



**Brigham and Women's Hospital**

Founding Member, Mass General Brigham

# **Evaluation of Cardiac and Pulmonary Risk in the Preop Patient**

Adam C. Schaffer, MD, MPH

Associate Physician, Hospital Medicine Unit

Department of Medicine

Brigham and Women's Hospital

Assistant Professor of Medicine, Part-Time

Harvard Medical School



# Adam Schaffer, MD, MPH



University of Pennsylvania School of Medicine  
Medicine Residency at Columbia  
Assistant Professor of Medicine, Part-time, HMS

- Clinical focus: Perioperative Medicine and Hospital Medicine
- Research Focus: Patient Safety

# Conflicts of Interest

- I have no conflicts of interest to declare



# Learning Objectives

Upon completion of this activity, participants will be able to:

- Summarize the recently revised perioperative guidelines
- Apply various tools for preoperative risk assessment
- Identify the importance of non-cardiac perioperative risks
- Recognize the risks specific to certain patient populations in the perioperative setting



# Introduction

- The role of the clinician performing preoperative evaluation is **not** to provide medical “clearance” prior to surgery
- Instead, the clinician should:
  - Assess the patient’s cardiac and other risks going into the procedure
  - Decide whether additional preoperative testing, such as a cardiac stress test, is needed
  - When indicated, recommend measures to reduce perioperative risk, such as beta blockers and statins
  - Assist the surgeon in deciding whether the benefits of the surgery outweigh the risks





**Brigham and Women's Hospital**  
Founding Member, Mass General Brigham

# Perioperative AHA/ACC Guidelines

# New Periop Guidelines were Published in November 2024

## **CLINICAL PRACTICE GUIDELINES**

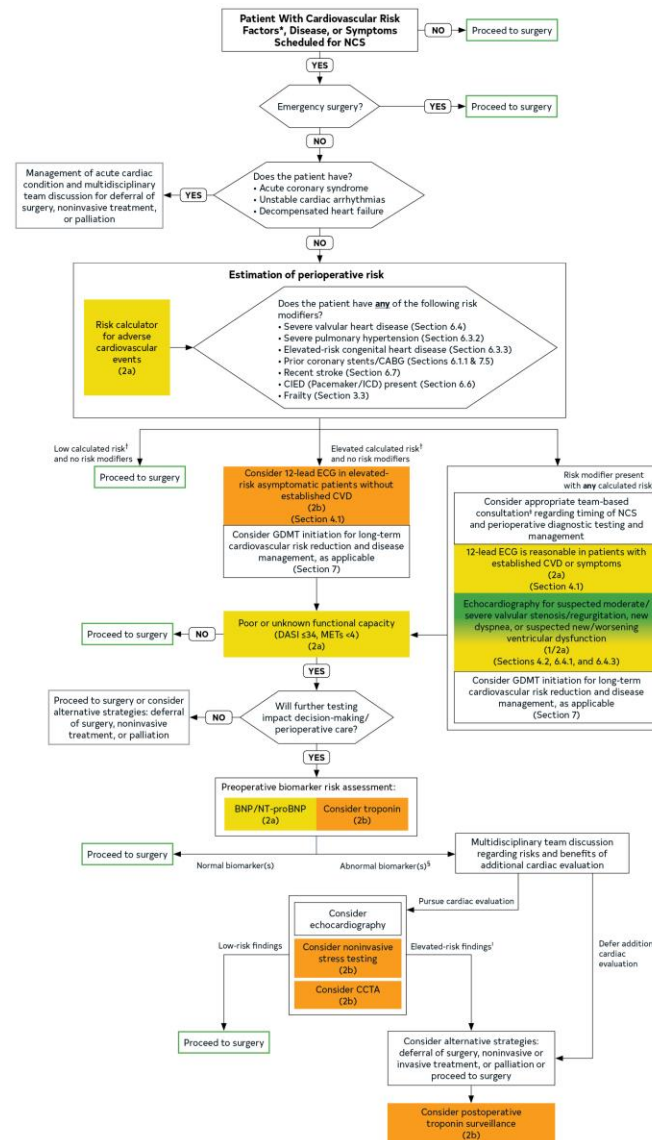
---

2024 AHA/ACC/ACS/ASNC/HRS/SCA/  
SCCT/SCMR/SVM Guideline for Perioperative  
Cardiovascular Management for Noncardiac  
Surgery: A Report of the American College of  
Cardiology/American Heart Association Joint  
Committee on Clinical Practice Guidelines

*Developed in Collaboration With and Endorsed by the American College of Surgeons, American Society of Nuclear Cardiology, Heart Rhythm Society, Society of Cardiovascular Anesthesiologists, Society of Cardiovascular Computed Tomography, Society for Cardiovascular Magnetic Resonance, and the Society for Vascular Medicine*



# ACC/AHA 2024 Periop Guidelines

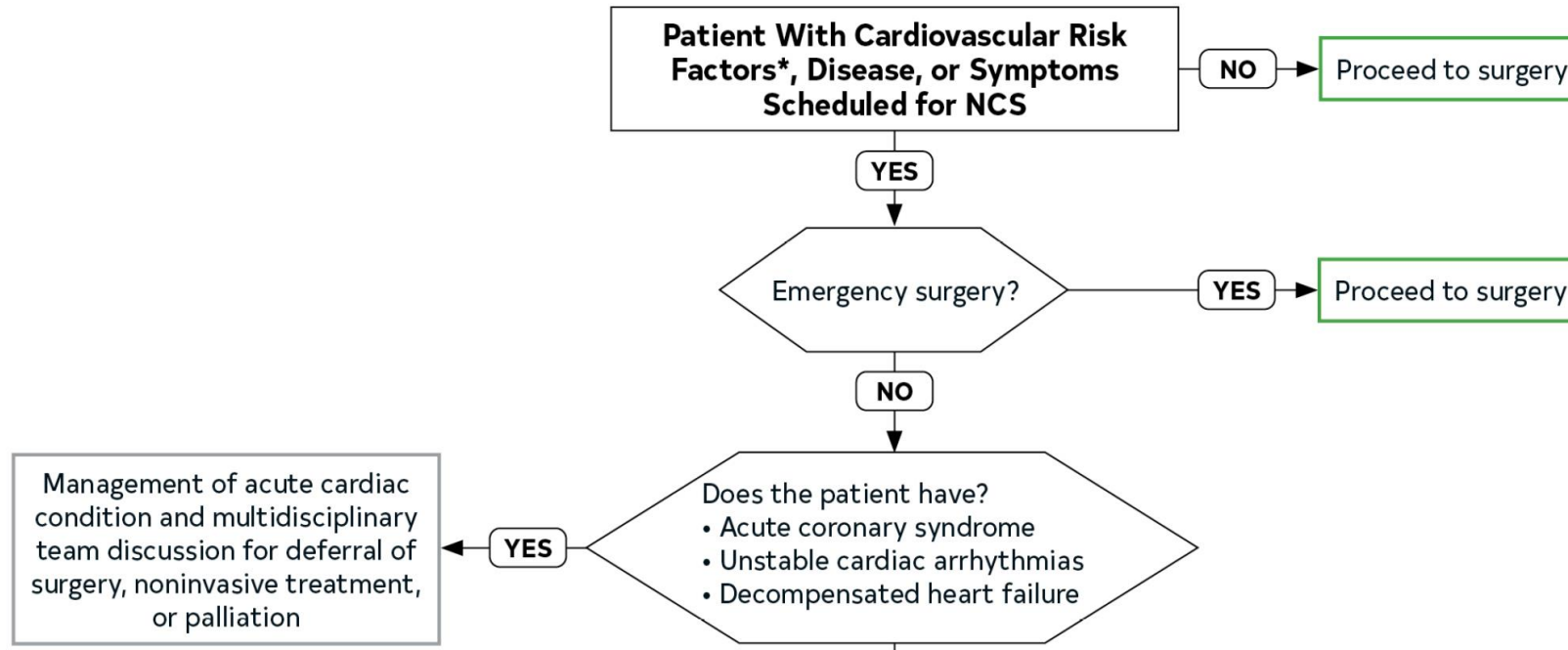


Source: 2024  
 AHA/ACC/ACS/ASNC/HRS/SCA/SCCT/SCMR/SV  
 M Guideline for Perioperative Cardiovascular  
 Management for Noncardiac Surgery ...  
 Circulation. 2024 Nov 5;150(19):e351-e442.

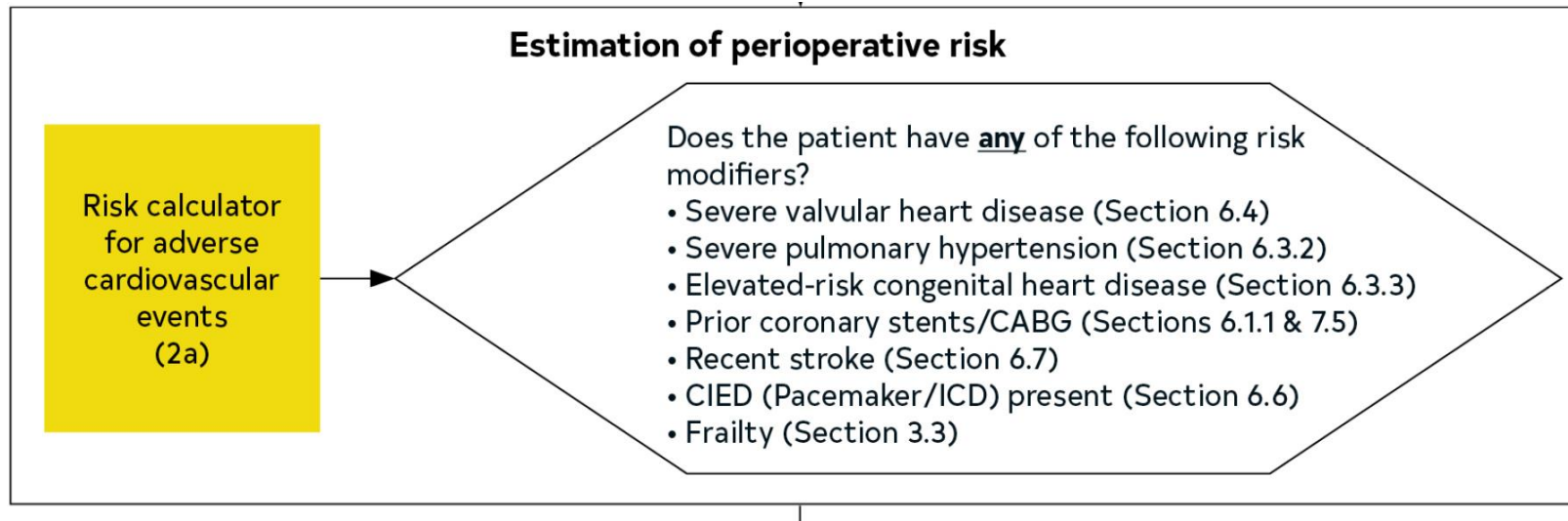




# ACC/AHA 2024 Periop Guidelines



# ACC/AHA 2024 Periop Guidelines



“MACE [major adverse cardiac event] with any perioperative risk calculator >1% is used as a threshold to identify patients at elevated risk.”

# Risk Assessment in the 2024 Periop Guidelines

- For risk assessment, the 2024 guidelines recommend estimating the preoperative risk of a major adverse cardiac event (MACE)
- The risk of MACE is a function of both the risk associated with the procedure and the risk associated with the patient
- If there is a low risk of MACE, which is defined as  $< 1\%$ , then one goes to surgery



# Risk Assessment in the 2024 Periop Guidelines

The guidelines suggest three ways to determine if the MACE risk is  $\geq 1\%$ :

1. ACS NSQIP Surgical Risk Calculator  
(<https://riskcalculator.facs.org/RiskCalculator/>)
2. Perioperative Cardiac Risk Calculator (MICA calculator)  
(<https://www.mdcalc.com/calc/4038/gupta-perioperative-risk-myocardial-infarction-cardiac-arrest-mica>)
3. RCRI score (though one of the two options above is preferred because they outperform the RCRI score)

“Although many risk scores exist, data are lacking to support the use of one risk index over another, and research is underway to further refine perioperative risk.”



# ACS NSQIP Surgical Risk Calculator

## Enter Patient and Surgical Information

Procedure

Clear

Begin by entering the procedure name or CPT code. One or more procedures will appear below the procedure box. You will need to click on the desired procedure to properly select it. You may also search using two words (or two partial words) by placing a '+' in between, for example: "cholecystectomy + cholangiography"

Reset All Selections

Are there other potential appropriate treatment options?

☐ Other Surgical Options

☐ Other Non-operative options

☐ None

Please enter as much of the following information as you can to receive the best risk estimates.  
A rough estimate will still be generated if you cannot provide all of the information below.

Age (between 18 and 112):

50

Sex

Female

Functional Status

Independent

Emergency Case

No

ASA Class

Healthy patient

Steroid use for chronic condition

No

Ascites within 30 days prior to surgery

No

Systemic Sepsis within 48 hours prior to surgery

None

Ventilator Dependent

No

Disseminated Cancer

No

Diabetes

No

Hypertension requiring medication

No

Congestive Heart Failure in 30 days prior to surgery

No

Dyspnea

No

Current Smoker within 1 Year

No

History of Severe COPD

No

Dialysis

No

Acute Renal Failure

No

BMI Calculation:

Height:  in /  cm

Weight:  lb /  kg

Back

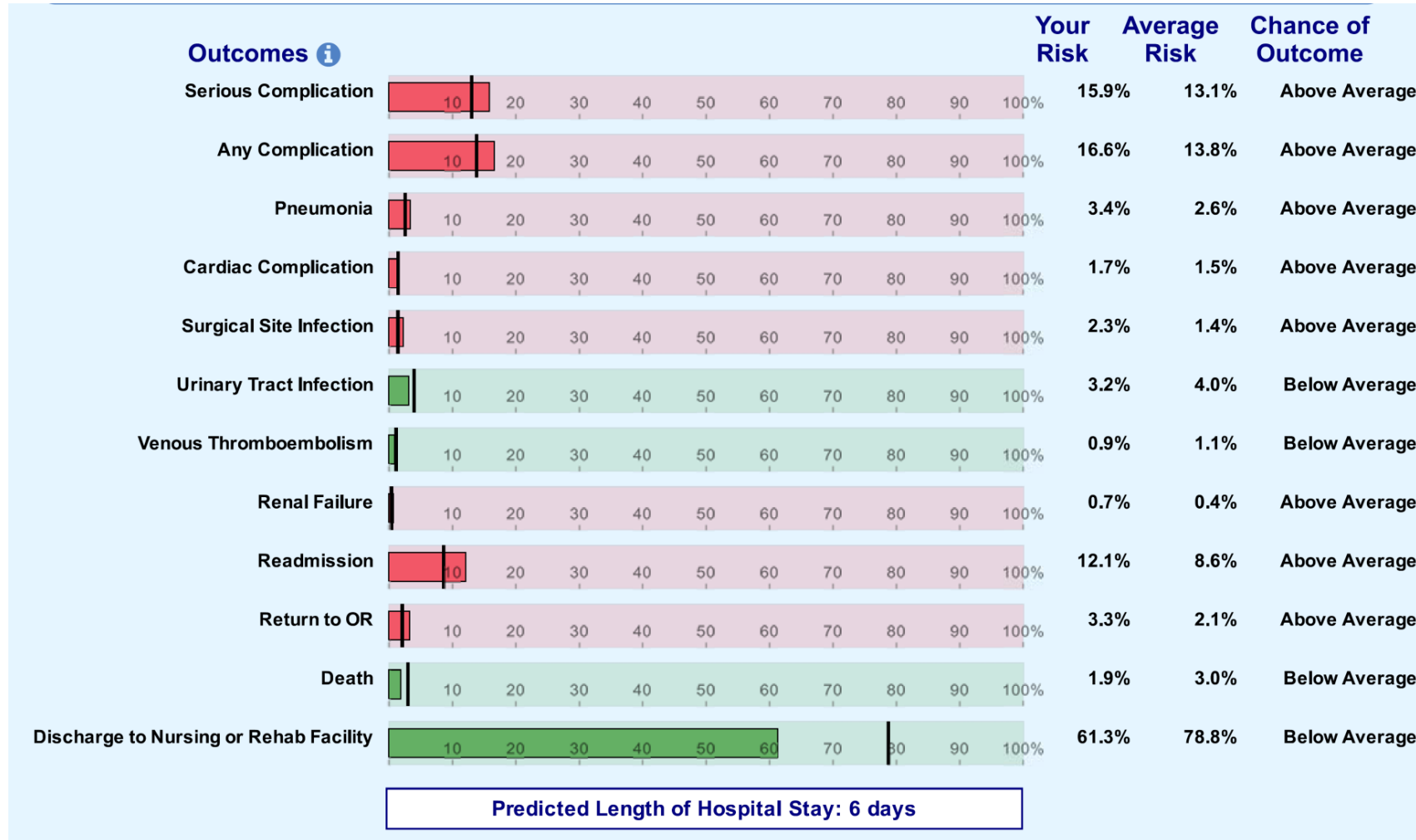
Continue

Step 2 of 4

Source: Cohen ME, Ko CY, Bilimoria KY, et al. Optimizing ACS NSQIP modeling for evaluation of surgical quality and risk: .... Journal of the American College of Surgeons. Aug 2013;217(2):336-346.e331.

13

# ACS NSQIP Surgical Risk Calculator



# Perioperative Cardiac Risk Calculator

**Estimate risk of perioperative myocardial infarction or cardiac arrest.**

Age

Creatinine

ASA Class

ASA 1 = Normal healthy patient  
ASA 2 = Patients with mild systemic disease  
ASA 3 = Patients with severe systemic disease  
ASA 4 = Patients with severe systemic disease  
that is a constant threat to life  
ASA 5 = Moribund patients who are not expected  
to survive without the operation

Preoperative Function

Procedure



# Revised Cardiac Risk Index

| Risk Factor                                  | Definition                                                                                          |
|----------------------------------------------|-----------------------------------------------------------------------------------------------------|
| 1. High-risk type of surgery                 | Intraperitoneal, intrathoracic, or suprainguinal vascular procedures                                |
| 2. Ischemic heart disease                    | History of MI, positive stress test, current cardiac CP, nitrate usage, ECG with pathologic Q waves |
| 3. History of congestive heart failure       | History of CHF, pulmonary edema, or PND; rales or S3 on exam; chest x-ray with pulmonary edema      |
| 4. History of cerebrovascular disease        | History of transient ischemic attack or stroke                                                      |
| 5. Insulin therapy for diabetes              |                                                                                                     |
| 6. Preoperative serum creatinine > 2.0 mg/dL |                                                                                                     |

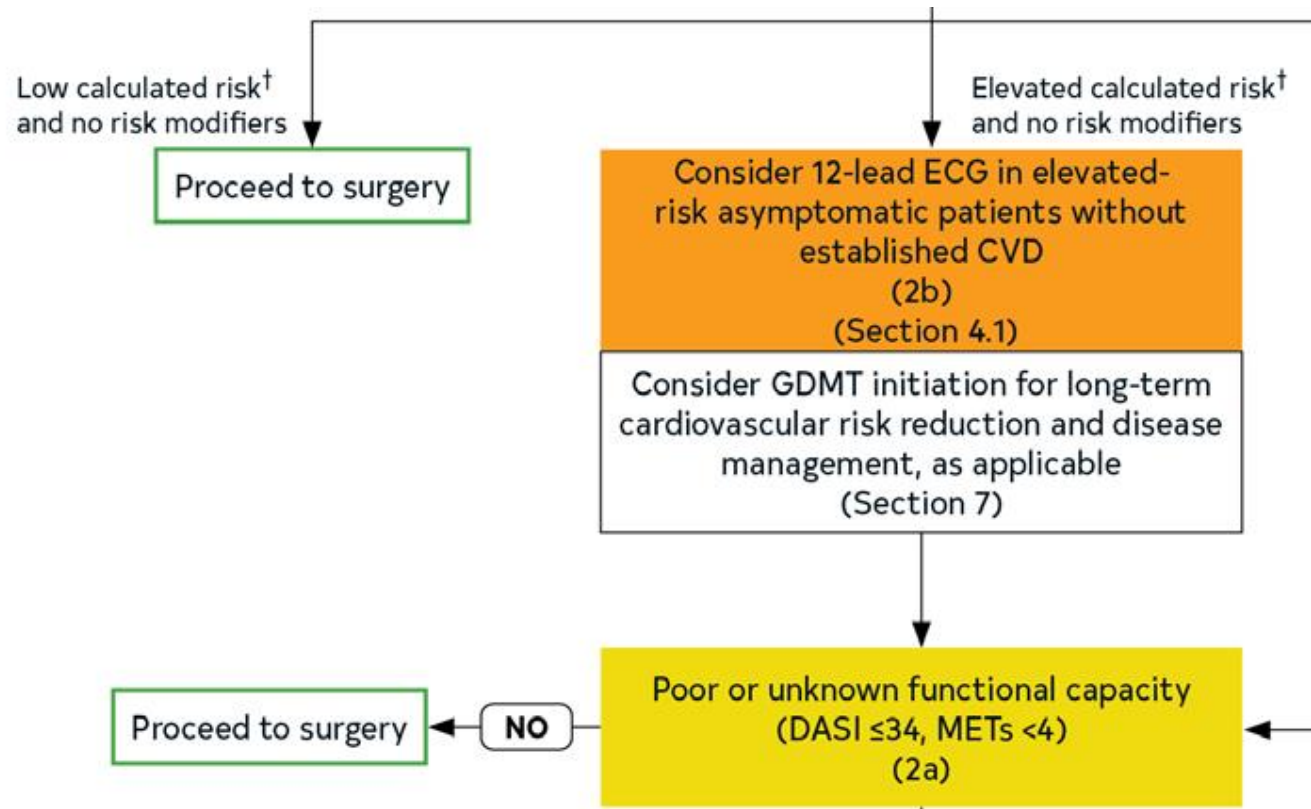
“Traditionally a **RCRI >1** or a calculated risk of MACE with any perioperative risk calculator >1% is used as a threshold to identify patients at elevated risk.”



Sources: Lee TH, Marcantonio ER, Mangione CM, et al. Derivation and prospective validation of a simple index for prediction of cardiac risk of major noncardiac surgery. *Circulation*. Sep 7 1999;100(10):1043-1049. 2024 AHA/ACC/ACS/ASNC/HRS/SCA/SCCT/SCMR/SVM Guideline for Perioperative Cardiovascular Management for Noncardiac Surgery ... *Circulation*. 2024 Nov 5;150(19):e351-e442



# ACC/AHA 2024 Periop Guidelines



Source: 2024  
AHA/ACC/ACS/ASNC/HRS/SCA/SC  
CT/SCMR/SVM Guideline for  
Perioperative Cardiovascular  
Management for Noncardiac  
Surgery ... Circulation. 2024 Nov  
5;150(19):e351-e442.



# Duke Activity Status Index

1. Take care of yourself by eating, dressing, bathing, toileting (2.75)
2. Walk indoors, such as around your house (1.75)
3. Walk a block or 2 on level ground (2.75)
4. Climb a flight of stairs or walk up hill (5.50)
5. Run a short distance (8.00)
6. Do light housework, such as dusting or washing dishes (2.70)
7. Do moderate housework, such as vacuuming, sweeping, or carrying groceries (3.50)
8. Do heavy housework, such as scrubbing floors or moving heavy furniture (8.00)
9. Do yard work, such as raking, weeding, or pushing a power mower (4.50)
10. Have sexual relations (5.25)
11. Moderate recreation, such as golf, bowling, dance, doubles tennis (6.00)
12. Strenuous sports, such as swimming, singles tennis, football, basketball (7.50)

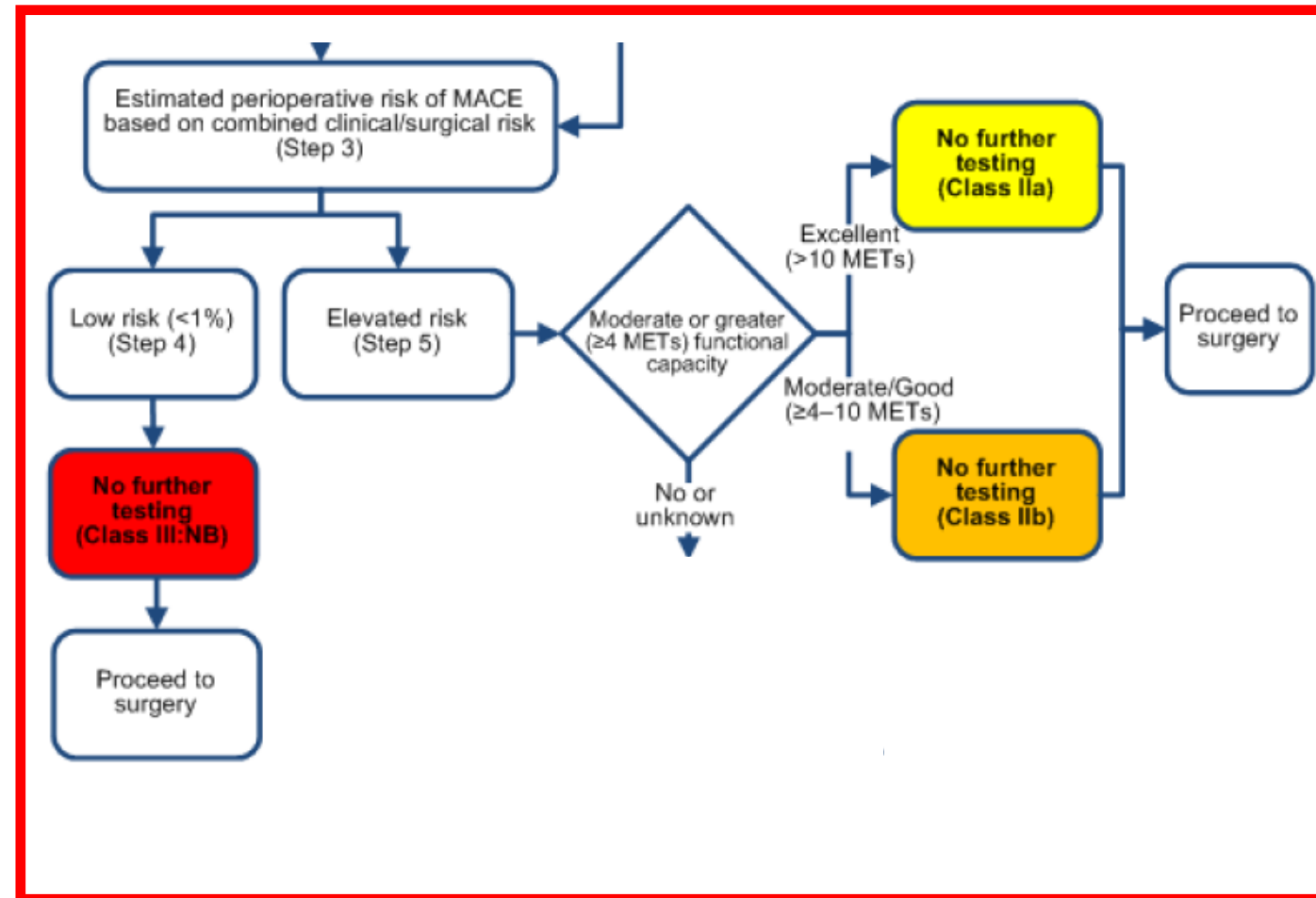
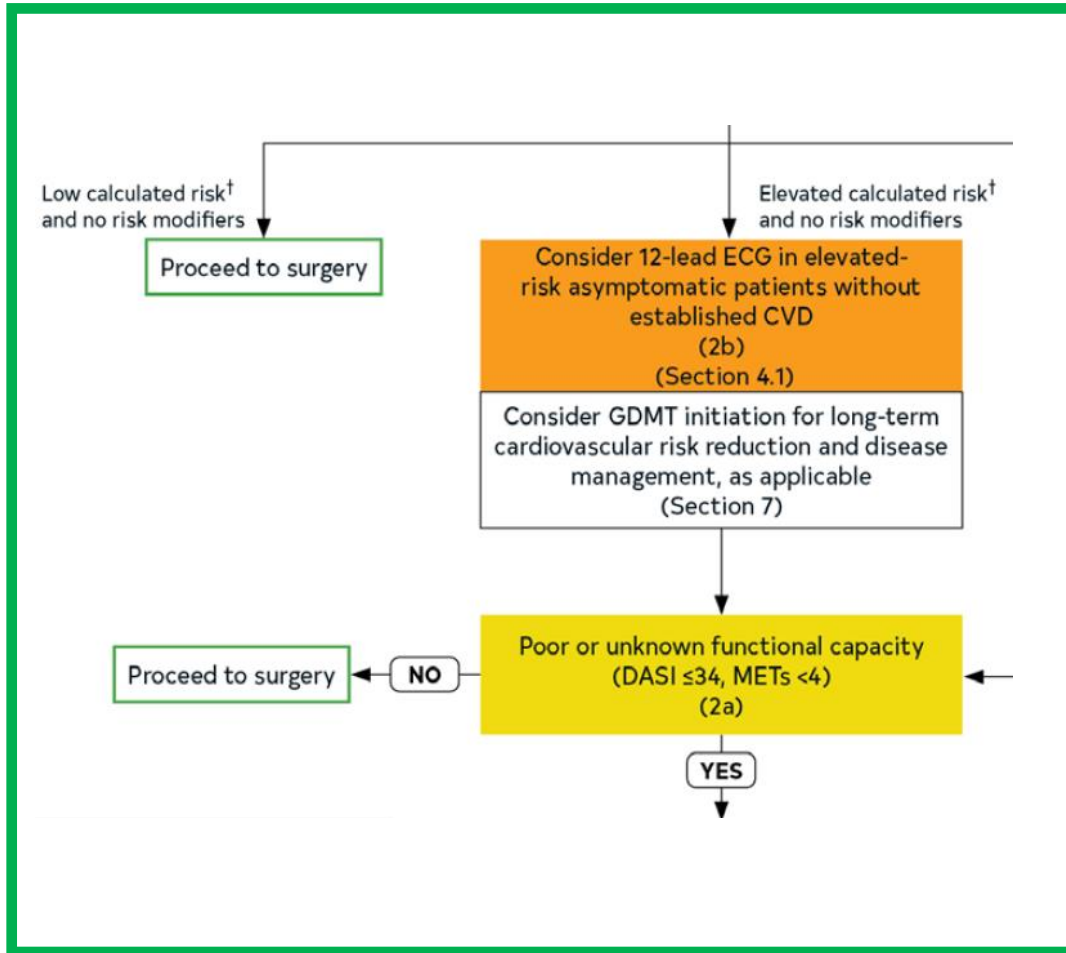


# Duke Activity Status Index

- Methods to use the DASI:
  - Online METs calculators based on DASI
    - E.g.: <https://www.mdcalc.com/calc/3910/duke-activity-status-index-dasi>
  - DASI scores > 34 are associated with a reduced risk of 30-d death or MI



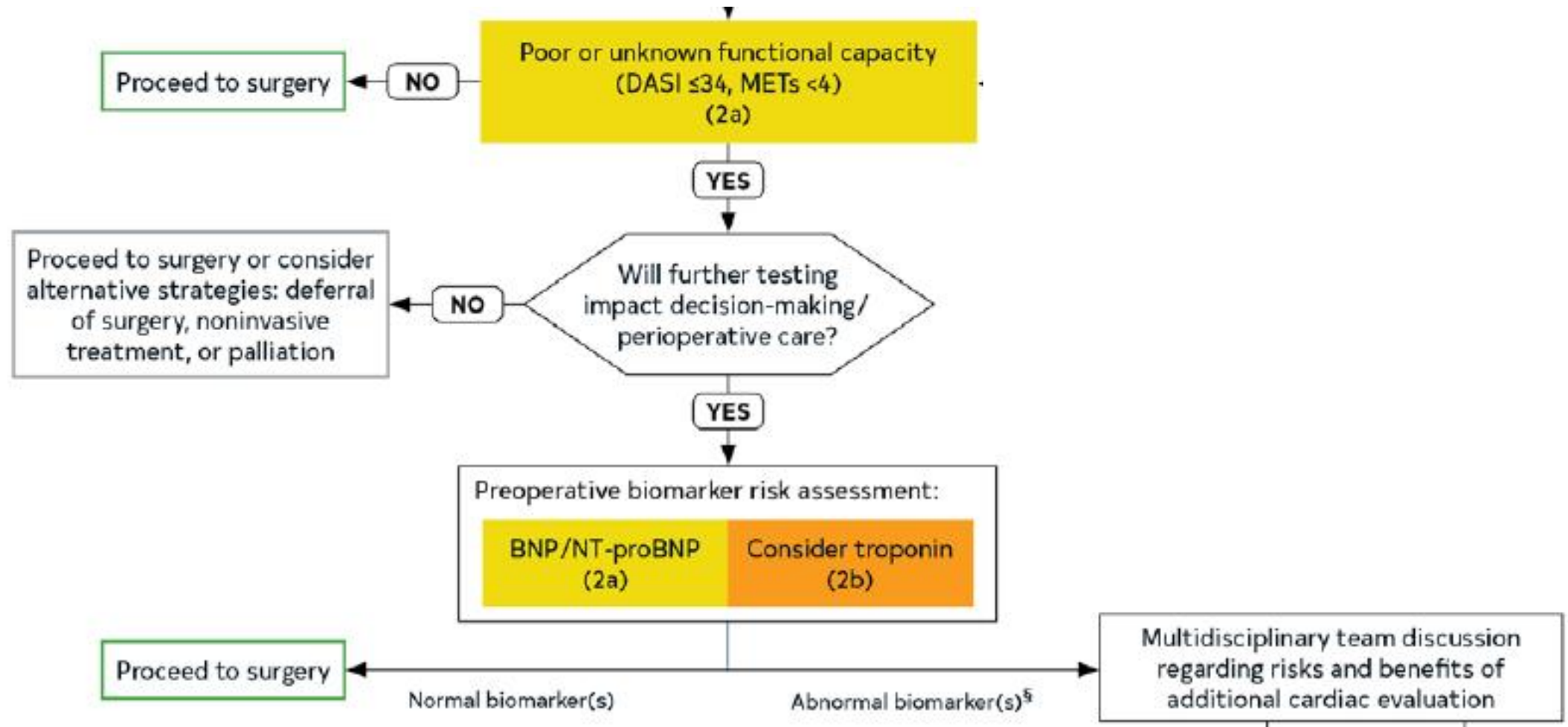
# ACC/AHA 2024 vs. 2014 Periop Guidelines: Fundamental Similarity



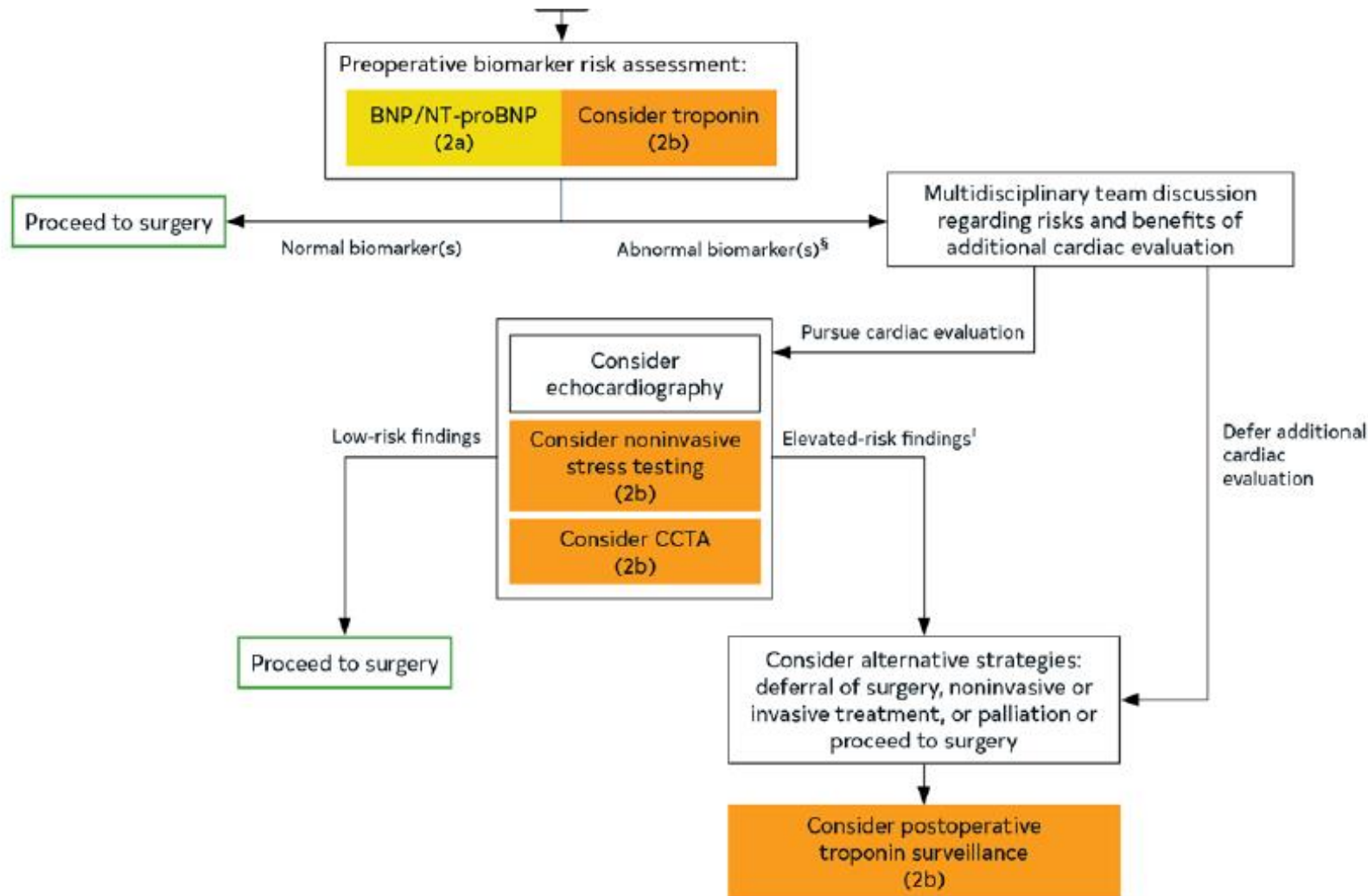
Source: 2024 AHA/ACC/ACS/ASNC/HRS/SCA/SCCT/SCMR/SVM Guideline for Perioperative Cardiovascular Management for Noncardiac Surgery ... Circulation. 2024 Nov 5;150(19):e351-e442.

Source: 2014 ACC/AHA guideline on perioperative cardiovascular evaluation and management...Circulation. 2014 Dec 9;130(24):e278-333.

# ACC/AHA 2024 Periop Guidelines



# ACC/AHA 2024 Periop Guidelines

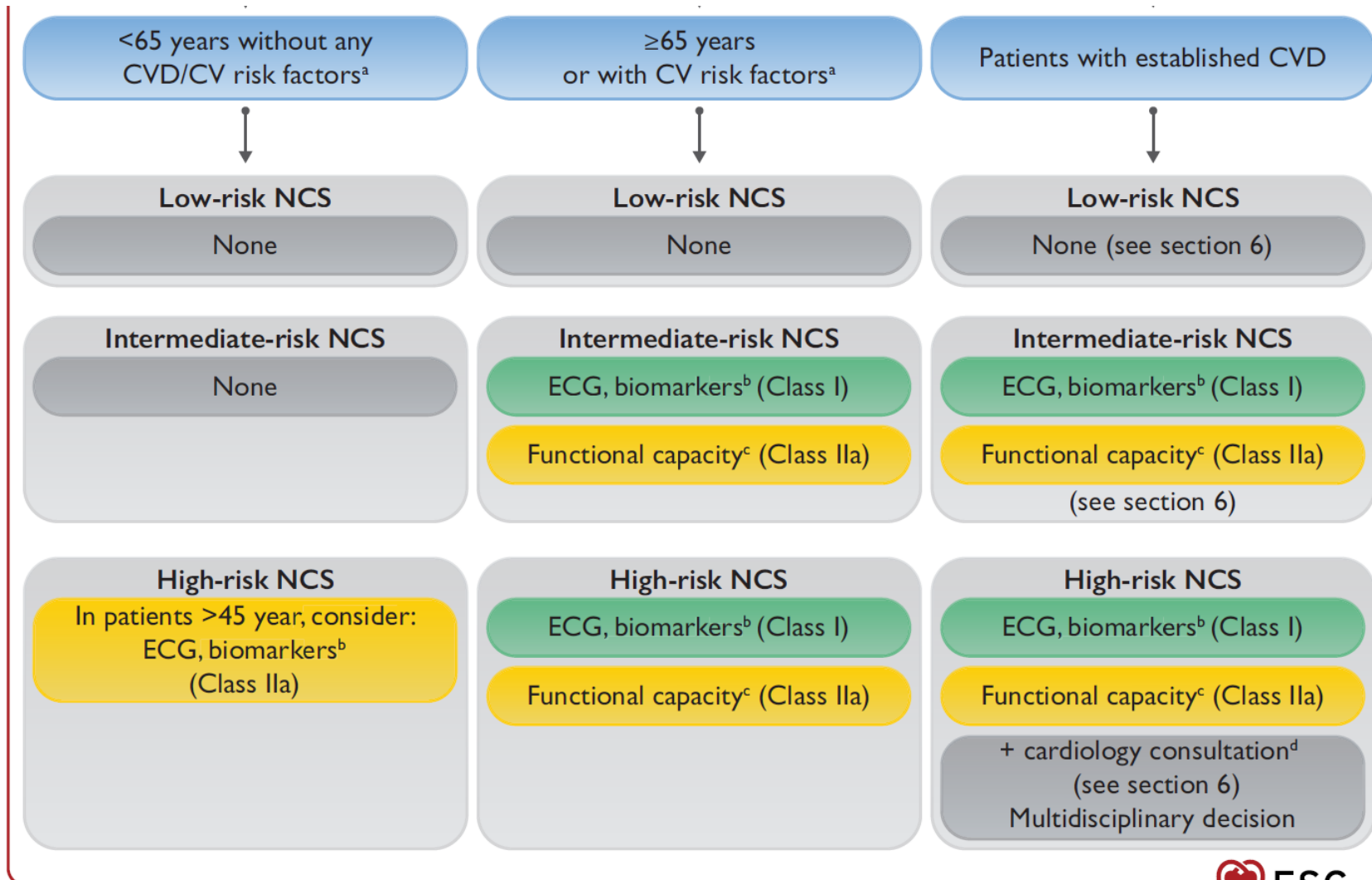


# Perioperative Troponin Measurements: Guideline Recommendations

- 2014 ACC/AHA Guidelines: “The usefulness of postoperative screening with troponin levels in patients at high risk for perioperative MI but without signs or symptoms suggestive of myocardial ischemia or MI is uncertain”
- 2018 European Society of Anaesthesiology Guidelines: “We suggest considering assessment of cardiac troponins in high-risk patients, both before and 48 to 72 h after major surgery”



# Perioperative Troponin Measurements: 2022 ESC Guidelines



Source: Halvorsen S, et al. ESC Scientific Document Group. 2022 ESC Guidelines on cardiovascular assessment and management of patients undergoing non-cardiac surgery. Eur Heart J. 2022 Oct 14;43(39):3826-3924.





# Preoperative Troponin Measurements: ACC/AHA 2024 Periop Guidelines

## 3.4. Preoperative Biomarkers for Risk Stratification

| Recommendations for Preoperative Biomarkers for Risk Stratification<br>Referenced studies that support the recommendations are summarized in the <a href="#">Online Data Supplement</a> . |      |                                                                                                                                                                                                                                                                                                                                     |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| COR                                                                                                                                                                                       | LOE  | Recommendations                                                                                                                                                                                                                                                                                                                     |
| 2a                                                                                                                                                                                        | B-NR | 1. In patients with known CVD, or age ≥65 years, or age ≥45 years with symptoms suggestive of CVD undergoing elevated-risk NCS, it is reasonable to measure B-type natriuretic peptide (BNP) or N-terminal pro-B-type natriuretic peptide (NT-proBNP) before surgery to supplement evaluation of perioperative risk. <sup>1-3</sup> |
| 2b                                                                                                                                                                                        | B-NR | 2. In patients with known CVD, or age ≥65 years, or age ≥45 years with symptoms suggestive of CVD undergoing elevated-risk NCS, it may be reasonable to measure cardiac troponin (cTn) before surgery to supplement evaluation of perioperative risk. <sup>4-6</sup>                                                                |

- On BNP: “Optimal threshold values of BNP or NT-proBNP for perioperative risk prediction are not clearly established.”
- On troponins: **“There is no action predicated on this knowledge alone**, although preoperative baseline troponin concentrations also inform the interpretation of postoperative troponin measurements and can help confirm a diagnosis of acute myocardial injury in the postoperative setting.”
- “Abnormal biomarker thresholds: troponin >99th percentile peer reference limit for the assay; BNP >92 ng/L, NT-proBNP ≥300 ng/L”



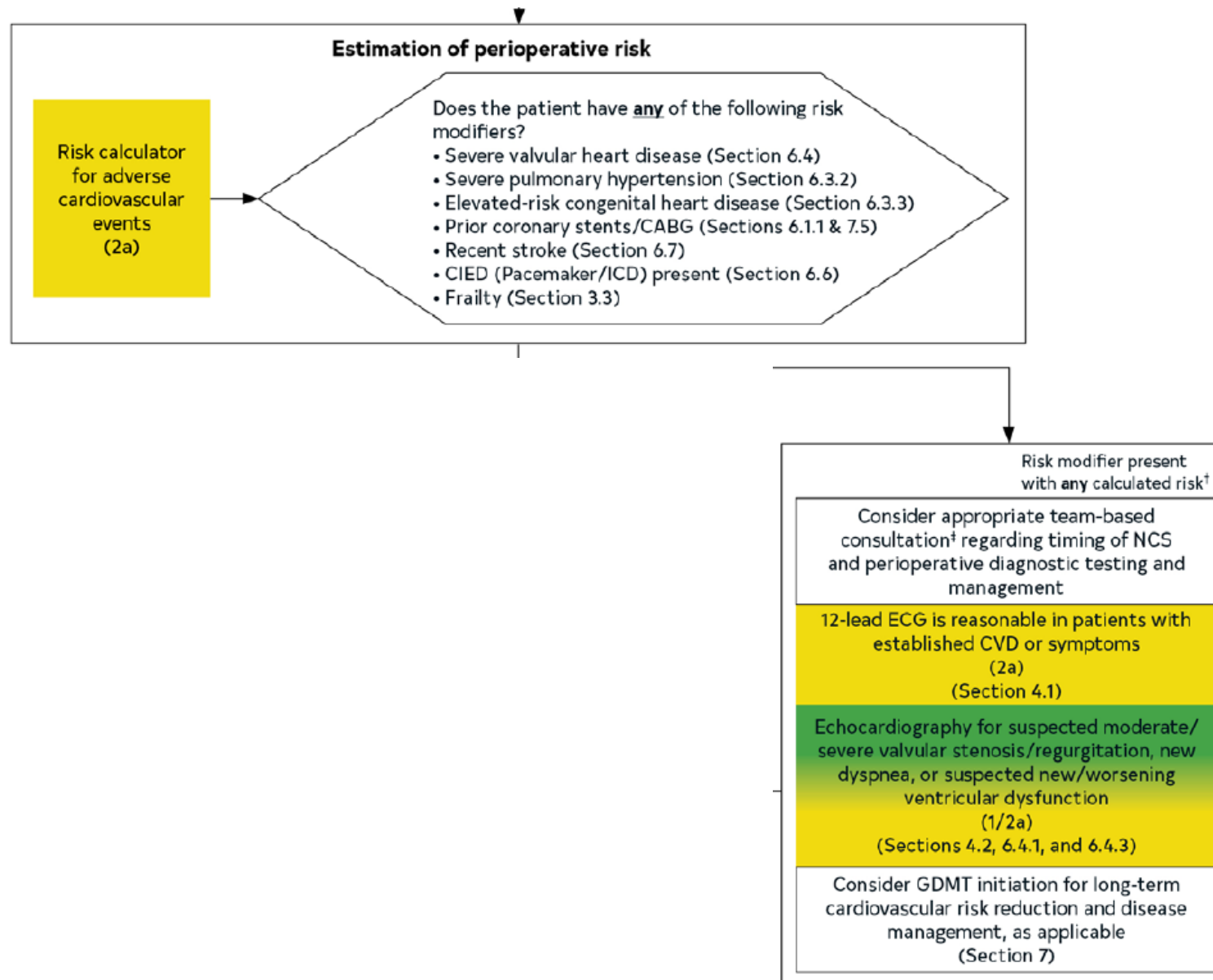
# Postoperative Troponin Measurements: ACC/AHA 2024 Periop Guidelines

## 9.1. Myocardial Injury After Noncardiac Surgery Surveillance and Management

| Recommendations for Myocardial Injury After Noncardiac Surgery<br>Surveillance and Management<br>Referenced studies that support the recommendations are<br>summarized in the <a href="#">Online Data Supplement</a> . |      |                                                                                                                                                                                                                                                    |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| COR                                                                                                                                                                                                                    | LOE  | Recommendations                                                                                                                                                                                                                                    |
| MINS Surveillance                                                                                                                                                                                                      |      |                                                                                                                                                                                                                                                    |
| 2b                                                                                                                                                                                                                     | B-NR | 1. In patients with known CVD, symptoms of CVD, or age ≥65 years with cardiovascular risk factors undergoing elevated-risk NCS, it may be reasonable to measure cTn at 24 and 48 hours after surgery to identify myocardial injury. <sup>1-4</sup> |
| 3: No benefit                                                                                                                                                                                                          | B-NR | 2. In patients undergoing low-risk NCS, routine post-operative screening with cTn levels is not indicated without signs or symptoms suggestive of myocardial ischemia or MI. <sup>5,6</sup>                                                        |



# ACC/AHA 2024 Periop Guidelines



Source: 2024  
AHA/ACC/ACS/ASNC/HRS/SCA/SC  
CT/SCMR/SVM Guideline for  
Perioperative Cardiovascular  
Management for Noncardiac  
Surgery ... Circulation. 2024 Nov  
5;150(19):e351-e442.



# ACC/AHA 2024 Periop Guidelines

**Table 6. Frailty Assessment Tools**

| Name                                                       | Items                                                                          | Scoring                                                                             |
|------------------------------------------------------------|--------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|
| Physical Frailty Phenotype (Fried phenotype) <sup>15</sup> | Slowness, low activity, weight loss, exhaustion, weakness (1 point each)       | 0=Nonfrail<br>1-2=Prefrail<br>3-5=Frail                                             |
| Deficit Accumulation Index <sup>16</sup>                   | Variable; typically 30-70 items from multiple domains                          | Number of deficits/number of items scored; higher scores indicate greater frailty   |
| Edmonton Frail Scale <sup>17</sup>                         | 10 items across multiple domains                                               | Sum of scores/17; higher scores indicate greater frailty                            |
| FRAIL Scale <sup>18</sup>                                  | Fatigue, stair climb, ambulation, illnesses >5, weight loss ≥5% (1 point each) | 0=Nonfrail<br>1-2=Intermediate<br>3-5=Frail                                         |
| Clinical Frailty Scale <sup>19</sup>                       | 9 categories ranging from very fit to terminally ill as assessed by clinicians | Categories 5-8 indicate mild, moderate, severe, and very severe frailty             |
| SPPB <sup>20</sup>                                         | Gait speed, chair stands, balance tests                                        | Maximum 4 points per item, range, 0-12 points; ≥10=Nonfrail, 3-9=Frail, ≤2=Disabled |

Adapted with permission from frailtyscience.org. Copyright 2021 FrailtyScience.org.  
SPPB indicates Short Physical Performance Battery.



# Clinical Frailty Scale

| CLINICAL FRAILITY SCALE                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |          |                                                                                                                                                                                                                                                                                                                                                         |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | <b>1</b> | <b>VERY FIT</b> People who are robust, active, energetic and motivated. They tend to exercise regularly and are among the fittest for their age.                                                                                                                                                                                                        |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | <b>2</b> | <b>FIT</b> People who have no active disease symptoms but are less fit than category 1. Often, they exercise or are very active occasionally, e.g., seasonally.                                                                                                                                                                                         |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | <b>3</b> | <b>MANAGING WELL</b> People whose medical problems are well controlled, even if occasionally symptomatic, but often are not regularly active beyond routine walking.                                                                                                                                                                                    |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | <b>4</b> | <b>LIVING WITH VERY MILD FRAILITY</b> Previously "vulnerable," this category marks early transition from complete independence. While not dependent on others for daily help, often symptoms limit activities. A common complaint is being "slowed up" and/or being tired during the day.                                                               |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | <b>5</b> | <b>LIVING WITH MILD FRAILITY</b> People who often have more evident slowing, and need help with high order instrumental activities of daily living (finances, transportation, heavy housework). Typically, mild frailty progressively impairs shopping and walking outside alone, meal preparation, medications and begins to restrict light housework. |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | <b>6</b> | <b>LIVING WITH MODERATE FRAILITY</b> People who need help with all outside activities and with keeping house. Inside, they often have problems with stairs and need help with bathing and might need minimal assistance (cuing, standby) with dressing.                                                                                                 |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | <b>7</b> | <b>LIVING WITH SEVERE FRAILITY</b> Completely dependent for personal care, from whatever cause (physical or cognitive). Even so, they seem stable and not at high risk of dying (within ~6 months).                                                                                                                                                     |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | <b>8</b> | <b>LIVING WITH VERY SEVERE FRAILITY</b> Completely dependent for personal care and approaching end of life. Typically, they could not recover even from a minor illness.                                                                                                                                                                                |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | <b>9</b> | <b>TERMINALLY ILL</b> Approaching the end of life. This category applies to people with a life expectancy <6 months, who are not otherwise living with severe frailty. (Many terminally ill people can still exercise until very close to death.)                                                                                                       |
| <b>SCORING FRAILITY IN PEOPLE WITH DEMENTIA</b><br><p>The degree of frailty generally corresponds to the degree of dementia. Common symptoms in mild dementia include forgetting the details of a recent event, though still remembering the event itself, repeating the same question/story and social withdrawal.</p> <p>In moderate dementia, recent memory is very impaired, even though they seemingly can remember their past life events well. They can do personal care with prompting. In severe dementia, they cannot do personal care without help. In very severe dementia they are often bedfast. Many are virtually mute.</p> |          |                                                                                                                                                                                                                                                                                                                                                         |
|  <b>DALHOUSIE UNIVERSITY</b><br><a href="http://www.geriatricmedicineresearch.ca">www.geriatricmedicineresearch.ca</a>                                                                                                                                                                                                                                                                                                                                                                                                                                 |          |                                                                                                                                                                                                                                                                                                                                                         |
| <small>Clinical Frailty Scale ©2005–2020 Rockwood, Version 2.0 (EN). All rights reserved. For permission: <a href="http://www.geriatricmedicineresearch.ca">www.geriatricmedicineresearch.ca</a><br/>             Rockwood K et al. A global clinical measure of fitness and frailty in elderly people. CMAJ 2005;173:489–495.</small>                                                                                                                                                                                                                                                                                                      |          |                                                                                                                                                                                                                                                                                                                                                         |

Sources: Rockwood K et al. A global clinical measure of fitness and frailty in elderly people. CMAJ. 2005 Aug 30;173(5):489-95 and Rockwood K, Theou O. Using the clinical frailty scale in allocating scarce health care resources. Can Geriatr J. 2020 Sep 1;23(3):210-215.



FIGURE 1. The Clinical Frailty Scale (CFS) version 2.0

# Enhanced Preop Evaluation of Frail Patient May Impact Mortality

Figure. Interrupted Time Series Analysis

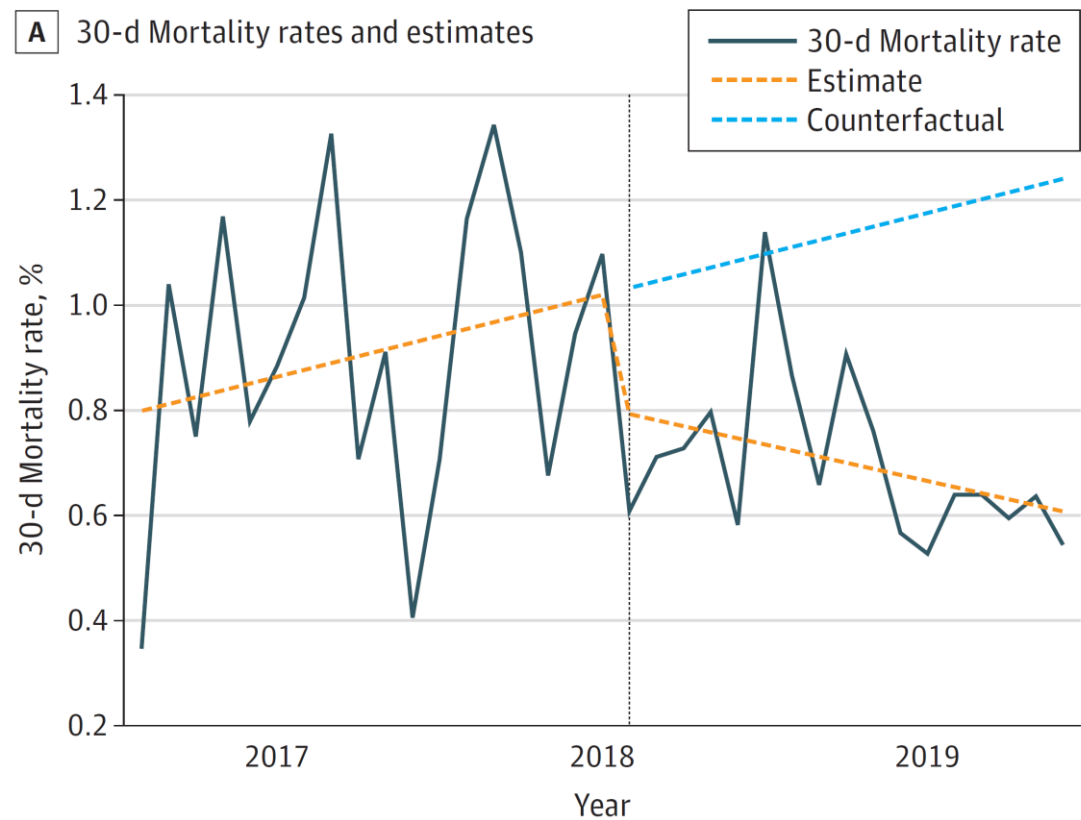
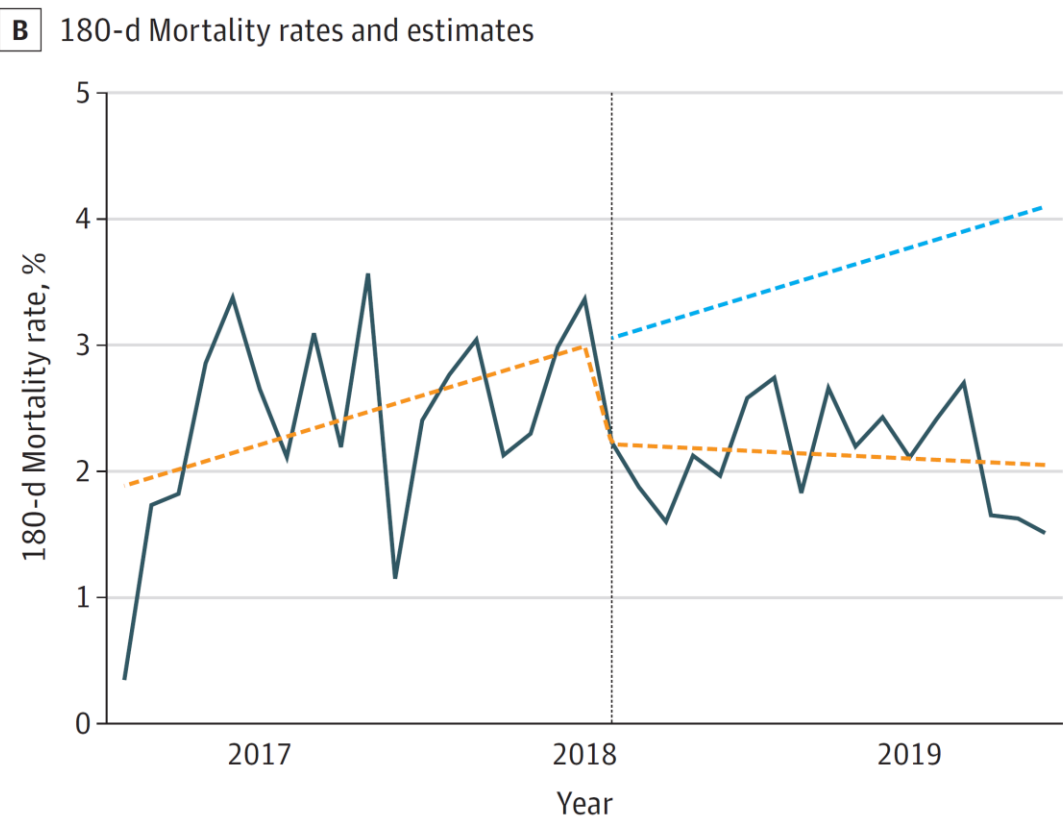


Figure. Interrupted Time Series Analysis





**Brigham and Women's Hospital**  
Founding Member, Mass General Brigham

# Perioperative Medical Therapy



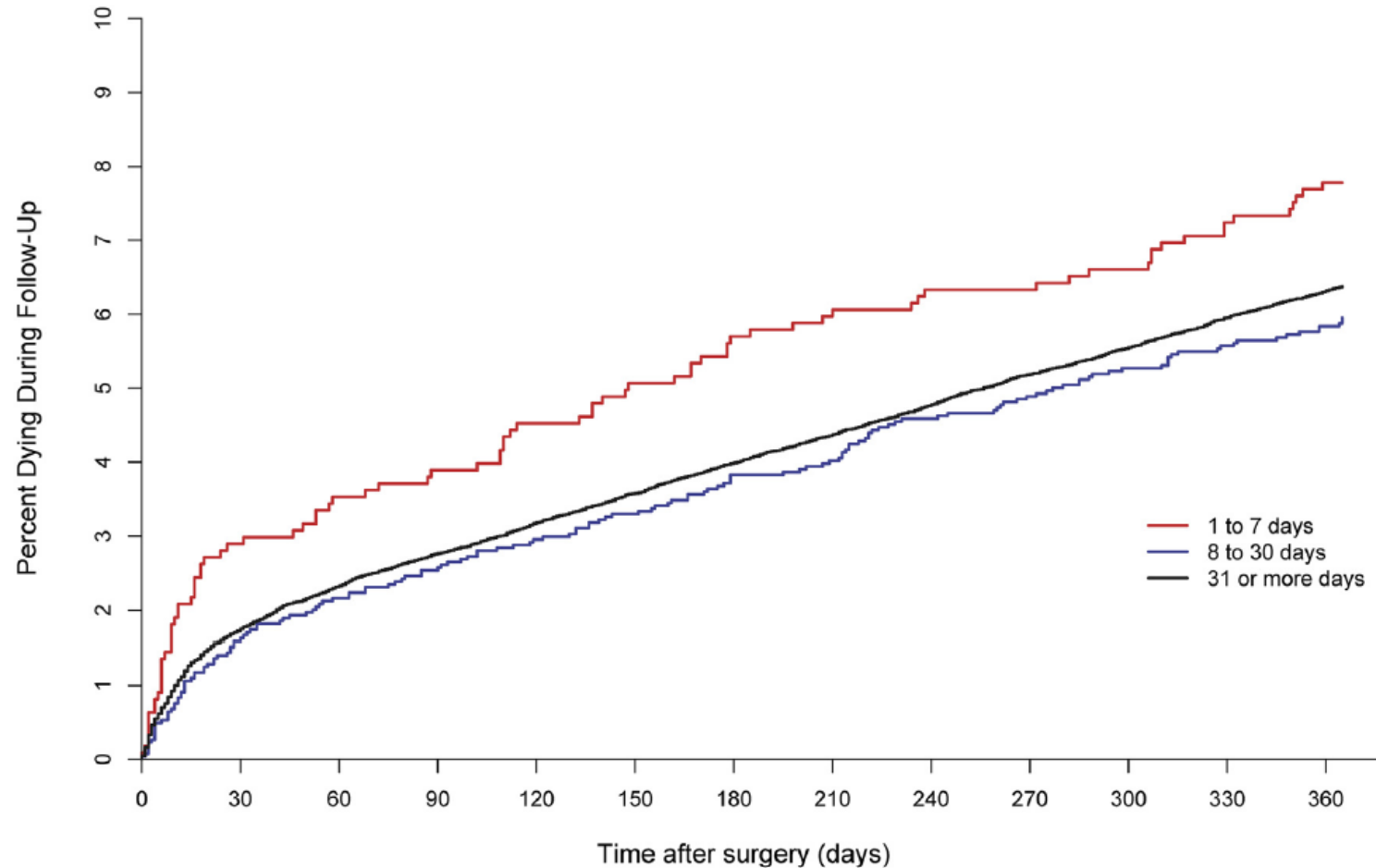
# Perioperative Beta Blockers: The POISE Trial (prospective RCT)

- The PeriOperative ISchemic Evaluation (POISE) Trial enrolled 8351 patients undergoing noncardiac surgery with at least one cardiac risk factor
- Patients were randomized to either placebo or controlled-release metoprolol (CR metoprolol) 100 mg orally 2 – 4 h before surgery, a postop dose of CR metoprolol based on heart rate and BP, and then 200 mg of CR metoprolol orally daily for the next 30 d
- The beta blocker arm had a lower rate of the primary outcome (30-day cardiac events): 5.8% in the beta blocker arm versus 6.9% in the placebo arm ( $P=0.04$ )
- However, the total mortality was higher in the CR metoprolol group (3.1%) than in the placebo group (2.3%) ( $P=0.03$ )
- The general view of this trial is that the dose of periop beta blockers given was too large, and so led to the increased stroke rate





# Perioperative Beta Blockers: Cohort Study



Source: Wijeyesundera DN, et al. Duration of preoperative  $\beta$ -blockade and outcomes after major elective noncardiac surgery. Can J Cardiol. 2014 Feb;30(2):217-23.

# Perioperative Beta Blockers: ACC/AHA 2024 Periop Guidelines

| Recommendations for Perioperative Beta Blockers<br>Referenced studies that support the recommendations are summarized in the <a href="#">Online Data Supplement</a> . |      |                                                                                                                                                                                                                                                      |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| COR                                                                                                                                                                   | LOE  | Recommendations                                                                                                                                                                                                                                      |
| 1                                                                                                                                                                     | B-NR | 1. In patients on stable doses of beta blockers undergoing NCS, beta blockers should be continued through the perioperative period as appropriate based on the clinical circumstances. <sup>1,2</sup>                                                |
| 2b                                                                                                                                                                    | B-NR | 2. In patients scheduled for elective NCS who have a new indication for beta blockade, beta blockers may be initiated far enough before surgery (optimally >7 days) to permit assessments of tolerability and drug titration if needed. <sup>3</sup> |
| 3:<br>Harm                                                                                                                                                            | B-R  | 3. In patients undergoing NCS and with no immediate need for beta blockers, beta blockers should not be initiated on the day of surgery due to increased risk for postoperative mortality. <sup>4</sup>                                              |



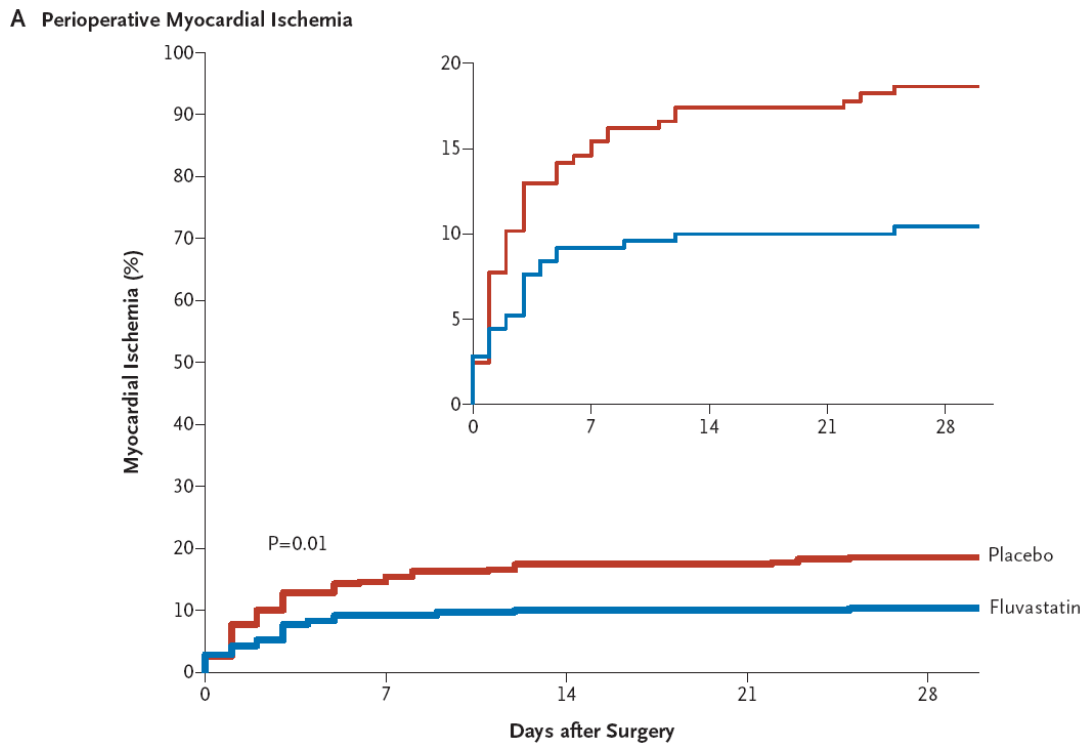
# Perioperative Statins

- The DECREASE-III trial enrolled 497 patients, age > 40, at elevated cardiac risk, scheduled to undergo noncardiac vascular surgery
- All patients had to be statin naïve
- All patients were on beta blockers
  - Patients who were already taking a beta blocker were continued on this beta blocker
  - Patients who were not on a beta blocker were started on one, and their dose was titrated based on their HR
- Patients were randomized to fluvastatin 80 mg daily or a placebo. This statin was started on average 37 days prior to surgery and continued for at least 30 days after surgery

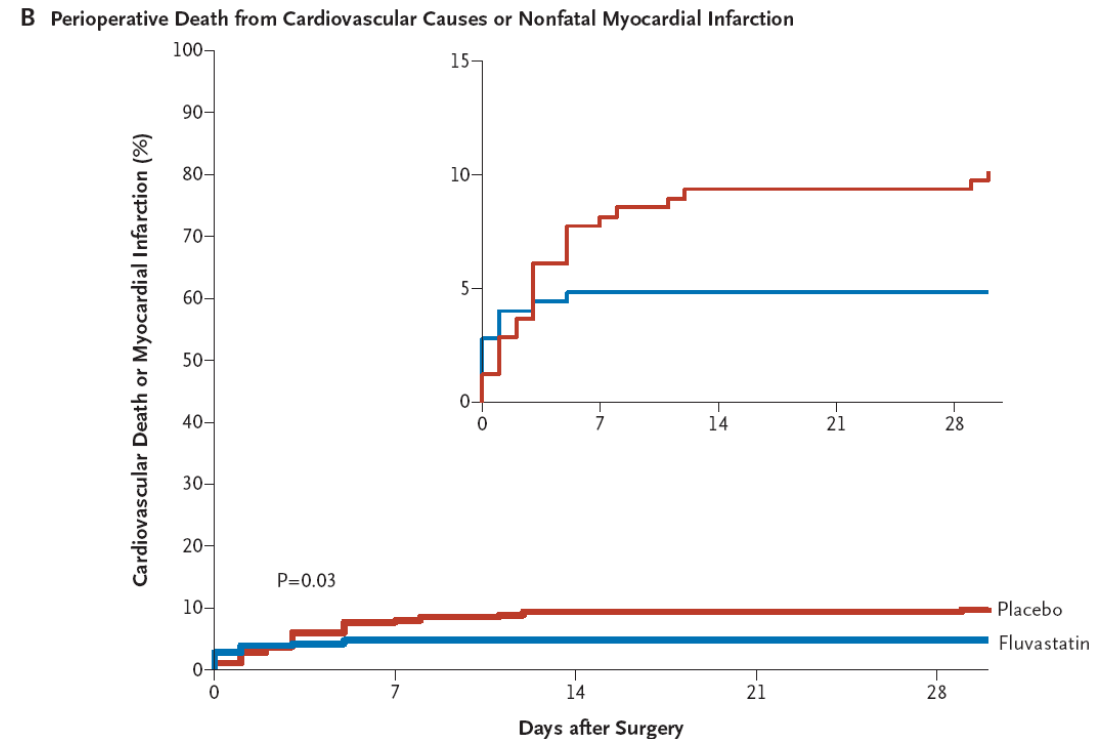


# Perioperative Statins

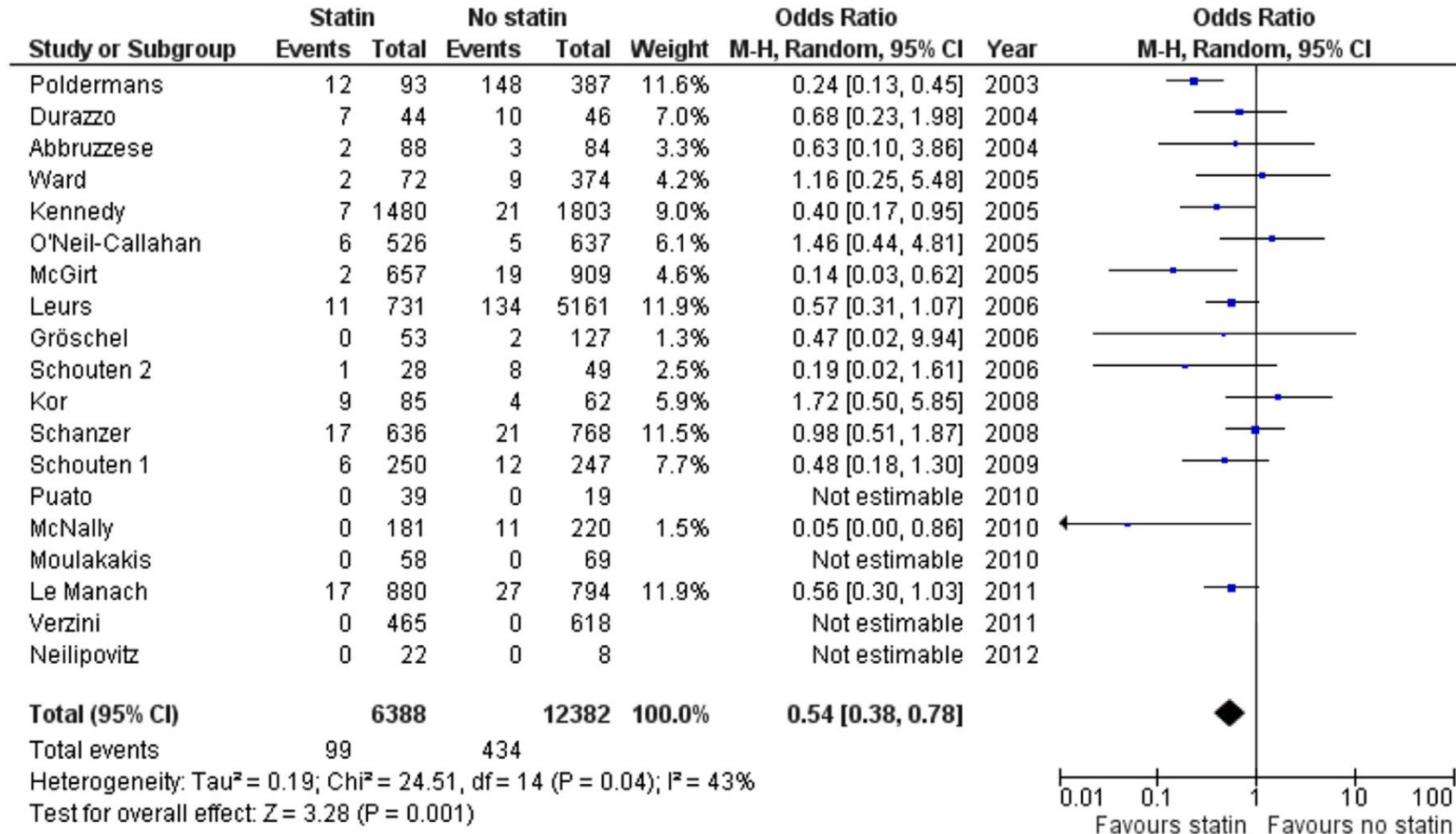
Perioperative Myocardial Ischemia: 10.8% in the statin arm vs. 19.0% in the placebo arm ( $P = 0.01$ )



Perioperative death from CV cause or MI: 4.8% in the statin arm vs. 10.1% in the placebo arm ( $P = 0.03$ )



# Perioperative Statins: Meta-Analysis



# Perioperative Statins: ACC/AHA 2024 Periop Guidelines

| Recommendations for Statins<br>Referenced studies that support the recommendations are summarized in the <a href="#">Online Data Supplement</a> . |      |                                                                                                                                                                                                                                                   |
|---------------------------------------------------------------------------------------------------------------------------------------------------|------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| COR                                                                                                                                               | LOE  | Recommendations                                                                                                                                                                                                                                   |
| 1                                                                                                                                                 | B-NR | 1. In patients currently on statins and scheduled for NCS, continuation of statin therapy is recommended to reduce the risk of MACE. <sup>1-3</sup>                                                                                               |
| 1                                                                                                                                                 | B-R  | 2. In statin-naïve adult patients who meet criteria for statin use based on ASCVD history or 10-year risk assessment and are scheduled for NCS, perioperative initiation of statin is recommended with intention of long-term use. <sup>4,5</sup> |



# Perioperative Aspirin

- The POISE 2 Trial was an that looked at the effect of perioperative ASA
- The trial enrolled 10,010 patients undergoing noncardiac surgery who were at risk for vascular complications
- Patient within the coronary stent critical periods were excluded
- The primary endpoint was death or nonfatal MI at 30 days
- The patients were stratified by whether they were already taking ASA (continuation group) or not (initiation group)



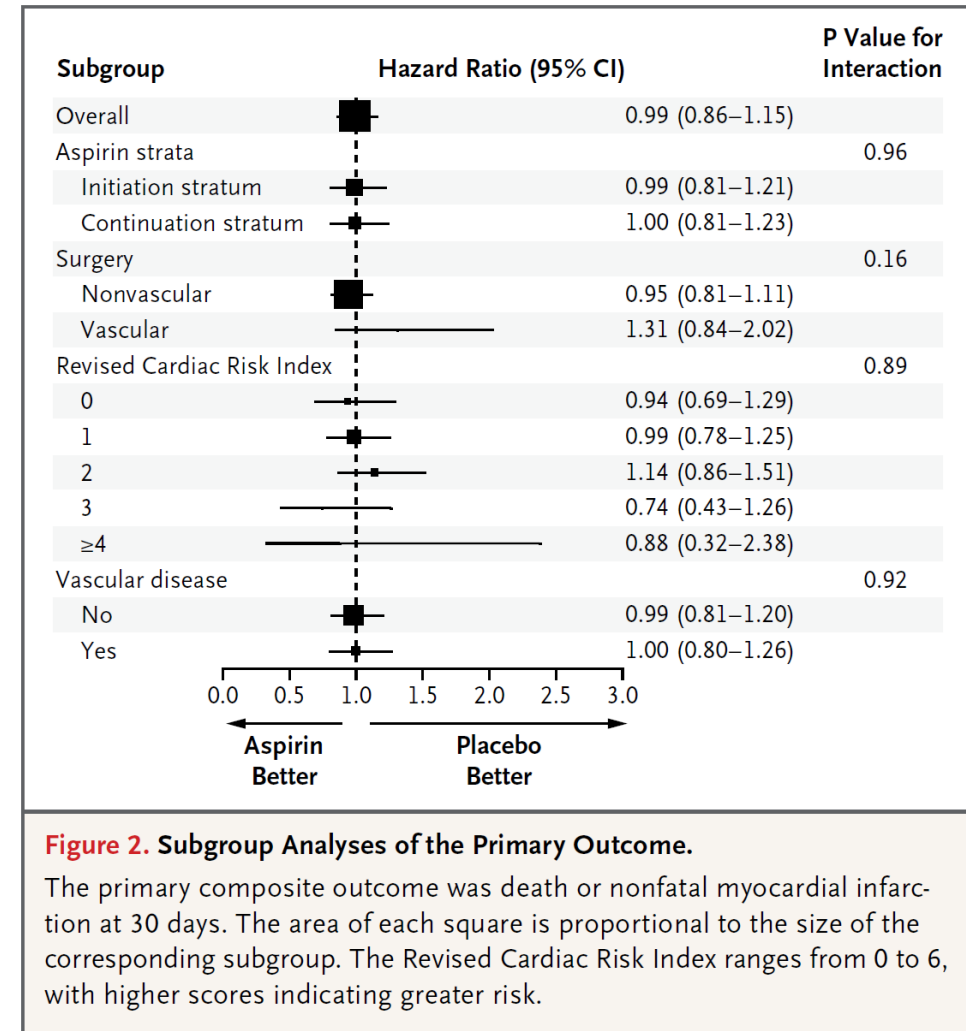
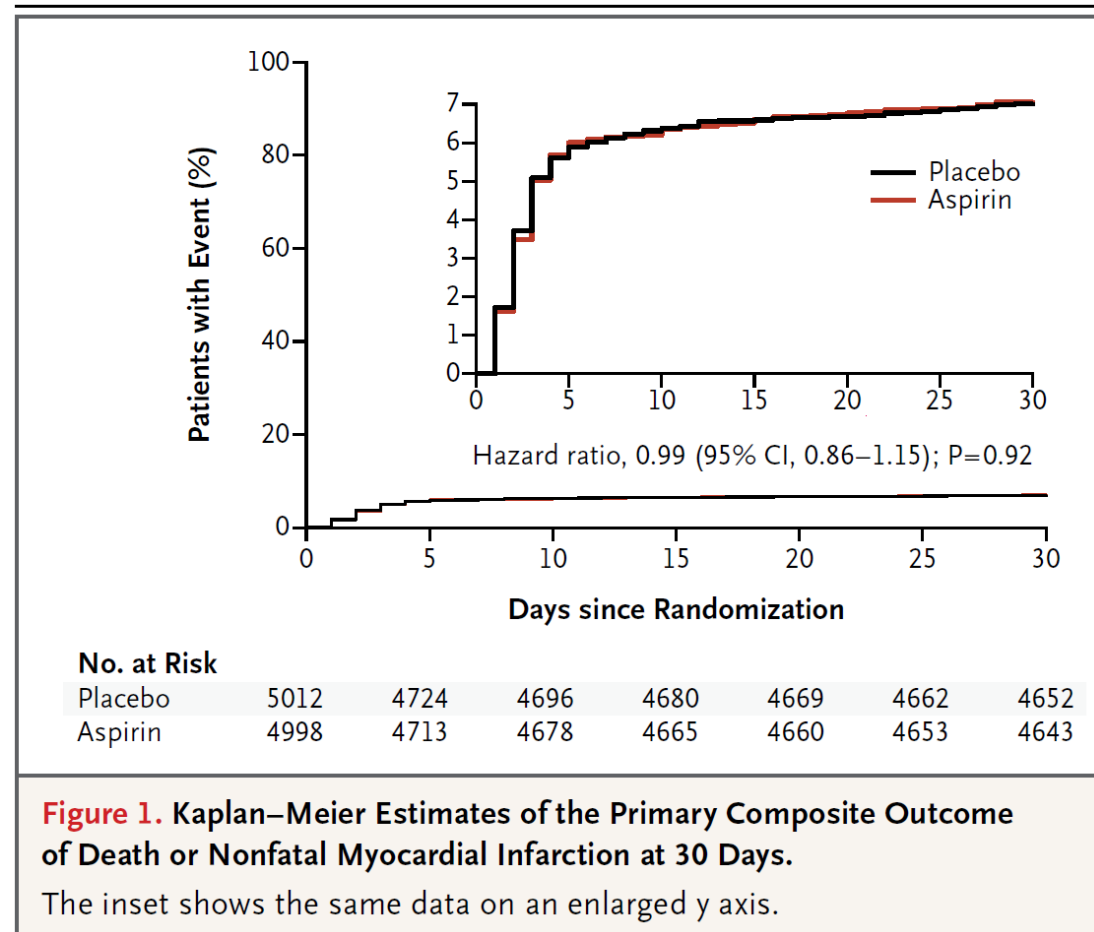
# Perioperative Aspirin

- There was no benefit to ASA in the primary outcome or any of the secondary outcomes
- The negative results were the same for the continuation group and the initiation group
- Taking ASA was associated with an increased risk of major bleeding





# Perioperative Aspirin



# Perioperative Aspirin: ACC/AHA 2024 Periop Guidelines

| Recommendations for Antiplatelet Therapy and Timing of Noncardiac Surgery in Patients With Coronary Artery Disease<br>Referenced studies that support the recommendations are summarized in the <a href="#">Online Data Supplement</a> . |     |                                                                                                                                                                                                                       |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| COR                                                                                                                                                                                                                                      | LOE | Recommendations                                                                                                                                                                                                       |
| 2b                                                                                                                                                                                                                                       | B-R | 11. In patients with CCD without prior PCI undergoing elective NCS, it may be reasonable to continue aspirin in selected patients when the risk of cardiac events outweighs the risk of bleeding. <sup>27,34,35</sup> |
| 3: No benefit                                                                                                                                                                                                                            | B-R | 12. In patients with CAD but without prior PCI who are undergoing elective noncarotid NCS, routine initiation of aspirin is not beneficial. <sup>27,36</sup>                                                          |

CCD=chronic coronary disease



# Perioperative ACEi/ARB: ACC/AHA 2024 Periop Guidelines

| Recommendations for Perioperative Renin-Angiotensin-Aldosterone System Inhibitors<br>Referenced studies that support the recommendations are summarized in the <a href="#">Online Data Supplement</a> . |      |                                                                                                                                                                                                                                                 |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| COR                                                                                                                                                                                                     | LOE  | Recommendations                                                                                                                                                                                                                                 |
| 2b                                                                                                                                                                                                      | B-R  | 1. In select* patients on chronic renin-angiotensin-aldosterone system inhibitors (RAASi) for hypertension undergoing elevated-risk NCS, omission 24 hours before surgery may be beneficial to limit intraoperative hypotension. <sup>1-6</sup> |
| 2a                                                                                                                                                                                                      | C-EO | 2. In patients on chronic RAASi for HFrEF, perioperative continuation is reasonable.† <sup>1,2</sup>                                                                                                                                            |

\*Patients with controlled BP and undergoing elevated-risk surgical procedures.

†Modified from the “2022 AHA/ACC/HFSA Guideline for the Management of Heart Failure.”<sup>7</sup>



# Should We Hold ACEi/ARB Preop?

JAMA | **Original Investigation**

## Continuation vs Discontinuation of Renin-Angiotensin System Inhibitors Before Major Noncardiac Surgery The Stop-or-Not Randomized Clinical Trial

JAMA. 2024;332(12):970-978. doi:[10.1001/jama.2024.17123](https://doi.org/10.1001/jama.2024.17123)

Published online August 30, 2024.



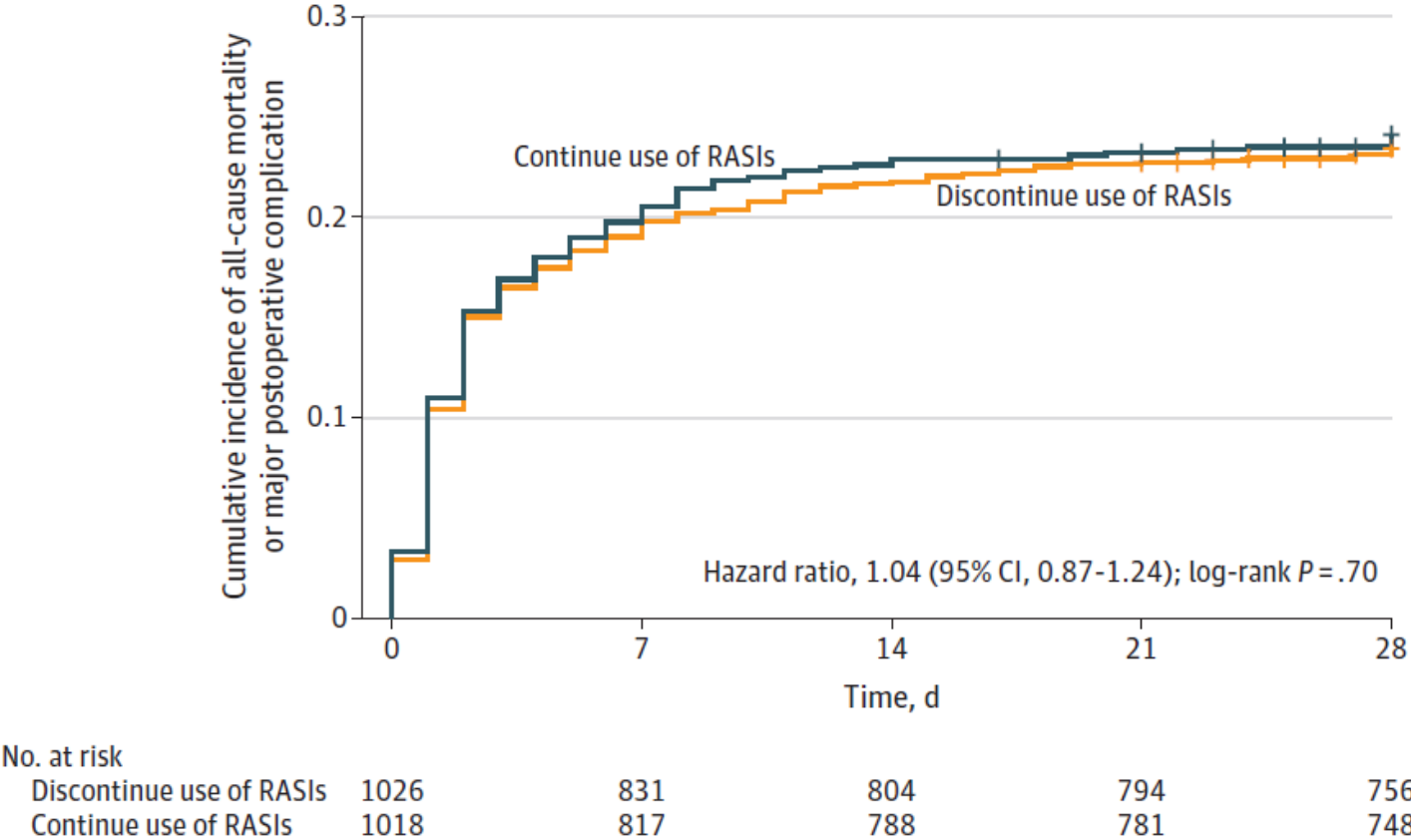
# Should We Hold ACEi/ARB Preop?

- Prospective RCT of 2222 patients in France
- Patients were on a renin-angiotensin system inhibitors (RASIs) (ACEi or ARB) for  $\geq 3$  months
- Patients were randomized 1:1 to the continuation group (continued ACEi/ARB to the day of surgery) or discontinuation group (held ACEi/ARB for 48 h before surgery)



# Should We Hold ACEi/ARB Preop?

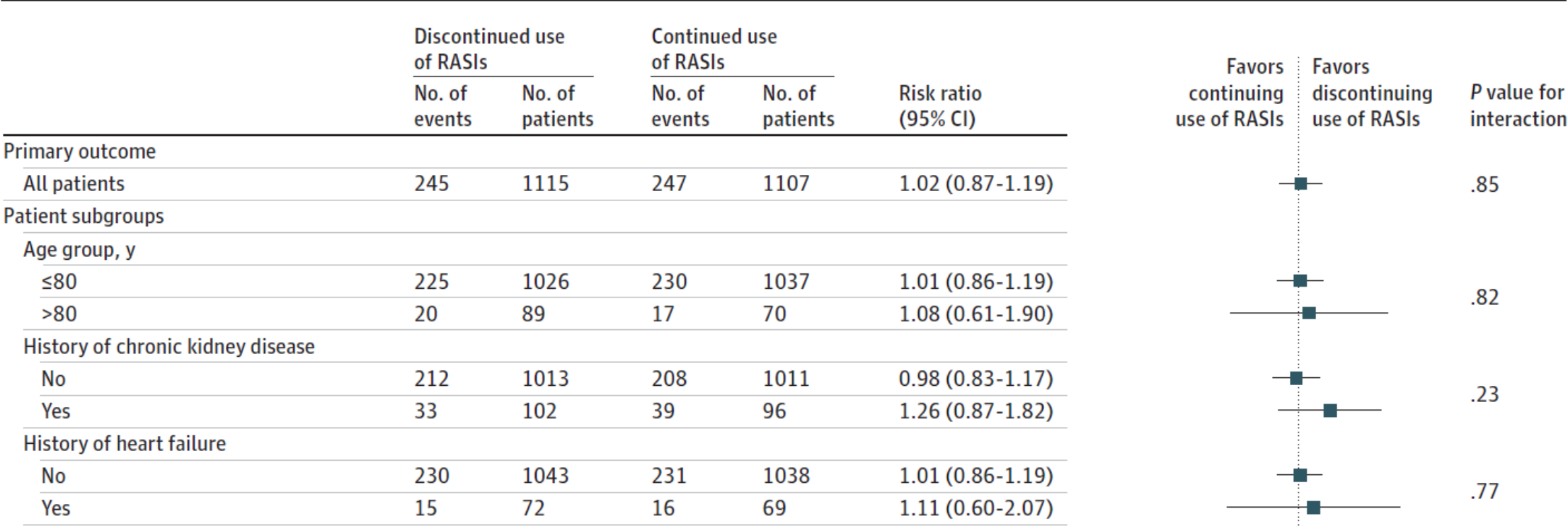
Figure 3. Cumulative Incidence of the Primary Outcome by Treatment Group



Source: Legrand M, et al; Stop-or-Not Trial Group. Continuation vs Discontinuation of Renin-Angiotensin System Inhibitors Before Major Noncardiac Surgery: The Stop-or-Not Randomized Clinical Trial. JAMA. 2024 Sep 24;332(12):970-978.

# Should We Hold ACEi/ARB Preop?

Figure 2. Primary Outcome for All Patients and by Individual Patient Subgroups



# Perioperative Considerations for GLP-1 Agonists

Guidance from the American Society of Anesthesiologists:

- For patients who take GLP-1 agonists daily, consider holding the medication on the day of surgery
- For patients who take GLP-1 agonists weekly, consider holding the medication a week prior to surgery
- If the patient has GI symptoms such as serious bloating or N/V, consider delaying the procedure
- If the patient has no GI symptoms but did not hold the GLP-1 agonist, then use “full stomach” precautions





# Perioperative Considerations for GLP-1 Agonists

Guidance from the American Society of Anesthesiologists:

- For patients who take GLP-1 agonists daily, consider holding the medication on the day of surgery
- For patients who take GLP-1 agonists weekly, consider holding the medication a week prior to surgery
- If the patient has GI symptoms such as serious bloating or N/V, consider delaying the procedure
- If the patient has no GI symptoms but did not hold the GLP-1 agonist, then use “full stomach” precautions

However, critics of this guidance have noted:

- EGD studies that examined whether GLP-1 agonist use is associated with retained gastric contents have yielded mixed results
- The duration that GLP-1 agonist need to be held to reduce the risk of retained gastric contents is unclear
- The benefits of better glycemic control may be offsetting



# Periop Management of Diabetes Medications

Figure. Suggested Administration of Insulin and Other Diabetes Medications on the Morning of Surgery

| Patient due for elective surgery                                                                                                                                                                                                                                                                              | Medication plan for morning of surgery                                  |          |                                                     |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------|----------|-----------------------------------------------------|
| No known type 1 diabetes and no similar clinical features                                                                                                                                                                                                                                                     | Hold                                                                    | 50% Dose | Continue normal therapy                             |
| ► Noninsulin therapies only                                                                                                                                                                                                                                                                                   | ●                                                                       |          |                                                     |
| Combination of insulin and noninsulin therapies                                                                                                                                                                                                                                                               |                                                                         | ●        |                                                     |
| ► Long- and intermediate-acting insulin                                                                                                                                                                                                                                                                       |                                                                         |          |                                                     |
| ► Short- or rapid-acting insulin and noninsulin therapies                                                                                                                                                                                                                                                     | ●                                                                       |          |                                                     |
| Known type 1 diabetes or similar clinical features present <sup>a</sup>                                                                                                                                                                                                                                       | Continue basal insulin therapy                                          |          |                                                     |
| Combination of short- or rapid-acting and intermediate-acting insulin                                                                                                                                                                                                                                         | ●                                                                       |          |                                                     |
| ► Short- or rapid-acting insulin                                                                                                                                                                                                                                                                              |                                                                         |          |                                                     |
| ► Intermediate-acting insulin                                                                                                                                                                                                                                                                                 |                                                                         | ●        |                                                     |
| Combination of short- or rapid-acting and long-acting insulin                                                                                                                                                                                                                                                 | ●                                                                       |          |                                                     |
| ► Short- or rapid-acting insulin                                                                                                                                                                                                                                                                              |                                                                         |          |                                                     |
| ► Long-acting insulin (appropriate dose)                                                                                                                                                                                                                                                                      |                                                                         |          | ●                                                   |
| ► Long-acting insulin (inappropriately high dose)                                                                                                                                                                                                                                                             |                                                                         | ●        |                                                     |
| Indications for inappropriately high long-acting insulin dose:<br>Frequent hypoglycemia, especially at night or early morning<br>Steep overnight decline in blood glucose (>40 mg/dL)<br>Patient requires bedtime snack to avoid hypoglycemia<br>Long-acting insulin dose is >60% of total daily insulin dose |                                                                         |          |                                                     |
| Insulin pump therapy                                                                                                                                                                                                                                                                                          | Discontinue insulin pump and start intravenous insulin infusion therapy |          |                                                     |
| ► Continued perioperative insulin pump use is not indicated                                                                                                                                                                                                                                                   | ●                                                                       |          |                                                     |
| ► Continued perioperative insulin pump use is indicated                                                                                                                                                                                                                                                       |                                                                         |          | ●                                                   |
| Indications for continued perioperative use:<br>Patient has good glucose control and is adept at pump usage<br>Short surgery duration (<2 h) and quick recovery expected<br>No hemodynamic compromise<br>Pump infusion site is not close to surgical field                                                    |                                                                         |          | Reduce to 25% if basal rate is inappropriately high |

Source: Simha V, Shah P. Perioperative Glucose Control in Patients With Diabetes Undergoing Elective Surgery. *JAMA*. Jan 7 2019.



# Bridging Anticoagulation

- The BRIDGE trial randomized 1884 patients with Afib on coumadin who were scheduled for an elective procedure to either bridging with LMWH (dalteparin) or placebo.
- Patients had to have at least 1 of the CHADS<sub>2</sub> risk factors.
- The mean CHADS<sub>2</sub> score was 2.3



# Bridging Anticoagulation

| Table 3. Study Outcomes.  |                                                                 |                                                              |              |
|---------------------------|-----------------------------------------------------------------|--------------------------------------------------------------|--------------|
| Outcome                   | No Bridging<br>(N = 918)<br><i>number of patients (percent)</i> | Bridging<br>(N = 895)<br><i>number of patients (percent)</i> | P Value      |
| <b>Primary</b>            |                                                                 |                                                              |              |
| Arterial thromboembolism  | 4 (0.4)                                                         | 3 (0.3)                                                      | 0.01*, 0.73† |
| Stroke                    | 2 (0.2)                                                         | 3 (0.3)                                                      |              |
| Transient ischemic attack | 2 (0.2)                                                         | 0                                                            |              |
| Systemic embolism         | 0                                                               | 0                                                            |              |
| Major bleeding            | 12 (1.3)                                                        | 29 (3.2)                                                     | 0.005†       |
| <b>Secondary</b>          |                                                                 |                                                              |              |
| Death                     | 5 (0.5)                                                         | 4 (0.4)                                                      | 0.88†        |
| Myocardial infarction     | 7 (0.8)                                                         | 14 (1.6)                                                     | 0.10†        |
| Deep-vein thrombosis      | 0                                                               | 1 (0.1)                                                      | 0.25†        |
| Pulmonary embolism        | 0                                                               | 1 (0.1)                                                      | 0.25†        |
| Minor bleeding            | 110 (12.0)                                                      | 187 (20.9)                                                   | <0.001†      |

\* P value for noninferiority.

† P value for superiority.



# Perioperative Anticoagulation with DOACS

| Preoperative DOAC Schedule                                              |                         |                           |        |        |        |        |        |                       |                          |        |        |        |
|-------------------------------------------------------------------------|-------------------------|---------------------------|--------|--------|--------|--------|--------|-----------------------|--------------------------|--------|--------|--------|
|                                                                         | Procedure Bleeding Risk | Preoperative Interruption |        |        |        |        |        | Surgery/<br>Procedure | Postoperative Resumption |        |        |        |
|                                                                         |                         | Day -6                    | Day -5 | Day -4 | Day -3 | Day -2 | Day -1 | Day 0                 | Day +1                   | Day +2 | Day +3 | Day +4 |
| Apixaban, edoxaban, rivaroxaban                                         | High                    | *                         | *      | *      | *      | †      | †      | †                     | †                        | †      | *      | *      |
|                                                                         | Low/Moderate            | *                         | *      | *      | *      | *      | †      | †                     | *                        | *      | *      | *      |
|                                                                         | Minimal                 | *                         | *      | *      | *      | *      | *      | *                     | *                        | *      | *      | *      |
| Apixaban, edoxaban, rivaroxaban with renal impairment (CrCl <30 mL/min) | High                    | *                         | *      | *      | †      | †      | †      | †                     | †                        | †      | *      | *      |
|                                                                         | Low/Moderate            | *                         | *      | *      | *      | †      | †      | †                     | *                        | *      | *      | *      |
|                                                                         | Minimal                 | *                         | *      | *      | *      | *      | *      | *                     | *                        | *      | *      | *      |
| Dabigatran CrCl ≥50 mL/min                                              | High                    | *                         | *      | *      | *      | †      | †      | †                     | †                        | †      | *      | *      |
|                                                                         | Low/Moderate            | *                         | *      | *      | *      | *      | †      | †                     | *                        | *      | *      | *      |
|                                                                         | Minimal                 | *                         | *      | *      | *      | *      | *      | *                     | *                        | *      | *      | *      |
| Dabigatran CrCl <50 mL/min                                              | High                    | *                         | *      | †      | †      | †      | †      | †                     | †                        | †      | *      | *      |
|                                                                         | Low/Moderate            | *                         | *      | *      | *      | †      | †      | †                     | *                        | *      | *      | *      |
|                                                                         | Minimal                 | *                         | *      | *      | *      | *      | *      | *                     | *                        | *      | *      | *      |





**Brigham and Women's Hospital**  
Founding Member, Mass General Brigham

# Perioperative Pulmonary Considerations

# Perioperative Pulmonary Complications

**Table 1.** The Seven ARISCAT Risk Predictors,  $\beta$  Regression Coefficients, and Points Assigned\*

|                                         | $\beta$ Regression Coefficients | Score |
|-----------------------------------------|---------------------------------|-------|
| Age (yr)                                |                                 |       |
| ≤50                                     | 0                               | 0     |
| 51–80                                   | 0.331                           | 3     |
| >80                                     | 1.619                           | 16    |
| Preoperative SpO <sub>2</sub>           |                                 |       |
| ≥96%                                    | 0                               | 0     |
| 91–95%                                  | 0.802                           | 8     |
| ≤90%                                    | 2.375                           | 24    |
| Respiratory infection in the last month |                                 |       |
| No                                      | 0                               | 0     |
| Yes                                     | 1.698                           | 17    |
| Preoperative anemia (Hb ≤10 g/dl)       |                                 |       |
| No                                      | 0                               | 0     |
| Yes                                     | 1.105                           | 11    |
| Surgical incision                       |                                 |       |
| Peripheral                              | 0                               | 0     |
| Upper abdominal                         | 1.480                           | 15    |
| Intrathoracic                           | 2.431                           | 24    |
| Duration of surgery (h)                 |                                 |       |
| <2                                      | 0                               | 0     |
| 2–3                                     | 1.593                           | 16    |
| >3                                      | 2.268                           | 23    |
| Emergency procedure                     |                                 |       |
| No                                      | 0                               | 0     |
| Yes                                     | 0.768                           | 8     |

\*Three levels of risk were indicated by the following cutoffs: <26 points, low risk; 26–44 points, moderate risk; and ≥45 points, high risk.

ARISCAT = Assess Respiratory Risk in Surgical Patients in Catalonia; Hb = hemoglobin; SpO<sub>2</sub> = arterial oxyhemoglobin saturation by pulse oximetry.

- Tested on 5,859 patients in 63 centers
- Respiratory complications were defined as:
  - Respiratory infection or failure
  - Bronchospasm
  - Atelectasis
  - Pleural effusion
  - Pneumothorax
  - Aspiration pneumonitis
- Score:
  - < 26 denotes a 3.4% risk
  - 26–45 denotes a 13.0% risk
  - >45 denotes a 38.0% risk



# Perioperative Pulmonary Risk Reduction Strategies: Lung Expansion

- In patients at elevated risk, such as those undergoing abdominal surgery, a lung expansion maneuver is appropriate, and is more effective than no intervention
- Options include incentive spirometry, lung expansion exercises, and continuous positive airway pressure
- There is no compelling evidence favoring one lung expansion intervention over another
- CPAP may be appropriate in patients who are unable to undergo either incentive spirometry or lung expansion exercises. CPAP is advisable in OSA patients.





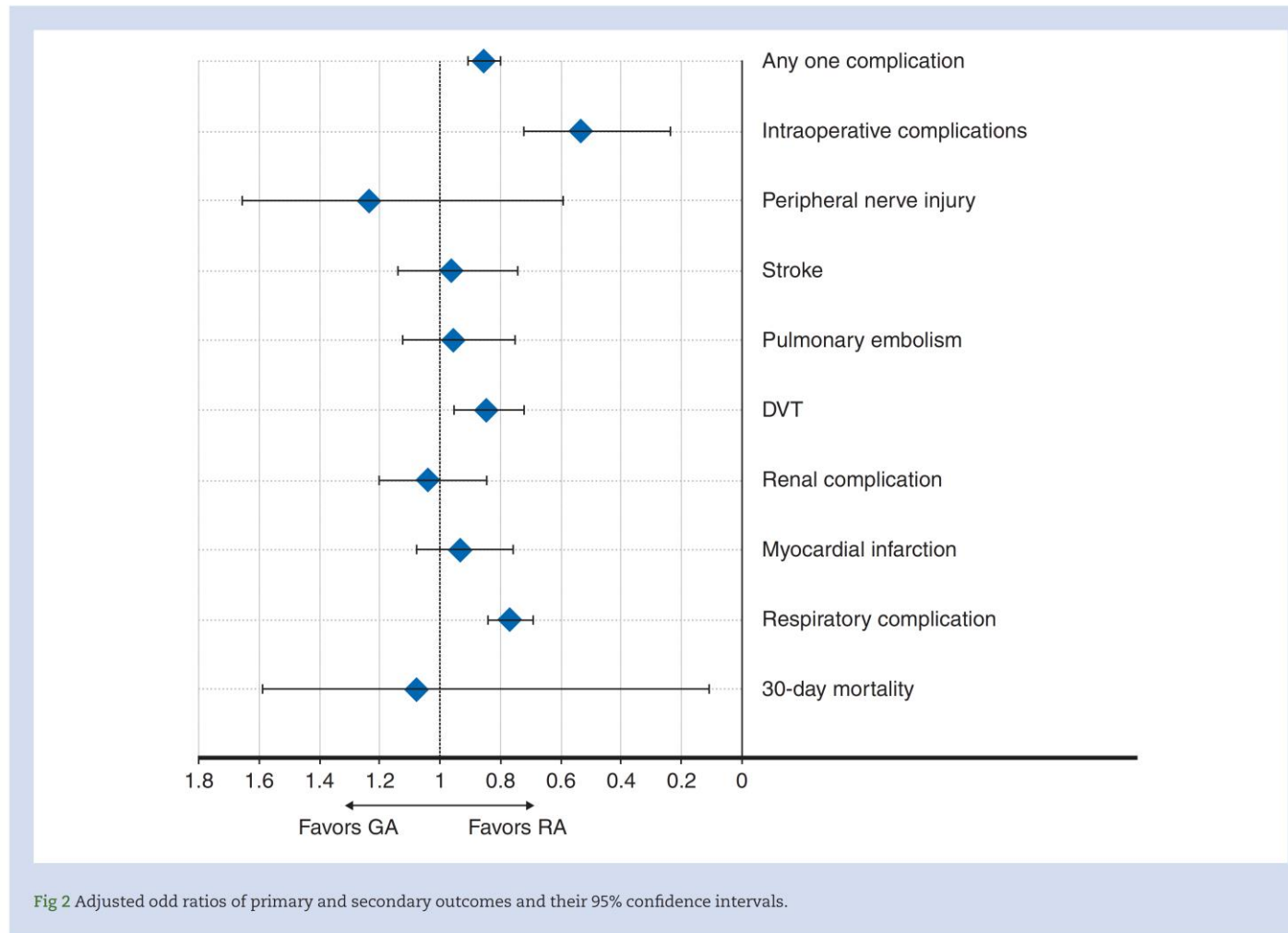
# Perioperative Pulmonary Risk Reduction Strategies

- Smoking cessation
  - May help reduce the incidence of postop pulmonary complications
  - However, smoking cessation immediately (< 8 weeks) prior to surgery may increase the risk of postop pulmonary complications
- Anesthesia techniques need to be considered
  - Use of regional anesthesia, compared to general anesthesia, reduces the incidence of postop pulmonary complications



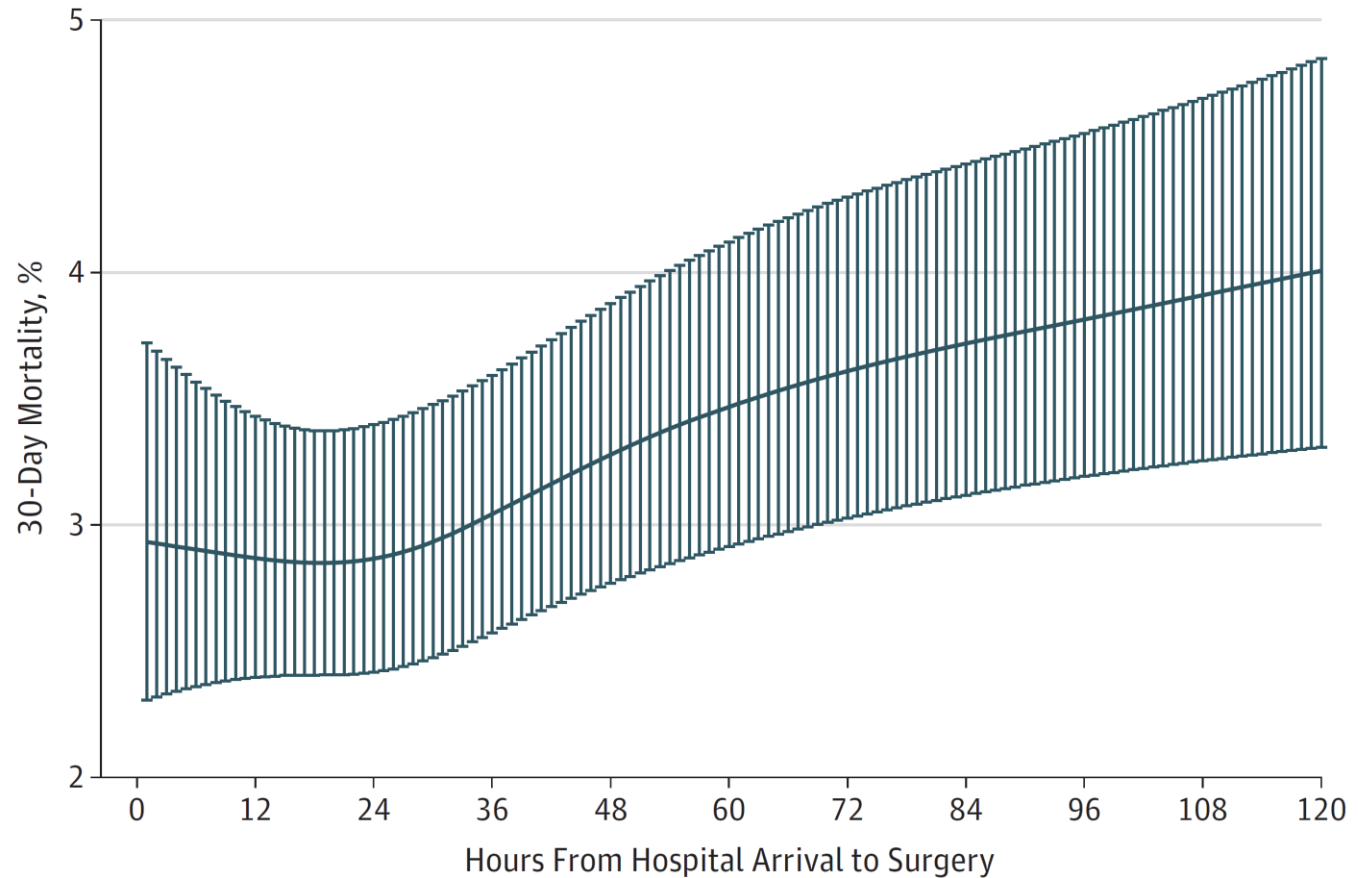
# General versus Regional Anesthesia Complications

## Propensity Matched General Surgical Population (NSQIP) (n=328,540)



# The Timing of Surgery for Hip Fracture Patients

- Retrospective cohort analysis of 42,230 hip fracture patients in Ontario
- Mean age around 80, around 70% female
- Primary outcome was 30-d mortality



# Periop Issues for OSA Patients

- Both respiratory and cardiovascular periop complications are more common in patients with untreated OSA than comparable patients without OSA
- Prescribing CPAP for patients with OSA can reduce postop complications
- Neglecting to prescribe CPAP in patients on CPAP when postop in the hospital is an “unforced error”
- Opioids need to be used with caution in OSA patients



# Periop Issues for Obese Patients

- There are an increasing number of case reports of obese patients having postop rhabdomyolysis
- It is likely that the immobilization and weight on the gluteal muscle results in necrosis
- If an obese patient has postop AKI, consider rhabdomyolysis and check a CK
- Obese patients has restrictive lung physiology, and so consider CPAP in hypoxic obese patients postop



# Principal Take Aways

- Use one of the on-line risk assessment tools to determine the MACE risk of your patients
- Consider the role for the various perioperative risk reduction interventions
  - Medical: beta blockers, statins
- Have a plan for perioperative management of different medications, such as ACEI/ARBs and ASA
- Recognize that perioperative risk is more than just cardiovascular risk
- Assess patients for frailty
- Communicate with the surgeon and anesthesiologist



# Selected References

1. Thompson A, et al. 2024 AHA/ACC/ACS/ASNC/HRS/SCA/SCCT/SCMR/SVM Guideline for Perioperative Cardiovascular Management for Noncardiac Surgery: A Report of the American College of Cardiology/American Heart Association Joint Committee on Clinical Practice Guidelines. *Circulation*. 2024 Nov 5;150(19):e351-e442.
2. Legrand M, et al. Stop-or-Not Trial Group. Continuation vs Discontinuation of Renin-Angiotensin System Inhibitors Before Major Noncardiac Surgery: The Stop-or-Not Randomized Clinical Trial. *JAMA*. 2024 Sep 24;332(12):970-978.
3. Devereaux PJ, Mrkoberada M, Sessler DI, et al. Aspirin in Patients Undergoing Noncardiac Surgery. *NEJM*. Apr 17 2014;370(16):1494-1503.
4. Simha V, Shah P. Perioperative Glucose Control in Patients With Diabetes Undergoing Elective Surgery. *JAMA*. Jan 7 2019;321(4):399–400.
5. Smilowitz NR, Berger JS. Perioperative Cardiovascular Risk Assessment and Management for Noncardiac Surgery: A Review. *JAMA*. 2020 Jul 21;324(3):279-290.

