Pre-operative Management. Who needs testing and what tests they need.

Luke C Kohan MD

Disclosures

- None

It is very difficult to make an accurate prediction, especially about the future.

--Niels Bohr

- A 53-year-old female with a history of type 2 diabetes, and severe symptomatic peripheral vascular disease is referred to see you for "clearance" prior to a left fem-pop bypass. She has not history of coronary disease. She denies chest pain or shortness of breath. Her exam is notable for diminished lower extremity pulses in the left leg.

- Home medications include:
  - Aspirin 81mg daily
  - Lipitor 40mg daily
  - Metformin 500mg BID

- Her lab work is notable for a serum creatinine of 1.7.

- Her ECG shows:
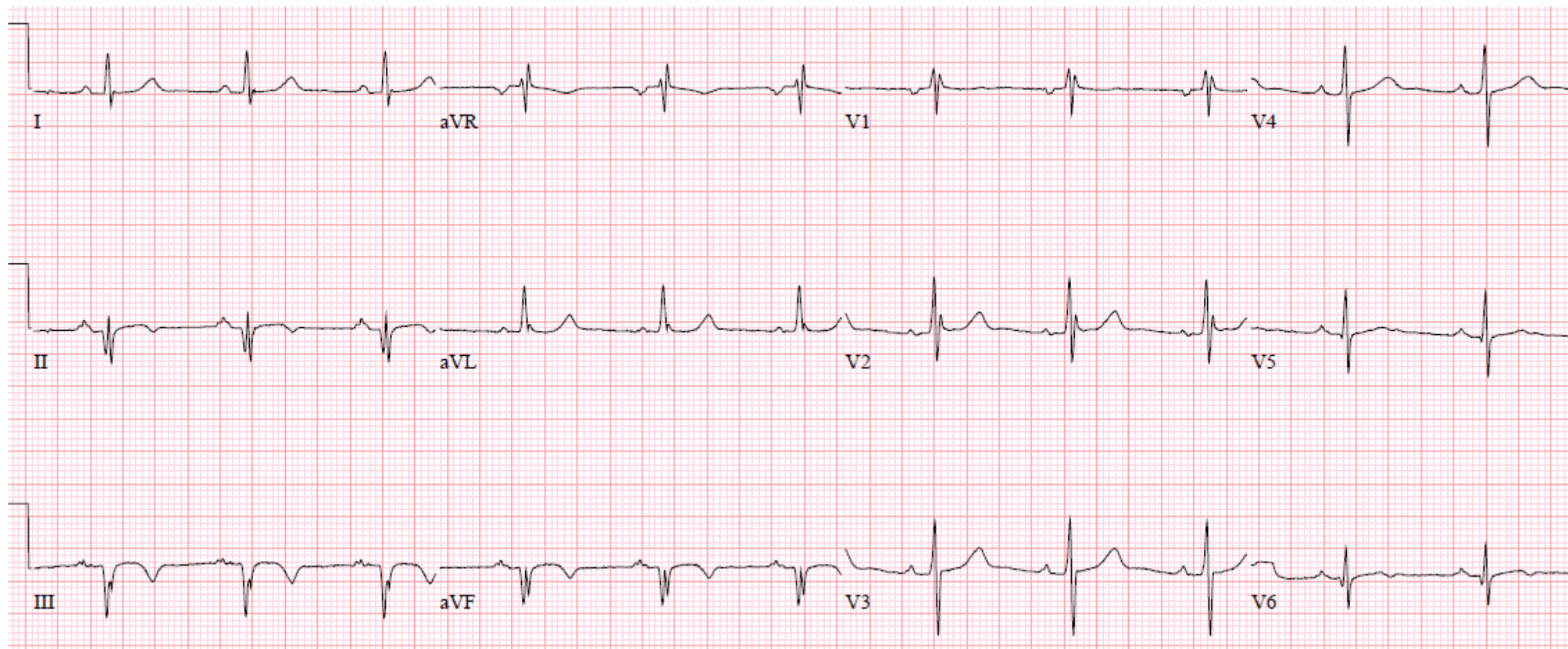
Sinus rhythm, inferior q-waves

Which of the following statements is true?

- A: DM2 is not a clinical marker of increased pre-operative risk
- B: A pharmacologic stress test would not help in further risk assessment.
- C: Initiating high dose beta-blocker therapy will reduce her risk of peri-operative MI
- D: The cardiac risk of fem-pop bypass is similar to that of aortic surgery.
- E: Calcium channel blockers will lower her risk of perioperative MI

Insert rant here…

2014 ACC/AHA Guideline on Perioperative Cardiovascular Evaluation and Management of Patients Undergoing Noncardiac Surgery: Executive Summary

A Report of the American College of Cardiology/American Heart Association
Task Force on Practice Guidelines

Developed in Collaboration With the American College of Surgeons, American Society of
Anesthesiologists, American Society of Echocardiography, American Society of Nuclear Cardiology,
Heart Rhythm Society, Society for Cardiovascular Angiography and Interventions
Society of Cardiovascular Anesthesiologists, and Society of Vascular Medicine

Endorsed by the Society of Hospital Medicine

2022 ESC Guidelines on cardiovascular assessment and management of patients undergoing non-cardiac surgery

Developed by the task force for cardiovascular assessment and management of patients undergoing non-cardiac surgery of the European Society of Cardiology (ESC)

Endorsed by the European Society of Anaesthesiology and Intensive Care (ESAIC)
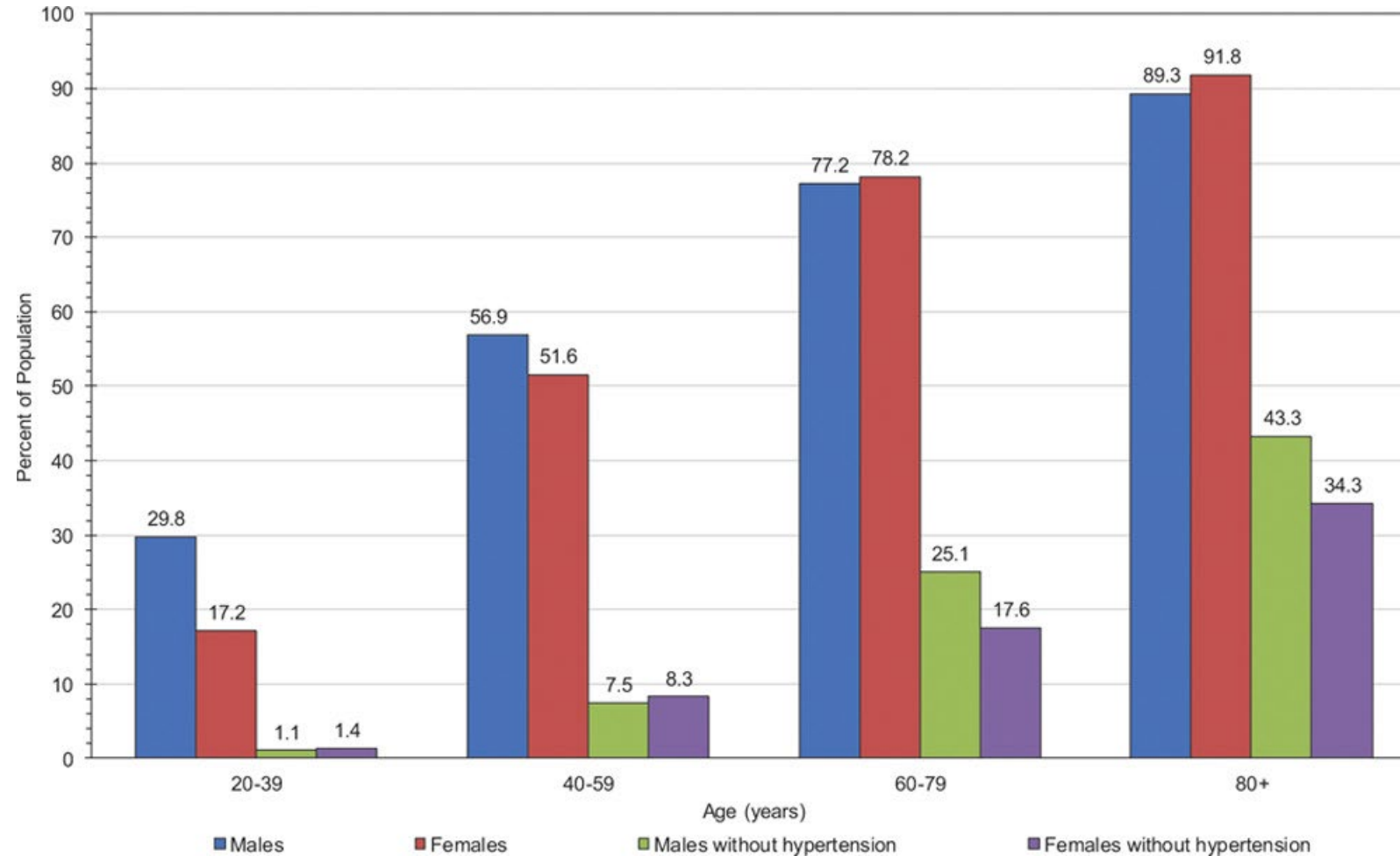
IT'S MORE WHAT YOU'D CALL GUIDELINES

THAN ACTUAL RULES

quickmeme.com

Why does this matter

- 50% of patients undergoing non-cardiac surgery(NCS) have at least 2 CV risk factors
  - 18% have known CAD
    - This was in 2012-13
      - Americans haven't gotten healthier
- One in seven patients undergoing inpatient NCS will have MI or CVA within 30 days.

Smilowitz NR, Gupta N, Guo Y, Beckman JA, Bangalore S, Berger JS. Trends in cardiovascular risk factor and disease prevalence in patients undergoing non-cardiac surgery. Heart 2018;104:1180–1186.

Prevalence of Cardiovascular disease

Prevalence of cardiovascular disease in US adults ≥20 years of age, by age and sex (NHANES, 2013–2016), with and without hypertension. These data include coronary heart disease, heart failure, stroke, and with and without hypertension. NHANES indicates National Health and Nutrition Examination Survey. Source: Unpublished National Heart, Lung, and Blood Institute tabulation using NHANES, 2013 to 2016.
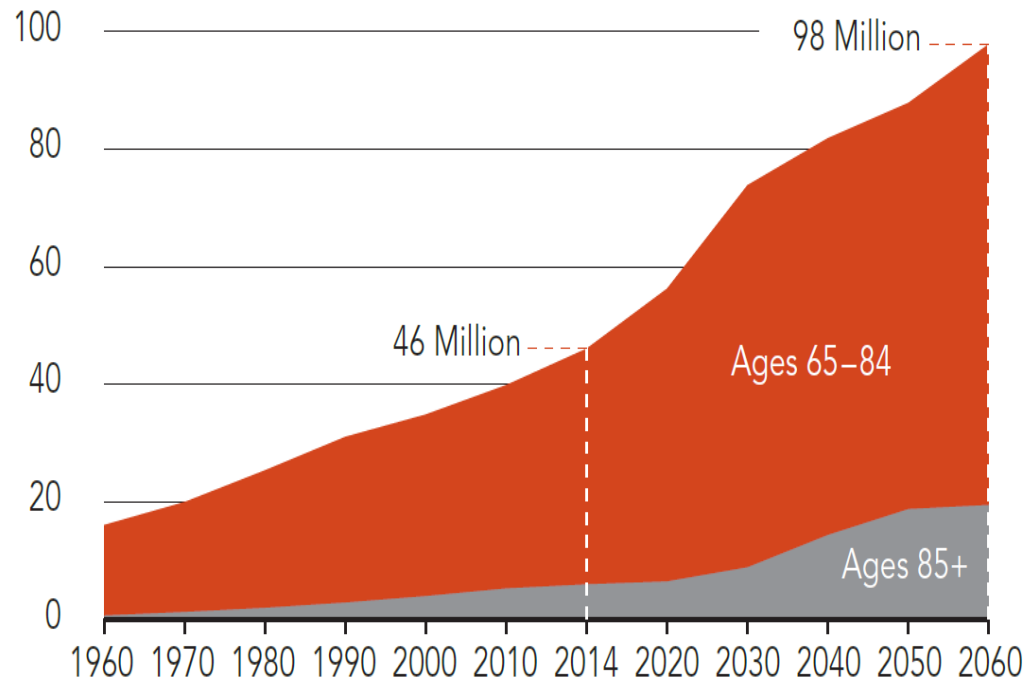
PAD/CAD OVERLAP
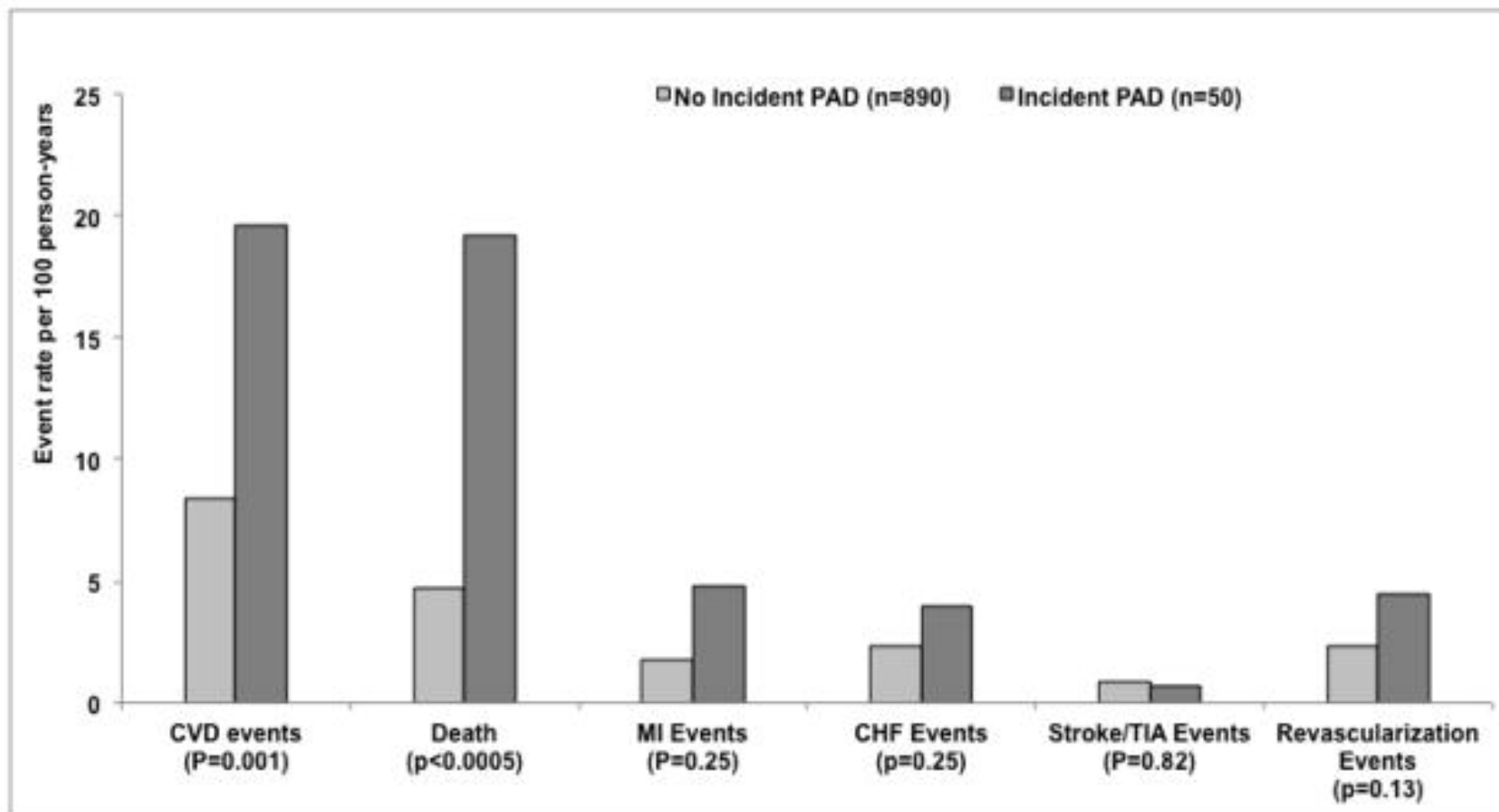
Peripheral artery disease and risk of cardiovascular events in patients with coronary artery disease: Insights from the Heart and Soul Study
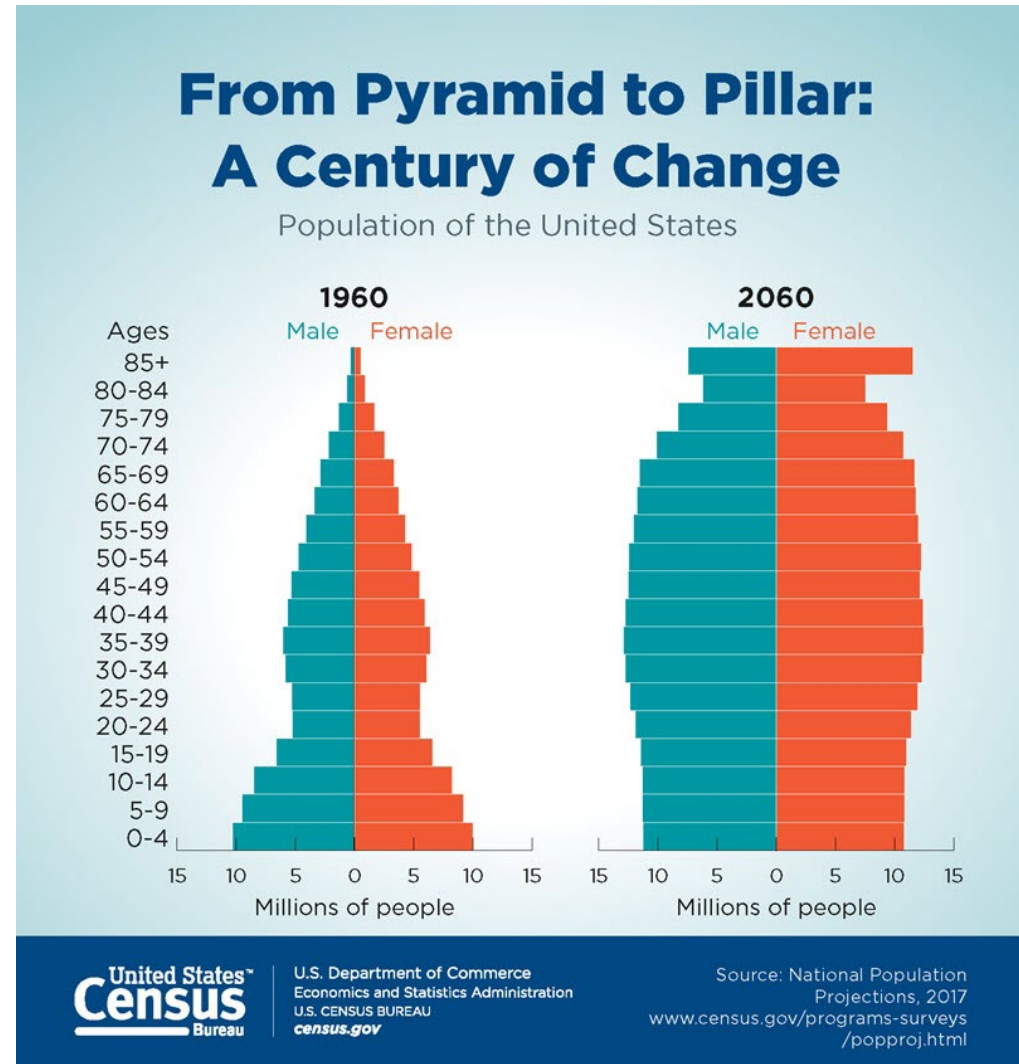
S. Marlene Grenon,[1,2] Eric Vittinghoff,[3,4] Christopher D. Owens,[1,2] Michael S. Conte,[1] Mary Whooley,[3,4,5] and Beth E. Cohen[4,5]

AGING POPULATION OF US

U.S. Population Ages 65 and Older, 1960 to 2060 (Millions)

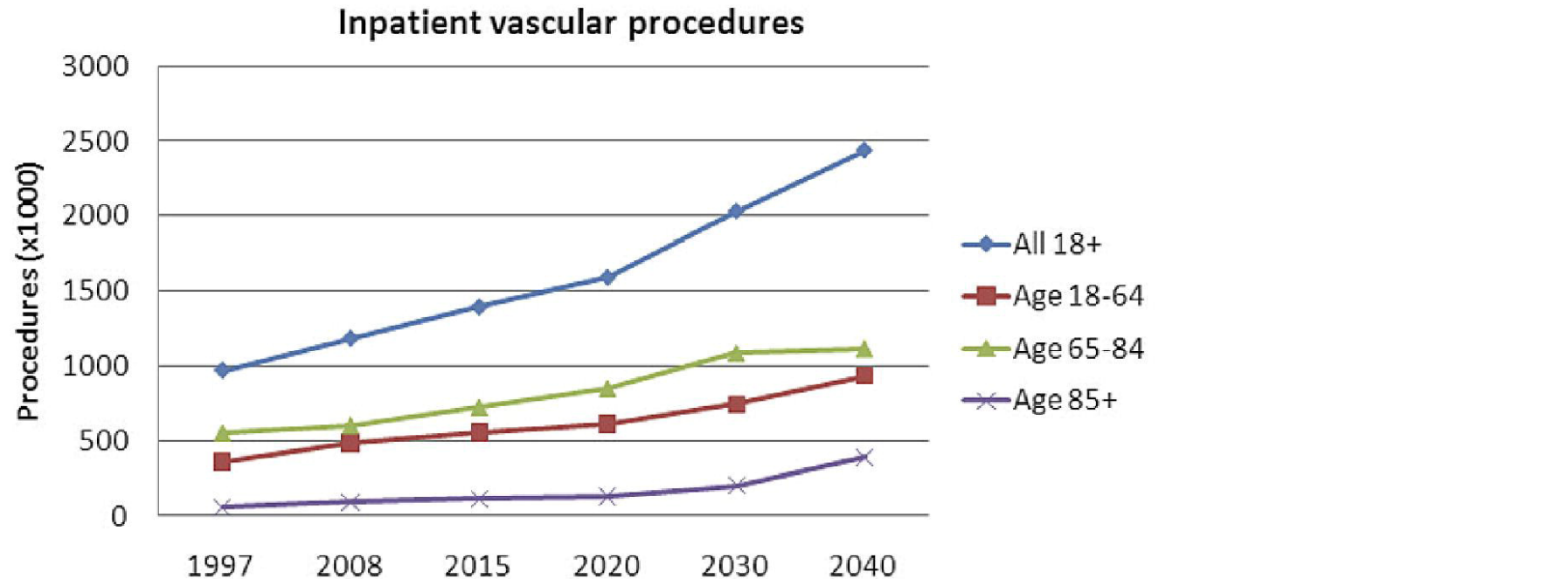

Source: PRB analysis of data from the U.S. Census Bureau.

Volume of vascular procedures

Inpatient vascular procedures

	1997	*2008*	*2015*	*2020*	*2030*	*2040*
Volume (10^3)	971	1183	1394	1590	2031	2440
Change		**	17%	34%	72%	106%

How do we approach pre-op

- The average surgical patient today is older and sicker than ever before
- Most procedures are elective, there is time to reduce risk

What are our goals?

- Reduce adverse outcomes
  - Perioperative MI
  - Acute heart failure
  - Stent thrombosis
  - Hemodynamically significant arrhythmias
  - Stroke
  - Death
  - Major bleeding

5 Questions

- Is the surgery emergent?
- Is the patient having acute coronary syndrome?
- What is the clinical(patient centered) and surgical risk?
- What is the patient's functional capacity?
- Will further testing change anything?(Who should get testing?)
  - Type of surgery, timing of surgery, medical therapy before surgery

The 5 Questions– Q1, Q2
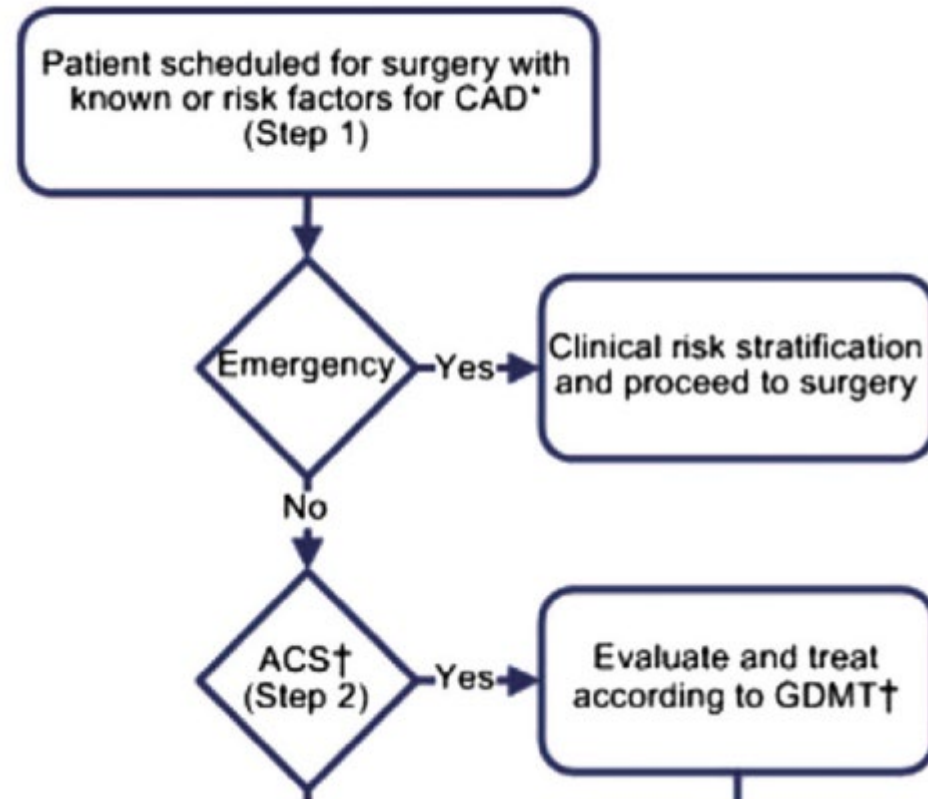
What is urgent?

- Urgent
  - 6-24 hours
- Time-sensitive
  - A delay of 1-6 weeks will not negatively affect outcome
- Elective
  - Can be delayed up to 1 year

Fleisher LA, et al. JACC 2014.

Q3– Clinical and Surgical Risk

Risk Assessment

- Patient-related
- Surgery-related

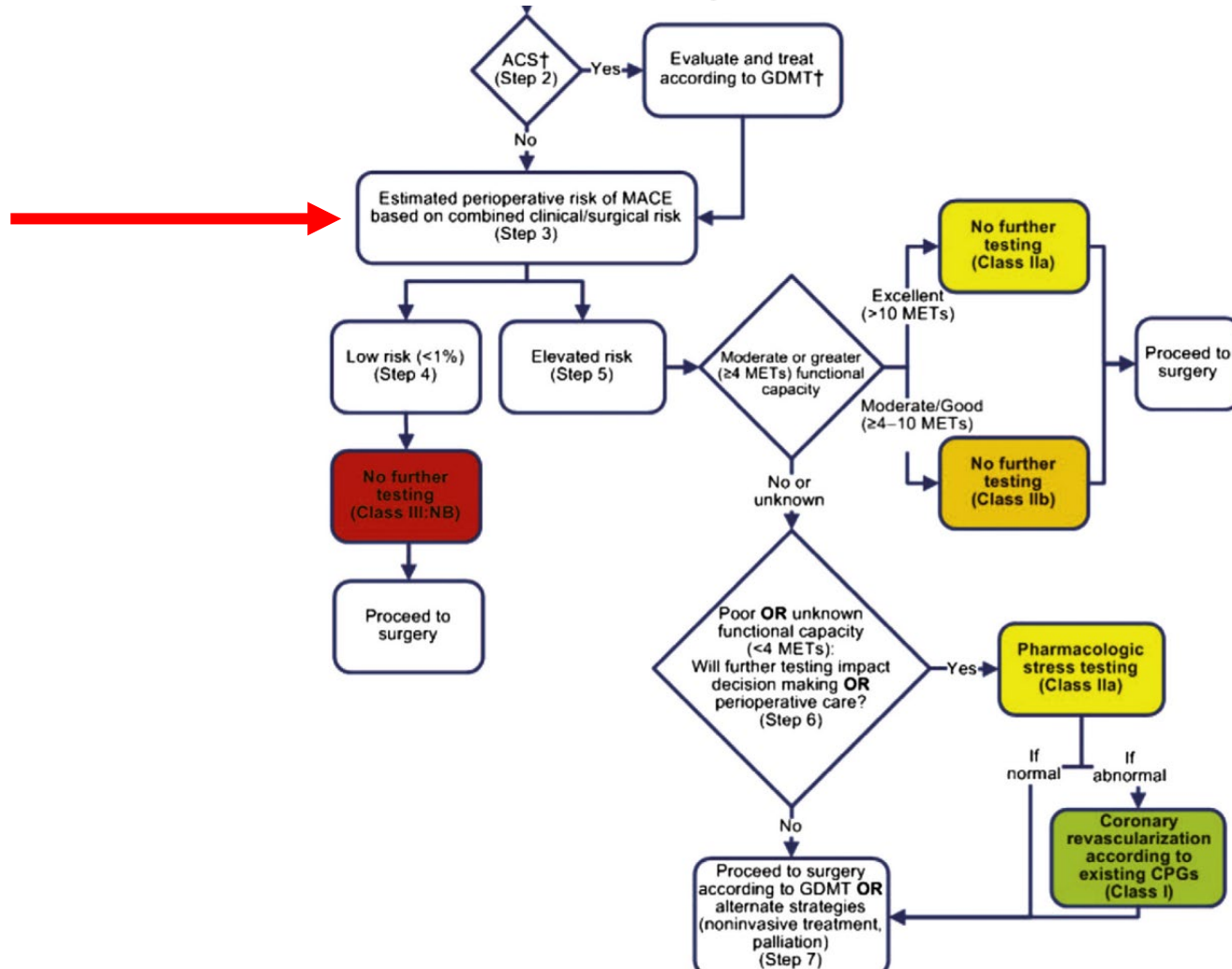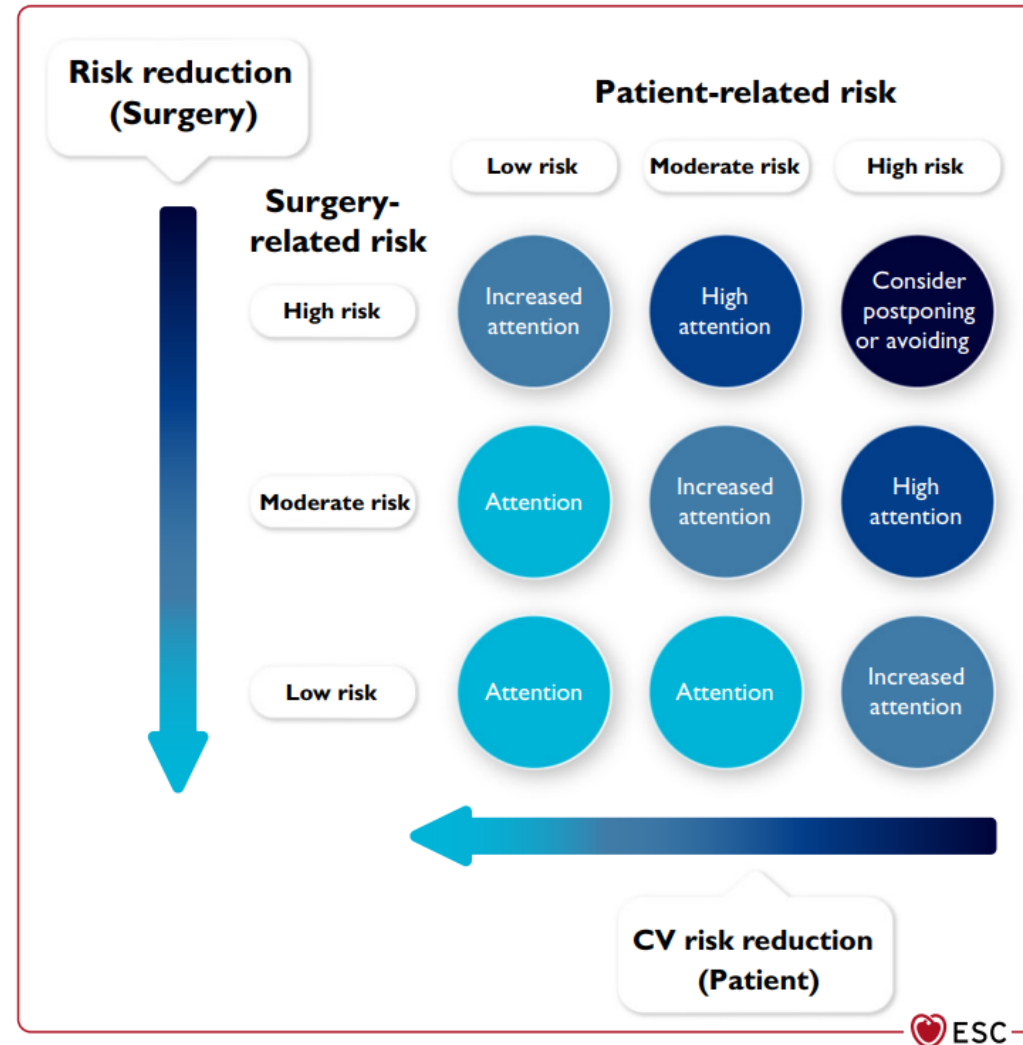| Low surgical risk (<1%)	Intermediate surgical risk (1–5%)	High surgical risk (>5%)
• Breast	• Carotid asymptomatic (CEA or CAS)	• Adrenal resection
• Dental	• Carotid symptomatic (CEA)	• Aortic and major vascular surgery
• Endocrine: thyroid	• Endovascular aortic aneurysm repair	• Carotid symptomatic (CAS)
• Eye	• Head or neck surgery	• Duodenal-pancreatic surgery
• Gynaecological: minor	• Intraperitoneal: splenectomy, hiatal hernia repair, cholecystectomy	• Liver resection, bile duct surgery
• Orthopaedic minor (meniscectomy)	• Intrathoracic: non-major	• Oesophagectomy
• Reconstructive	• Neurological or orthopaedic: major (hip and spine surgery)	• Open lower limb revascularization for acute limb ischaemia or amputation
• Superficial surgery	• Peripheral arterial angioplasty	• Pneumonectomy (VATS or open surgery)
• Urological minor: (transurethral resection of the prostate)	• Renal transplants	• Pulmonary or liver transplant
• VATS minor lung resection	• Urological or gynaecological: major	• Repair of perforated bowel
		• Total cystectomy

CAS, carotid artery stenting; CEA, carotid endarterectomy; CV, cardiovascular; MI, myocardial infarction; VATS, video-assisted thoracic surgery.
Surgical risk estimate is a broad approximation of 30 day risk of CV death, MI, and stroke that takes into account only the specific surgical intervention, without considering the patient's comorbidities.
Adapted from data in Glance et al., Muller et al., Bendixen et al., and Falcoz et al.[18–23]

Endovascular approach should be considered for patient with high cardiovascular risk (Class IIa)

Risk of 30 day MACE
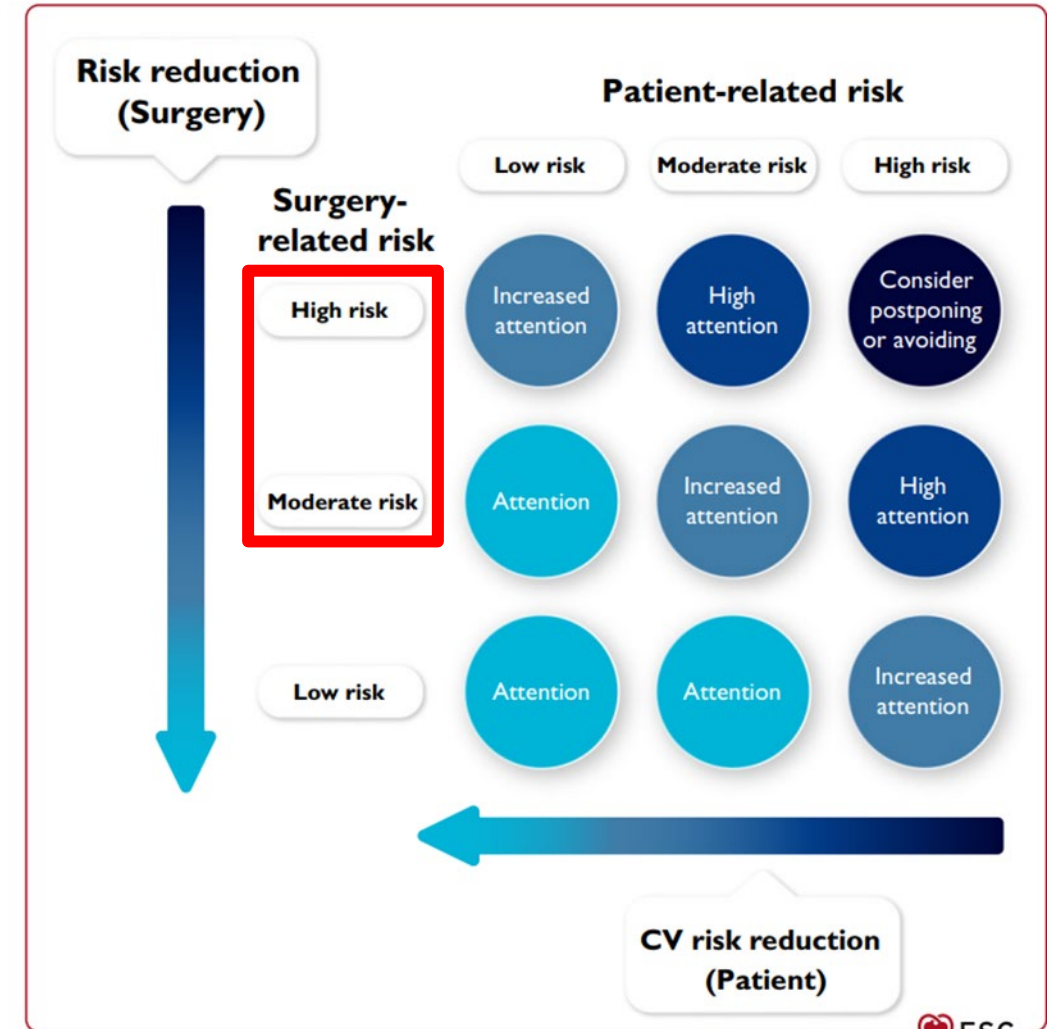
Procedural Risk
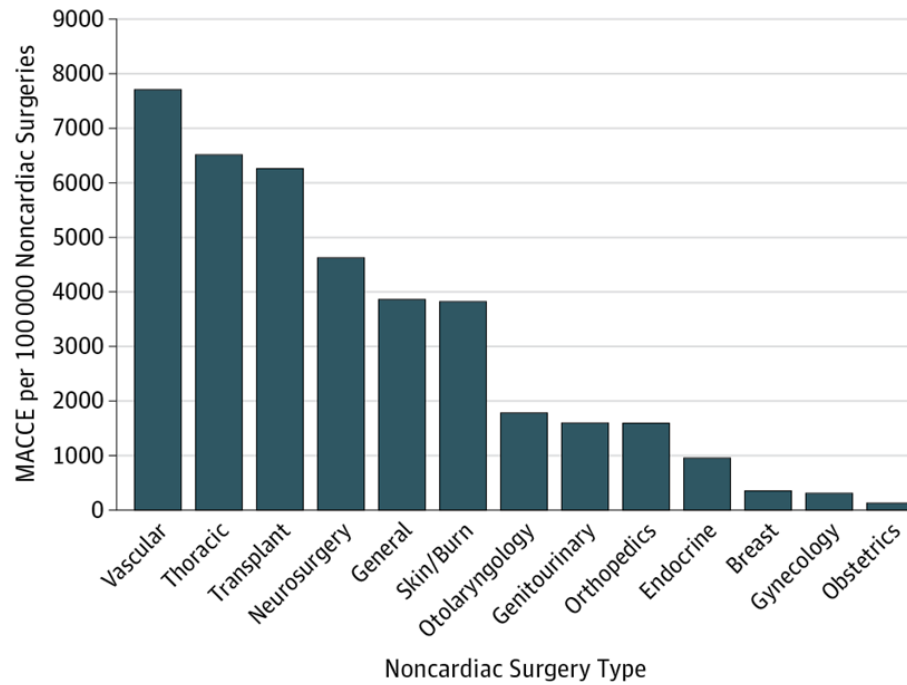
Hospital Volume and Surgical Mortality in the United States

John D. Birkmeyer, M.D., Andrea E. Siewers, M.P.H., Emily V.A. Finlayson, M.D., Therese A. Stukel, Ph.D., F. Lee Lucas, Ph.D., Ida Batista, B.A., H. Gilbert Welch, M.D., M.P.H., and David E. Wennberg, M.D., M.P.H.
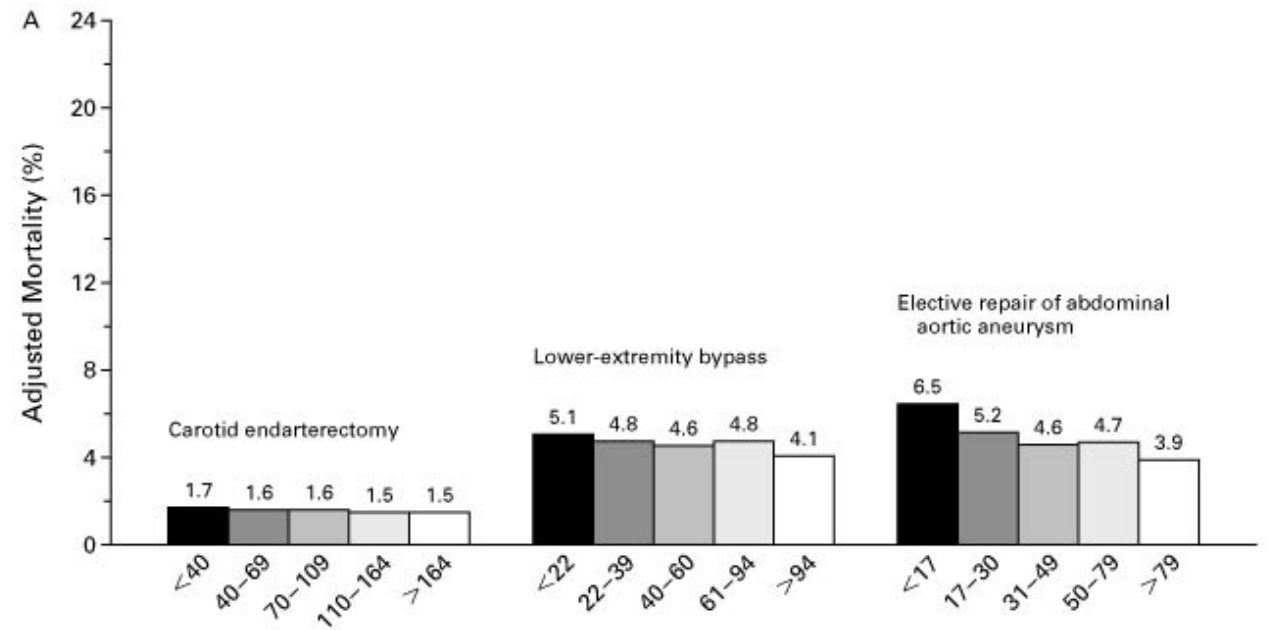
N Engl J Med 2002; 346:1128-1137

How do we assess patient-related risk?

How do we assess patient-related risk?

- All patients undergoing NCS should have accurate history and physical done
- All patients should have a risk assessment performed
  - Prognostic value higher for elective surgery than urgent
- Revised Cardiac Risk Index(RCRI)
- American College of Surgery, National Surgical Quality Improvement Program Risk Calculator (ACS-NSQIP)
- RCRI, ACS-NSQIP→ 30 day MACE. Neither study routinely checked cardiac biomarkers

RCRI

- Updates the Original Cardiac Risk Index(Goldman Index)
  - 2893 patients validated in 1422 patients
    - Patients over 50 undergoing NCS. Analysis found 6 independent variables
    - Risk of MACE
  - CAD RR 2.4
  - HF RR 1.9
  - DM2 RR 3.0
  - CKD RR 3.0
  - CVA RR 2.0

Revised Cardiac Risk Index
1. History of ischemic heart disease
2. History of congestive heart failure
3. History of cerebrovascular disease (stroke or transient ischemic attack)
4. History of diabetes requiring preoperative insulin use
5. Chronic kidney disease [creatinine > 2 mg/dL (176.8 µmol/L)]
6. Undergoing suprainguinal vascular, intraperitoneal, or intrathoracic surgery
Risk for cardiac death, nonfatal myocardial infarction, and nonfatal cardiac arrest:
0 predictors = 3.9%, 1 predictor = 6.0%, 2 predictors = 10.1%, ≥3 predictors = 15% (Duceppe 2017)

Lee, T. H.; Marcantonio, E. R.; Mangione, C. M.; Thomas, E. J.; Polanczyk, C. A.; Cook, E. F.; Sugarbaker, D. J.; Donaldson, M. C.; Poss, R.; Ho, K. K.; Ludwig, L. E.; Pedan, A.; Goldman, L. (1999). "Derivation and prospective validation of a simple index for prediction of cardiac risk of major noncardiac surgery". *Circulation*. **100** (10): 1043–1049.

Source	Crude Events, No.	Sample Size, No.	Odds Ratio (95% CI)
30-d MACE			
No prior stroke	1923	474046	1 [Reference]
Prior stroke anytime	389	7137	4.03 (3.55-4.57)
Stroke <3 mo prior	153	862	14.23 (11.61-17.45)
Stroke 3 to <6 mo prior	34	469	4.85 (3.32-7.08)
Stroke 6 to <12 mo prior	37	898	3.04 (2.13-4.34)
Stroke ≥12 mo prior	165	4908	2.47 (2.07-2.95)
30-d all-cause mortality			
No prior stroke	2914	474046	1 [Reference]
Prior stroke anytime	254	7137	1.75 (1.51-2.03)
Stroke <3 mo prior	66	862	3.07 (2.30-4.09)
Stroke 3 to <6 mo prior	21	469	1.97 (1.22-3.19)
Stroke 6 to <12 mo prior	29	898	1.45 (0.95-2.20)
Stroke ≥12 mo prior	138	4908	1.46 (1.21-1.77)
30-d ischemic stroke			
No prior stroke	368	474046	1 [Reference]
Prior stroke anytime	210	7137	16.24 (13.23-19.94)
Stroke <3 mo prior	103	862	67.60 (52.27-87.42)
Stroke 3 to <6 mo prior	21	469	24.02 (15.03-38.39)
Stroke 6 to <12 mo prior	16	898	10.39 (6.18-17.44)
Stroke ≥12 mo prior	70	4908	8.17 (6.19-10.80)

Odds Ratio (95% CI)

Prior stroke at ANY time is a very strong predictor of MACE!!
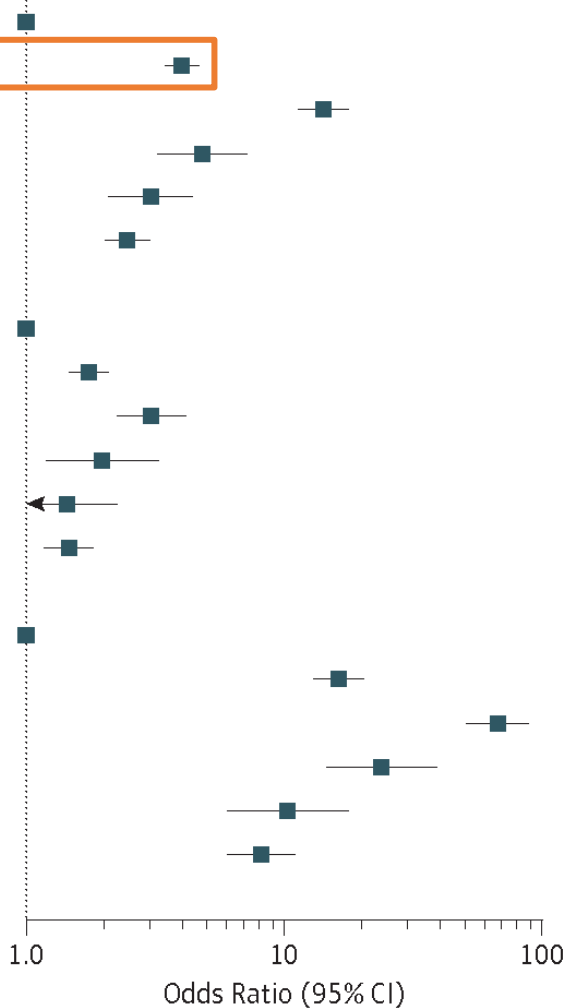
RCRI

Perioperative Major Adverse Cardiovascular and Cerebrovascular Events Associated With Noncardiac Surgery

Nathaniel R. Smilowitz, MD[1]; Navdeep Gupta, MD[2]; Harish Ramakrishna, MD[3]; et al

Supplemental Figure 2. Frequency of perioperative MACCE by RCRI score

Revised Cardiac Risk Index Score	MACCE per 100,000 Non-Cardiac Surgeries
Score of 0	1,261
1	3,416
2	5,788
3	7,871
4	9,345
5+	10,829
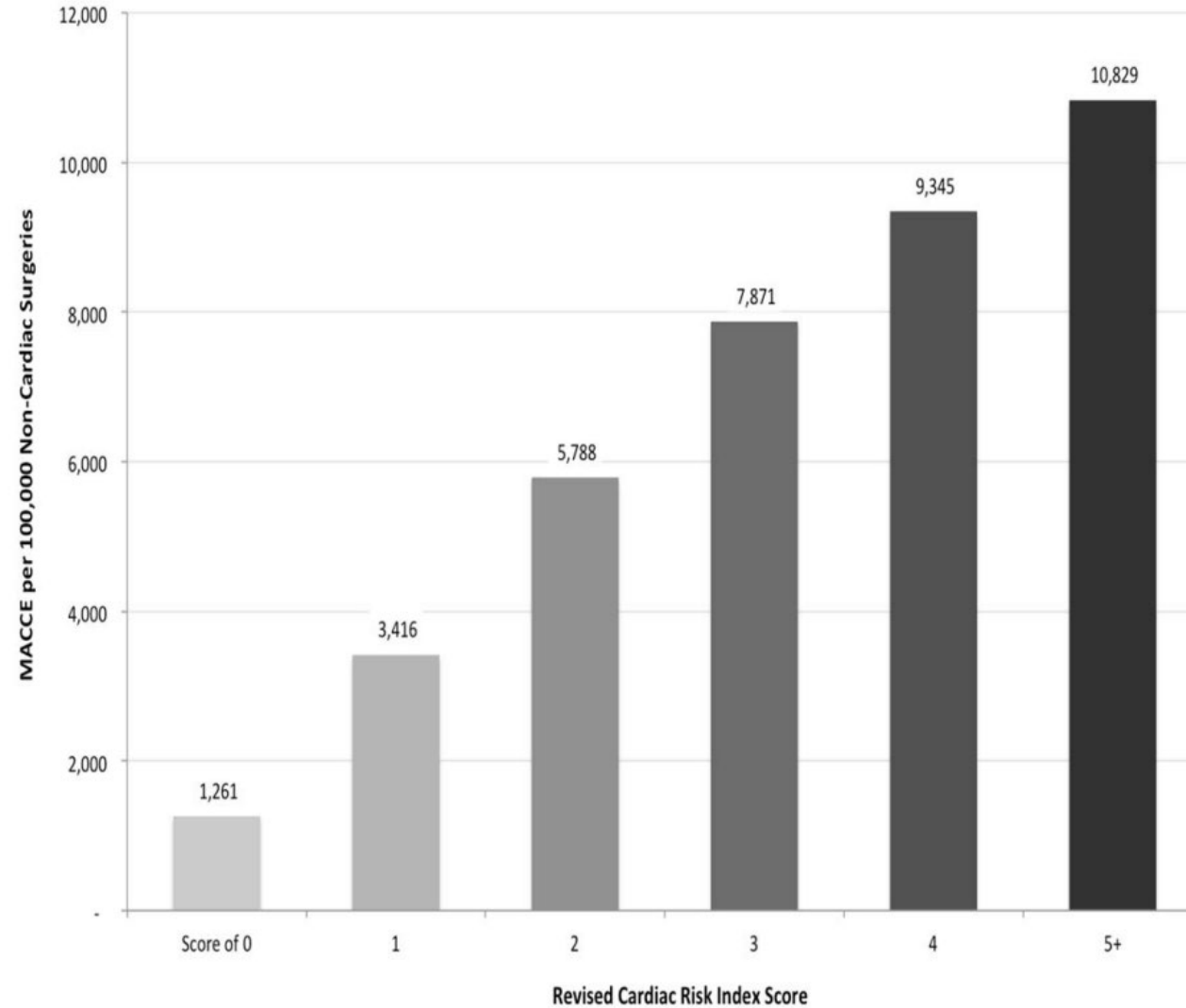
Patient risk: Functional capacity

- Can you walk 4 blocks?
  - A block is 80 meters.
  - If answer is no, risk of complications(MACE) is about double (RR 1.9)

Self-reported Exercise Tolerance and the Risk of Serious Perioperative Complications

Dominic F. Reilly, MD; Marguerite J. McNeely, MD, MPH; Diane Doerner, MD, PhD; Deborah L. Greenberg, MD; Thomas O. Staiger, MD; Michael J. Geist, MD; Philip A. Vedovatti, MD; John E. Coffey, MD; Marc W. Mora, MD; Timothy R. Johnson, MD; Eugenia D. Guray, MD; Gail A. Van Norman, MD; Stephan D. Fihn, MD, MPH

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Table 4. Patient Characteristics Associated With an Increased Risk for All Serious Perioperative Complications*

Patient Characteristics	No. of Patients With Complications/Total	Odds Ratios (95% CI)†	
		Age-Adjusted	Multivariable Model‡
Poor exercise tolerance	70/343	2.13 (1.33-3.42)	1.94 (1.19-3.17)
Smoking ≥20 pack-years	59/280	2.01 (1.29-3.13)	2.16 (1.36-3.44)
Coronary disease	32/142	1.64 (1.01-2.66)	NS
Peripheral vascular disease	20/76	1.97 (1.12-3.48)	NS
Prior myocardial infarction	19/72	1.98 (1.11-3.54)	NS
Congestive heart failure	19/52	3.38 (1.83-6.26)	2.88 (1.52-5.48)
Ventricular arrhythmia	14/44	2.55 (1.29-5.03)	NS
Dementia	5/10	4.54 (1.26-16.33)	5.54 (1.51-20.41)
Parkinson disease	5/8	8.26 (1.93-35.37)	8.14 (1.76-37.67)

ACS-NSQIP

- Built using data from over 5 million operations at over 800 hospitals between 2016-2020
  - Assess risk for 18 different outcomes within 30 days of surgery
  - Accounts for the type of procedure being performed
    - Based on CPT code

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 Group
[Under 65 years ▾]

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 ▪▪▪▫▫

Procedure: 34710 - Delayed placement of distal or proximal extension prosthesis for endovascular repair of infrarenal abdominal aortic or iliac aneurysm, false aneurysm, dissection, endoleak, or endograft migration, including pre-procedure sizing and device selection, all nonselective catheterization(s), all associated radiological supervision and interpretation, and treatment zone angioplasty/stenting, when performed; initial vessel treated

Risk Factors:

Change Patient Risk Factors

Note: Your Risk has been rounded to one decimal point.

Outcomes ℹ		Your Risk	Average Risk	Chance of Outcome
Serious Complication		1.8%	8.6%	Below Average
Any Complication		3.0%	10.7%	Below Average
Pneumonia		0.1%	1.4%	Below Average
Cardiac Complication		0.0%	1.9%	Below Average
Surgical Site Infection		0.6%	1.2%	Below Average
Urinary Tract Infection		0.2%	0.5%	Below Average
Venous Thromboembolism		0.2%	0.7%	Below Average
Renal Failure		0.0%	1.3%	Below Average
Readmission		1.7%	6.8%	Below Average
Return to OR		2.1%	4.6%	Below Average
Death		0.0%	2.1%	Below Average
Discharge to Nursing or Rehab Facility		0.3%	5.4%	Below Average
Sepsis		0.2%	1.1%	Below Average

Predicted Length of Hospital Stay: 1 day

How to Interpret the Graph Above:

Your Risk — Average Patient Risk — Your % Risk

X%
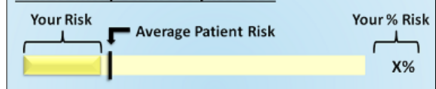
Surgeon Adjustment of Risks ℹ

This will need to be used infrequently, but surgeons may adjust the estimated risks if they feel the calculated risks are underestimated. This should only be done if the reason for the increased risks was NOT already entered into the risk calculator.

1 - No adjustment necessary ▾

Back   Continue

Step 3 of 4

Procedural-Patient Risk

- Independent Predictors of Risk (Relative Risk)
    - CAD RR 2.4
    - HF RR 1.9
    - DM2 RR 3.0
    - CVA/TIA RR 2.0
    - CKD RR 3.0
    - Poor functional capacity RR 1.9
    - High risk surgery RR 2.8
    - Vascular surgery RR 2.38!!
    - Emergent Surgery RR 7.4!!

Age-Specific Performance of the Revised Cardiac Risk Index for Predicting Cardiovascular Risk in Elective Noncardiac Surgery

Charlotte Andersson, MD, PhD, Mads Wissenberg, MD, Mads Emil Jørgensen, MB, Mark A. Hlatky, MD, Charlotte Mérie, MD, PhD, Per Føge Jensen, MD, PhD, MHM, Gunnar H. Gislason, MD, PhD, Lars Køber, MD, DSc, and Christian Torp-Pedersen, MD, DSc

ACS† (Step 2)

— Yes → Evaluate and treat according to GDMT†

— No → Estimated perioperative risk of MACE based on combined clinical/surgical risk (Step 3)

- Low risk (<1%) (Step 4) → No further testing (Class III:NB) → Proceed to surgery

- Elevated risk (Step 5) → Moderate or greater (≥4 METs) functional capacity

  - Excellent (>10 METs) → No further testing (Class IIa) → Proceed to surgery
  - Moderate/Good (≥4–10 METs) → No further testing (Class IIb) → Proceed to surgery
  - No or unknown → Poor OR unknown functional capacity (<4 METs): Will further testing impact decision making OR perioperative care? (Step 6)

    - Yes → Pharmacologic stress testing (Class IIa)
      - If normal → Proceed to surgery according to GDMT OR alternate strategies (noninvasive treatment, palliation) (Step 7)
      - If abnormal → Coronary revascularization according to existing CPGs (Class I) → Proceed to surgery according to GDMT OR alternate strategies (noninvasive treatment, palliation) (Step 7)
    - No → Proceed to surgery according to GDMT OR alternate strategies (noninvasive treatment, palliation) (Step 7)

Q4—What is the patient's functional capacity?

- How many METS?
  - What are METs?
  - Metabolic equivalent
    - Amount of O2 consumed at rest

What is the functional capacity?

- ACC/AHA guideline decision point is at ≥4 METS

Physical activity	MET
Light intensity activities	**< 3**
sleeping	0.9
watching television	1.0
writing, desk work, typing	1.8
walking, 1.7 mph (2.7 km/h), level ground, strolling, very slow	2.3
walking, 2.5 mph (4 km/h)	2.9
Moderate intensity activities	**3 to 6**
bicycling, stationary, 50 watts, very light effort	3.0
walking 3.0 mph (4.8 km/h)	3.3
calisthenics, home exercise, light or moderate effort, general	3.5
walking 3.4 mph (5.5 km/h)	3.6
bicycling, <10 mph (16 km/h), leisure, to work or for pleasure	4.0
bicycling, stationary, 100 watts, light effort	5.5
Vigorous intensity activities	**> 6**
jogging, general	7.0
calisthenics (e.g. pushups, situps, pullups,jumping jacks), heavy, vigorous effort	8.0
running jogging, in place	8.0
rope jumping	10.0

Who should get testing?/What test?

- The best "test" is a good history
  - Trying to uncover→
    - Unstable coronary syndrome
    - Decompensated heart failure
      - Important to understand etiology/physiology
        - HFpEF vs HFrEF vs HCM etc
    - Significant arrhythmia
    - Severe valvular disease
      - Severe AS, asymptomatic 3% risk of mortality 30days
      - Severe regurgitant disease about half that risk

REMEMBER

- Cardiovascular complications are caused by
  - Catecholeamine surges
  - Volume shift
  - Blood loss
  - Plaque rupture
  - pro-thrombotic milieu
  - Fixed coronary stenosis
- Stress testing only identifies fixed coronary disease

Clinical Assessment Only
1,081 patients

Estimated risk level ▶
Observed event rate ▶
95% Confidence interval ▶

Low
3%(10/344)
(1-7%)

Moderate
8%(42/550)
(6-10%)
p<.0001

High
18%(35/187)
(12-24%)

Dipyridamole
Thallium
344 patients

Low
3%(9/281)
(2-6%)

Moderate
3%(1/33)
(0-16%)
p = .618

High
0%(0/30)
(0-12%)

Dipyridamole
Thallium
550 patients

Low
3%(11/348)
(2-6%)

Moderate
9%(7/76)
(4-18%)
p<.0001

High
19%(24/139)
(13-26%)

Dipyridamole
Thallium
187 patients

Low
12%(3/25)
(3-31%)

Moderate
7%(2/31)
(0-21%)
p=.107

High
24%(28/131)
(15-30%)

Patients undergoing vascular surgery (AAA repairs)

Who should get pre-op testing?

- Patients <65, no history of CV
  - No testing
    - Family history of genetic cardiomyopathy
      - Routine ECG, TTE prior to NCS
- Patients 45-65 without CVD
  - ECG should be considered before high-risk NCS
- Patients over 65 or with known CVD
  - ECG prior to intermediate and high-risk NCS

Which tests should we order?

- ACC/AHA guidelines
  - Pharmacologic stress echo, pharmacologic stress nuclear
    - Patients with elevated risk with poor function capacity IF changes management
      - The role of CCTA is unknow at this point
- ESC
  - High risk patient, AND high risk surgery AND poor/unknown functional capacity if it will change management
- If it won't change anything, then you don't need the test
- Recommendations for stress test is for elective procedures, NOT urgent procedures.

Who should not get testing? What testing should I not order?

- Low risk patients undergoing low and intermediate risk NCS (Class III)
- Routine evaluation of LV function
- Routine stress imaging prior to NCS
- Routine swan-ganz catheters
- Routine post-operative cardiac biomarkers

But they have coronary disease, don't they need a cath first?

- NO
- The indications for coronary angiography/revascularization are the same as in the non-surgical setting
  - Exception
    - Class IIb, in patients with stable chronic coronary disease undergoing elective surgical CEA
- CARP Trial
  - Revascularization prior to vascular surgery(elective)
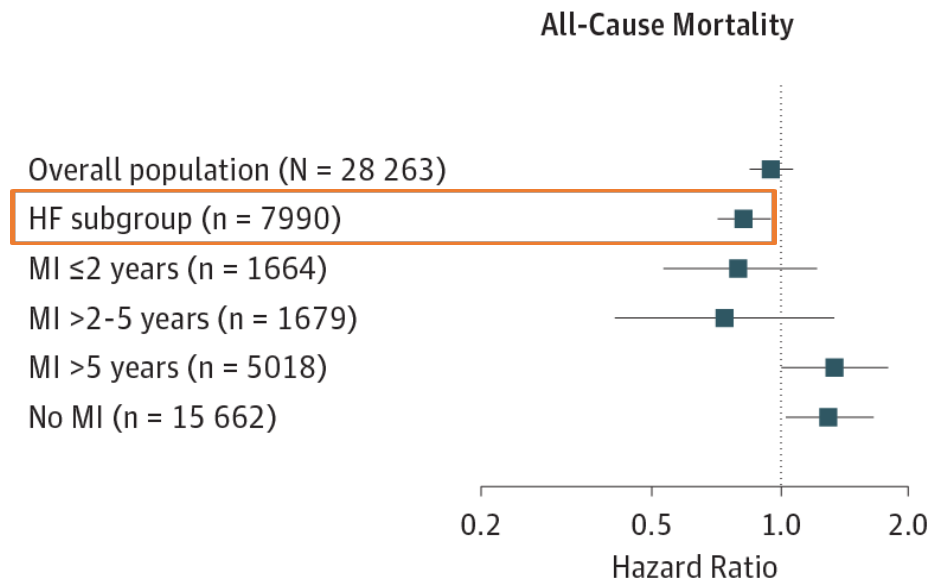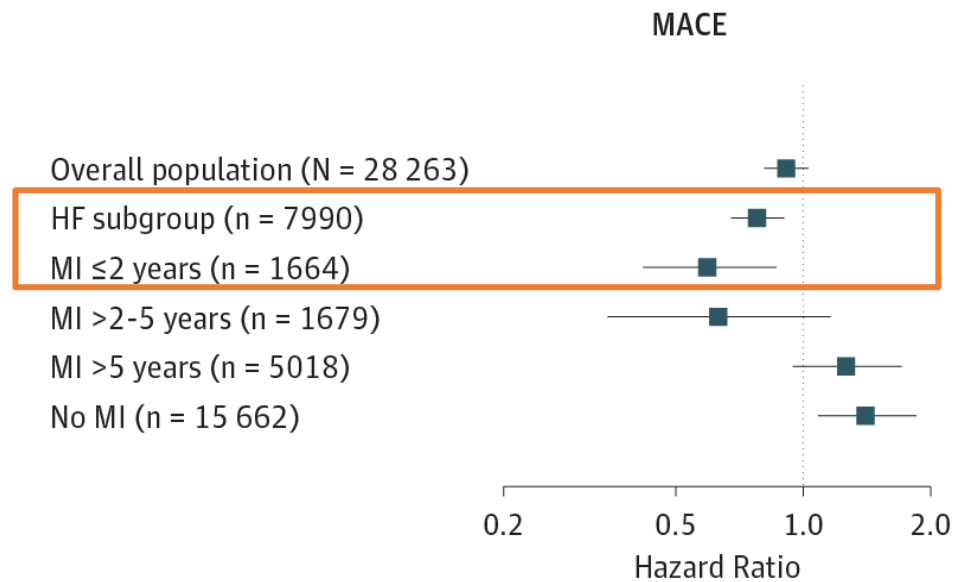 - No benefit

What do I do with abnormal results?

- Manage same way if surgery wasn't happening
  - Based on risk of test result
- Revascularization to get someone through an operation is of no benefit(CARP)
  - Doesn't improve outcomes
    - Left main disease, 3 vessel different story. These patients should be revascularized regardless of NCS plans

What medical therapy should I be thinking about?

- Beta blockers have been recommended in:
    - Patients with ≥2 RCRI risk factors undergoing high-risk NCS
        - Titration recommended
    - Preferred BB is B-1 selectives
    - POISE Trial, do not start beta blocker within 24 hours of NCS, ideally start at least 1 week prior
        - Started patients on 100mg toprol XL
        - Morality WORSE!
    - Don't stop beta blocker if they are already on one
    - Also don't routinely START beta blocker either
- Indication to start statin but most pts are already on them
    - Reduce perioperative risk by about 1/3
    - Should be started prior to vascular surgery, ideally ≥ 2 weeks prior to surgery
- Do not start aspirin prior to surgery
    - No reduction in MACE, but increase in bleeding
- On other hand do not stop aspirin

Beta-Blockers

MACE

Overall population (N = 28 263)
HF subgroup (n = 7990)
MI ≤2 years (n = 1664)
MI >2-5 years (n = 1679)
MI >5 years (n = 5018)
No MI (n = 15 662)

0.2   0.5   1.0   2.0
Hazard Ratio

All-Cause Mortality

Overall population (N = 28 263)
HF subgroup (n = 7990)
MI ≤2 years (n = 1664)
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0.2   0.5   1.0   2.0
Hazard Ratio

March 2014

Association of β-Blocker Therapy With Risks of Adverse Cardiovascular Events and Deaths in Patients With Ischemic Heart Disease Undergoing Noncardiac Surgery
A Danish Nationwide Cohort Study

What meds can I stop?

- Patients without HF
  - Can stop RAAS to avoid intra-op hypotension
- Patients on diuretics for <u>hypertension</u>
  - Can stop prior to surgery
- SGLT2i(Farxiga, Jardiance)
  - Class IIa to stop 3 days prior to intermediate, high-risk NCS
  - Reduces risk of Euglycemic DKA

Conclusions

- Routine testing is not recommended
- Make decisions regardless of the non-cardiac surgery