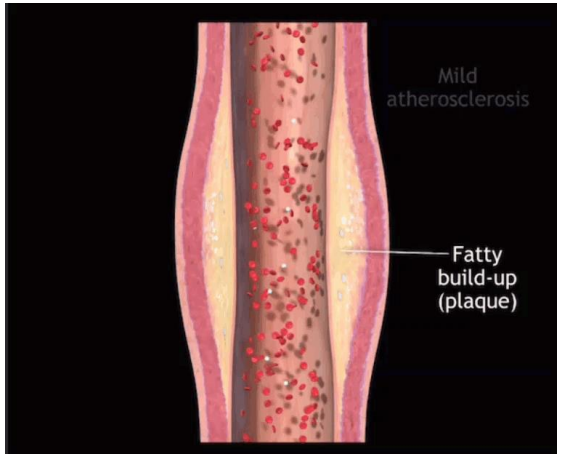
# Heart Attack





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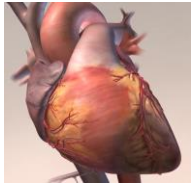
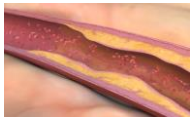
Associate Professor of Research, Preventive Cardiology PA
Intermountain Heart & Vascular; Patients Health First, L.C.
@VietHeartPA

# Disclosures

- Relationship with Novartis Pharmaceuticals Corporation, Amgen, Amarin, Bayer, Pfizer, Lexicon Pharmaceuticals, and Idorsia that includes consulting or advising.
- Relationship with Janssen that includes research grant funding paid directly to the research department

# Objectives





We will

- review the continuum of coronary artery disease from acute coronary syndrome to chronic management.
- Discuss chronic management through lifestyle and the importance of pharmacologic treatment

# Not all MI's are the same: Type 1 - 5

**TABLE A** **Universal Classification of MI**

**Type 1: Spontaneous MI**

Spontaneous MI related to atherosclerotic plaque rupture, ulceration, fissuring, erosion, or dissection with resulting intraluminal thrombus in ≥1 of the coronary arteries leading to decreased myocardial blood flow or distal platelet emboli with ensuing myocyte necrosis. The patient may have underlying severe CAD, but on occasion nonobstructive or no CAD.

**Type 2: MI secondary to ischemic imbalance**

In instances of myocardial injury with necrosis where a condition other than CAD contributes to an imbalance between $MVO_2$, e.g., coronary endothelial dysfunction, coronary artery spasm, coronary embolism, tachy-/bradyarrhythmias, anemia, respiratory f… hypertension with or without LVH.

**Type 3: MI resulting in death when biomarker values are unavailable**

Cardiac death with symptoms suggestive of myocardial ischemia and presumed new ischemic … anges or new LBBB, but death occurred before blood samples could be obtained, before ca… cases wh… cted for cardiac biomarker testing.

**Ty…**

M… …rily defined by el… …ntile URL… …) or a rise …line values are e… …ddition, e… …ischemic …s or new LBBB, (… …ajor coro… …olization, …n of new loss o… …wall mot…

**Ty… …rombosis**

M… …the setti… …iomarker

**Type 5: MI related to CA…**

MI associated with CABG… …vation of cardiac biomark… …s (<99th percentile URL). In ac… …ogical Q waves or new LB… …occlusion, or (iii) imaging evide… …yocardium or new region…

CABG indicates coronary a… …ary artery disease; cTn, car… …ock; LVH, left ventricular hypertrophy; MI, myocardial infarction; $MVO_2$, myocard… …percutaneous coronary inte…
Modified from Thygesen et…


J Am Coll Cardiol. 2014 Dec, 64 (24) e139–e228; Circulation. 2018;138:e618–e651.

# Not all MI's are the same: Type 1 - 5

**TABLE A** Universal Classification of MI

**Type 1: Spontaneous MI** — STEMI or NSTEMI

Spontaneous MI related to atherosclerotic plaque rupture, ulceration, fissuring, erosion, or dissection with resulting intraluminal thrombus in ≥1 of the coronary arteries leading to decreased myocardial blood flow or distal platelet emboli with ensuing myocyte necrosis. The patient may have underlying severe CAD, but on occasion nonobstructive or no CAD.

**Type 2: MI secondary to ischemic imbalance** — Demand Ischemia/infarct **NOT** STEMI or NSTEMI

In instances of myocardial injury with necrosis where a condition other than CAD contributes to an imbalance between $MVO_2$, e.g., coronary endothelial dysfunction, coronary artery spasm, coronary embolism, tachy-/bradyarrhythmias, anemia, respiratory failure, hypotension, and hypertension with or without LVH.

**Type 3: MI resulting in death when biomarker values are unavailable**

Cardiac death with symptoms suggestive of myocardial ischemia and presumed new ischemic electrocardiographic changes or new LBBB, but death occurred before blood samples could be obtained, before cardiac biomarker could rise, or in rare cases where blood was not collected for cardiac biomarker testing.

**Type 4a: MI related to PCI**

MI associated with PCI is arbitrarily defined by elevation of cTn values >5 × 99th percentile URL in patients with normal baseline values (<99th percentile URL) or a rise of cTn values >20% if baseline values are elevated and are stable or falling. In addition, either (i) symptoms suggestive of myocardial ischemia, (ii) new ischemic electrocardiographic changes or new LBBB, (iii) angiographic loss of patency of a major coronary artery or a side branch or persistent slow or no flow or embolization, or (iv) imaging demonstration of new loss of viable myocardium or new regional wall motion abnormality is required.

**Type 4b: MI related to stent thrombosis**

MI associated with stent thrombosis is detected by coronary angiography or autopsy in the setting of myocardial ischemia and with a rise and/or fall of cardiac biomarker values with ≥1 value above the 99th percentile URL.

**Type 5: MI related to CABG**

MI associated with CABG is arbitrarily defined by elevation of cardiac biomarker values >10 × 99th percentile URL in patients with normal baseline cTn values (<99th percentile URL). In addition, either (i) new pathological Q waves or new LBBB, or (ii) angiographically documented new graft or new native coronary artery occlusion, or (iii) imaging evidence of new loss of viable myocardium or new regional wall motion abnormality.

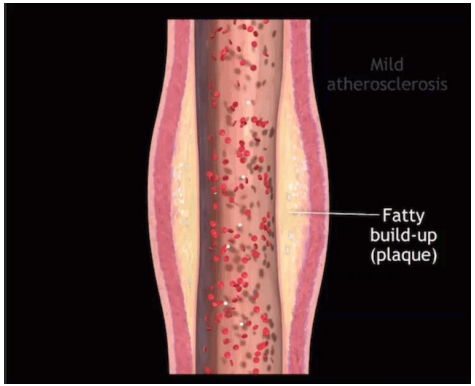
CABG indicates coronary artery bypass graft; CAD, coronary artery disease; cTn, cardiac troponin; LBBB, left bundle-branch block; LVH, left ventricular hypertrophy; MI, myocardial infarction; $MVO_2$, myocardial oxygen consumption; PCI, percutaneous coronary intervention; and URL, upper reference limit.
Modified from Thygesen et al. (21).

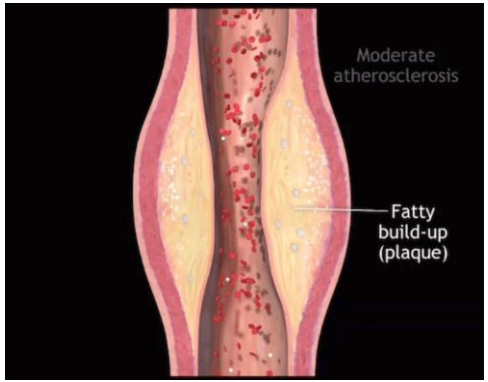
J Am Coll Cardiol. 2014 Dec, 64 (24) e139–e228; Circulation. 2018;138:e618–e651.

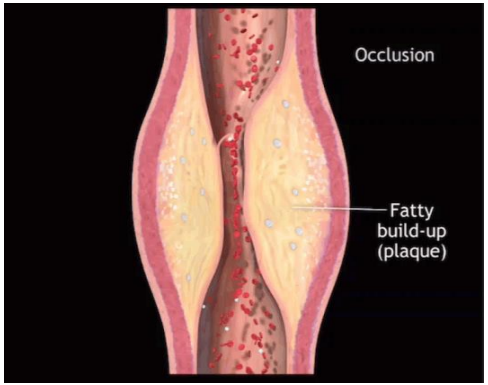
# Acute Coronary Syndrome/Chronic Stable







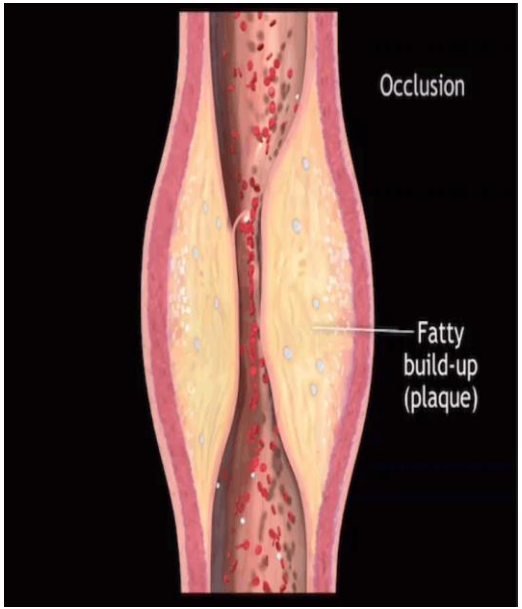
# Acute Tools of the “trade”

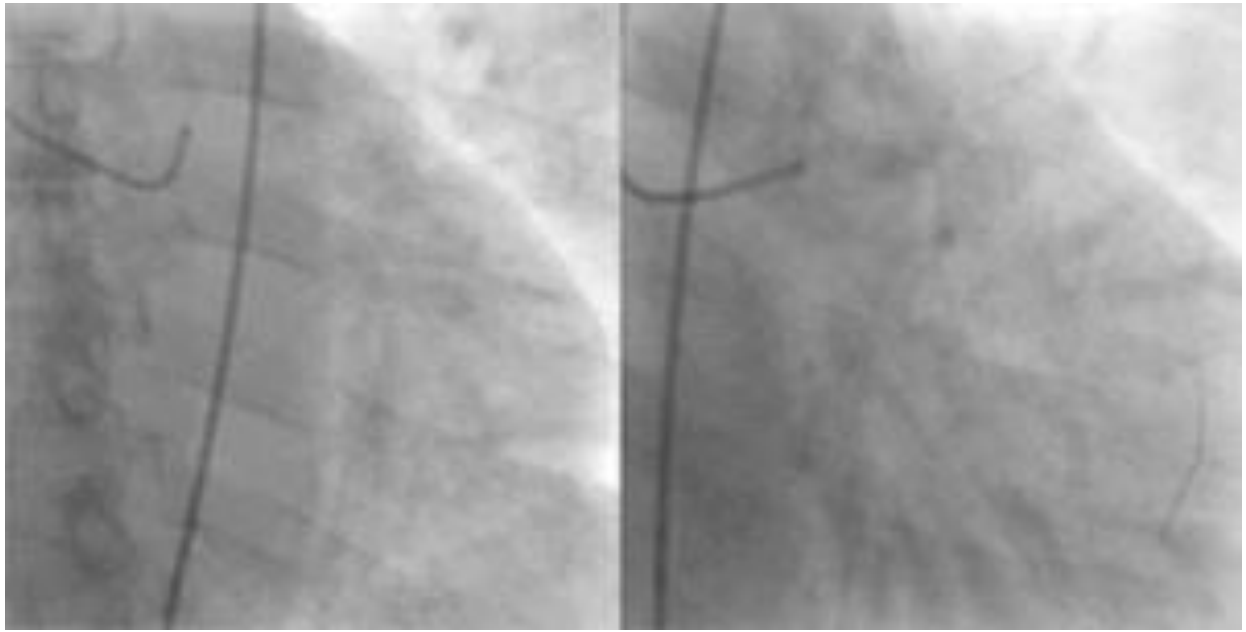
https://www.plumbing-draincleaning.com/drain-cleaning.html

www.plumbingsupply.com%2Fclogbusters.html&psig=AOvVaw3iT0dXRoxDvHDBT5VcXh4y&ust=1668264017895000&source=images&cd=vfe&ved=0CBEQ3YkBahcKEwjYtqeVr6b7AhUAAAAAHQAAAAQAAQC

www.amazon.com%2FUpgraded-Anti-break-Plumbing-Bathroom-Cleaning%2Fdp%2FB09GK99MQ4&psig=AOvVaw3iT0dXRoxDvHDBT5VcXh4y&ust=1668264017895000&source=images&cd=vfe&ved=0CA0Q3YkBahcKEwjYtqeVr6b7AhUAAAAAHQAAAAQAAw

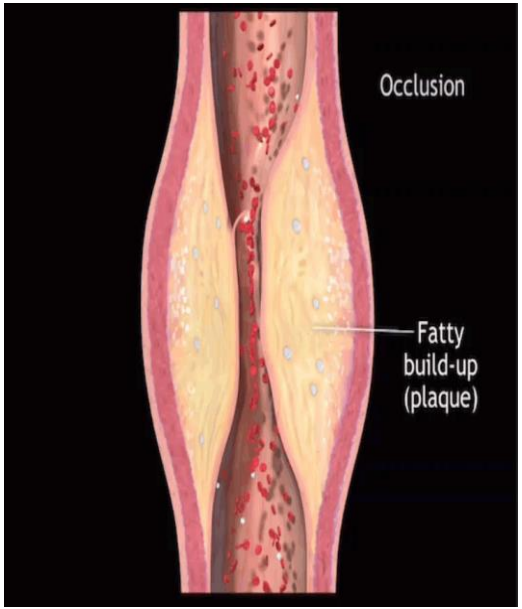
# Tools of the “trade”

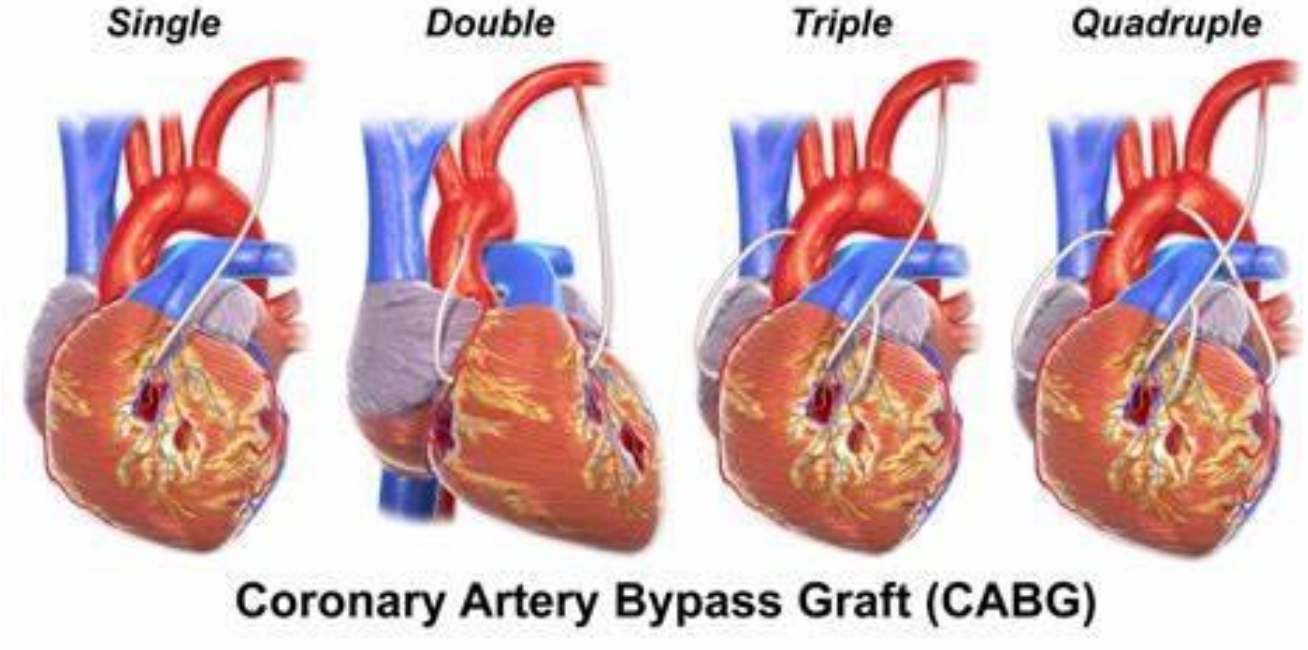


https://en.ecgpedia.org/index.php?title=File:Before-and-After_copy.gif

# Acute Tools of the “trade”

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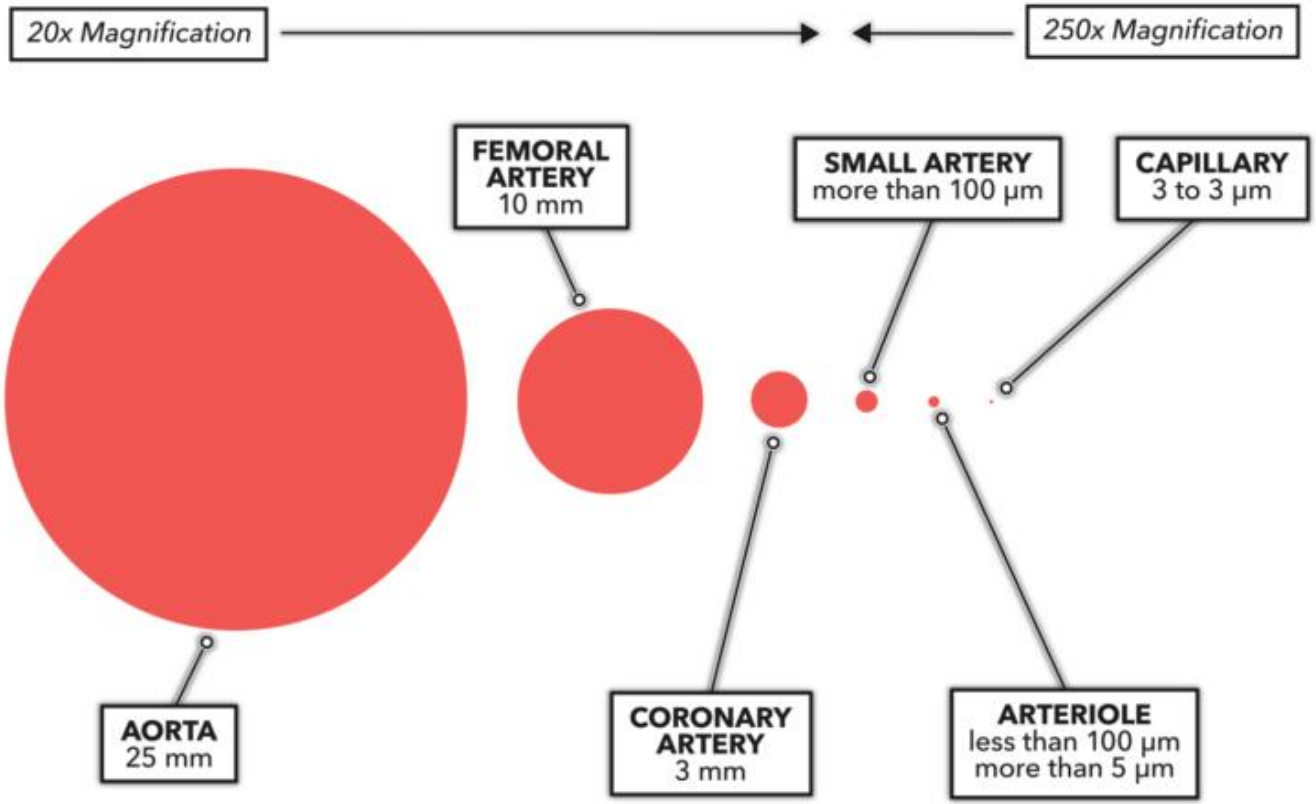
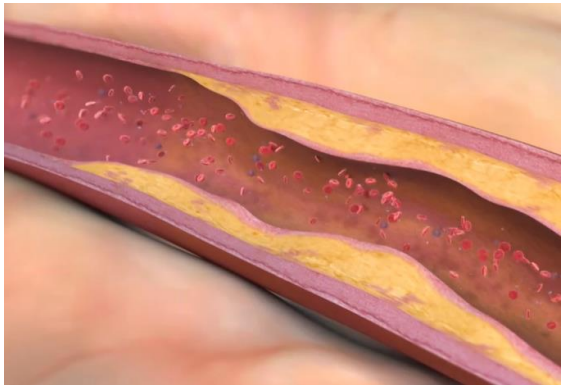




https://www.crossfit.com/essentials/the-heart-part-6-blood-vessel-basics; Lorbeer. 2018. PLoS One. 13(6): e0197559; Dodge Jr. 1992. Circulation. 86:232–246; Paruchuri. 2015. Cardiology. 131:265-272

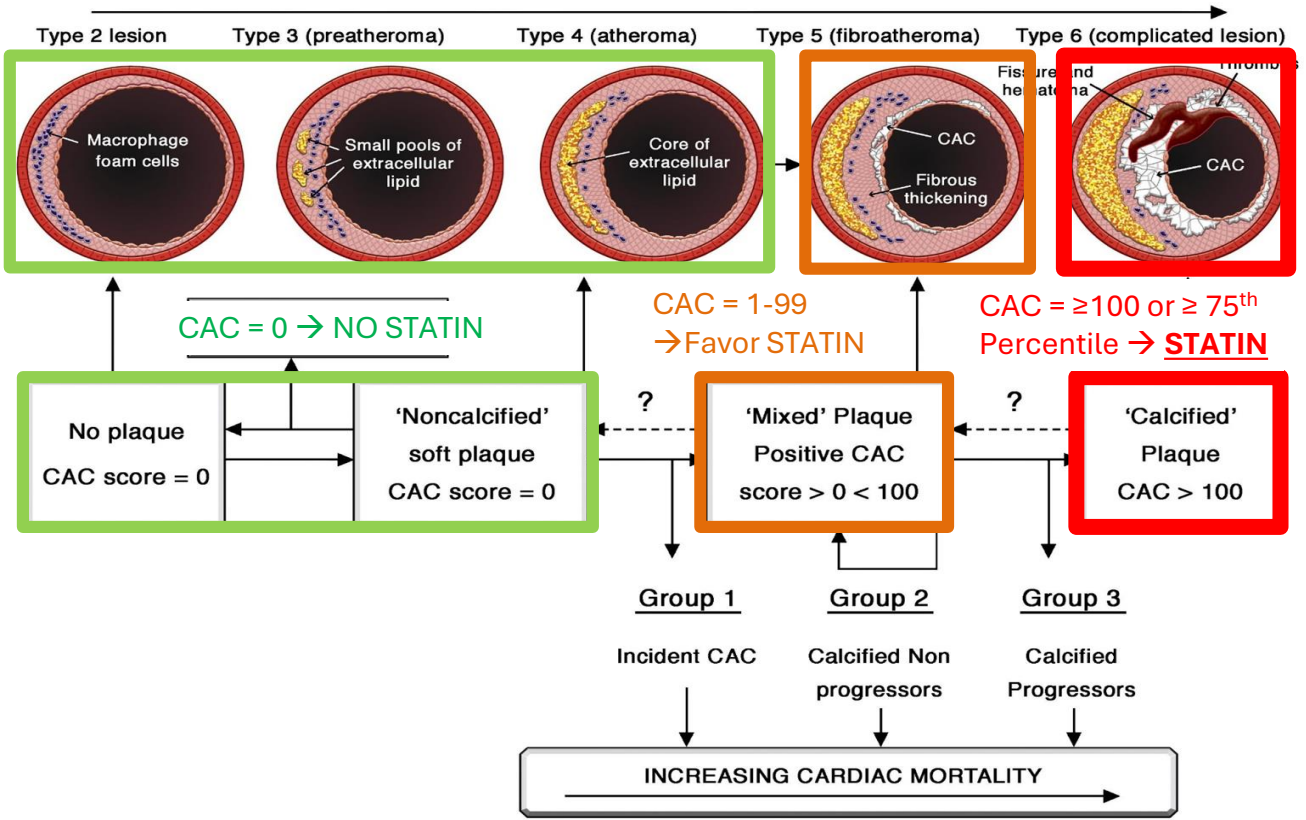
# Coronary Calcium and statin eligibility (2019 GL)



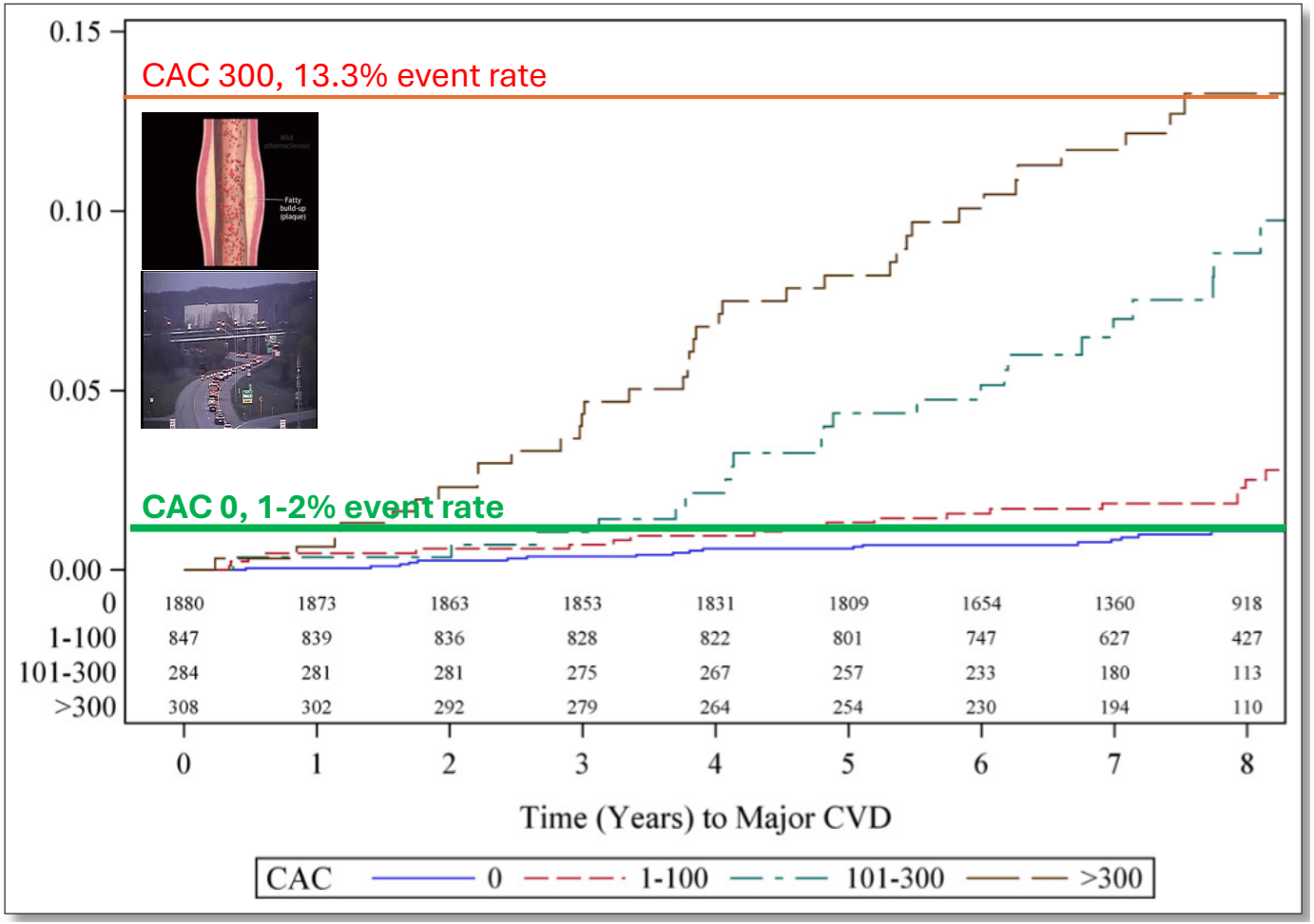
CAC = 0 → NO STATIN

CAC = 1-99 → Favor STATIN

CAC = ≥100 or ≥ 75th Percentile → **STATIN**




McEvoy, et al, JACC 2010. https://doi.org/10.1016/j.jacc.2010.06.038



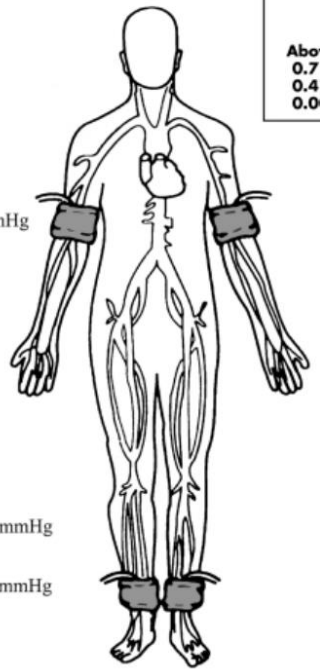

POPULATION:
Framingham (Offspring and 3rd Generation).
50±10 yrs of age. Female 50.9%.

**MAJOR CVD** included:
1 coronary heart disease (CHD),
2 stroke, and
3 peripheral arterial disease.
Additionally, authors included
4 MI, and
5 death from CHD (i.e., fatal coronary event, MI, or cerebrovascular accident [i.e., ischemic stroke, hemorrhagic stroke]).

Hoffmann. JAHA. 2016 Feb 22;5(2):e003144

# ABI WORKSHEET

**Ankle-Brachial Index Interpretation**
Above 0.90: Normal
0.71 - 0.90: Mild Obstruction
0.41 - 0.70: Moderate Obstruction
0.00 - 0.40: Severe Obstruction



**Right Arm:**
Systolic Pressure ☐☐☐ mmHg

**Left Arm:**
Systolic Pressure ☐☐☐ mmHg

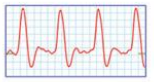
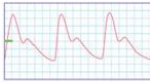
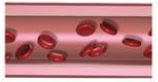
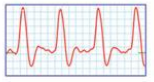
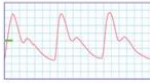
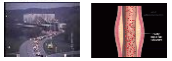
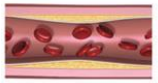
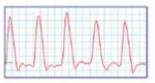
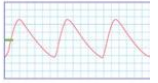
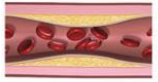
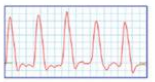
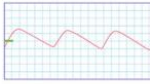
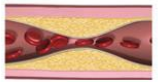
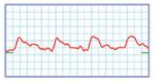
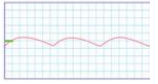
**Right Ankle:**
**Systolic Pressure**
Posterior Tibial (PT) ☐☐☐ mmHg
Dorsalis Pedis (DP) ☐☐☐ mmHg

**Left Ankle:**
**Systolic Pressure**
Posterior Tibial (PT) ☐☐☐ mmHg
Dorsalis Pedis (DP) ☐☐☐ mmHg

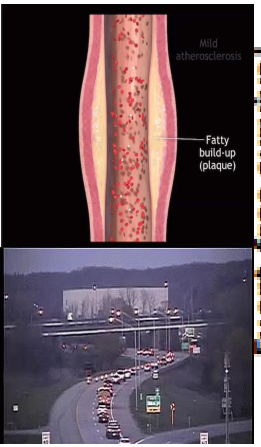
***Right ABI equals Ratio of:***
Higher of the Right Ankle Pressures (PT or DP) ☐☐☐ mmHg
Higher Arm Pressure (right or left arm) ☐☐☐ mmHg
= ☐.☐☐ *

***Left ABI equals Ratio of:***
Higher of the Left Ankle Pressures (PT or DP) ☐☐☐ mmHg
Higher Arm Pressure (right or left arm) ☐☐☐ mmHg
= ☐.☐☐ *

* The lower of these numbers is the patient's overall ABI.
Overall ABI (lower ABI) = _____

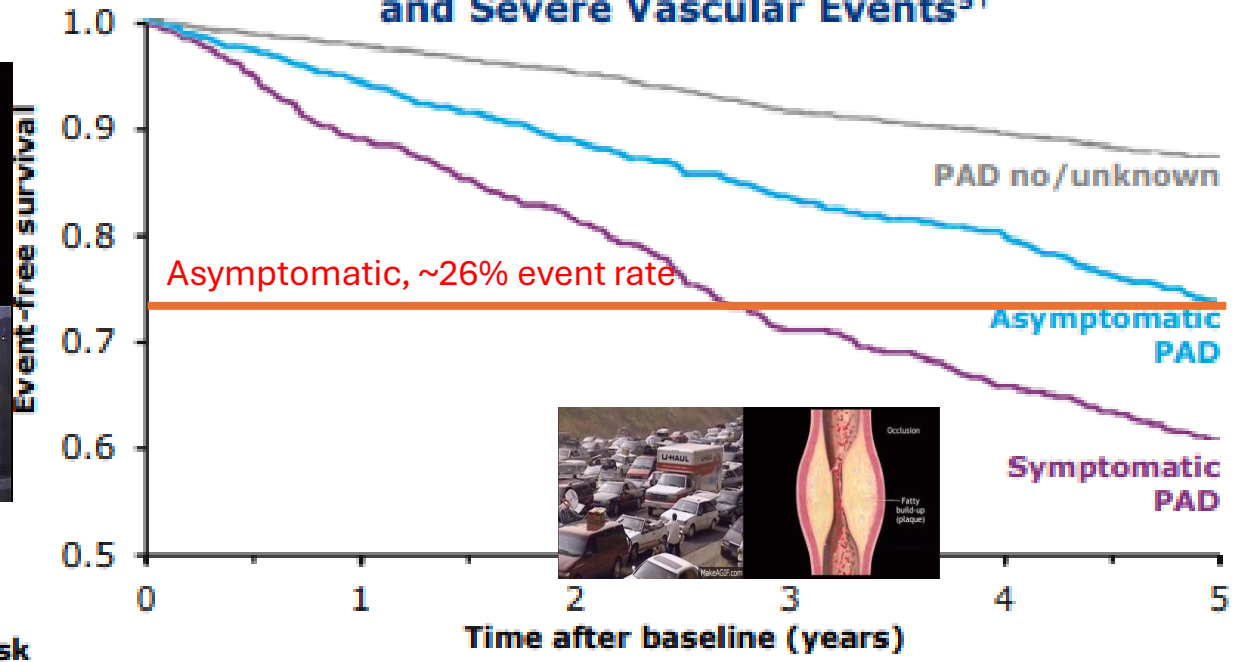
| Vessel Disease | | ABI | TBI | Doppler | PVR |
|---|---|---|---|---|---|
| Calcified Vessel |  | > 1.4 | unaffected |  |  |
| Normal |  | 0.9 - 1.4 | > 0.6 |  |  |
| Mild PAD  |  | 0.7 - 0.89 | 0.34 - 0.59 |  |  |
| Moderate PAD  |  | 0.51 - 0.69 | 0.12 - 0.34 |  |  |
| Severe PAD  |  | ≤ 0.5 | ≤ 0.11 |  |  |

Sibley III. 2017. Radiographics. 37:1, 346-357






## 5-Year KM Estimates of ACM and Severe Vascular Events[5†]





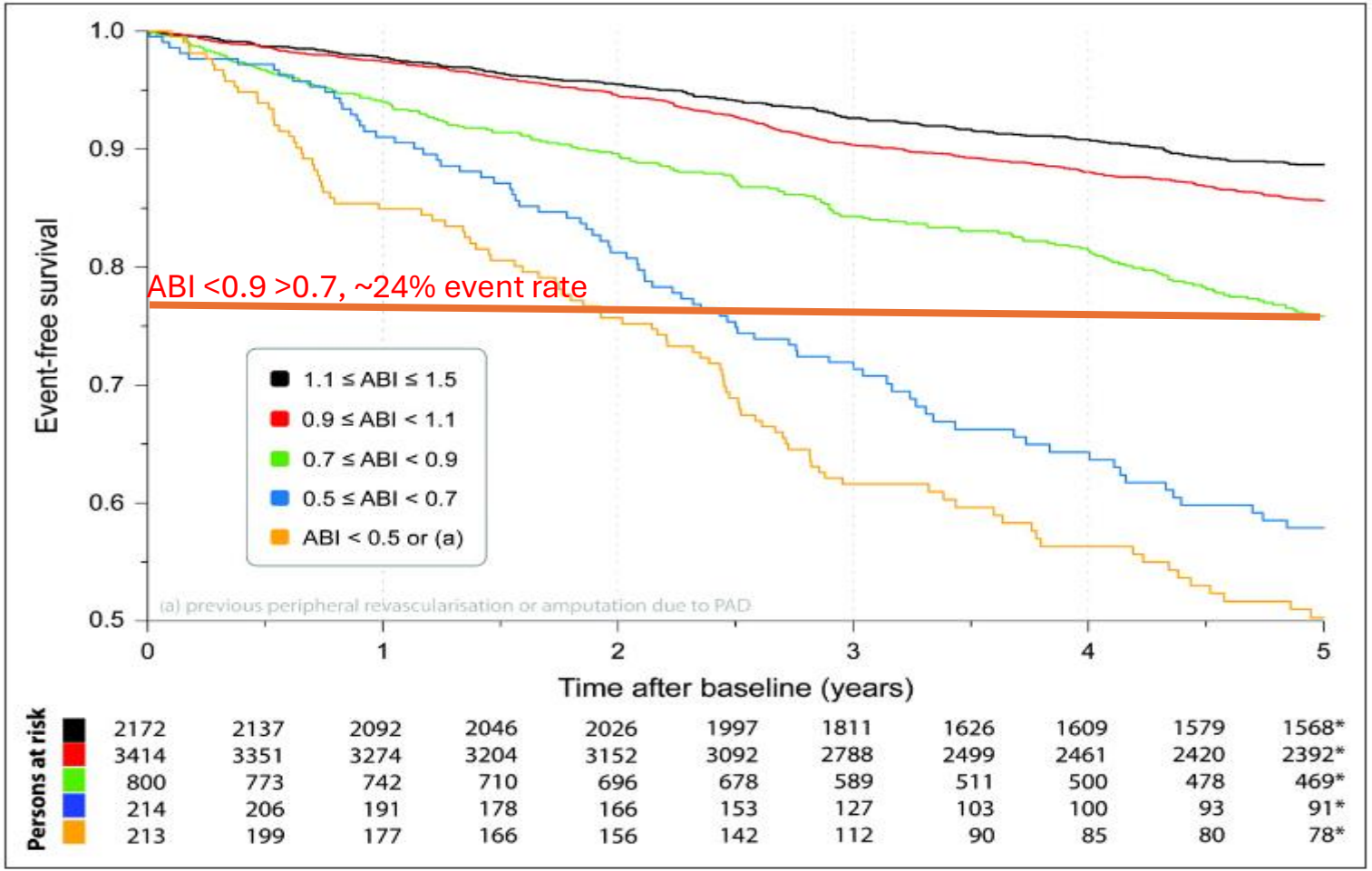


| Persons at risk | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| PAD no/unknown | 5392 | 5303 | 5192 | 5085 | 5017 | 4935 | 4464 | 4004 | 3953 | 3885 | 3850‡ |
| Asymptomatic PAD | 836 | 810 | 776 | 742 | 722 | 700 | 612 | 528 | 520 | 493 | 484‡ |
| Symptomatic PAD | 593 | 561 | 515 | 484 | 463 | 433 | 357 | 301 | 286 | 276 | 268‡ |

Older: 72
Female: 58%
ABI >1.5 excluded

**OUTCOMES:**
1 all-cause mortality OR severe vascular events
2 myocardial infarction,
3 coronary revascularization,
4 stroke,
5 carotid revascularization,
6 peripheral revascularization, or
7 amputation

Diehm C et al. Circulation. 2009;120(21):2053-2061.




Older: 72
Female: 58%
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**OUTCOMES:**
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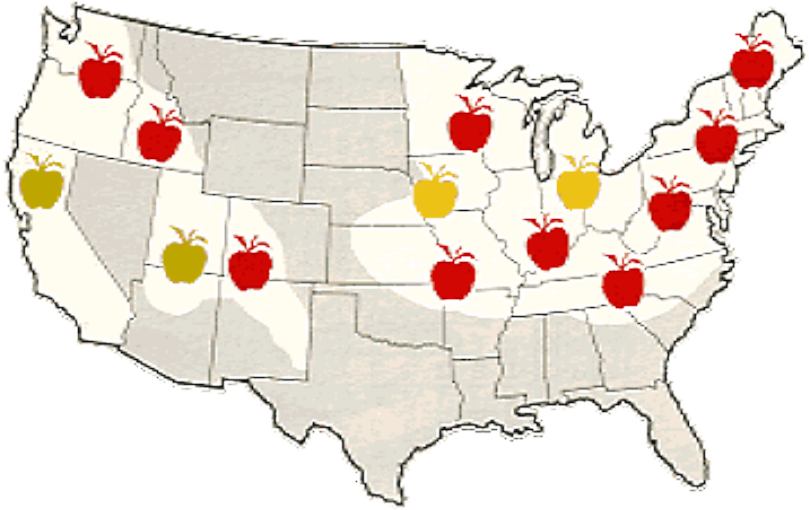
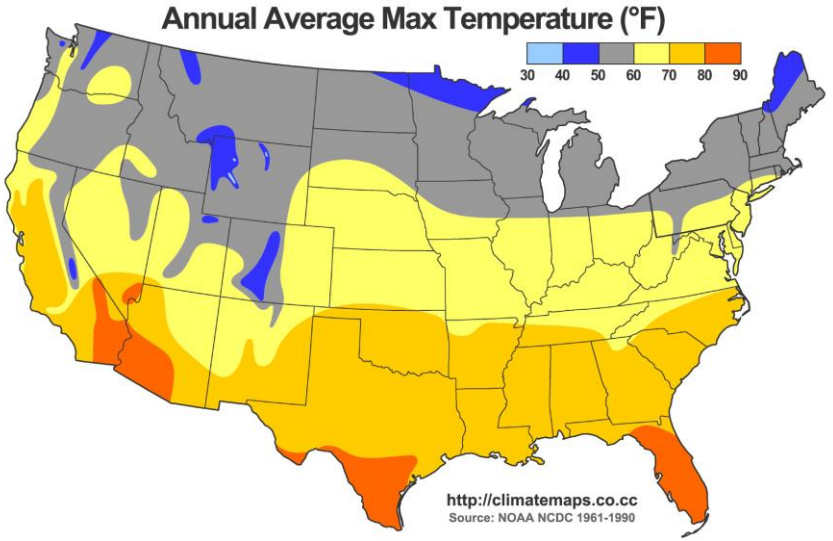
4 stroke,
5 carotid revascularization,
6 peripheral revascularization, or
7 amputation

Diehm C et al. Circulation. 2009;120(21):2053-2061.

# Where would you find a stand of trees that would most likely yield apples?



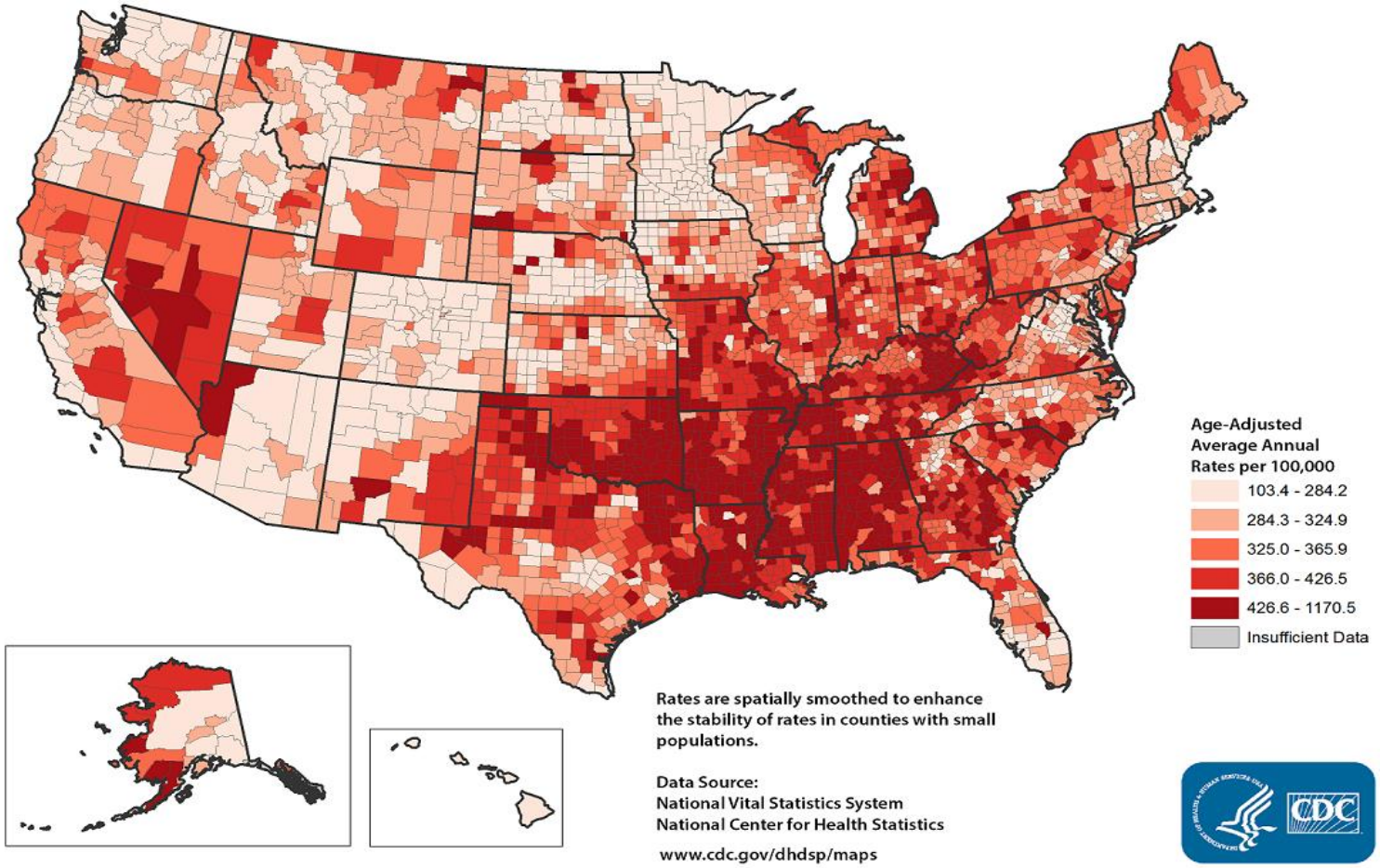
https://web.extension.illinois.edu/apples/images/us_map.gif




https://en.wikipedia.org/wiki/Climate_of_the_United_States

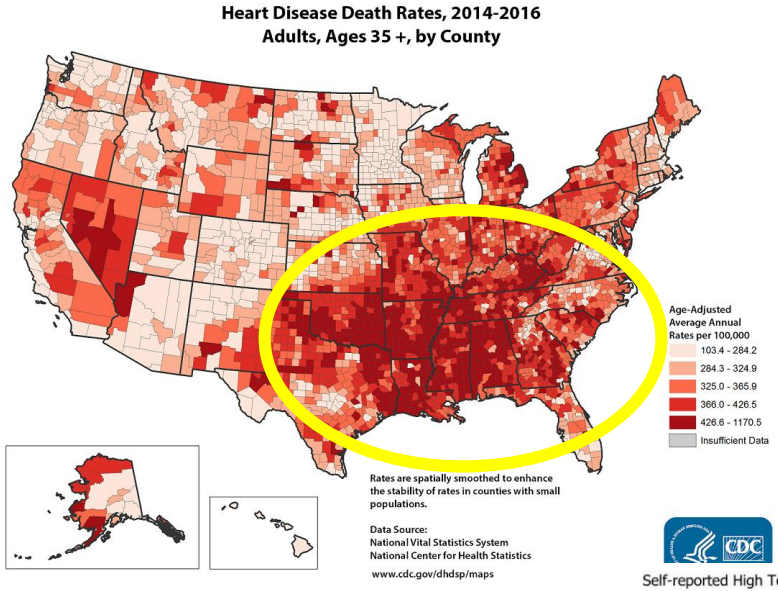
# Which stand of trees would you most likely find apples?

# Heart Disease Death Rates, 2014-2016
## Adults, Ages 35 +, by County




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

@VietHeartPA

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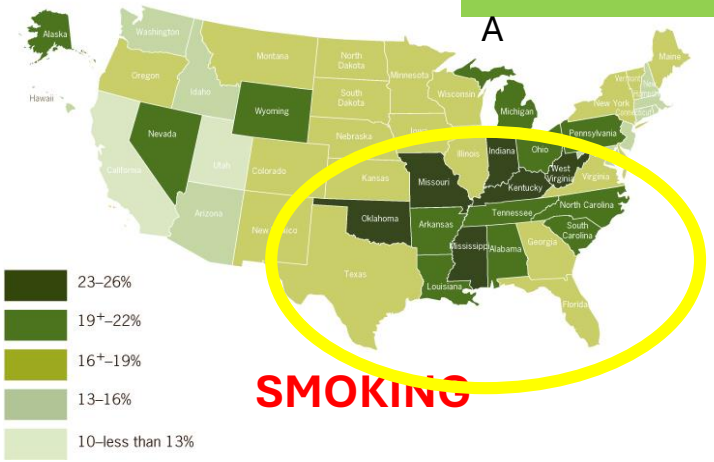
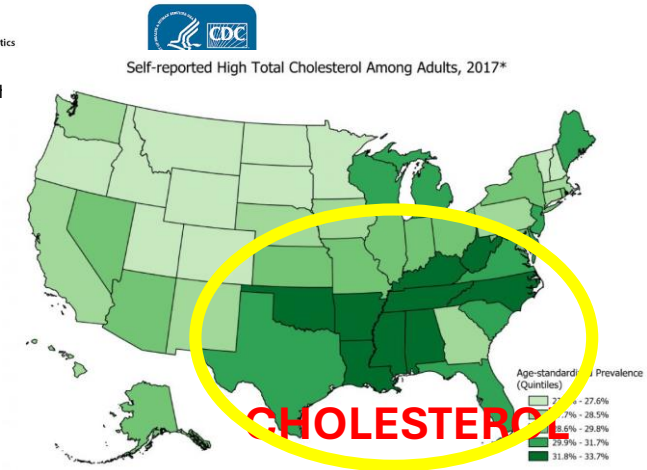
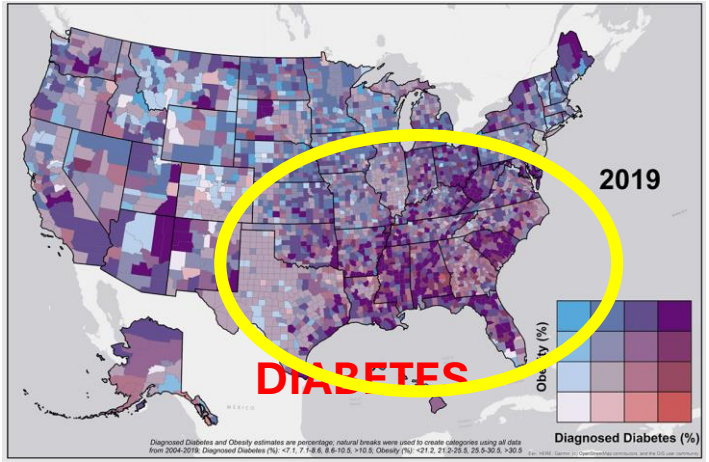



https://www.cdc.gov/vitalsigns/tobaccouse/smoking/infographic.html




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

*Data Source: BRFSS, Adults (20+) who answered "yes" to the question, "Have you ever been told by a doctor, nurse or other health professional that your blood cholesterol is high?"



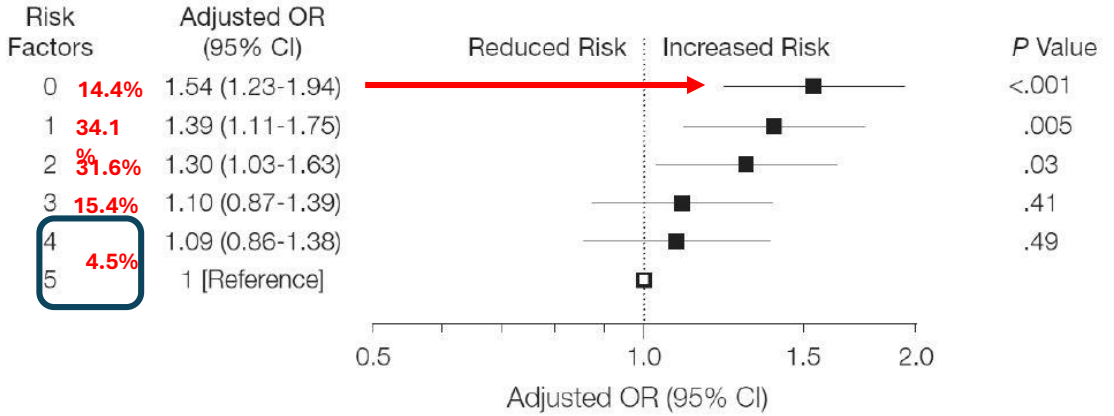

https://www.cdc.gov/diabetes/data/center/slides.html

# Traditional risk factors in First MI

WAIT!!

- Significant number of folks with 1st MI also have 0 RF; in addition, they may have an increased risk of death.
- In 542,008 patients presenting with a first myocardial infarction: the percentage with **0, 1, 2, 3, and 4 risk factors was 14.4%, 34.1%, 31.6%, 15.4%, and 4.1%,** respectively

**Risk Factors:**
**Hypertension**
**Smoking**
**Dyslipidemia**
**Diabetes**
**Family Hx of CAD**




Canto et al, JAMA 2011;306:2120–7.

# SMuRF-Less


Intermountain data presented at ACC 22. Patients with 1st STEMI from 2000-2021comparing those with standard modifiable risk factors (SMuRF)* and those without **SMuRF-Less**.

- STEMI pts (n=3,510), SMuRF-Less made up over 1 in 4 pts, or 26.2% (n=919).
- SMuRF-Less pts were younger, more frequently male, and had fewer overall co-morbidities
- While unadjusted HR for MACE favored SMuRF-Less, an adjusted HR demonstrated similar outcomes other than persistent lower HF admissions.

| A. Demographics | SMuRF | | SMuRF-less | |
|---|---|---|---|---|
| | n=2591 | | n=919 | |
| | n | % | n | % |
| Age groups | | | | |
| <40 | 85 | 3.28% | 49 | 5.33% |
| 40-49 | 360 | 13.89% | 140 | 15.23% |
| 50-59 | 720 | 27.79% | 228 | 24.81% |
| 60-69 | 717 | 27.67% | 271 | 29.49% |
| 70-79 | 471 | 18.18% | 150 | 16.32% |
| >79 | 238 | 9.19% | 80 | 8.71% |
| Gender | | | | |
| Male | 1885 | 72.75% | 709 | 77.15% |
| Female | 706 | 27.25% | 210 | 22.85% |
| Race | | | | |
| White/Caucasian | 2260 | 87.23% | 818 | 89.01% |
| African American | 14 | 0.54% | 8 | 0.87% |
| Asian | 57 | 2.20% | 15 | 1.63% |
| Pacific Islander | 5 | 0.19% | 3 | 0.33% |
| Unknown | 255 | 9.84% | 75 | 8.16% |

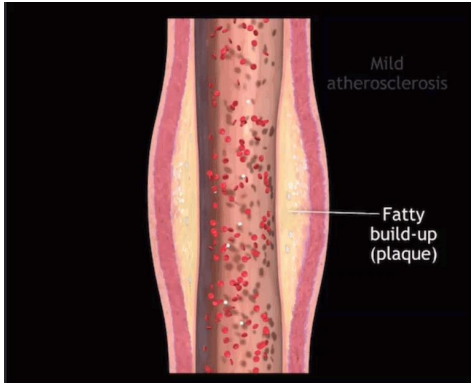
@VietHeartP

*Diabetes, hypertension, smoking, hyperlipidemia

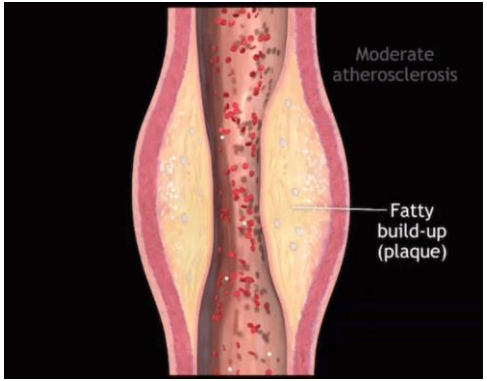
# You have a patient with Atherosclerosis. Now WHAT?



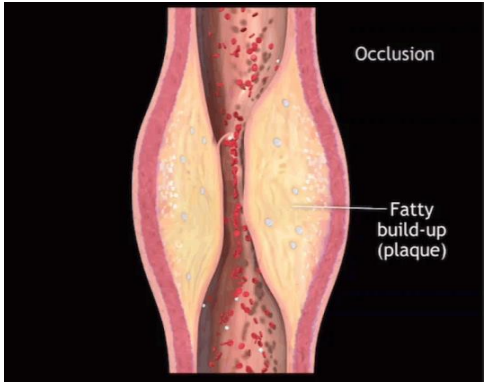
## Stable Angina/Claudication



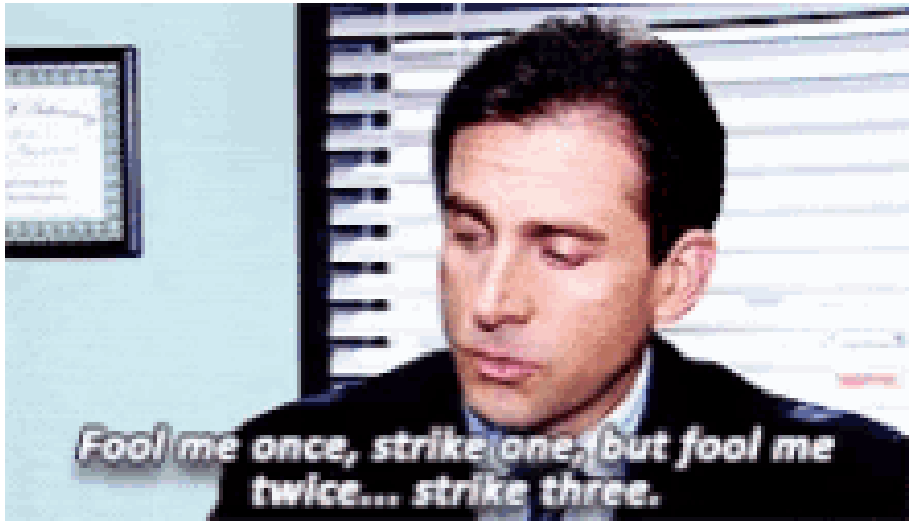

## NSTE-ACS/Acute limb ischemia


## STEMI/Stroke/Amputation

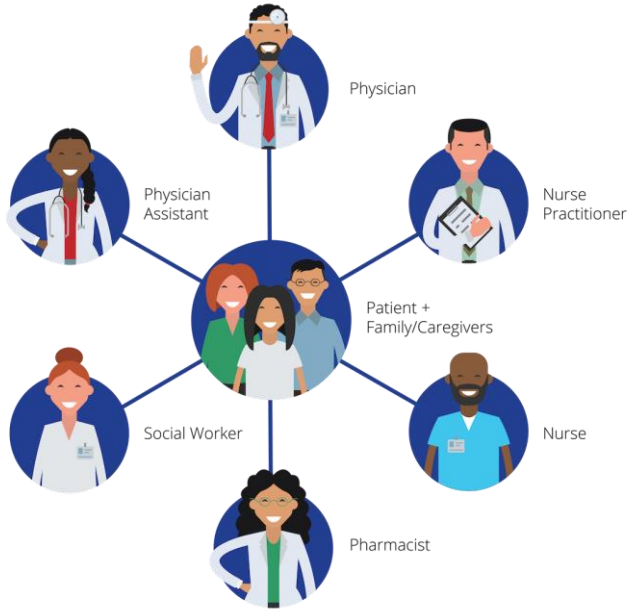



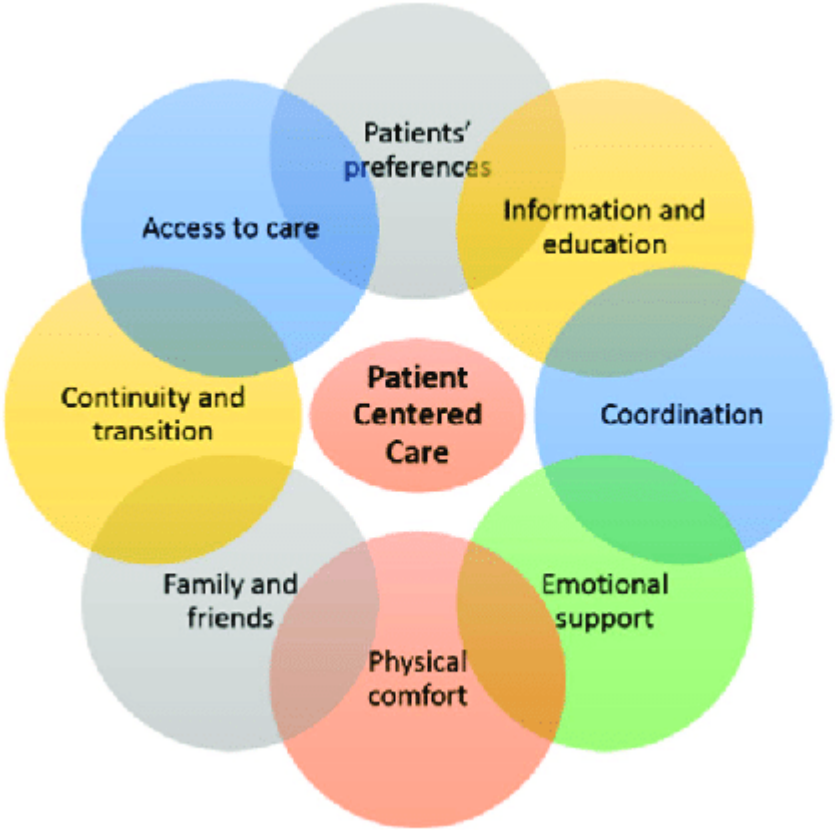
# Secondary Prevention: Avoiding a 2nd Event




Find the culprits for future problems

# Team-Based Care



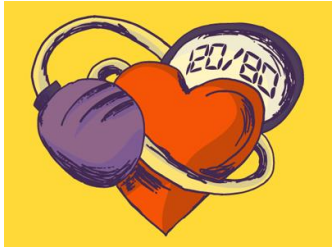




https://www.acponline.org/practice-resources/covid-19-practice-management-resources/covid-19-recovery-team-based-care-toolkit

Int. J. Environ. Res. Public Health 2021, 18(11), 6057

# Risk Factors

- Hypertension
- Smoking
- Dyslipidemia
- Diabetes
- Family Hx of CAD

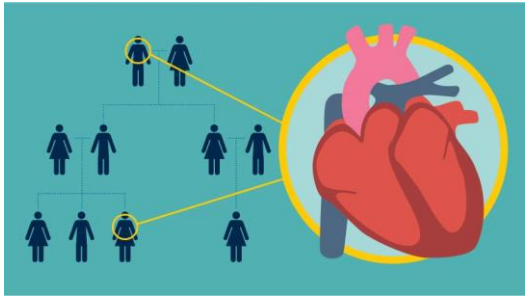



https%3A%2F%2Fdribbble.com%2Fshots%2F2092098-Know-Your-Numbers&psig=AOvVaw1hJasK6jFWqkMS4GtzZaTK&ust=1668266362677000&source=images&cd=vfe&ved=0CBEQ3YkBahcKEwig2r7Ttqb7AhUAAAAAHQAAAAAQCA

www.tandfonline.com%2Fdoi%2Fpdf%2F10.1080%2F14779072.2017.1372193&psig=AOvVaw3LYXMOz7MMRgNzhUxbxRui&ust=1668266458800000&source=images&cd=vfe&ved=0CBEQ3YkBahcKEwjguKSQt6b7AhUAAAAAHQAAAAAQDA

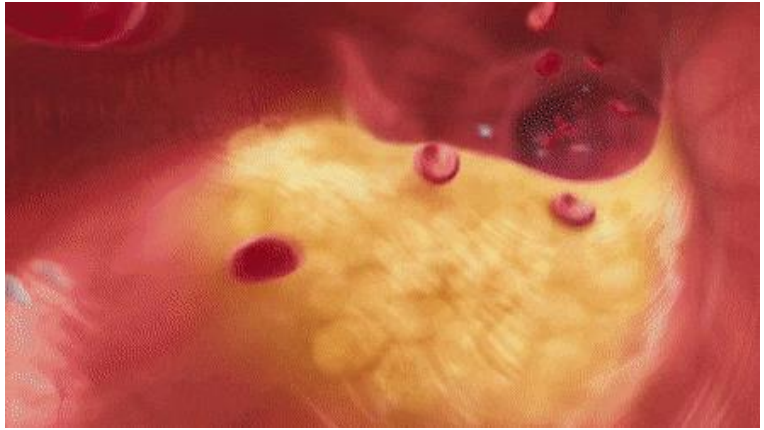
https%3A%2F%2Fgiphy.com%2Fexplore%2Fsmokers&psig=AOvVaw2SpAccR8J5kzAqJdyxMlj1&ust=1668265641971000&source=images&cd=vfe&ved=0CBAQ3YkBahcKEwjQmMv5s6b7AhUAAAAAHQAAAAAQBA

www.genengnews.com%2Fnews%2Fnovel-diabetes-therapy-might-be-found-in-protein-commonly-found-throughout-the-body%2F&psig=AOvVaw35kYHy3dHbnP8eRYj5AGmt&ust=1668266607632000&source=images&cd=vfe&ved=0CBEQ3YkBahcKEwiw_Zbwt6b7AhUAAAAAHQAAAAAQAw

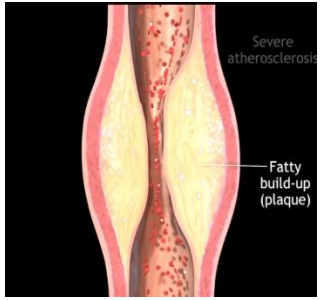


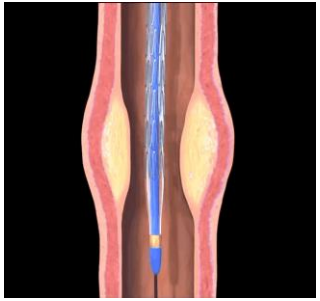
https://healthblog.uofmhealth.org/heart-health/what-you-should-know-about-counseling-and-testing-for-genetic-heart-disease

# Antiplatelet(s):
# Plaque presence = potential for rupture or thrombus;



https://gfycat.com/gifs/search/myocardial



1. **Aspirin** 81 mg or 325 mg

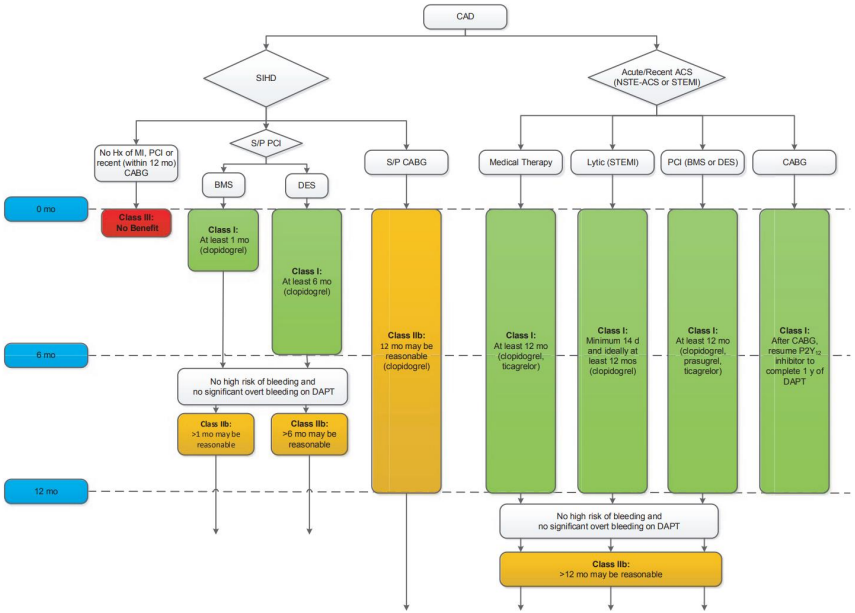
- ADAPTABLE trial = either; 81 mg demonstrates same benefit, less bleeding

2. **P2y12 inhibitors**: Clopidogrel 75 mg, Prasugrel 10 mg, or Ticagrelor (90 mg po bid or 60 mg po bid).

3. **Dual antiplatelet therapy (DAPT)**: Both ASA + P2y12i

When to go to ASA or P2y12i alone?

**FIGURE 1** Master Treatment Algorithm for Duration of $P2Y_{12}$ Inhibitor Therapy in Patients With CAD Treated With DAPT



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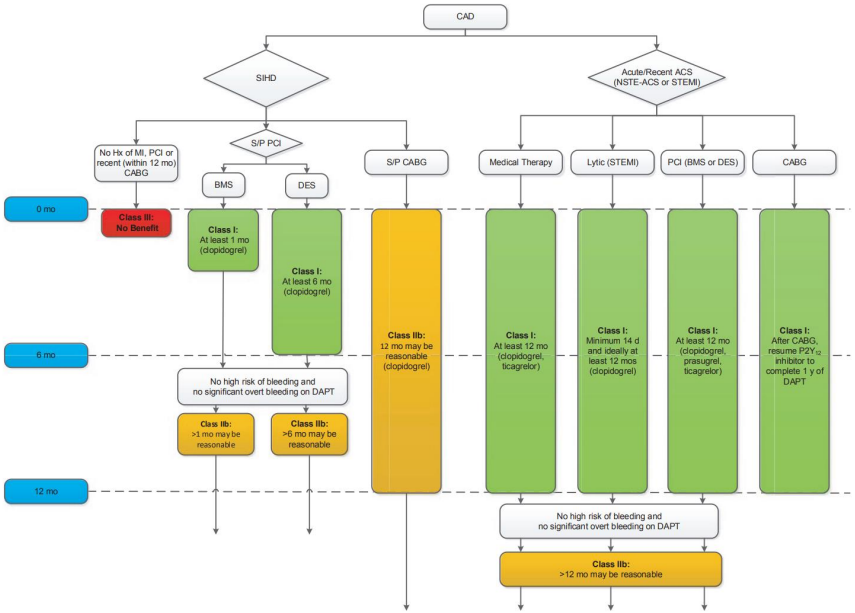

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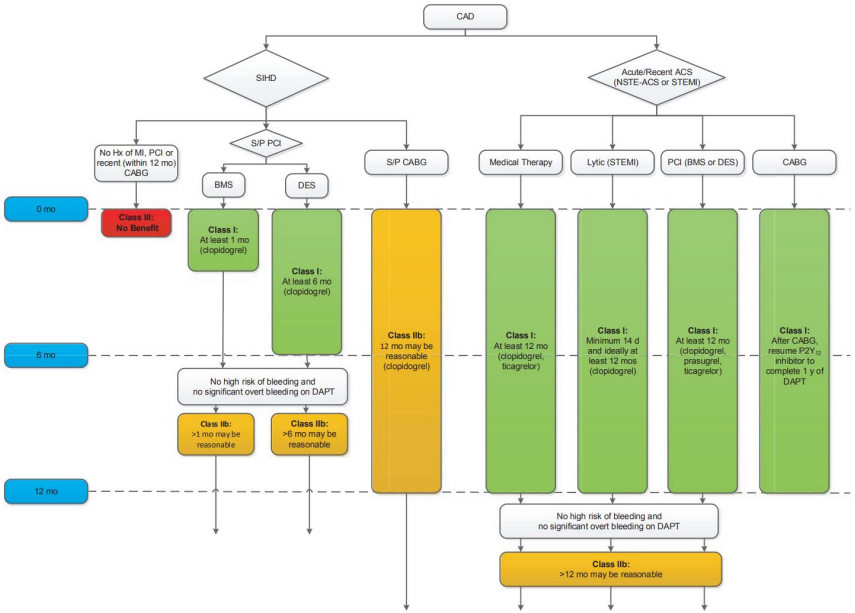

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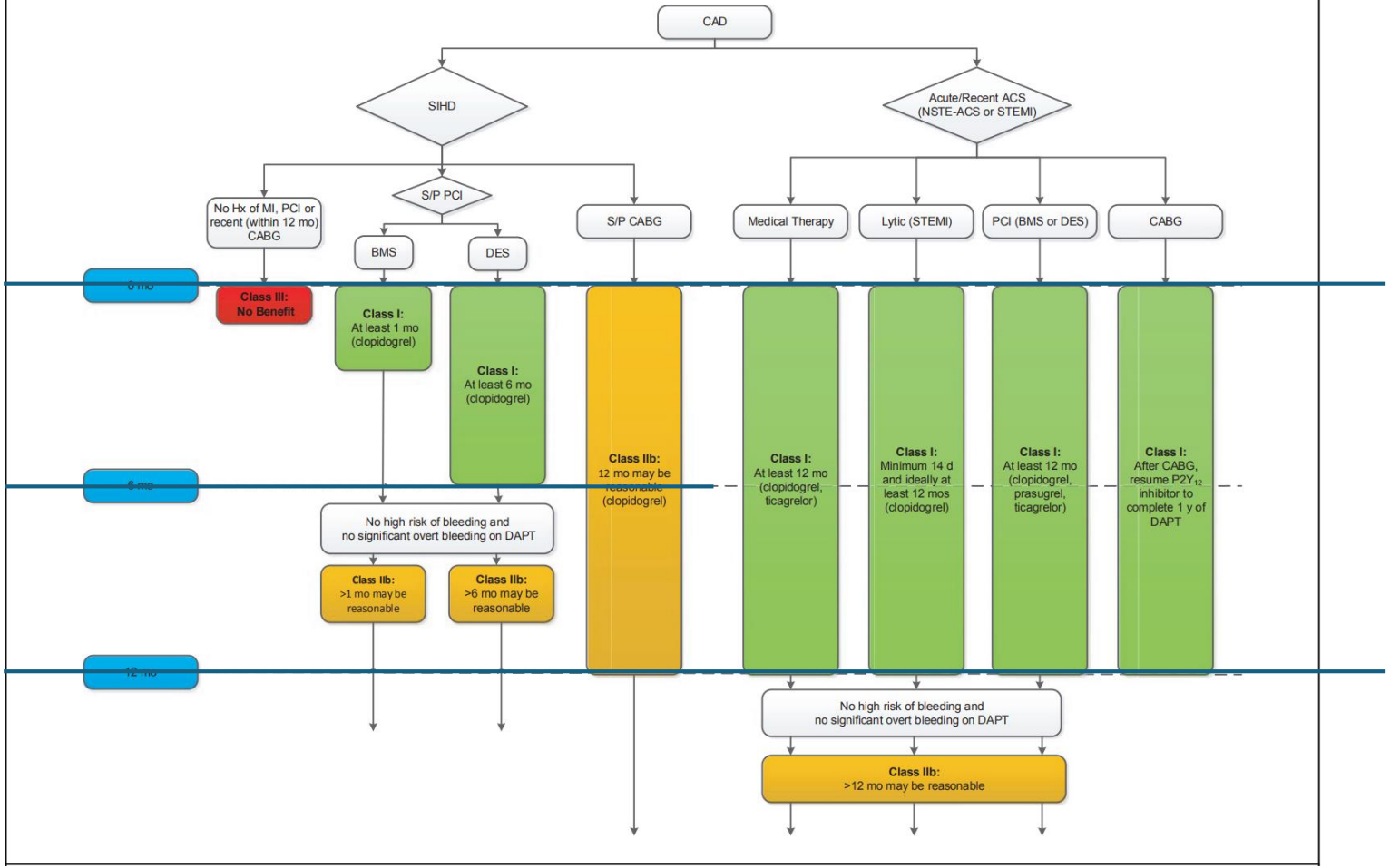

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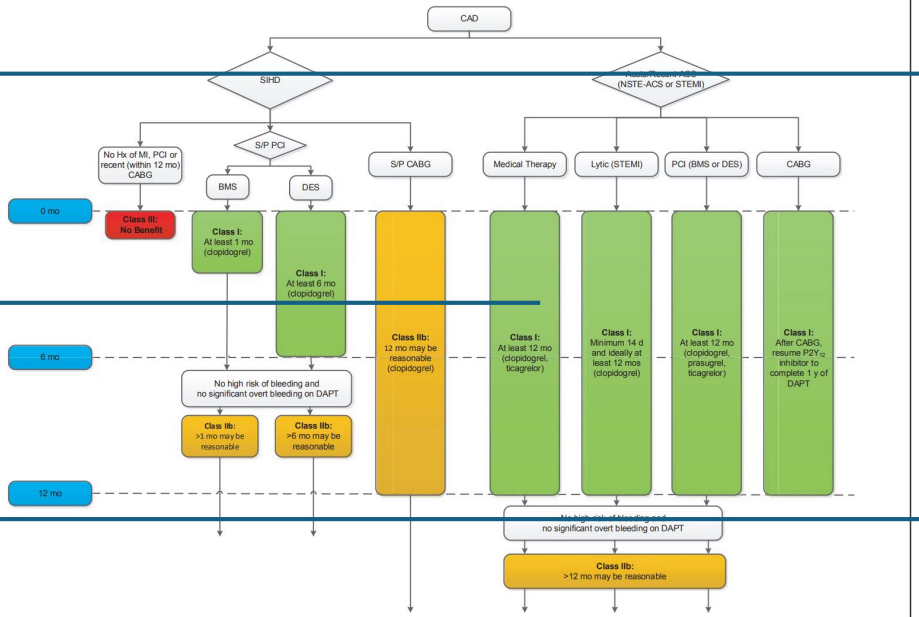


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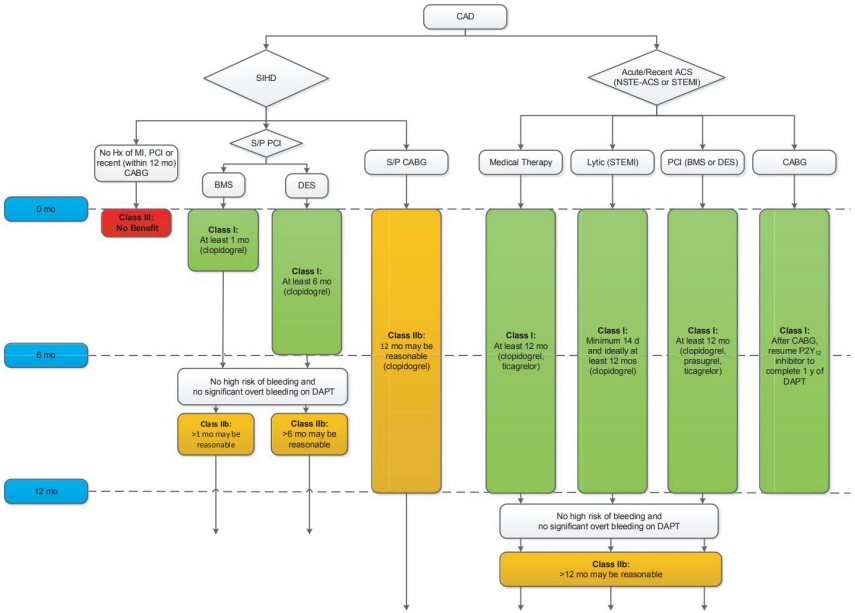

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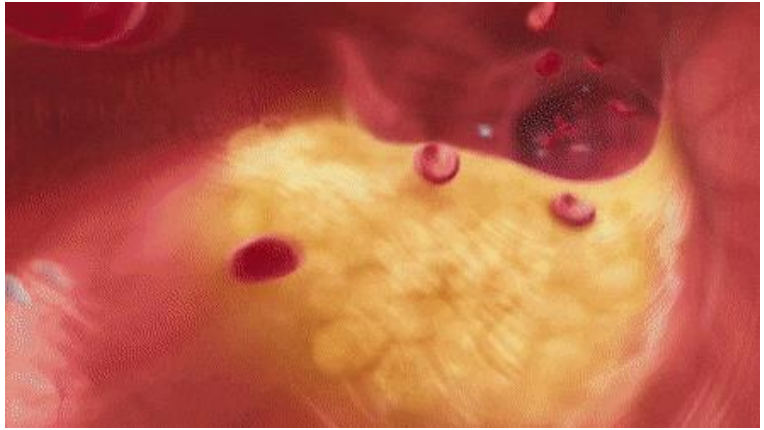
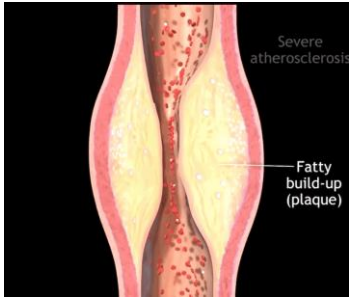
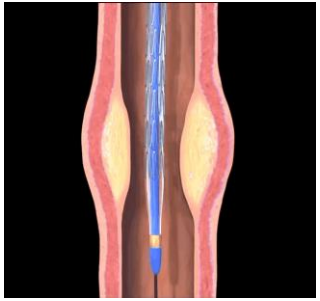


https://gfycat.com/gifs/search/myocardial



1. **<u>Aspirin</u>** 81 mg or 325 mg OR **<u>P2y12 inhibitors</u>** Clopidogrel 75 mg, Prasugrel 10 mg, or Ticagrelor (90 mg po bid or 60 mg po bid).

As a single agent going forward? CAPRIE, 1996 study demonstrated cardiovascular benefit and less bleeding with clopidogrel over aspirin monotherapy.

Host-Exam 2022 affirmed data from CAPRIE trial of P2Y12i over aspirin.

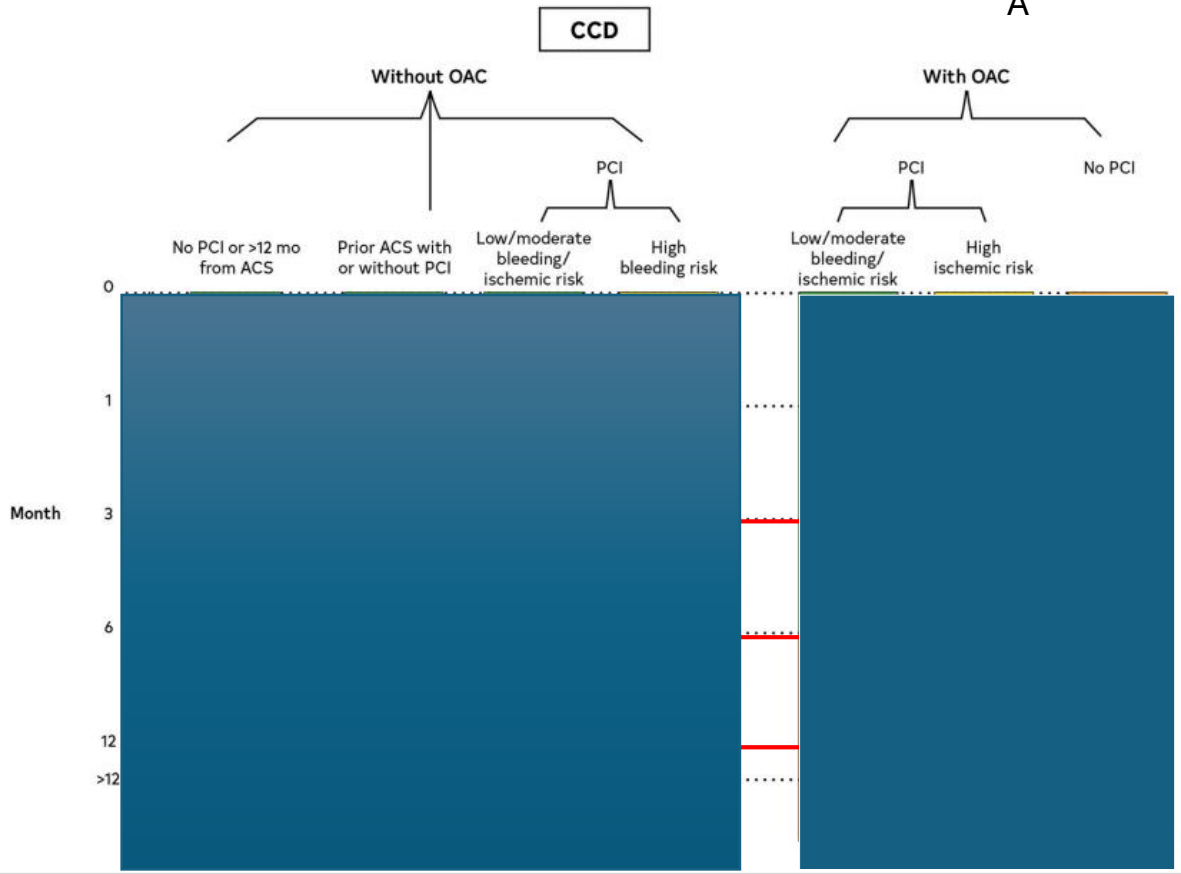
ULTIMATE-DAPT 2024 POST MI Ticagrelor monotherapy vs DAPT after 30 days. Ticagrelor>DAPT

Guidelines are still geared to ASA 81 mg monotherapy.

# What about Atrial Fibrillation and Coronary Artery Disease?

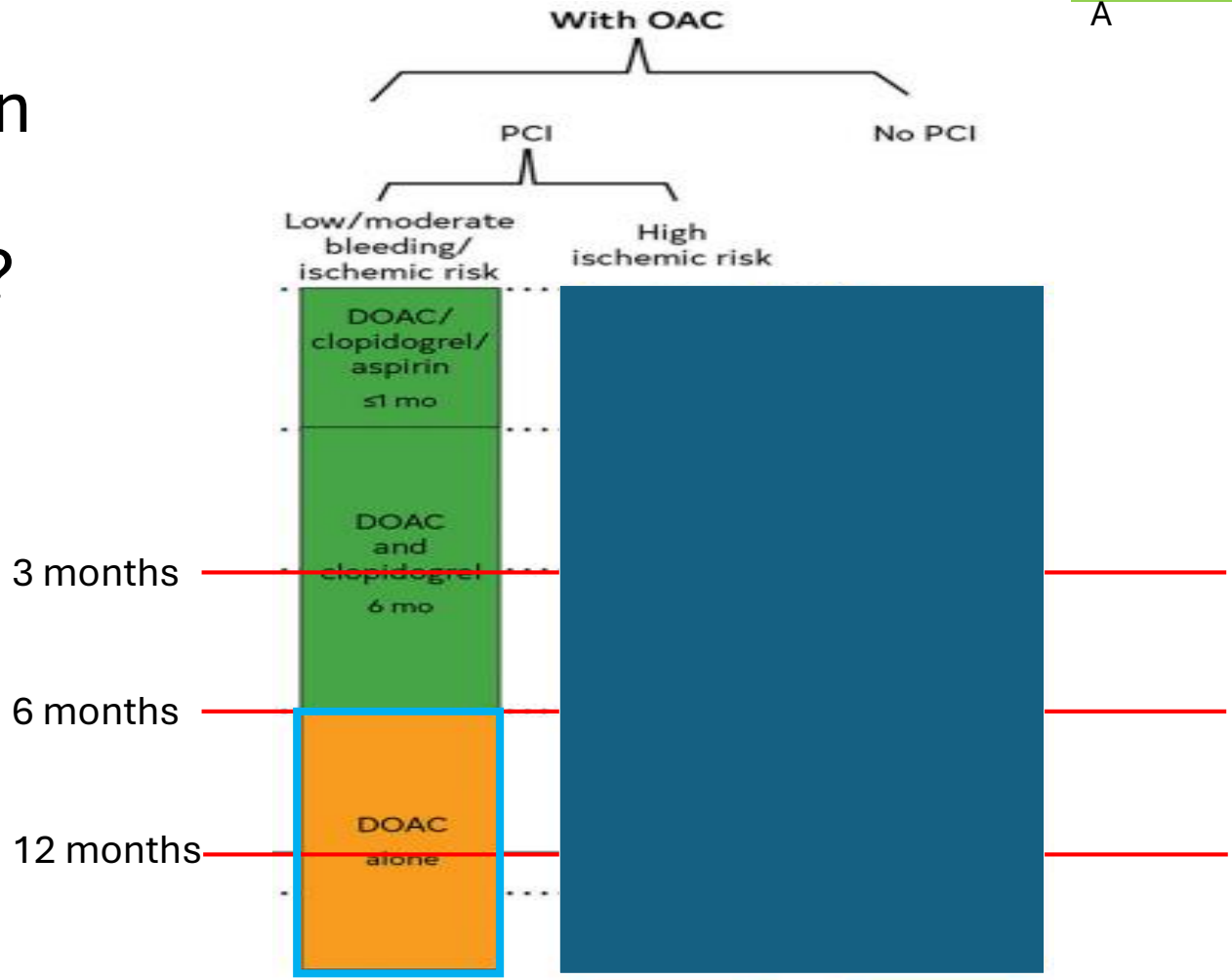


**FIGURE 9** Recommended Duration of Antiplatelet Therapy*†




ACS indicates acute coronary syndrome; ASA, aspirin; CCD, chronic coronary disease; DAPT, dual antiplatelet therapy; DES, drug-eluting stent; DOAC, direct oral anticoagulant; MI, myocardial infarction; OAC, oral anticoagulants; PCI, percutaneous coronary intervention; SAPT, single antiplatelet therapy. *Colors correspond to Class of Recommendation in Table 3. †This figure does not encompass all recommendations within this section.

# What about Atrial Fibrillation and Coronary Artery Disease?



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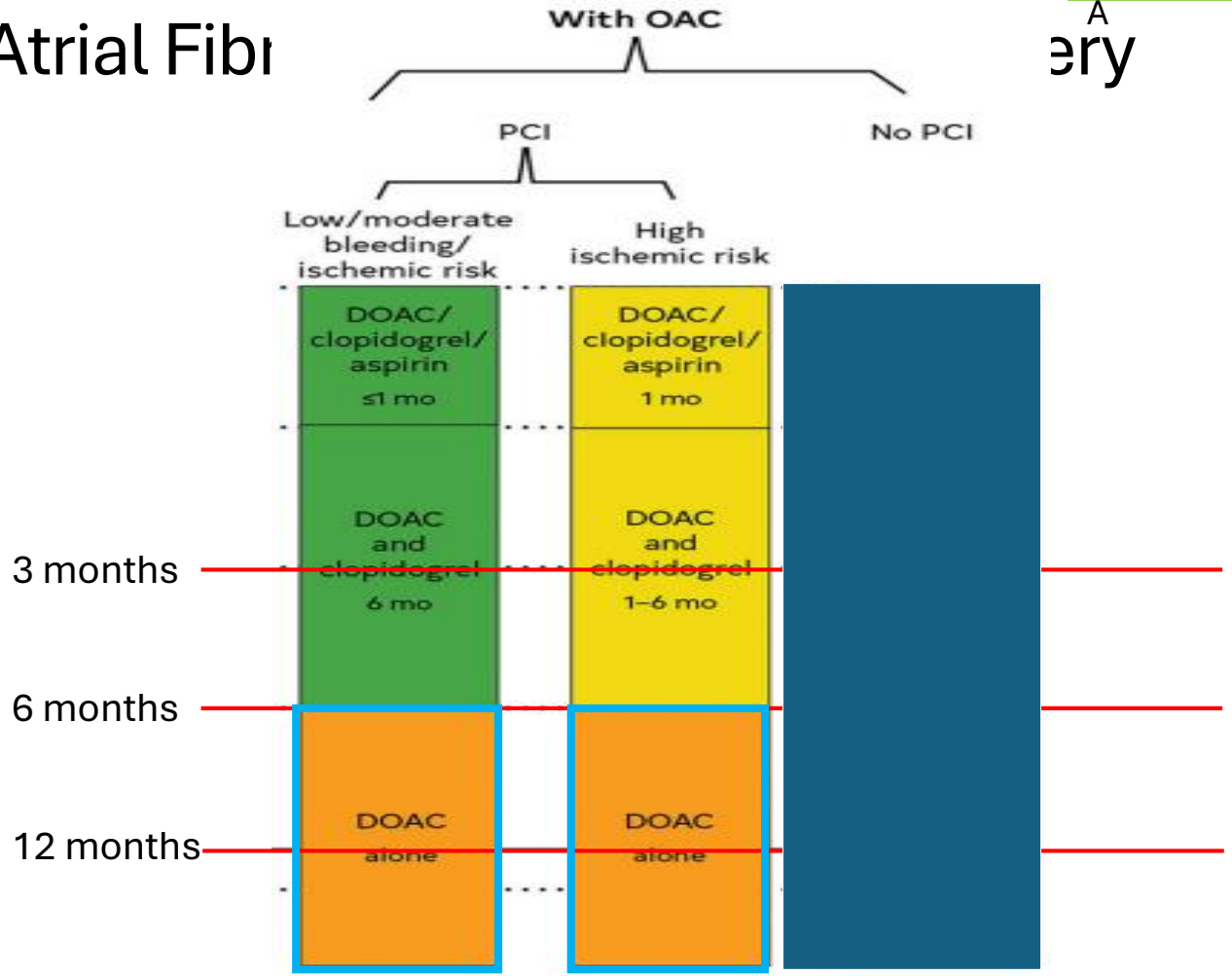

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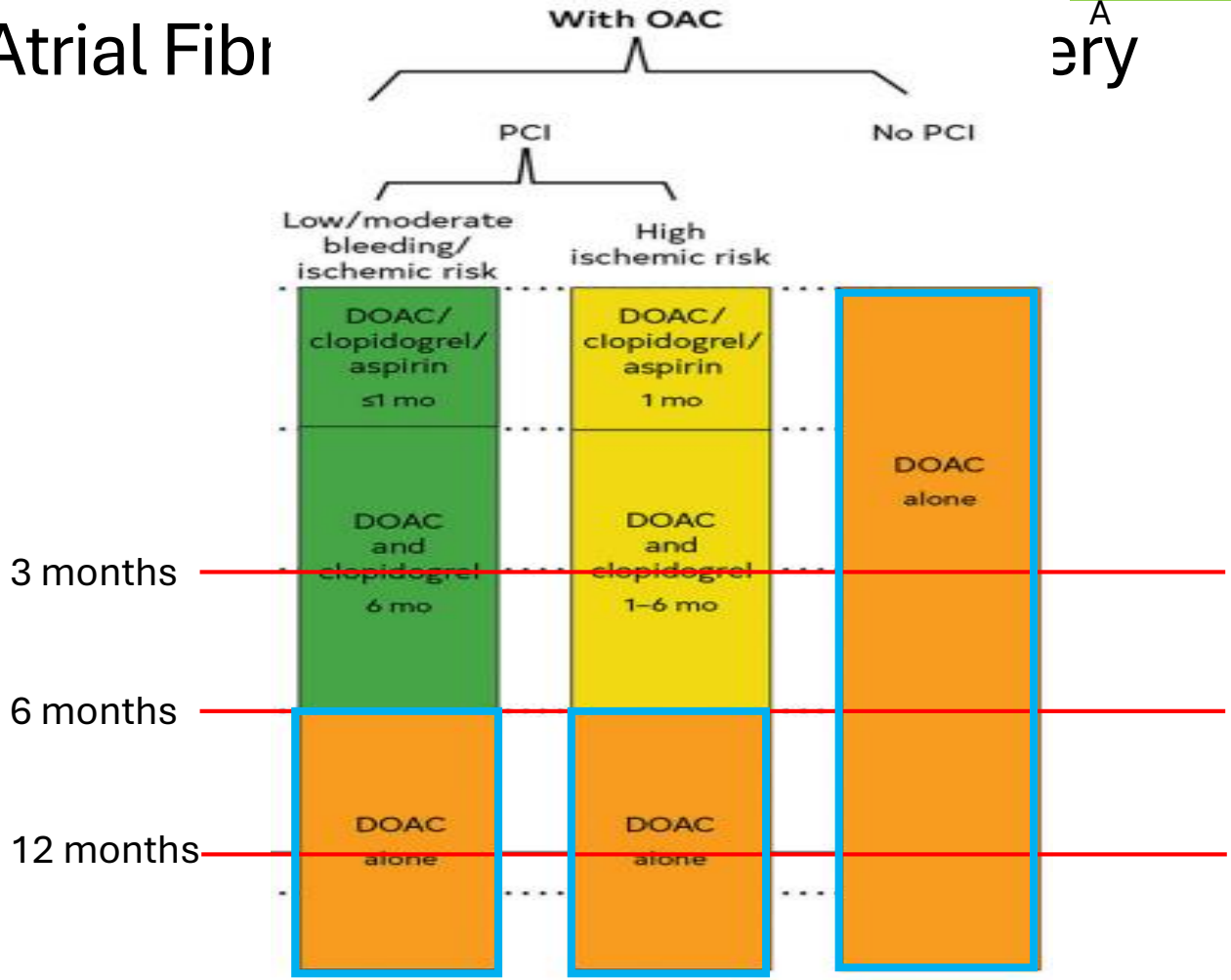
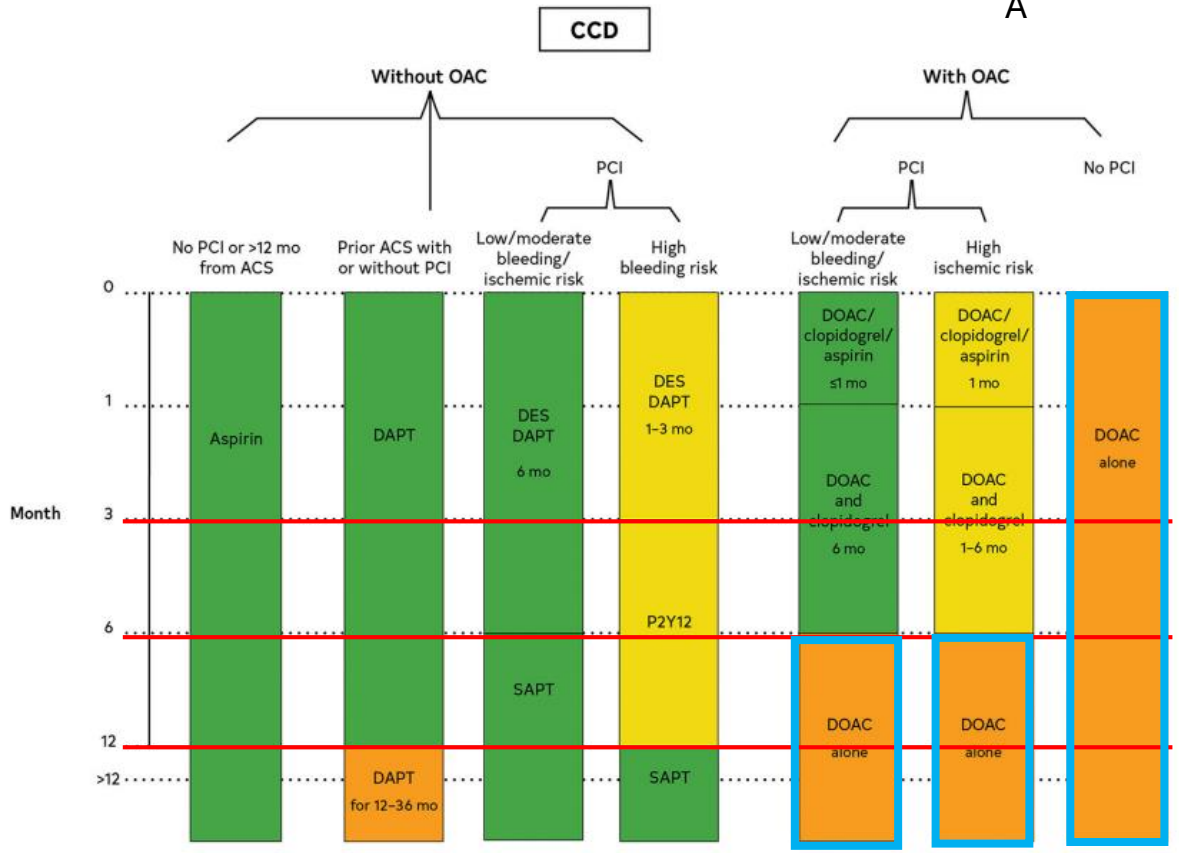


# What about At
# Disease?



**FIGURE 9** Recommended Duration of Antiplatelet Therapy*†




ACS indicates acute coronary syndrome; ASA, aspirin; CCD, chronic coronary disease; DAPT, dual antiplatelet therapy; DES, drug-eluting stent; DOAC, direct oral anticoagulant; MI, myocardial infarction; OAC, oral anticoagulants; PCI, percutaneous coronary intervention; SAPT, single antiplatelet therapy. *Colors correspond to Class of Recommendation in Table 3. †This figure does not encompass all recommendations within this section.

Circulation. 2021;143:583–596.

# Case

55-year-old man returns for annual follow-up.

PMHx: Had an MI at age 50, 2vCABG. Has Paroxysmal Afib.

FMHx: Mom had MI at age 55. Has one sister, A&W.

SocHx: Florist. Single. Lifetime non-smoker, drinks 1-2 beers on the weekends. Lifts weights 2-3 times a week at the gym.

MEDS: Clopidogrel 75 mg, rosuvastatin 40 mg, ezetimibe 10 mg, bi-weekly Repatha 140 mg/mL SC, metoprolol succinate 50 mg. SL NTG 0.4 mg PRN.

Vitals: BP 120/80, HR 55, SaO2 95%, T 98.7, Wt 200 Ht 5'9" BMI 29.5

LABS: TC 200, Trig 110, HDL 42, LDL 50. A1c 5.5%, Fasting Glucose 92 mg/dL

What are your recommendations?

**Paroxysmal AF. Antithrombotic regimen?**

1. Lifestyle modifications for health
2. **Initiate oral anticoagulant and stop P2y12 inhibitor.**
3. Watch for bleeding complications of bleeding (e.g., GI)

# What about B-blockers in those who have had an acute myocardial infarction

2021 – recommendation in those prescribed beta-blockers during an AMI event, to stop after 3 years if LV Function was “normal” – LVEF ≥50%

2023 – reassess beta-blocker therapy when LVEF ≥50% at >1 year.

2024 – what about, right “out of the gate” with AMI and LVEF ≥50%?

## 4.3.2. Beta Blockers

**Recommendations for Beta Blockers**
**Referenced studies that support the recommendations are summarized in the Online Data Supplement.**

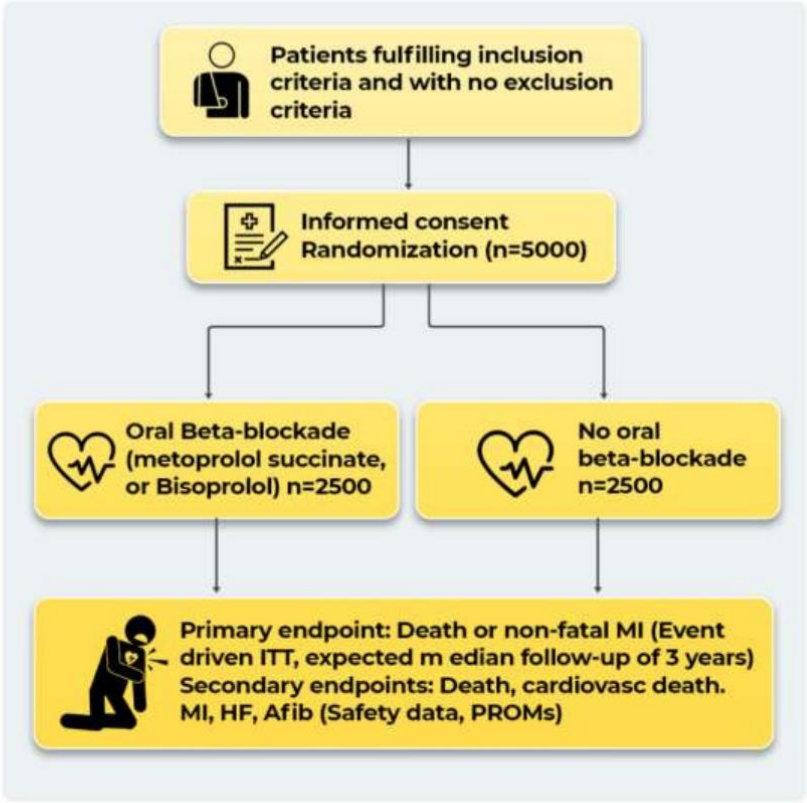
| COR | LOE | Recommendations |
|---|---|---|
| 1 | A | 1. In patients with CCD and LVEF ≤40% with or without previous MI, the use of beta-blocker therapy is recommended to reduce the risk of future MACE, including cardiovascular death.[1–3] |
| 1 | A | 2. In patients with CCD and LVEF <50%, the use of sustained release metoprolol succinate, carvedilol, or bisoprolol with titration to target doses is recommended in preference to other beta blockers.*[1,3–8] |
| 2b | B-NR | 3. In patients with CCD who were initiated on beta-blocker therapy for previous MI without a history of or current LVEF ≤50%, angina, arrhythmias, or uncontrolled hypertension, it may be reasonable to reassess the indication for long-term (>1 year) use of beta-blocker therapy for reducing MACE.[9–15] |
| 3: No Benefit | B-NR | 4. In patients with CCD without previous MI or LVEF ≤50%, the use of beta-blocker therapy is not beneficial in reducing MACE, in the absence of another primary indication for beta-blocker therapy.†[16–19] |

# Aim

To determine whether long-term oral beta-blocker treatment in patients with acute MI and preserved left ventricular function improves outcome

# Outcome

- Primary Endpoint
  - Composite of death of any cause or new myocardial infarction (MI)
- Secondary Endpoints
  - All-cause death
  - Cardiovascular death
  - Myocardial infarction
  - Hospital admission due to atrial fibrillation
  - Hospital admission due to heart failure
- Safety Outcomes
  - Bradyarrhythmia, hypotension or Syncope
  - Hospitalization due to asthma or COPD
  - Stroke

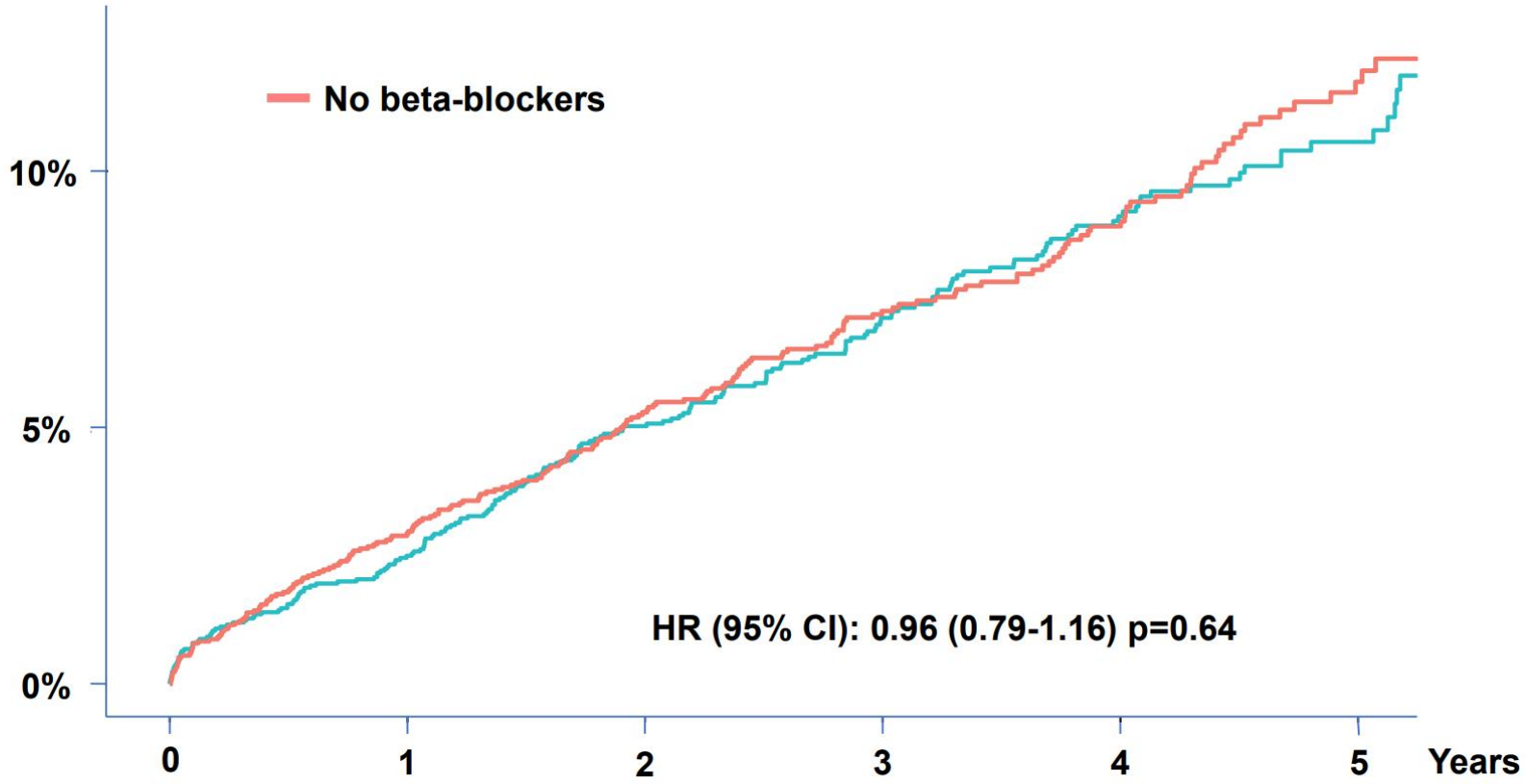


# Baseline characteristics

| Characteristic | Beta-blockers (n=2508) | No Beta-blockers (n=2512) |
|---|---|---|
| **Demography** | | |
| Median age (IQR) – year | 65 (57-73) | 65 (57-73) |
| Female sex, no (%) | 563 (22.4) | 568 (22.6) |
| **Risk Factors** | | |
| Current smoker, no (%) | 478 (19.4) | 530 (21.3) |
| Hypertension, no (%) | 1155 (46.1) | 1163 (46.3) |
| Diabetes mellitus, no (%) | 346 (13.8) | 354 (14.1) |
| **Prior cardiovascular disease** | | |
| Prior myocardial infarctions, no (%) | 165 (6.6) | 192 (7.7) |
| Prior PCI, no (%) | 147 (5.9) | 175 (7.0) |
| Prior CABG, no (%) | 33 (1.3) | 36 (1.4) |
| Prior Stroke, no (%) | 52 (2.1) | 67 (2.7) |
| Prior Heart failure, no (%) | 13 (0.5) | 22 (0.9) |
| **Presentation characteristics** | | |
| Chest pain as main symptoms, no (%) | 2421 (96.6) | 2417 (96.2) |
| CPR before hospital, no (%) | 10 (0.4) | 11 (0.4) |
| Pulmonary rales, no (%) | 29 (1.2) | 42 (1.7) |
| Atrial fibrillation, no (%) | 21 (0.8) | 23 (0.9) |
| ST-elevation MI, no (%) | 877 (35.0) | 892 (35.5) |
| On oral beta-blocker treatment, no (%) | 269 (10.9) | 302 (12.2) |

Baseline characteristics were similar between treatment groups

# Primary outcome (all-cause death or MI)



# Hypertension, the pressure is on!
# BP goal <130/80 mmHg with GDMT*

1. GDMT

- ACE Inhibitors or ARB
- Thiazides
- DHP/NDHP CCBs
- Beta-blockers

https://gfycat.com/totaltiredfinch


*Guideline directed medical therapies depending on indications, e.g., ACE inhibitor or ARBs, beta-blockers

# Differences in HTN categories

- JNC 7, JNC 8, and ACC/AHA 2017

**JNC 8 Guideline for the Prevention, Detection, Evaluation and Management of High Blood Pressure in Adults**

**BP Classification** (JNC 7 and ACC/AHA Guidelines)

| SBP | | DBP | JNC 7 | 2017 ACC/AHA |
|---|---|---|---|---|
| <120 | and | <80 | Normal BP | Normal BP |
| 120–129 | and | <80 | Prehypertension | Elevated BP |
| 130–139 | or | 80–89 | Prehypertension | Stage 1 hypertension |
| 140–159 | or | 90-99 | Stage 1 hypertension | Stage 2 hypertension |
| ≥160 | or | ≥100 | Stage 2 hypertension | Stage 2 hypertension |

- Blood Pressure should be based on an average of ≥2 careful readings on ≥2 occasions
- Adults being treated with antihypertensive medication designated as having hypertension

# HTN goals ACC/AHA 2017

| Patient group | 2017 ACC/AHA |
|---|---|
| General | <130/80 mm Hg* |
| Older patients | <130 mm Hg‡ |
| Diabetes | <130/80 mm Hg |
| Chronic kidney disease | <130/80 mm Hg |

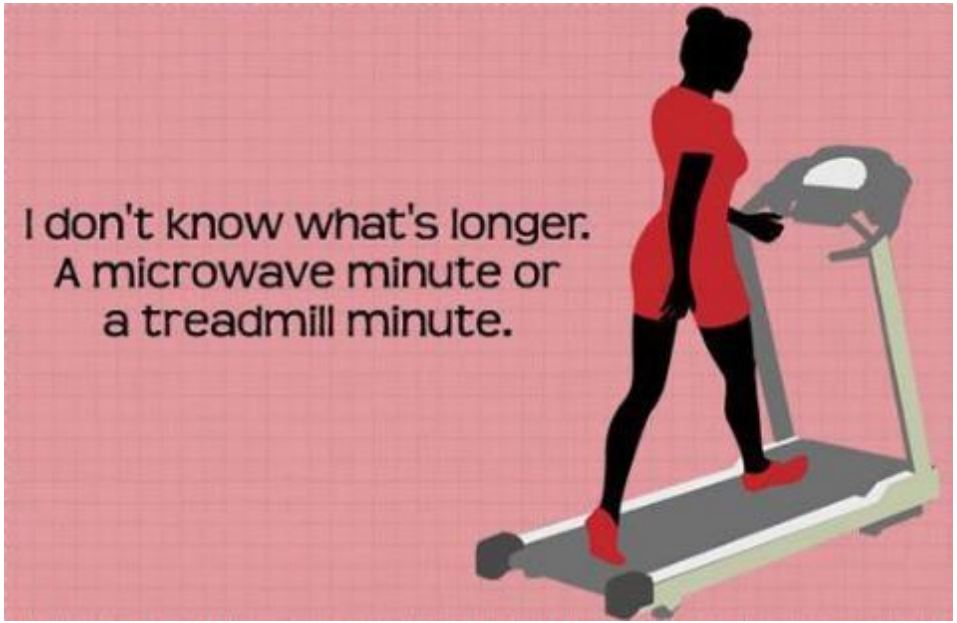
*Includes patients with atherosclerotic cardiovascular disease (ASCVD) or an estimated 10-year risk ≥10%, as well as patients needing primary prevention or those with 10-year ASCVD risk <10%.

†General population ≥60 years of age. Treatment does not need to be adjusted in patients ≥60 years who may have lower systolic BP (eg, <140 mm Hg) and are not experiencing adverse effects.

‡Ambulatory, community-dwelling, noninstitutionalized patients ≥65 years of age. Clinical judgment, patient preference, and a team-based approach to assess benefits and risks are reasonable for patients with a high burden of comorbidity and limited life expectancy.

# Lifestyle first, foremost, and always

- Its about the quality of life we live, not just how long we live it




Consider discussing lifestyle modifications not as “work” you do to become healthy. Rather as doing enjoyable activities by yourself or with others that happen to help keep you feeling healthy.

# Pharmacotherapeutics

- Initiation: what to start with? First-line and/or condition driven

Regardless of underlying conditions, start with agents that have data for clinical outcomes benefits, i.e., have clinical trial data demonstrating reduction of CVD events, CKD progression, etc.

Primary agents used in the treatment of hypertension include:

- **Thiazide diuretics** – (e.g., chlorthalidone, hydrochlorothiazide, indapamide, etc.)
- **ACE inhibitors*** – (e.g., enalapril, lisinopril, benazepril, etc.)*
- **ARBs* –** (e.g., candesartan, Olmesartan, irbesartan, losartan, etc.)
- **CCBs dihydropyridine** – (e.g., amlodipine, felodipine, nicardipine, etc.)
- **CCBs nondihydropyridine** – (e.g., diltiazem and verapamil)
- **B-blockers*** – (e.g., metoprolol succinate, carvedilol, bisoprolol)

***Class IB, preference towards ACEi/ARB and/or B-Blocker for HTN and/or MI/LV**

# Specific diseases and populations

- BP goals (<130/<80) for all. Individuals and disease presence may differ.

- **Stable Ischemic Heart Disease** – GDMT ACEi/ARB +/- B-blockers
  - **Angina Pectoris** present DHP CCB thiazides, B-blockers
  - **Post-ACS**, LV dysfunction present B-blocker +/- ACEi/ARB; not present ACEi/ARB

  e.g., lisinopril 5-10 mg/valsartan 80-160 mg, metoprolol succinate 25-50 mg, amlodipine 5-10 mg

- HFrEF – GDMT B-blockers, ACEi/ARB/ARNI, MRA. NDHP CCB NOT recommended.
- CKD – albuminuria (≥300 mg/day or ≥300 mg/g creatinine by first morning void) is present, ACEi, ARB if ACEi not tolerated. (**consider SGLT2i and ns-MRA)**
- DM – All first-line medications (e.g., thiazides, ACEi/ARB, DHP/NDHP CCBs) are reasonable.

# Case

63-year-old woman presents for follow-up. She continues to hav
stairs.

PMHx: Occasional headaches OB/GYN: Post-menopausal since
EF 55%.

FMHx: Parents have passed. 2 brothers, 1 with DMII.

SocHx: Medical Technologist, working part-time. Married with 2
Does not follow any specific physical activity regimen.

MEDS: Clopidogrel 75 mg, rosuvastatin 40 mg, ezetimibe 10 mg

Vitals: **BP 138/80**, HR 80, SaO2 96%, T 98.9, Wt 155 Ht 5'5" BMI

LABS: TC 220, Trig 200, HDL 50, LDL 68. A1c 5.6%, Fasting Gluc

What are your recommendations?

**Stage 1 - ≥ 130/ ≥ 80, ASCVD ≥ 10%**

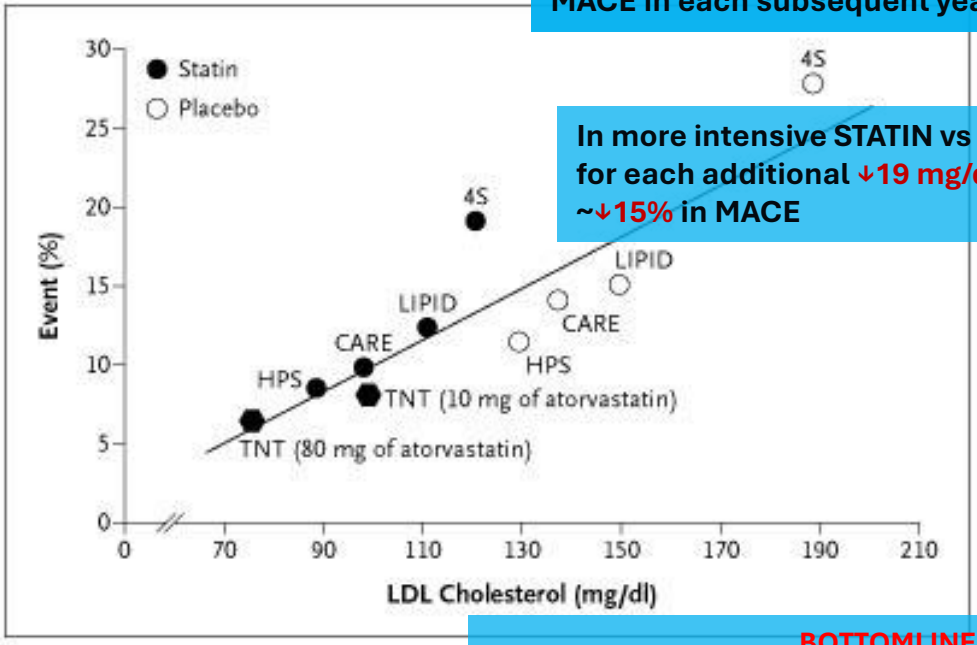
1. Lifestyle modifications for health
2. Titrate BP medication: **Increase valsartan to 160 mg and consider adding amlodipine 5 mg**
3. Reiterate the importance of self-measurement and keeping a home BP journal
4. Reassess in 4-6 weeks in-person or by appropriate real-time communication (e.g., text, phone, or video visit)

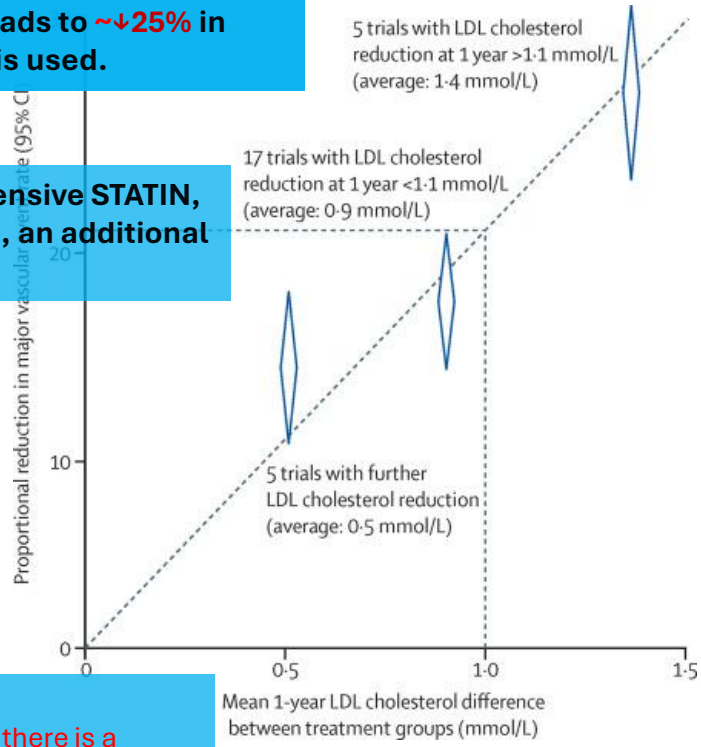
@VietHeartPA

**In STATIN vs NO-STATIN, for every ↓38 mg/dL LDL-C, there is a proportional ↓20% in MACE in the 1st year.**

**After the 1st year, ongoing statin use leads to ~↓25% in MACE in each subsequent year statin is used.**

**In more intensive STATIN vs less intensive STATIN, for each additional ↓19 mg/dL LDL-C, an additional ~↓15% in MACE**



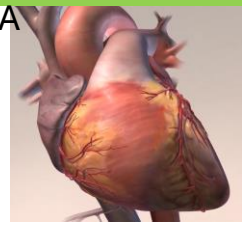

**BOTTOMLINE:**

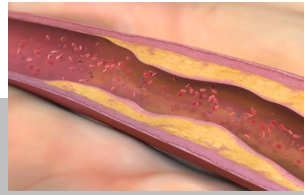
High intensity statin = Each ~ ↓ **50 mg/dL** LDL-C, there is a ~ ↓ **28%** MACE

LaRosa JC. N Engl J Med 2005; 352:1425-1435; Collins R. Lancet 2016; 388: 2532-61

# Secondary Prevention

## STATIN…please.





**MINIMUM 1st GOAL:**
**≥50% LDL-C Reduction from baseline.**

**High Intensity Statins (HIST)**
- Atorvastatin 40, 80 mg
- Rosuvastatin 20, 40 mg

**AHA/ACC 2018 2nd GOAL:**
**LDL-C <70 mg/dL OR non-HDL-C <100 mg/dL**

Key TAKEAWAY in ASCVD:
1. Statin FIRST
2. Reduce LDL-C by >50% from baseline.
3. Add non-statins when LDL-C >70 or LDL >55
4. Check lipids 4-6 weeks after initiation or dose titration.

**Updated AHA/ACC 2022:**
**ASCVD *NOT at very high-risk* LDL-C <70 mg/dL OR non-HDL-C <100 mg/dL**
**ASCVD at *Very HIGH RISK*, LDL-C <55 mg/dL OR non-HDL-C <85 mg/dL**

# Case

66-year-old man presents for follow-up. Returns for follow-up.

PMHx: Had an MI at 63, PCI w/2 stents to proximal LAD, EF 60%. Type II Diabetes

FMHx: 1 brother with DMII

SocHx: Retired construction worker. Married with 1 adult child. Former smoker, no EtOH. Walks daily for 40 minutes.

MEDS: Clopidogrel 75 mg, rosuvastatin 40 mg, ezetimibe 10 mg, valsartan HCT 160/12.5 mg, dapagliflozin 10 mg, semaglutide 1.7 mg/weekly. SL NTG 0.4 mg PRN.

Vitals: BP 125/80, HR 80, SaO2 96%, T 98.9, Wt 155 Ht 5'5" BMI 25.8

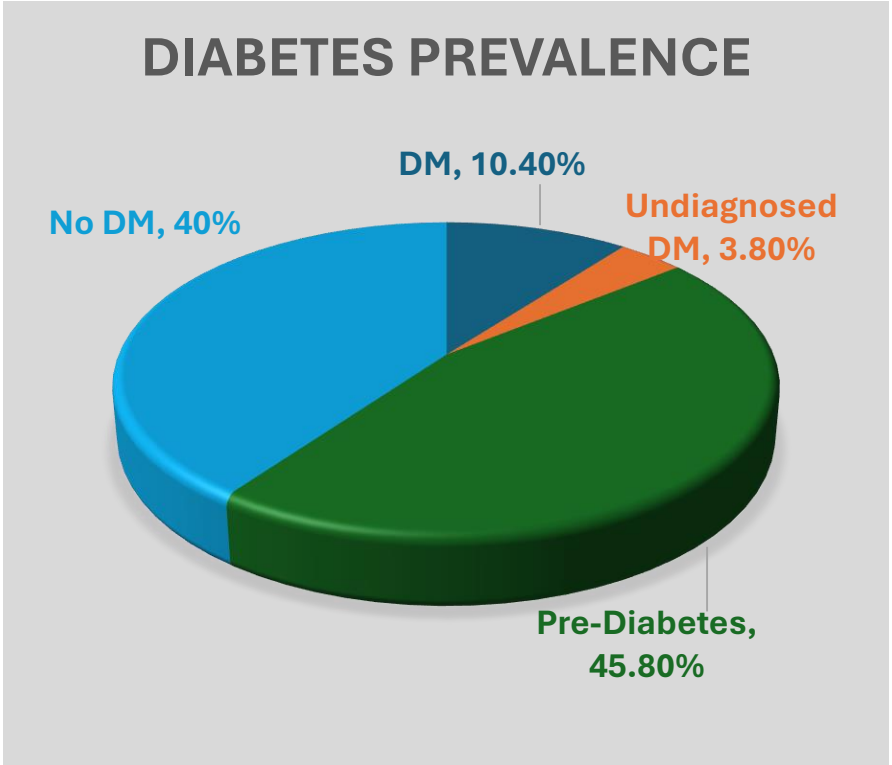
LABS: TC 220, Trig 200, HDL 50, LDL 88. A1c 6.7%, *UACR 40 mg/mmol. eGFR 92*

What are your recommendations?

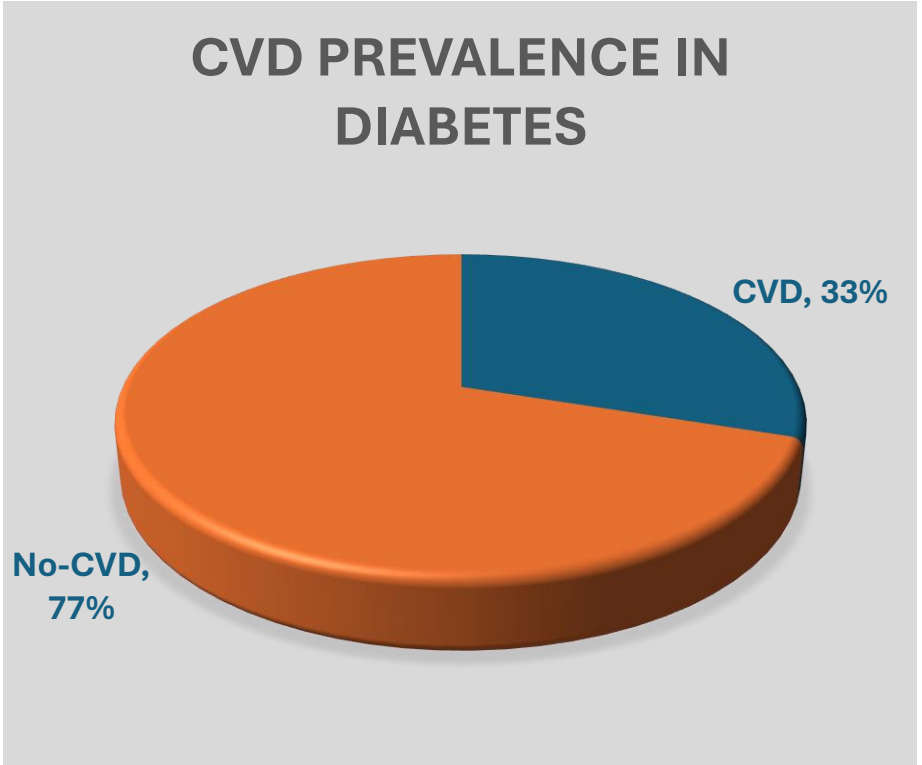
**Very High-Risk ASCVD, LDL-C <55 mg/dL**

1. Lifestyle modifications for health
2. Titrate lipid-lowering medication: **Add Repatha or Praluent (50% expected decrease, 88-(88*0.5) = 44 mg/dL).**
3. Reiterate the importance of self-measurement and keeping a home BP journal
4. Reassess in 4-6 weeks in-person or by appropriate real-time communication (e.g., text, phone, or video visit)

# Diabetes Mellitus + CAD

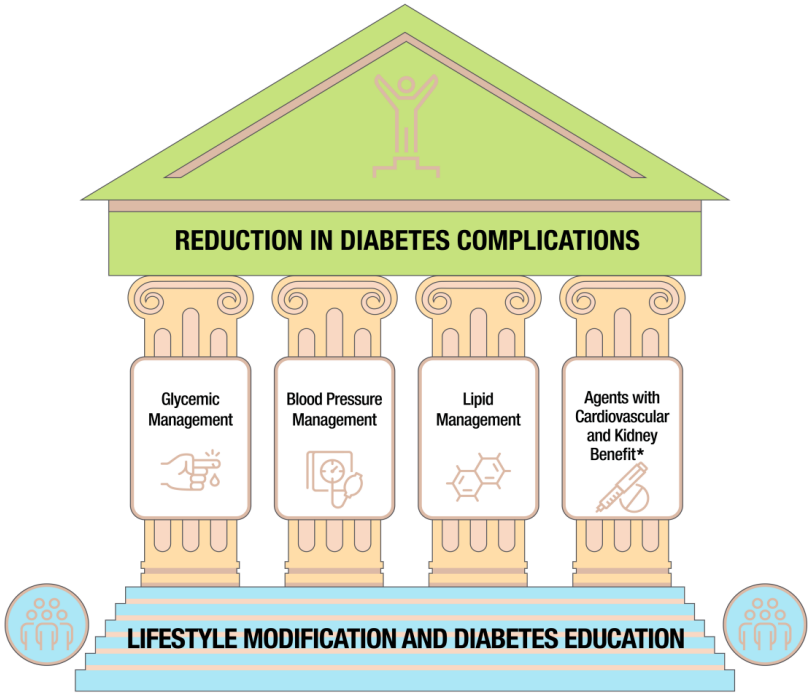


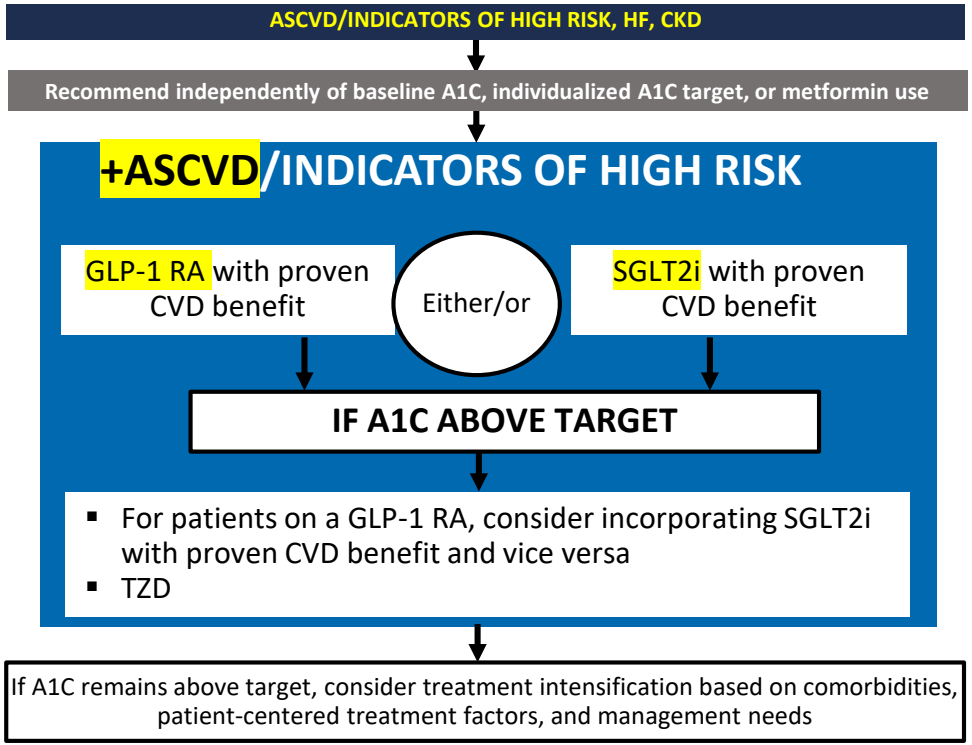

Cardiovasc Diabetol (2018) 17:83




Circulation.2022;145:e153–e639

# Diabetes Mellitus + CAD




Diabetes Care. 2022;45:S144.

# Case

50-year-old woman presents for follow-up.

PMHx: DMII since age 30. HTN. MI at age 45; 3VCABG. EF 55%

FMHx: Mom with DMII. Dad with MI age 70. 3 brothers, 2 with DMII.

SocHx: Director of Nursing. Married with 1 adult child. Life-time nonsmoker, no EtOH. Five day/week gym class.

MEDS: Clopidogrel 75 mg, rosuvastatin 40 mg, valsartan 180 mg. SL NTG 0.4 mg PRN. Metformin 1000 mg 2 tabs QD, Lantus 30U daily, Insulin Aspart 15U with meals, glipizide 10 mg bid

Vitals: BP 140/80, HR 60, SaO2 96%, T 98.9, Wt. 200 Ht. 5'3" BMI 35.4

LABS: TC 170, Trig 145, HDL 45, LDL 65. A1c 7.5%, Fasting Glucose 190 mg/dL

What are your recommendations?

**Very High-Risk ASCVD, goal LDL-C <55 mg/dL**

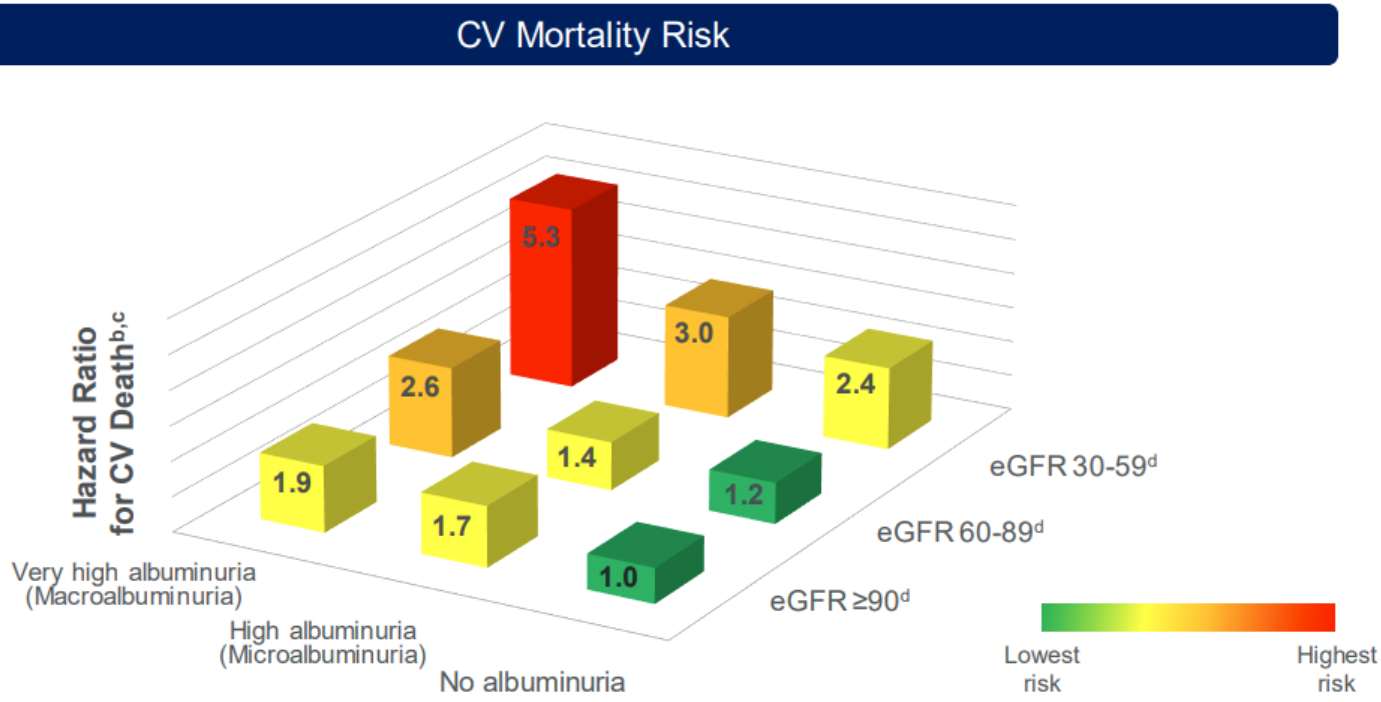
1. Lifestyle modifications for health
2. Add **ezetimibe 10 mg (20% expected to decrease, 65-(65*0.2) = 52)**
3. **Add Amlodipine, Chlorthalidone, or Metoprolol Succinate**
4. **Add SGLT2i and/or GLP1ra and remove glipizide, reducing basal and short-acting insulin.**
5. Reassess labs in 4-6 weeks, with BP check, glucose journal (CGM?), by appropriate real-time communication (e.g., in-person text, phone, or video-visit)

# ASCVD Sequelae

## Death, nonfatal MI or stroke, PAD, etc.

- Angina – Optimal medical therapy or revascularization (PCI or CABG) + Optimal medical therapy
- Surveillance – Ankle Brachial Index, Carotid and/or abdominal ultrasound, stress tests

# CV Mortality Risk by Albuminuria and eGFR Status in Patients With T2D[a]




[a]N=9795. [b]Reference group has eGFR ≥90 and no albuminuria. [c]Baseline adjustment for age, sex, duration of diabetes, smoking, body mass index, systolic blood pressure, HbA1c, HDL-cholesterol, LDL-cholesterol, triacylglycerol, retinopathy, RAAS inhibition and treatment group. [d]In mL/min/1.73 $m^2$.

CV, cardiovascular; eGFR, estimated glomerular filtration rate; HDL, high-density lipoprotein; LDL, low-density lipoprotein; HbA1c, glycated hemoglobin; RAAS, renin–angiotensin–aldosterone system; T2D, type 2 diabetes.

Drury PL, et al. *Diabetologia*. 2011;54:32-43.

# GFR and Albuminuria Are Predictive of CKD Progression

## Prognosis of CKD by GFR and Albuminuria Categories: *KDIGO 2012*[1]

| GFR Categories (mL/min/1.73 m²) Description and range | | | | Persistent Albuminuria Categories Description and range | | |
|---|---|---|---|---|---|---|
| | | | | A1 | A2 | A3 |
| | | | | Normal to mildly increased | Moderately increased | Severely increased |
| | | | | <30 mg/g <3 mg/mmol | 30-300 mg/g 3-30 mg/mmol | >300 mg/g >30 mg/mmol |
| | G1 | Normal or high | ≥90 | | | |
| | G2 | Mildly decreased | 60-89 | | | |
| | G3a | Mildly to moderately decreased | 45-59 | | | |
| | G3b | Moderately to severely decreased | 30-44 | | | |
| | G4 | Severely decreased | 15-29 | | | |
| | G5 | Kidney failure | <15 | | | |

Figure reprinted with permission of The International Society of Nephrology: Kidney Disease Improving Global Outcomes Diabetes Work Group. *Kidney Int.* 2021;99:S1-S87.

- **A2** = *microalbuminuria*[2] *(older classification system)*
- **A3** = *macroalbuminuria or proteinuria*[2] *(older classification system)*

**Risk of CKD Progression**[1]

- Low risk (if no other markers of kidney disease, no CKD)
- Moderately increased risk
- High risk
- Very high risk

CKD, chronic kidney disease; GFR, glomerular filtration rate; KDIGO, Kidney Disease Improving Global Outcomes.



**1.** Kidney Disease Improving Global Outcomes Diabetes Work Group. *Kidney Int.* 2021;99:S1-S87. **2.** Kidney Disease Improving Global Outcomes. *Kidney Int Suppl.* 2013;3:1-150.

# Medical Societies Support eGFR and Albuminuria Screening in All Patients With Diabetes

| | ADA (2022) | KDIGO (2021) | KDOQI (2007, 2012) |
|---|---|---|---|
| When to screen for CKD | Patients with **T1D duration ≥5 years** and **all patients with T2D** regardless of treatment should be screened **at least annually** for CKD[1]<br>Patients with diabetes and **UACR ≥300 mg/g** and/or **eGFR 30-60 mL/min/1.73 m²** should be **monitored twice annually**[1] | Patients with **diabetes** should be screened for CKD[3]<br>**Initiation and frequency** of CKD screening should be individualized **based on kidney and CV risk profiles and individual preferences**[3] | Patients with **T1D duration ≥5 years** and **all patients with T2D** should be screened **annually** for CKD[4] |
| Screening tests | **eGFR and UACR**[1] | **eGFR and UACR**[3] | **eGFR and UACR**[4] |
| Diagnosis | eGFR <60 mL/min/1.73 m²[a]: present for **>3 months**[1,2]<br>**AND/OR**<br>UACR ≥30 mg/g[b]: **2 of 3 specimens abnormal** within **3 to 6 months**[1] | Any of the following for **≥3 months**[3]:<br>eGFR <60 mL/min/1.73 m²[c]<br>UACR ≥30 mg/g[d] | eGFR <60 mL/min/1.73 m²: present for **>3 months**[4,5]<br>**AND/OR**<br>UACR ≥30 mg/g[b]: **2 of 3 specimens abnormal** within **3 to 6 months**[4] |

**Potential benefits of early screening include earlier detection and management to reduce/slow progression to ESRD, reduce CVD and other morbidity/mortality, improve quality of life, and reduce healthcare costs**[2]

[a]Calculated from serum creatinine (CKD-EPI).[1,2] [b]With random spot urine sample.[1,4] [c]Accurate eGFR estimation includes both creatinine and cystatin C for diagnosis and staging.[3] [d]Early morning urine sample is preferred.[2]

ADA, American Diabetes Association; CKD-EPI, Chronic Kidney Disease Epidemiology Collaboration; CV, cardiovascular; CVD, cardiovascular disease; eGFR, estimated glomerular filtration rate; ESRD, end-stage renal disease; KDIGO, Kidney Disease Improving Global Outcomes; KDOQI, Kidney Disease Outcomes Quality Initiative; T1D, type 1 diabetes; T2D, type 2 diabetes; UACR, urine albumin-to-creatinine ratio.

**1.** American Diabetes Association. Section 11. *Diabetes Care*. 2022;45(Suppl. 1):S175-S184. **2.** Kidney Disease Improving Global Outcomes. *Kidney Int Suppl*. 2013;3:1-150.
**3.** Shlipak MG, et al. *Kidney International*. 2021;99:34-47. **4.** National Kidney Foundation Kidney Disease Outcomes Quality Initiative. *Am J Kidney Dis*. 2007;49(Suppl. 2):S1-S180.
**5.** Inker LA, et al. *Am J Kidney Dis*. 2014;63(5):713-735.

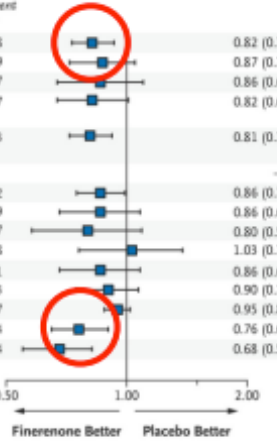
# MANAGEMENT

Slide credit: Dr. Kraus

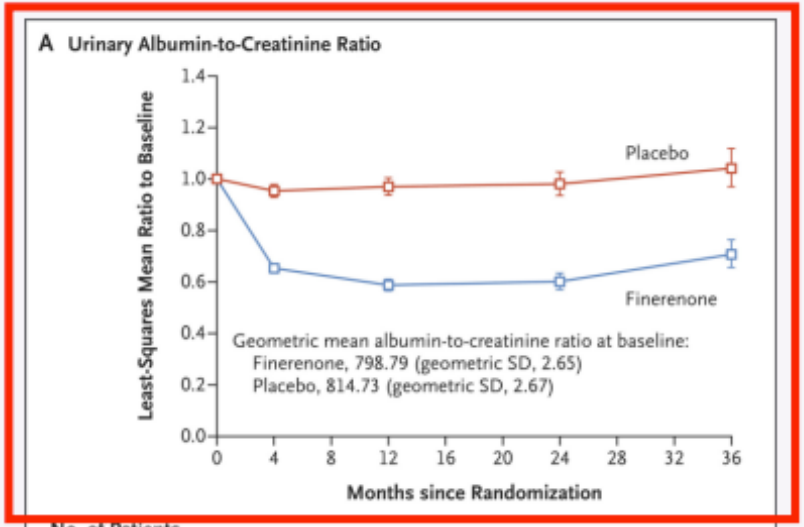
## HTN in Chronic Kidney Disease; MRAs

- Nonsteroidal MRAs, Finerenone
- FIDELIO-DKD (CKD G3-4)

| Outcome | Finerenone (N=2833) no. of patients with event (%) | Placebo (N=2841) no. of patients with event (%) | Finerenone (N=2833) per 100 patient-yr | Placebo (N=2841) per 100 patient-yr | Hazard Ratio (95% CI) | P Value |
|---|---|---|---|---|---|---|
| Primary composite outcome | 504 (17.8) | 600 (21.1) | 7.59 | 9.08 | 0.82 (0.73–0.93) | 0.001 |
| Kidney failure | 208 (7.3) | 235 (8.3) | 2.99 | 3.39 | 0.87 (0.72–1.05) | — |
| End-stage kidney disease | 119 (4.2) | 139 (4.9) | 1.60 | 1.87 | 0.86 (0.67–1.10) | — |
| Sustained decrease in eGFR to <15 ml/min/1.73 m² | 167 (5.9) | 199 (7.0) | 2.40 | 2.87 | 0.82 (0.67–1.01) | — |
| Sustained decrease of ≥40% in eGFR from baseline | 479 (16.9) | 577 (20.3) | 7.21 | 8.73 | 0.81 (0.72–0.92) | — |
| Death from renal causes | 2 (<0.1) | 2 (<0.1) | — | — | — | — |
| Key secondary composite outcome | 367 (13.0) | 420 (14.8) | 5.11 | 5.92 | 0.86 (0.75–0.99) | 0.03 |
| Death from cardiovascular causes | 128 (4.5) | 150 (5.3) | 1.69 | 1.99 | 0.86 (0.68–1.08) | — |
| Nonfatal myocardial infarction | 70 (2.5) | 87 (3.1) | 0.94 | 1.17 | 0.80 (0.58–1.09) | — |
| Nonfatal stroke | 90 (3.2) | 87 (3.1) | 1.21 | 1.18 | 1.03 (0.76–1.38) | — |
| Hospitalization for heart failure | 139 (4.9) | 162 (5.7) | 1.89 | 2.21 | 0.86 (0.68–1.08) | — |
| Death from any cause | 219 (7.7) | 244 (8.6) | 2.90 | 3.23 | 0.90 (0.75–1.07) | — |
| Hospitalization for any cause | 1263 (44.6) | 1321 (46.5) | 22.56 | 23.87 | 0.95 (0.88–1.02) | — |
| Secondary composite kidney outcome | 252 (8.9) | 326 (11.5) | 3.64 | 4.74 | 0.76 (0.65–0.90) | — |
| Sustained decrease of ≥57% in eGFR from baseline | 167 (5.9) | 245 (8.6) | 2.41 | 3.54 | 0.68 (0.55–0.82) | — |




Bakris etal., FIDELIO-DKD, NEJM, 2020.



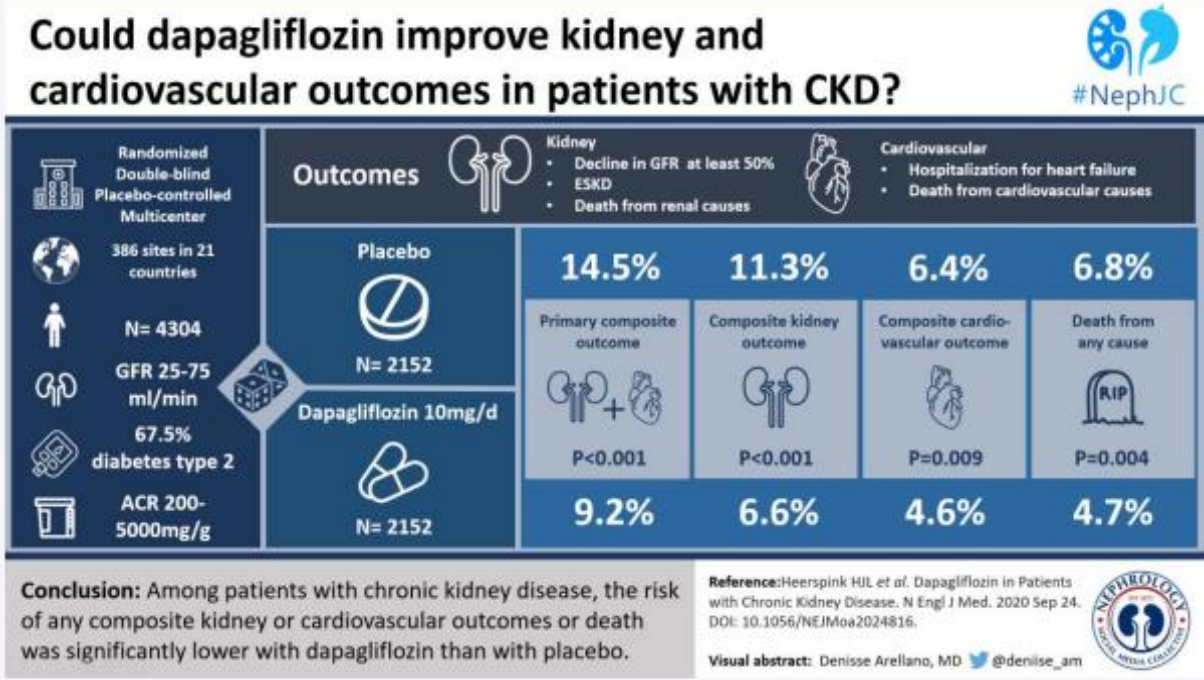

| No. of Patients | | | | | |
|---|---|---|---|---|---|
| Finerenone | 2831 | 2725 | 2582 | 1841 | 856 |
| Placebo | 2840 | 2726 | 2598 | 1825 | 834 |
| **Mean Change from Baseline (percent)** | | | | | |
| Finerenone | Ref. | −34.7 | −41.3 | −39.9 | −29.3 |
| Placebo | Ref. | −4.7 | −3.0 | −2.0 | 4.1 |

# MANAGEMENT

Slide credit: Dr. Kraus

## Chronic Kidney Disease – SGLT2i

- Sodium-Glucose CoTransporter-2 inhibitors (SGLT2i)
- Well established to reduce risk for renal events by 34-47% and CV events by 7-14%.
- DAPA-CKD; T2D & non-T2D




Intermountain Health

2023

# SELECT TRIAL

## Semaglutide and Cardiovascular Outcomes in Obesity without Diabetes

multicenter, double-blind, randomized, placebo-controlled

**Objective:** to determine the association of subcutaneous semaglutide with cardiovascular (CV) events in a secondary prevention cohort of patients with overweight or obesity and prior CV disease (CVD) without diabetes mellitus (DM)

**17,604 patients**

**Inclusion criteria:** Age ≥45 years; BMI ≥27 kg/m2
Prior MI, stroke, or peripheral arterial disease (PAD) with claudication and ankle-brachial index <0.85, prior revascularization, or amputation

**Semaglutide (n=8803)** vs. **Placebo (n=8801)**

### PRIMARY OUTCOME

| | | |
|---|---|---|
| 6.5 | composite of CV death, nonfatal MI, and nonfatal stroke %<br>HR 0.80, 95% CI 0.72-0.90, p < 0.001 | 8.0 |

### SECONDARY OUTCOME

| | | |
|---|---|---|
| 2.5 | CV death %<br>HR 0.85, 95% CI 0.71-1.01, p = 0.07 | 3.0 |
| 3.4 | CV death or HF hospitalization %<br>HR 0.82, 95% CI 0.71-0.96 | 4.1 |

**Conclusion:** In patients with preexisting cardiovascular disease and overweight or obesity but without diabetes, weekly subcutaneous semaglutide at a dose of 2.4 mg was superior to placebo in reducing the incidence of death from cardiovascular causes, nonfatal myocardial infarction, or nonfatal stroke at a mean follow-up of 39.8 months.

A. Michael Lincoff, et al. NEJM 2023;Nov 11:[Epub ahead of print].

Visualmed

# The rationale, design and baseline data of FLOW, a kidney outcomes trial with once-weekly semaglutide in people with type 2 diabetes and chronic kidney disease

## Background

Evidence has emerged of potential kidney-protective effects of GLP-1RAs in people with T2D.
FLOW is a dedicated kidney outcomes trial to assess semaglutide in a population with CKD and T2D at high risk of kidney disease progression.

## Methods

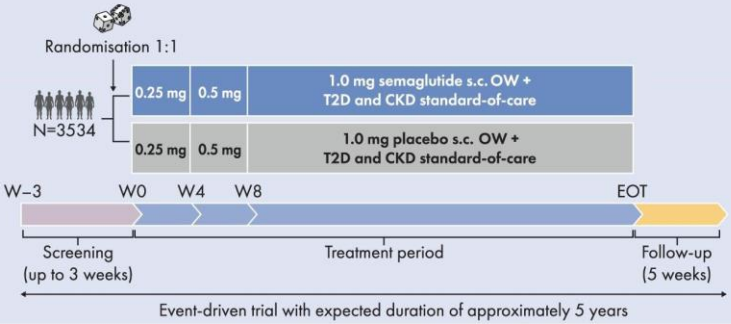
**Participants:**

- Adults with T2D
- eGFR ≥50 to ≤75 ml/min/1.73 m² and UACR >300 to <5000 mg/g OR
- eGFR ≥25 to <50 ml/min/1.73 m² and UACR >100 to <5000 mg/g

**Composite primary endpoint:**

Time to first occurrence of:

- Kidney failure (persistent eGFR <15 ml/min/1.73 m² or initiation of CKRT);
- Persistent ≥50% reduction in eGFR; or
- Death from kidney or CV causes




## Baseline characteristics

68.2% at very high risk for CKD progression according to KDIGO categorisation, eGFR of 47.0 (15) ml/min/1.73 m²; median UACR of 568 (range: 2–11 852) mg/g

**Advanced type 2 diabetes:**
Mean age 66.6 years
Mean diabetes duration 17.4 years
Mean $HbA_{1c}$ 7.8%

15.5% receiving SGLT-2is

CKD, chronic kidney disease; CKRT, chronic kidney replacement therapy; CV, cardiovascular; eGFR, estimated glomerular filtration rate; EOT, end of treatment; GLP-1RA, glucagon-like peptide-1 receptor agonist; $HbA_{1c}$, glycosylated haemoglobin; KDIGO, Kidney Disease: Improving Global Outcomes; OW, once weekly; s.c., subcutaneous; SGLT-2i, sodium-glucose cotransporter-2 inhibitor; T2D, type 2 diabetes; UACR, urine albumin-to-creatinine ratio; W, week.

## Conclusion

**FLOW will evaluate the effect of semaglutide on kidney outcomes in participants with CKD and T2D, and is expected to complete in late 2024.**

ERA ndt NEPHROLOGY DIALYSIS TRANSPLANTATION

Rossing, P., et al. NDT (2023)
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# Common Questions

Cardiac evaluation for non-cardiac surgery (2022 ESC https://www.ahajournals.org/doi/10.1161/cir.0b013e3182447787; 2014 AHA/ACC https://www.ahajournals.org/doi/full/10.1161/CIR.0000000000000106; Nice summary https://www.acc.org/latest-in-cardiology/ten-points-to-remember/2022/09/01/13/18/2022-esc-guidelines-on-noncardiac-surgery-esc-2022)

Return to work post cardiac bypass – work, severity, and patient dependent.

Intimacy and intercourse, 2012 AHA Scientific Statement (https://www.ahajournals.org/doi/10.1161/cir.0b013e3182447787)

When to de-escalate therapies (age, cognitive, failure to thrive, terminal illnesses, etc.) – (Beers Criteria, https://geriatricscareonline.org/ProductAbstract/american-geriatrics-society-updated-beers-criteria/CL001/?param2=search)