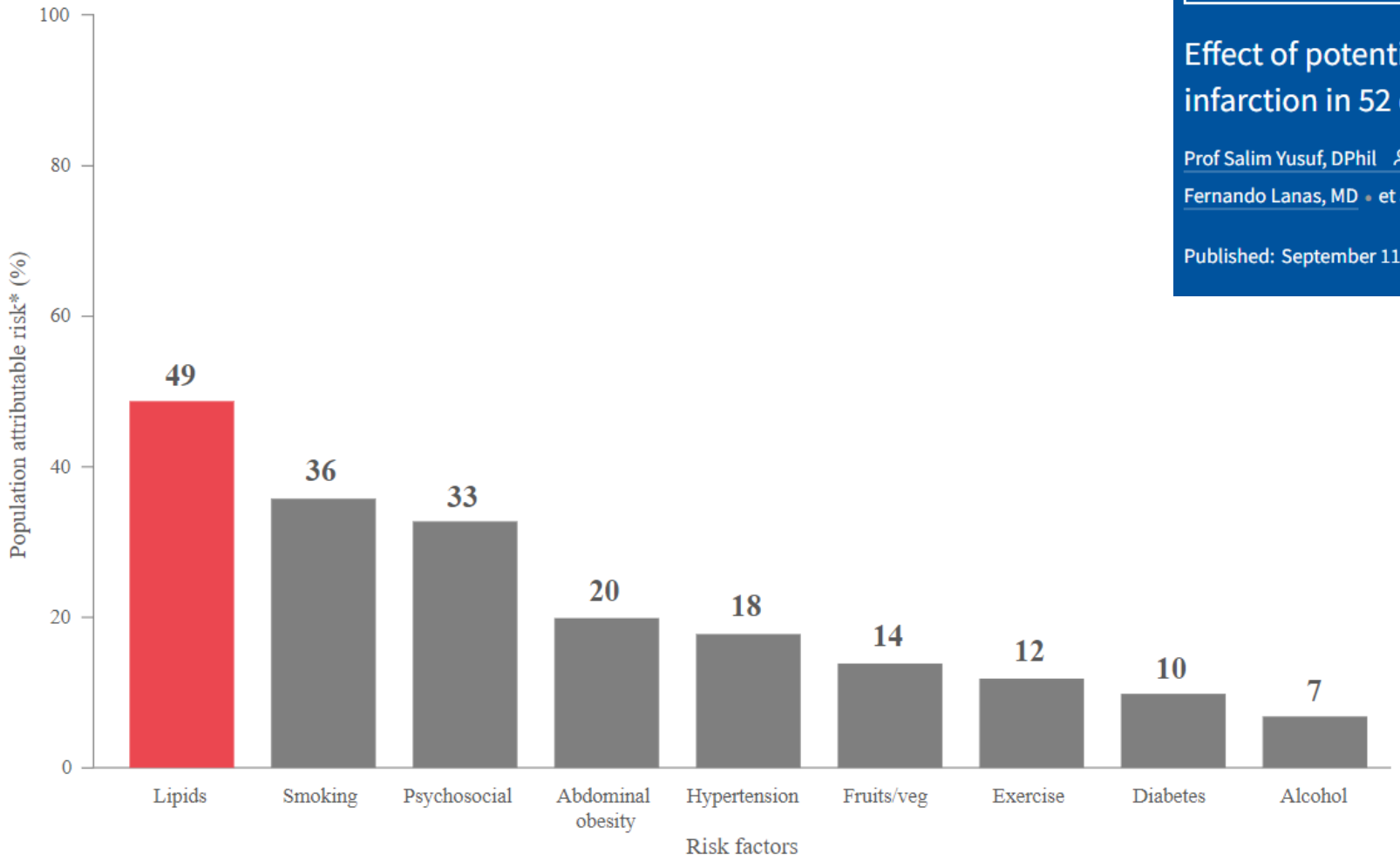


https://watchlearnlive.heart.org/?moduleSelect=chlcad

Modifiable Risk Factors

Boulder Community Health

Lipids Are One of the Most Critical Modifiable CV Risk Factors[2]



INTERHEART: nine modifiable factors account for 90% of first-MI risk worldwide; n = 15,152 patients and 14,820 controls in 52 countries.
*Proportional increase in population disease that would occur if exposure to a risk factor was reduced to an alternative ideal exposure scenario (eg, no tobacco use). Adjusted for all risk factors.
CV, cardiovascular; MI, myocardial infarction.

FAST TRACK — ARTICLES | VOLUME 364, ISSUE 9438, P937-952, SEPTEMBER 11, 2004

Download Full Issue

THE LANCET

Effect of potentially modifiable risk factors associated with myocardial infarction in 52 countries (the INTERHEART study): case-control study

Prof Salim Yusuf, DPhil • Steven Hawken, MSc • Stephanie Ôunpuu, PhD • Tony Dans, MD • Alvaro Avezum, MD • Fernando Lanas, MD • et al. Show all authors

Published: September 11, 2004 • DOI: https://doi.org/10.1016/S0140-6736(04)17018-9

What Can We Do?

Boulder Community Health

- Prevent cardiovascular disease in the first place.
- Aggressively manage those who have developed cardiovascular disease to minimize the risk of future events.

What Can We Do?

Boulder Community Health

- Follow a heart-healthy lifestyle
  - Throughout the continuum of life, this reduces cardiovascular risk.
  - Try to prevent the development of cardiovascular risk factors.
  - Create a strong foundation of health.

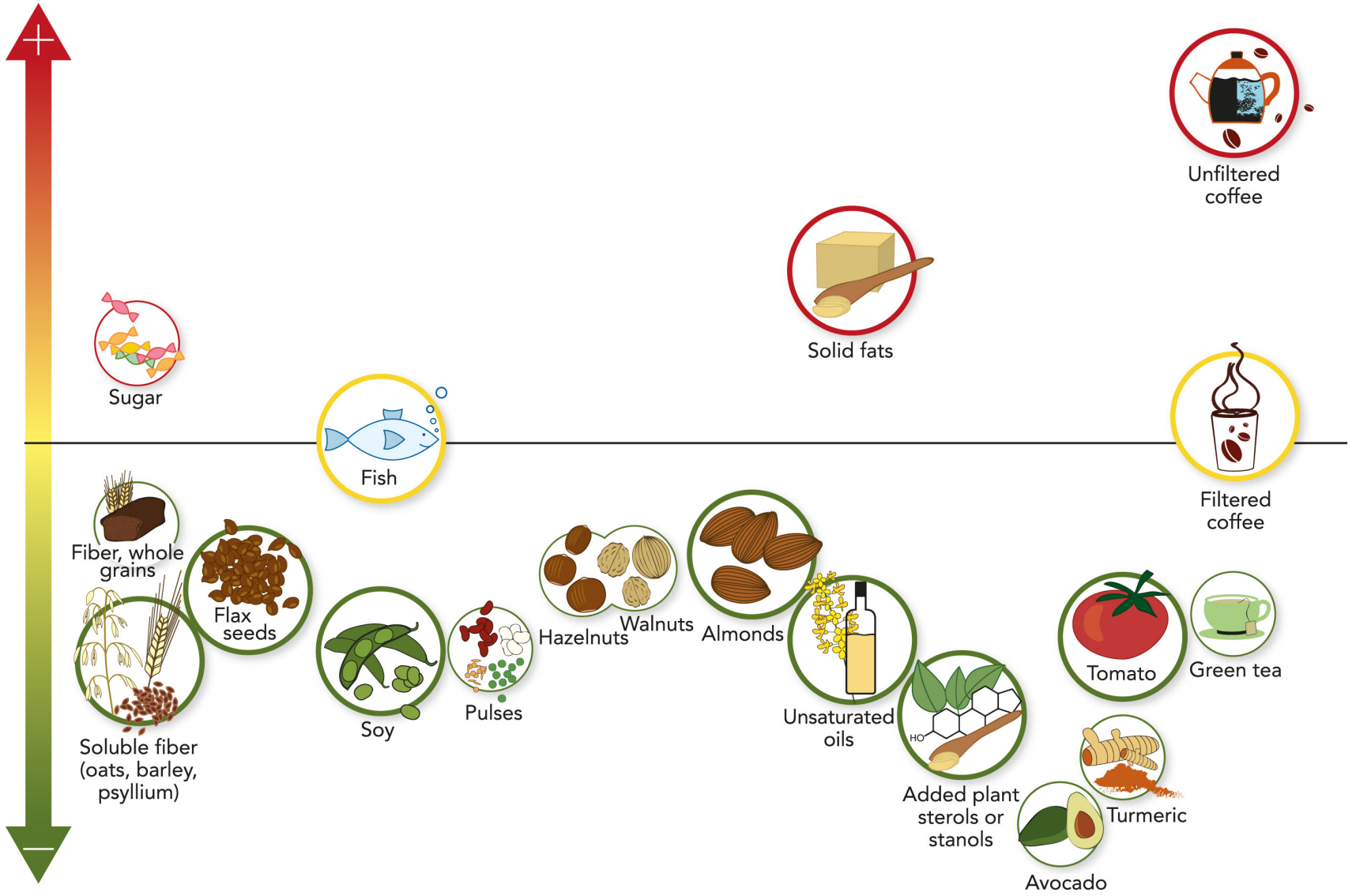
What Can We Do?

Boulder Community Health

- Eat a diet that encourages lowering cholesterol
  - Vegetables
  - Fruits
  - Nuts
  - Whole grains
  - Lean vegetable or animal protein
  - Fish

Foods That Affect Cholesterol

Boulder Community Health



https://www.sciencedirect.com/science/article/pii/S0939475321000028

What Can We Do?

Boulder Community Health

- Try to avoid
  - *Trans* fats
  - Red meat and processed red meats
  - Refined carbohydrates
  - Sweetened beverages

What Can We Do?

Boulder Community Health

- Diets that have data in reducing cardiovascular events
  - Mediterranean
  - DASH
  - Plant-based (Vegetarian/Vegan)
  - Flexitarian
  - Portfolio
    - Plant proteins, nuts, viscous fiber, phytosterols, plant monounsaturated fats

Comparison of Diets

Boulder Community Health

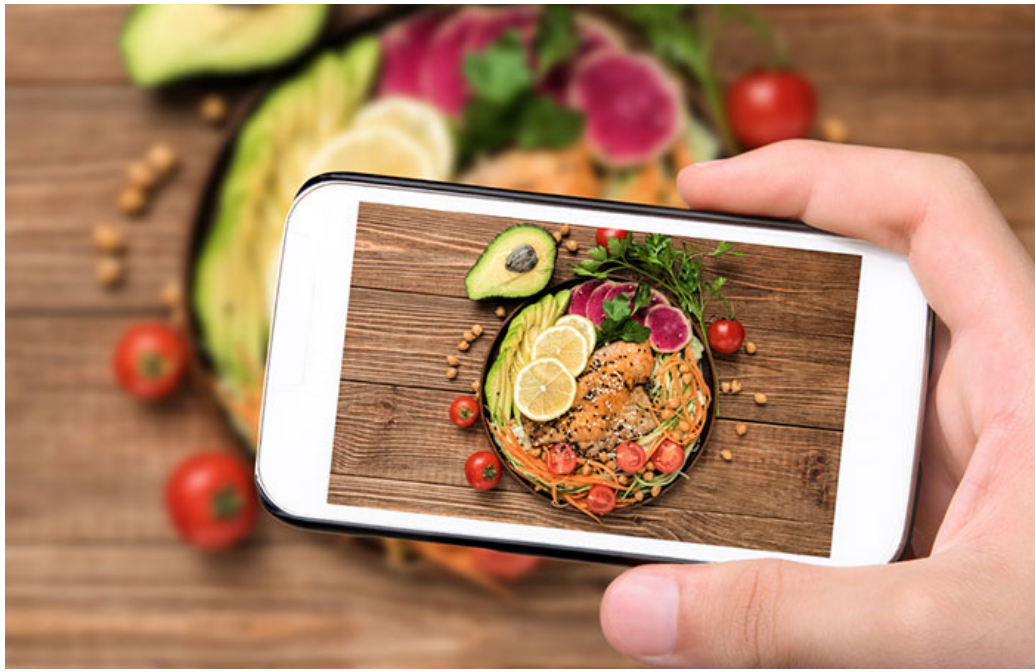
	Flexitarian	Vegan	Omnivore	
Blood lipid markers				
Cholesterol (mmol/L)	4.35 (4.00-5.05) *	3.80 (3.30–4.20) ***	4.90 (4.00-5.50) **	**< 0.001**
LDL-Cholesterol (mmol/L)	2.64 (2.11–3.47) *	2.14 (1.88–2.56) ***	3.17 (2.40–3.64) **	**< 0.001**
HDL-Cholesterol (mmol/L)	1.68 (1.48–1.88)	1.62 (1.23–1.81)	1.57 (1.29–1.72)	0.375
Triglycerides (mmol/L)	0.73 (0.61-1.00) *	0.77 (0.59–0.98)	1.14 (0.82–1.36) **	**0.008**

https://bmcnutr.biomedcentral.com/articles/10.1186/s40795-024-00839-9/tables/3

Dietary Modification

Boulder Community Health

- Reduce saturated fat
  - Lean meats
  - Remove skin
  - Broil on a rack to drain off fat
- Eat more fish
  - Salmon, trout, herring (omega-3)
- Substitute meatless options for meat
- Cook vegetables with minimal oil and without heavy sauces
- Reduce dairy fats
- Increase fiber and whole grains



What Can We Do?

Boulder Community Health

- Exercise
  - Recommend 150 minutes per week
  - Can lower LDL and triglycerides (generally at higher intensity)
  - Can raise HDL
  - Generally, these changes on the lipid profile are modest


ED FISCHER '08
yes, yes, yes- now, seriously- what can we do to improve our health!?
1. Exercise
2. Exercise
3. Exercise
4. Exercise
5. Exercise
6. Exercise
7. exercise
8 etc.
NEWS
EXERCISE- THE KEY

Exercise and Lipid Changes

Boulder Community Health

References	n	Design	Training time	Training frequency	Training strength	Changes of HDL-C	Changes of LDL-C	Changes of TG
LeMura et al. [21]	12 women	RCT	16 weeks	3 sessions/week	70–85% of the HRmax	Increased 0.4 mmol/L	Decreased 0.2 mmol/L	Decreased 0.2 mmol/L
Nybo et al. [22]	36 men	RCT	12 weeks	150 min/week	65% VO2max	Increased 0.1 mmol/L	Decreased 0.1 mmol/L	Not mentioned
Kraus et al. [23]	111 men and women	RCT	24 weeks	Expand 14–23 kcal/kg/week	65–80% VO2max	Increased 4.3 mg/dL	Decreased 1.9 mg/dL	Decreased 28.4 mg/dL
O'Donovan et al. [24]	64 men	RCT	24 weeks	400 kcal/session 3 sessions/week	60% VO2max	Increased 0.08 mmol/L	Increased 0.17 mmol/L	Increased 0.12 mmol/L

Wang, Y., Xu, D. Effects of aerobic exercise on lipids and lipoproteins. *Lipids Health Dis* **16**, 132 (2017). https://doi.org/10.1186/s12944-017-0515-5

What Can We Do?

Boulder Community Health

- Weight loss
  - In obesity, losing 3-5% of weight can increase HDL and decrease LDL.
- Manage stress
  - Increased cortisol levels can lead to higher cholesterol.

Cholesterol Medications

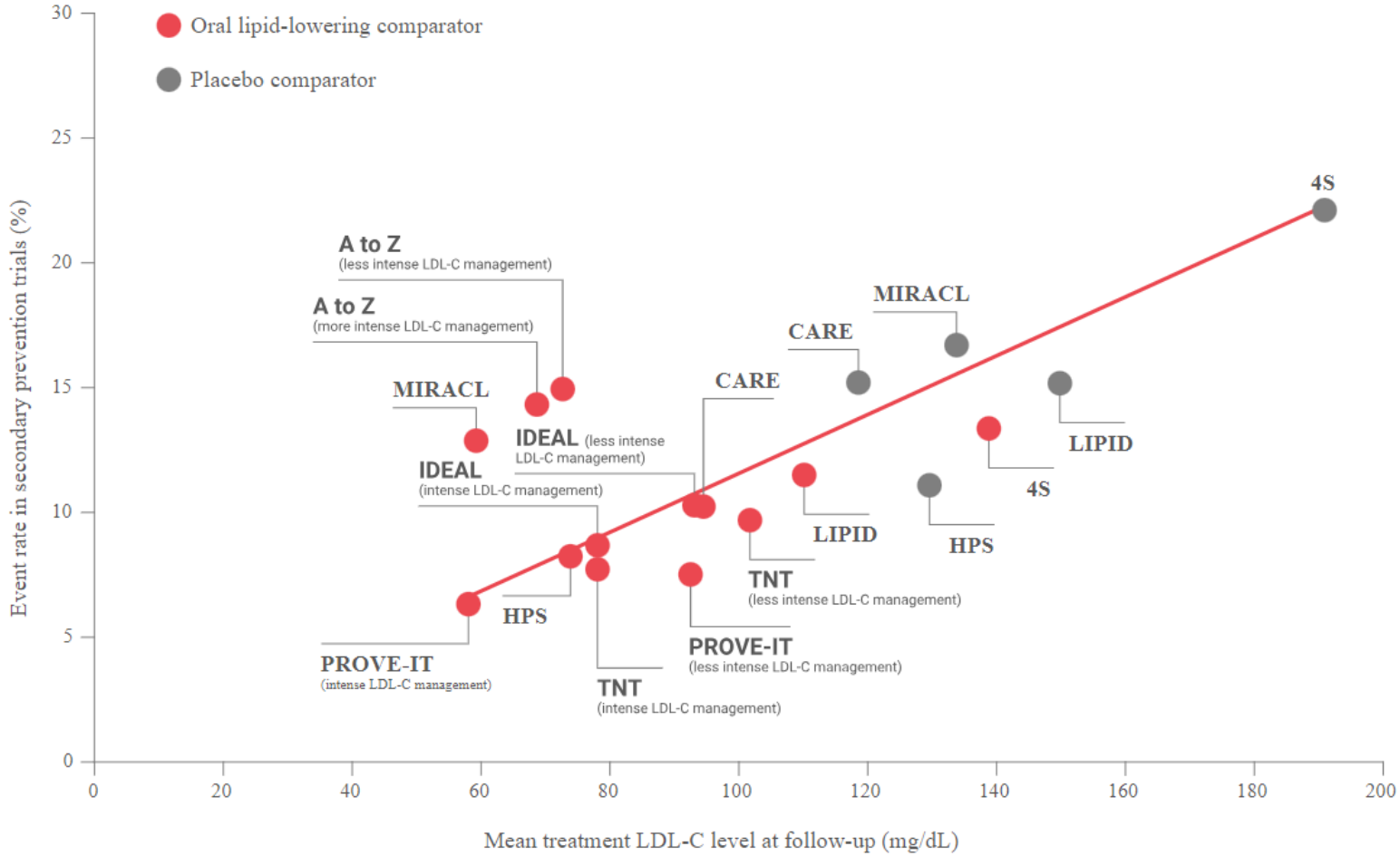
Boulder Community Health

- Despite doing well with lifestyle modification (diet and exercise), many people continue to have high cholesterol.
- May be reasonable to consider cholesterol medication.
- Recommend screening cholesterol in adults >20 years old.

LDL Reduction and CV Events

Boulder Community Health

Meta-analysis of Major Lipid Secondary Prevention Statin Trials Demonstrates Linear Correlation Between LDL-C Lowering and Risk of CV Events[11,16]



THE LANCET

Efficacy and safety of more intensive lowering of LDL cholesterol: a meta-analysis of data from 170 000 participants in 26 randomised trials

Cholesterol Treatment Trialists' (CTT) Collaboration • Show footnotes

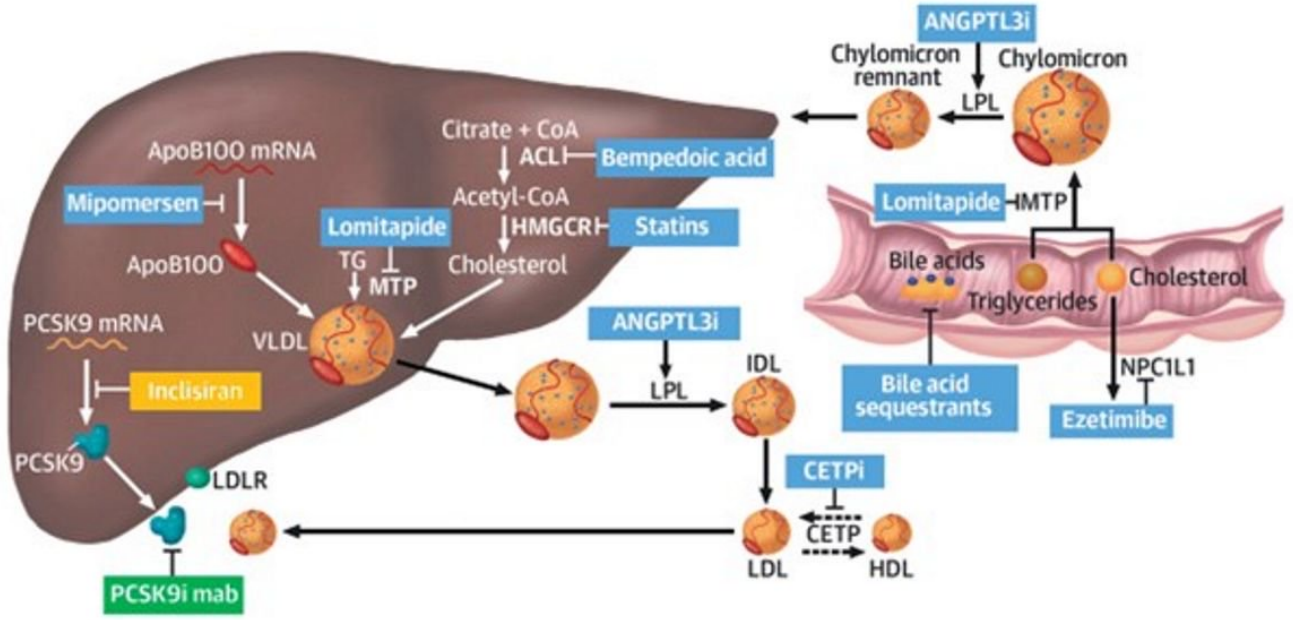
Open Access • Published: November 09, 2010 • DOI: https://doi.org/10.1016/S0140-6736(10)61350-5

CTTC meta-analysis of major lipid secondary prevention statin trials conducted in 2010: median follow-up ~ 5 years, N = 169,138.
CTTC, Cholesterol Treatment Trialists' Collaboration; CV, cardiovascular; LDL-C, low-density lipoprotein cholesterol.

Cholesterol Medications

Boulder Community Health

- There are multiple factors that your doctor will consider to determine the most appropriate treatment
  - Age
  - Risk factors
  - History of cardiovascular events
  - Shared decision-making

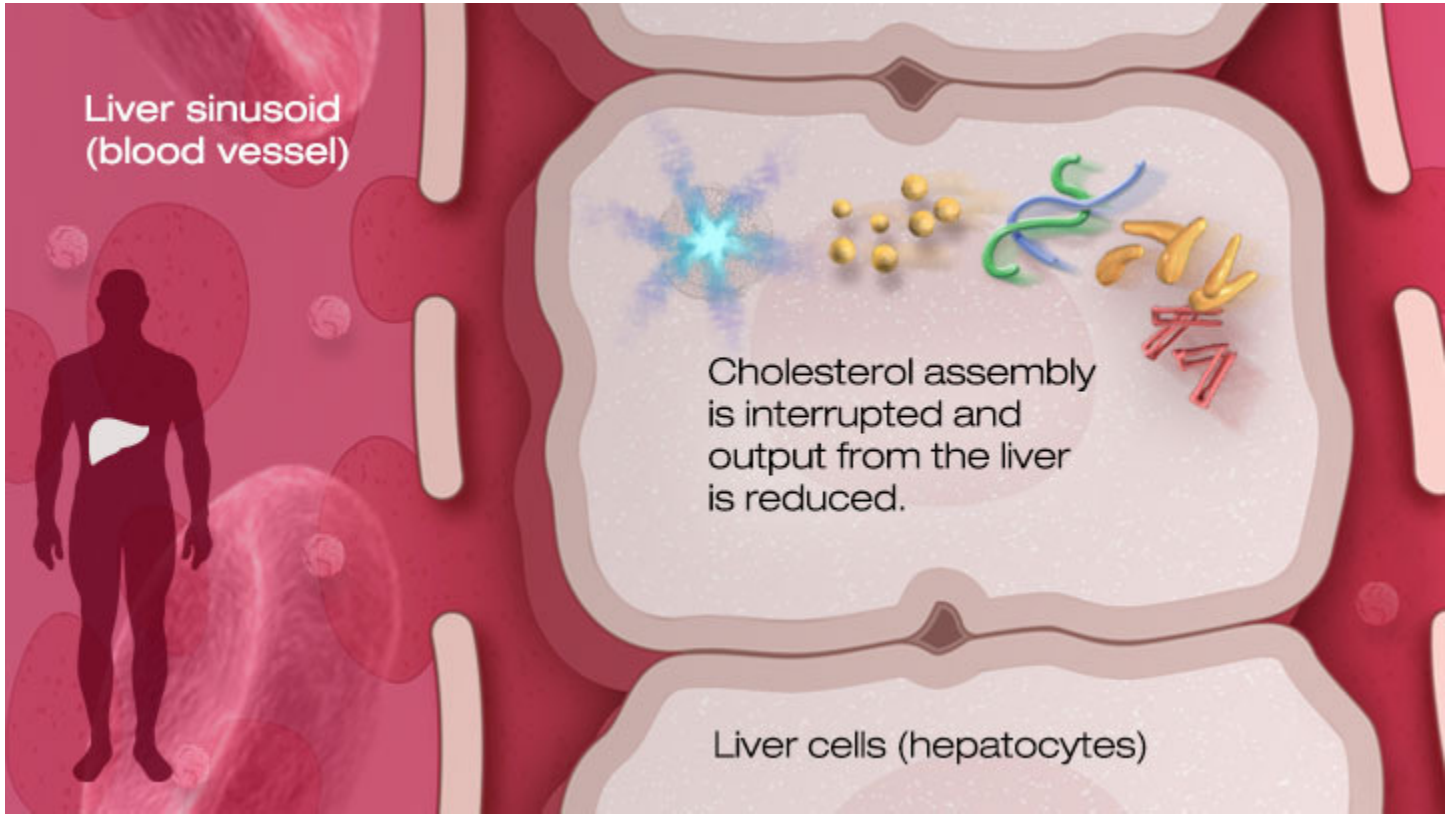


https://www.healio.com/cardiology/learn-the-heart/cardiology-review/topic-reviews/pcsk9-inhibitors-topic-review

Statin Medications

Boulder Community Health

- Most commonly prescribed cholesterol medication
- Work by blocking pathway of cholesterol synthesis in the liver

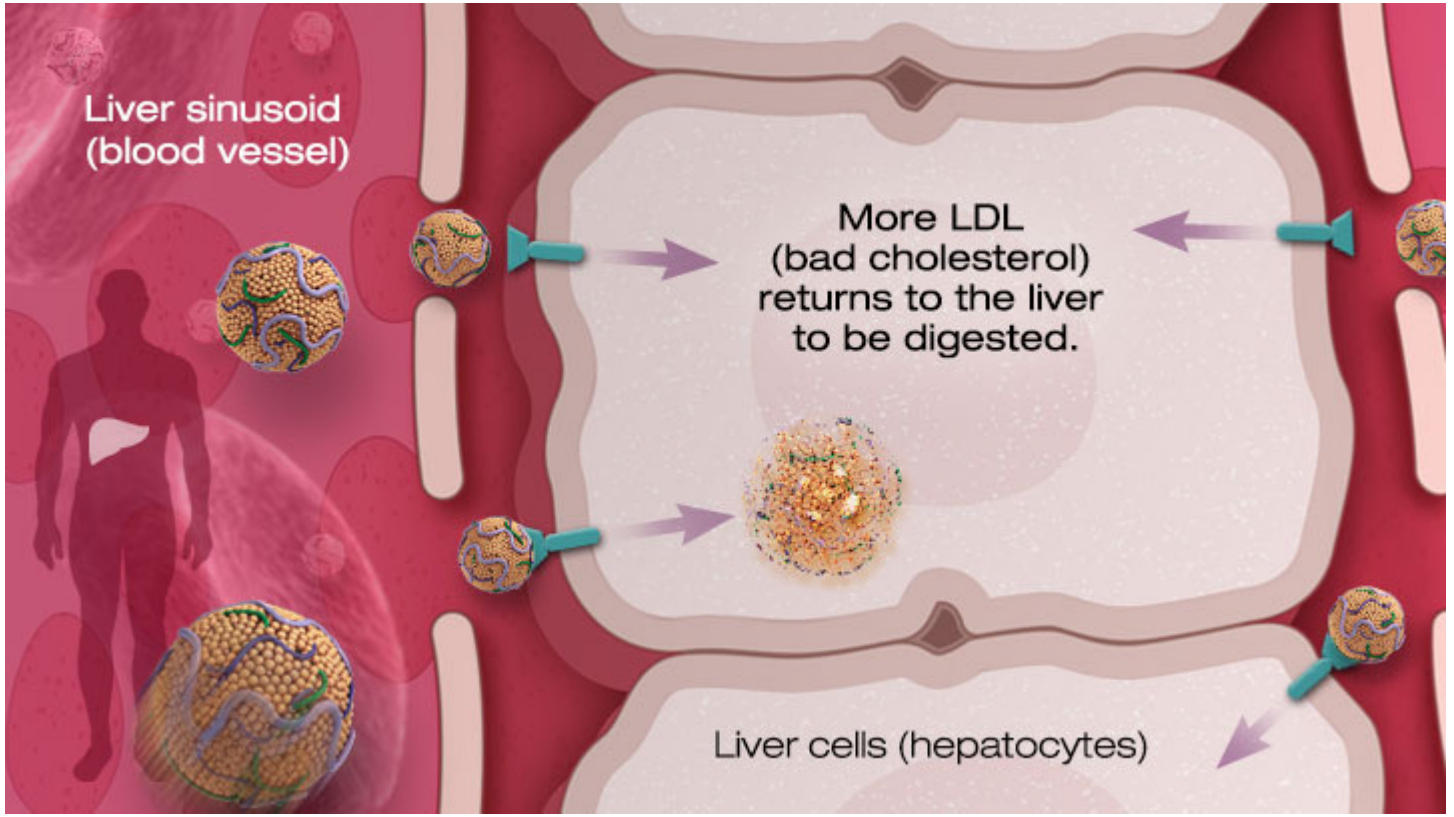


https://watchlearnlive.heart.org/?moduleSelect=chldrg

Statin Medications

Boulder Community Health

- LDL returned to liver to be digested



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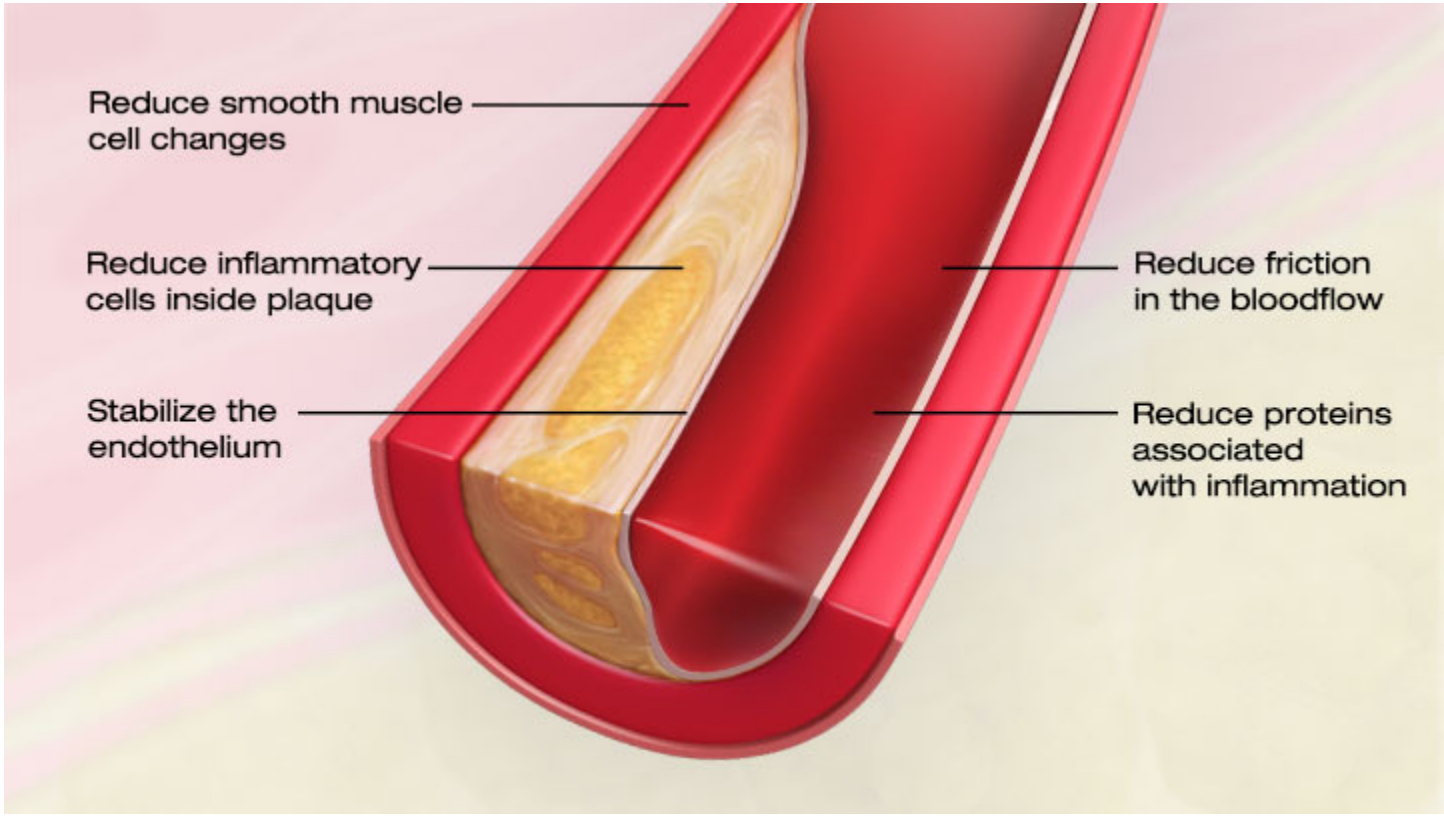
Statin Medications

Boulder Community Health

- Reduced inflammation
- Change of lipid composition of plaque such that they are more stable
- Reduced risk of stroke and heart attack



https://watchlearnlive.heart.org/?moduleSelect=chldrg

Looks like you're already familiar with the side effects

Boulder Community Health

Statin Adverse Events

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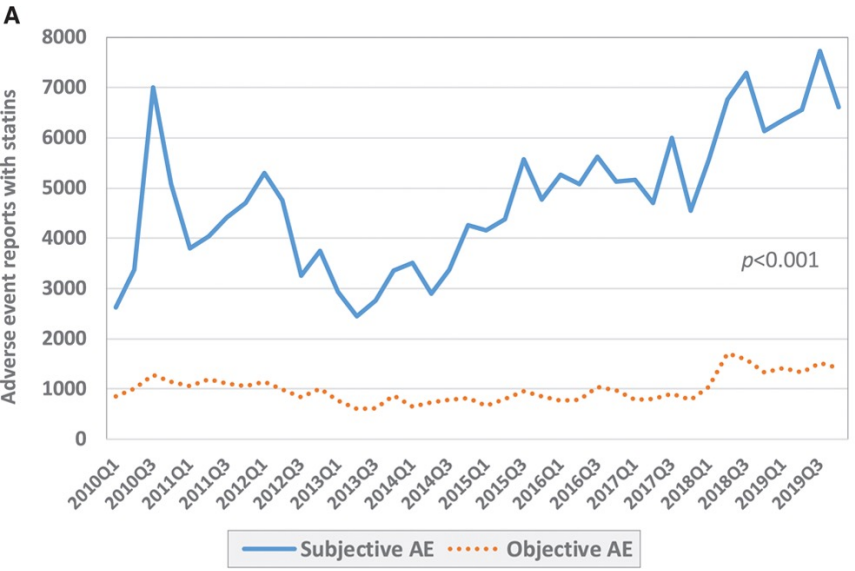
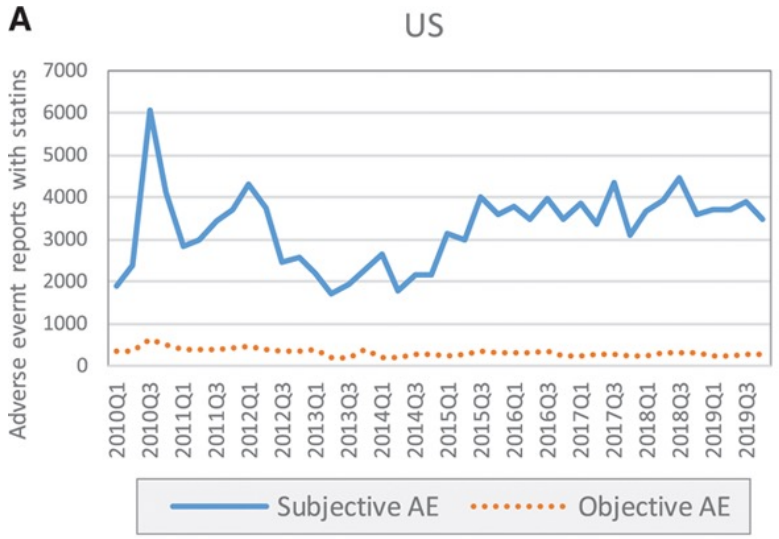
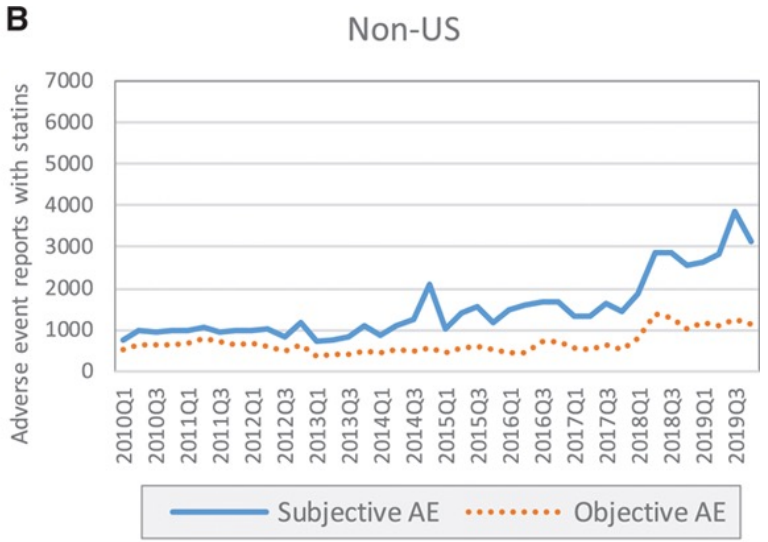


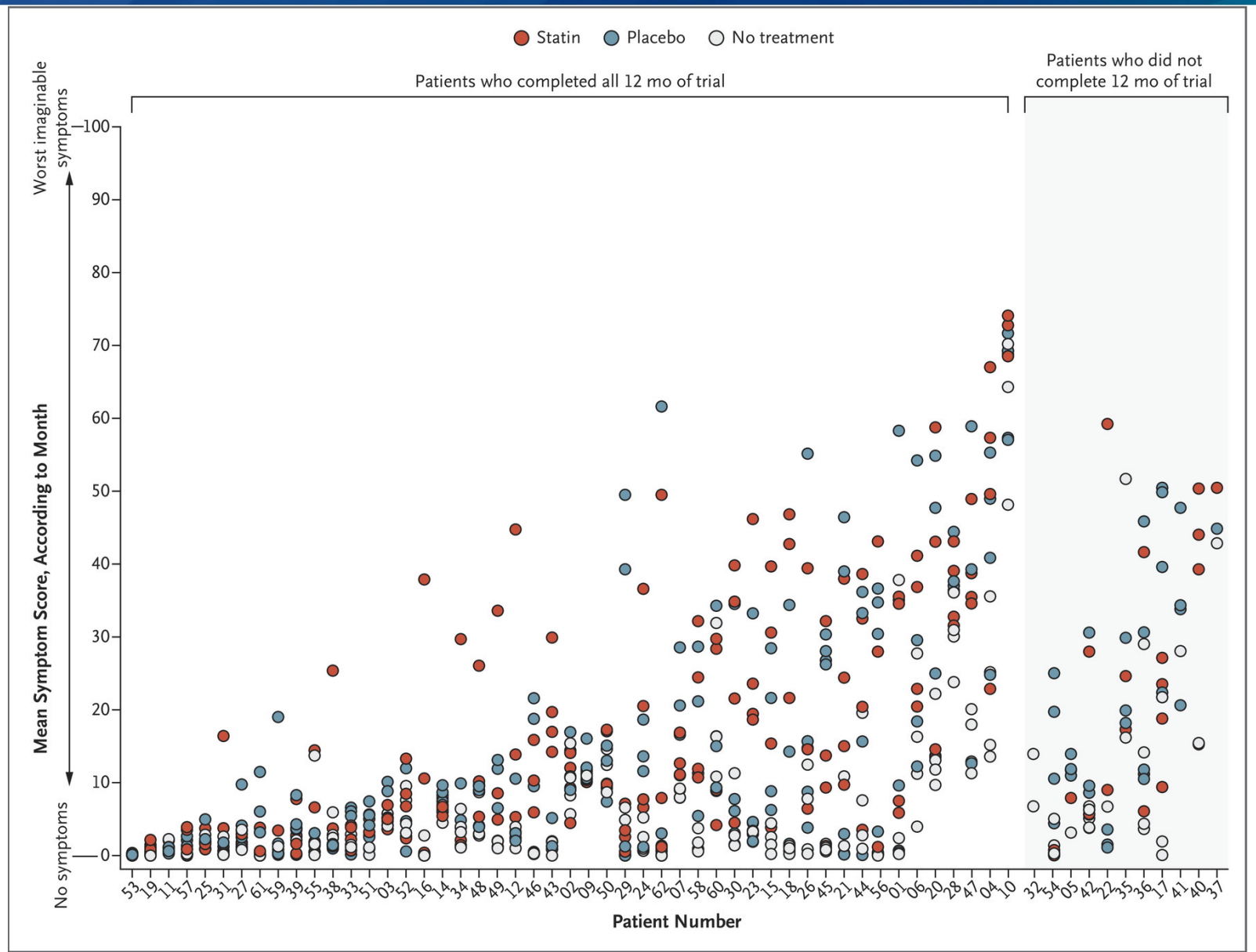




https://www.ahajournals.org/doi/full/10.1161/CIRCOUTCOMES.120.007480

Statin Side Effects

Boulder Community Health



N-of-1 Trial of a Statin, Placebo, or No Treatment to Assess Side Effects

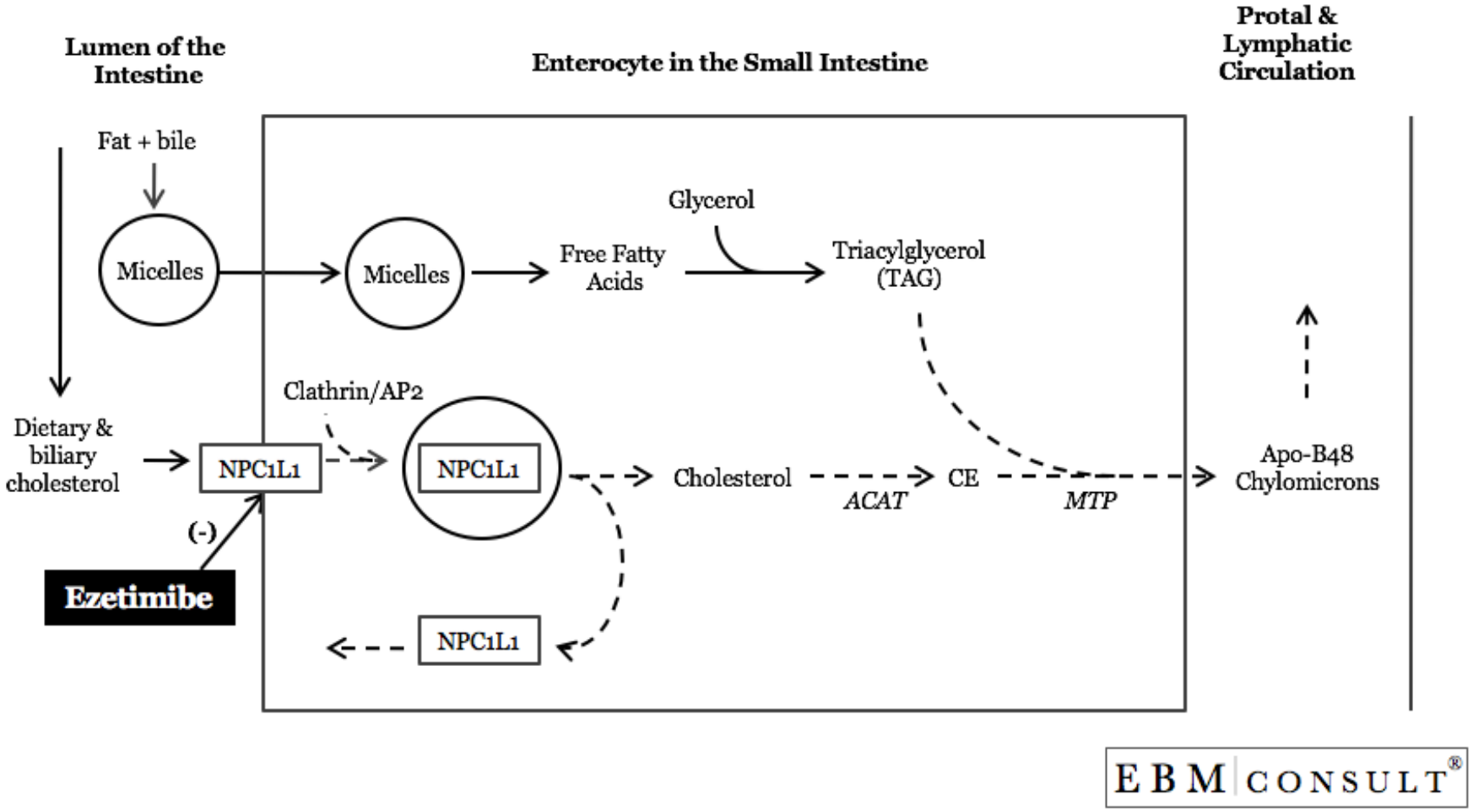
November 26, 2020

N Engl J Med 2020; 383:2182-2184
DOI: 10.1056/NEJMc2031173

Non-statin Medications

Boulder Community Health

- Ezetimibe
  - Blocks cholesterol absorption 54%
  - 18-20% reduction in LDL-C
  - Used in combination

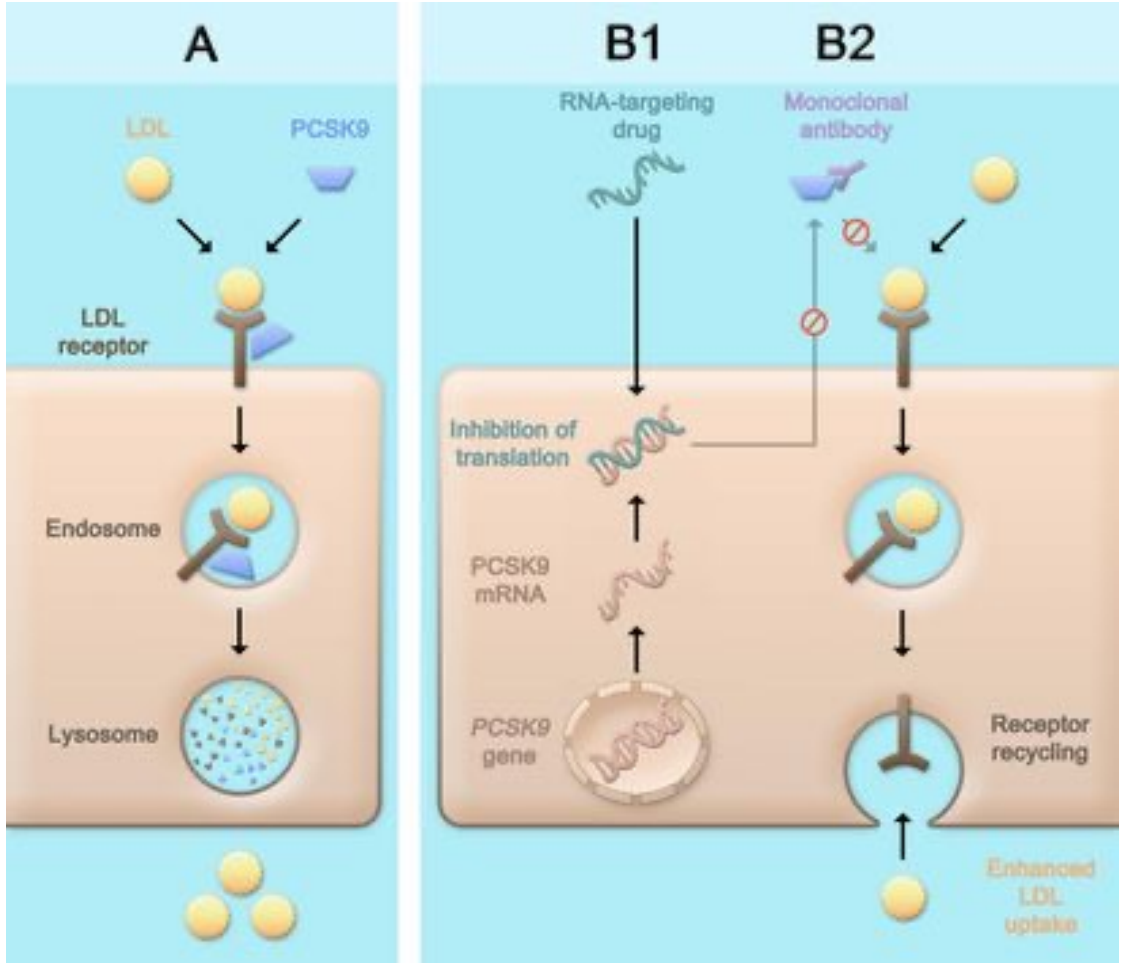


https://www.ebmconsult.com/articles/ezetimibe-mechanism-action-inhibit-cholesterol-absorption-intestine

Non-statin medications

Boulder Community Health

- Proprotein convertase subtilisin/kexin type 9 (PCSK9) inhibitors
  - Antibody binds to PCSK9
    - Blocks binding to LDL receptor
  - LDL receptor in liver is recycled back to surface to pick up more LDL
  - Up to 60% reduction in LDL-C



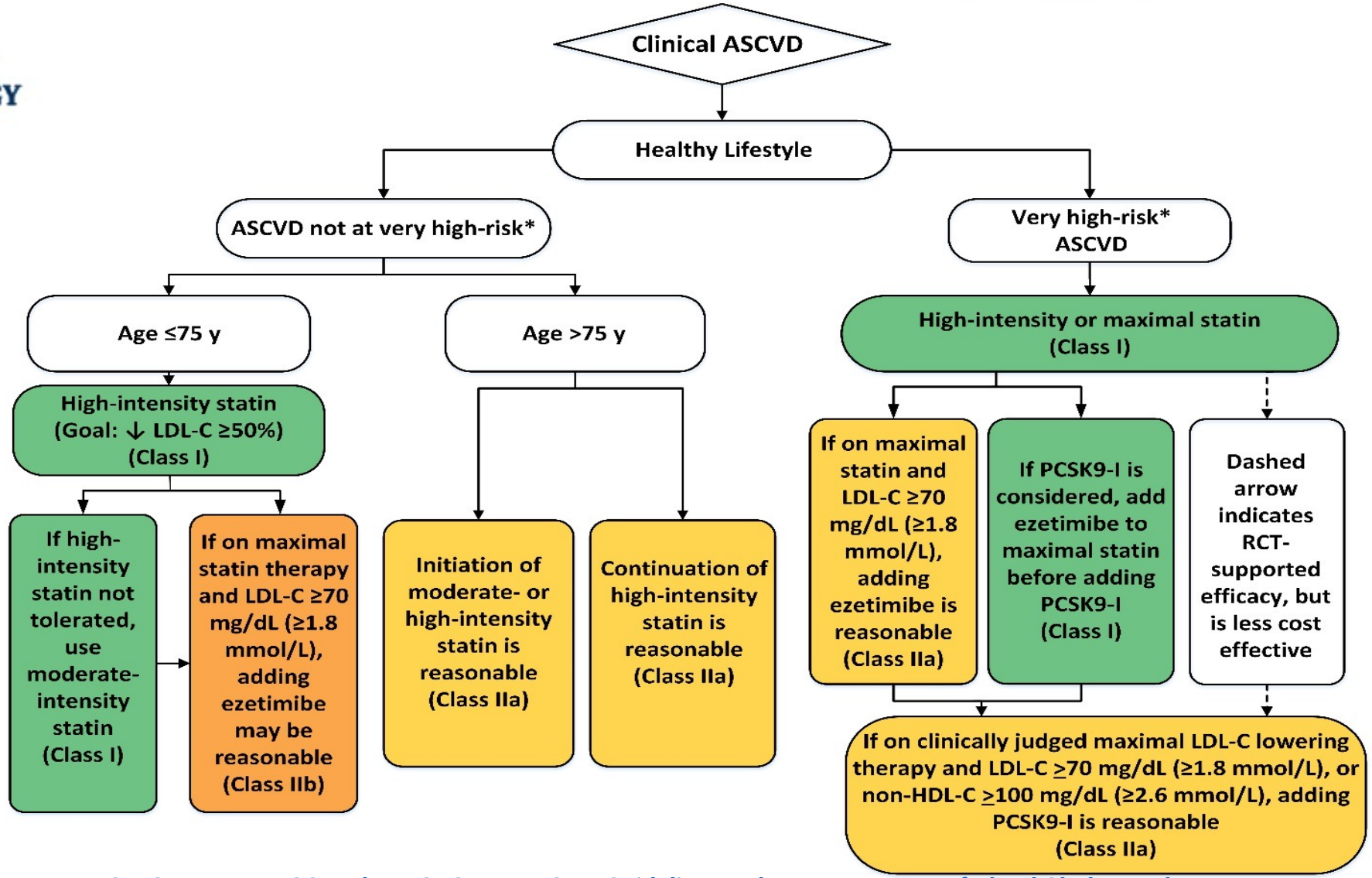
https://www.frontiersin.org/journals/physiology/articles/10.3389/fphys.2020.595819/full

Secondary Prevention

Boulder Community Health

AMERICAN COLLEGE of CARDIOLOGY

American Heart Association.



2018 AHA/ACC/AACVPR/AAPA/ABC/ACPM/ADA/AGS/APhA/ASPC/NLA/PCNA Guideline on the Management of Blood Cholesterol

Chairs: Scott M. Grundy, MD, PhD, Neil J. Stone, MD November 2018 DOI: 10.1016/j.jacc.2018.11.003

Primary Prevention

Boulder Community Health

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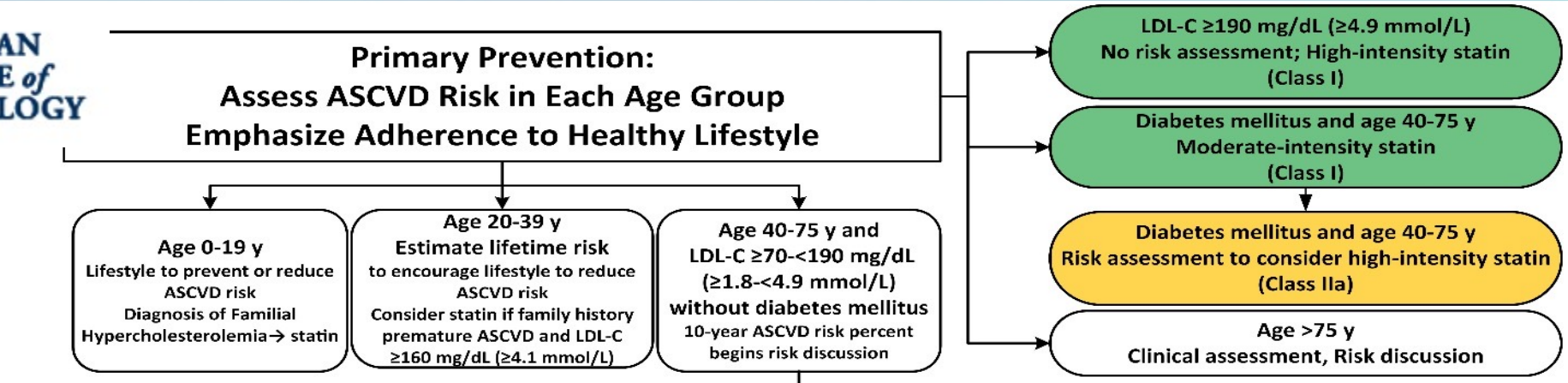


ASCVD Risk Enhancers:

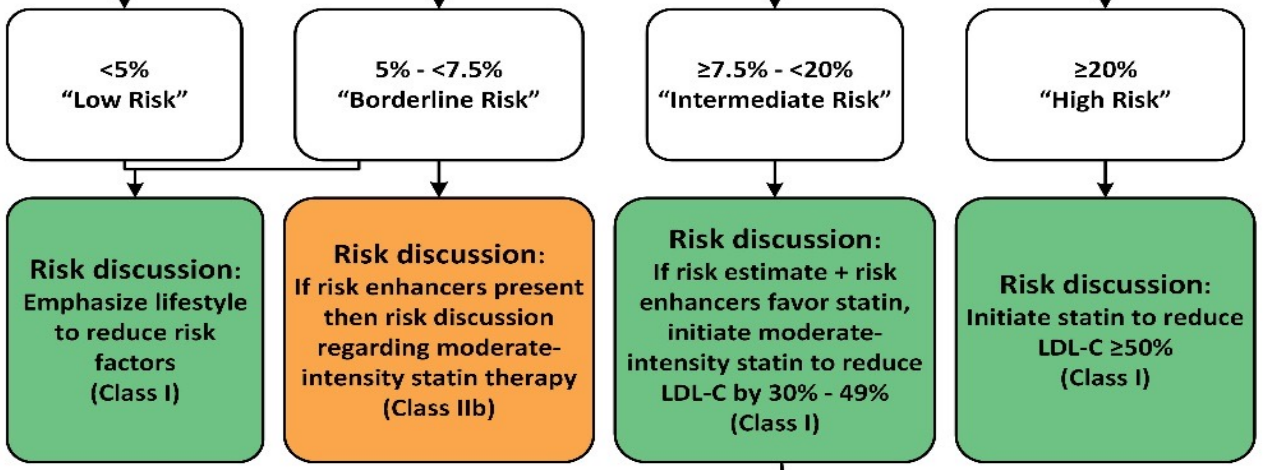
- Family history of premature ASCVD
- Persistently elevated LDL-C ≥160 mg/dL (≥4.1 mmol/L)
- Chronic kidney disease
- Metabolic syndrome
- Conditions specific to women (e.g., preeclampsia, premature menopause)
- Inflammatory diseases (especially rheumatoid arthritis, psoriasis, HIV)
- Ethnicity (e.g., South Asian ancestry)

Lipid/Biomarkers:

- Persistently elevated triglycerides (≥175 mg/dL, (≥2.0 mmol/L))

In selected individuals if measured:

- hs-CRP ≥2.0 mg/L
- Lp(a) levels >50 mg/dL or >125 nmol/L
- apoB ≥130 mg/dL
- Ankle-brachial index (ABI) <0.9



If risk decision is uncertain:
Consider measuring CAC in selected adults:
CAC = zero (lowers risk; consider no statin, unless diabetes, family history of premature CHD, or cigarette smoking are present)
CAC = 1-99 favors statin (especially after age 55)
CAC = 100+ and/or ≥75th percentile, initiate statin therapy

[2018 AHA/ACC/AACVPR/AAPA/ABC/ACPM/ADA/AGS/APhA/ASPC/NLA/PCNA Guideline on the Management of Blood Cholesterol]

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Conclusion

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- Management of cholesterol is generally a multi-pronged approach which should be discussed with your doctor.
- Dietary choices can have a substantial impact on cholesterol.
- Routine exercise can help to lower cholesterol.
- Many people fail to reach their goal cholesterol with these lifestyle modifications.
- Cholesterol medications are very safe and well tolerated and can significantly reduce both cholesterol numbers as well as risk of cardiovascular events.

Questions?

Boulder Community Health

Managing Your Cholesterol

Robert Shapiro, MD, MS-CR, FACC
Boulder Heart
720-853-3032

Boulder Community Health