

# How Do We Use Frailty Index to Optimize Results for Our Patients?

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M E D I C I N E

# DISCLOSURE

## Christopher Abullarage, MD

- No relevant financial relationship reported

# Frailty

- A biologic syndrome defined by a culmination of declining physiologic systems resulting in decreased reserve and resistance to stressors culminating in vulnerability to adverse outcomes
- **How sick is this patient I am about to operate on?**
- **What is their risk of complications?**

# Background

- Patient Frailty
  - Important preoperative assessment
    - Determine if patients will survive the procedure
    - Will patients live long enough to benefit from the intervention
  - Independent predictor of adverse outcomes across many specialties
  - How to quantify frailty?
  - Applicability to vascular surgery?

# Measures of Risk

- Eye ball test
- Traditional
  - ASA class, RCRI
- Calculated Frailty Indices
  - Canadian Study on Health and Aging
  - NSQIP mFI
- Online Calculators

# Measures of Risk

## Eyeball test



*“I shall not today attempt further to define the kinds of material I understand to be embraced within ‘hard-core pornography’, and perhaps I could never succeed in intelligibly doing so. But **I know it when I see it...**”*

– Judge Potter Stewart, *Jacobellis v. Ohio*, 1966

# Measures of Risk

## Eyeball test

Original article

### Predicting postoperative morbidity by clinical assessment

P. M. Markus, J. Martell, I. Leister, O. Horstmann, J. Brinker and H. Becker

Department of General Surgery, Georg-August Universität Goettingen, Robert Kochstrasse 40, 37075 Goettingen, Germany

*British Journal of Surgery* 2005; 92: 101–106

- Only study to evaluate surgeon's assessment of perioperative risk
- 1077 patients – major abdominal surgery
- Surgeon's gut feeling vs. Physiological and Operative Severity Score for the Enumeration of Mortality and Morbidity (POSSUM)

# Measures of Risk

## Eyeball test

Original article

### Predicting postoperative morbidity by clinical assessment

P. M. Markus, J. Martell, I. Leister, O. Horstmann, J. Brinker and H. Becker

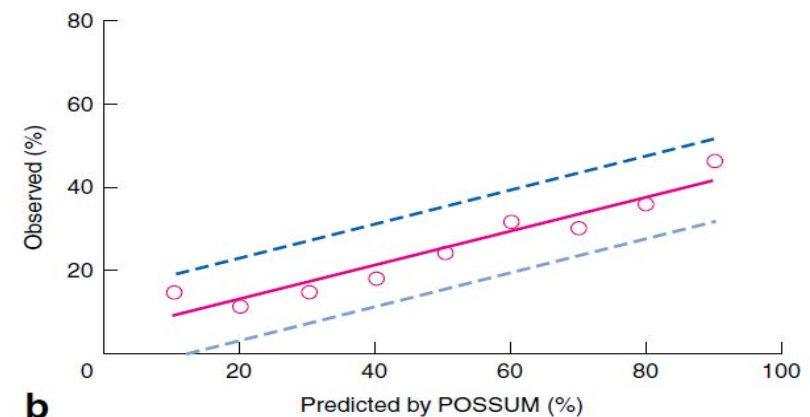
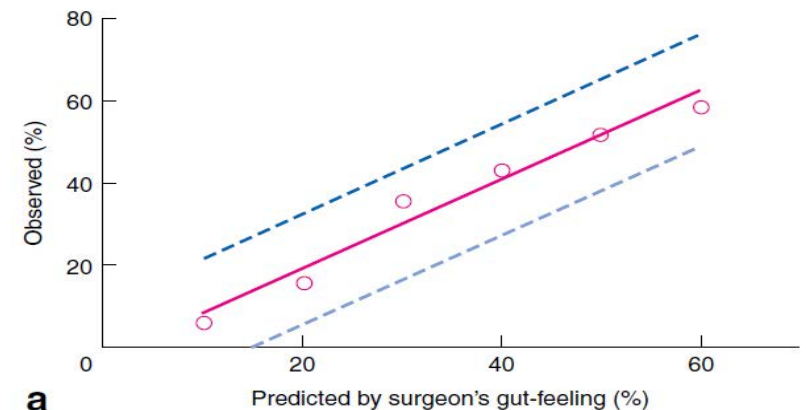
Department of General Surgery, Georg-August Universität Goettingen, Robert Kochstrasse 40, 37075 Goettingen, Germany

*British Journal of Surgery* 2005; 92: 101–106

## Conclusions

- Surgeon's gut feeling is a good predictor of postoperative outcome

## Morbidity





# Measures of Risk

## Eyeball test

Original article

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## Problems

- Only abdominal and hepatobiliary surgery
- Not reproducible
  - Interobserver variability is invariably high

# Measures of Risk

## Traditional

### ASA Classification

ASA PS Classification	Definitions	Examples, including, but not limited to:
ASA 1	Normal healthy patient	Non-smoking. Minimal etoh.
ASA 2	Mild systemic disease	Smoker. BMI 30-40. Pregnant. Well controlled HTN/DM. Mild lung dz. Minimal functional limitations.
ASA 3	Severe systemic disease	ESRD on dialysis. Poorly controlled HTN/DM. Substance abuse. Moderate CHF. Moderate/severe functional limitations.
ASA 4	Systemic disease that is a constant threat to life	Recent MI, CVA, TIA, stents (<3 mos). Severe CHF. Active CAD. Severe valvular dysfunction. Sepsis. ESRD not on dialysis.
ASA 5	Moribund patient who is not expected to survive w/o the operation	Ruptured TAAA, ruptured AAA, massive trauma, ICH with MLS
ASA 6	Organs are being removed for donation	

# Measures of Risk

## ASA Class

Original research

ASA class is a reliable independent predictor of medical complications and mortality following surgery



Nicholas J. Hackett <sup>a</sup>, Gildasio S. De Oliveira <sup>b</sup>, Umang K. Jain <sup>a</sup>, John Y.S. Kim <sup>a,\*</sup>

<sup>a</sup> Department of Surgery, Northwestern University, Chicago, IL, USA

<sup>b</sup> Department of Anesthesiology, Northwestern University, Chicago, IL, USA

*International Journal of Surgery* 18 (2015) 184–190

- ACS-NSQIP
- 2 million surgical cases
- Multiple surgical specialties
- Purpose: Assess predictive value of ASA class for complications and mortality

# Measures of Risk

## ASA Class

Original research

ASA class is a reliable independent predictor of medical complications and mortality following surgery



Nicholas J. Hackett <sup>a</sup>, Gildasio S. De Oliveira <sup>b</sup>, Umang K. Jain <sup>a</sup>, John Y.S. Kim <sup>a,\*</sup>

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**Table 3**  
Regression results of ASA PS<sup>a,b</sup>.

ASA PS	Medical complications				Mortality			
	P value	Odds ratio	95% confidence interval		P value	Odds ratio	95% confidence interval	
			Lower	Upper			Lower	Upper
1	–	1 (reference)	–	–	–	1 (reference)	–	–
2	0.000	2.049	1.956	2.146	0.000	5.769	4.033	8.253
3	0.000	4.995	4.767	5.233	0.000	47.171	33.11	67.203
4	0.000	16.809	16.008	17.650	0.000	292.895	205.479	417.499
5	0.000	63.254	57.968	69.022	0.000	2011.921	1403.249	2884.609
Z-score <sup>c</sup>	0.000	1.426	1.417	1.436	0.000	2.123	2.092	2.154

# Measures of Risk

## ASA Class

Original research

ASA class is a reliable independent predictor of medical complications and mortality following surgery



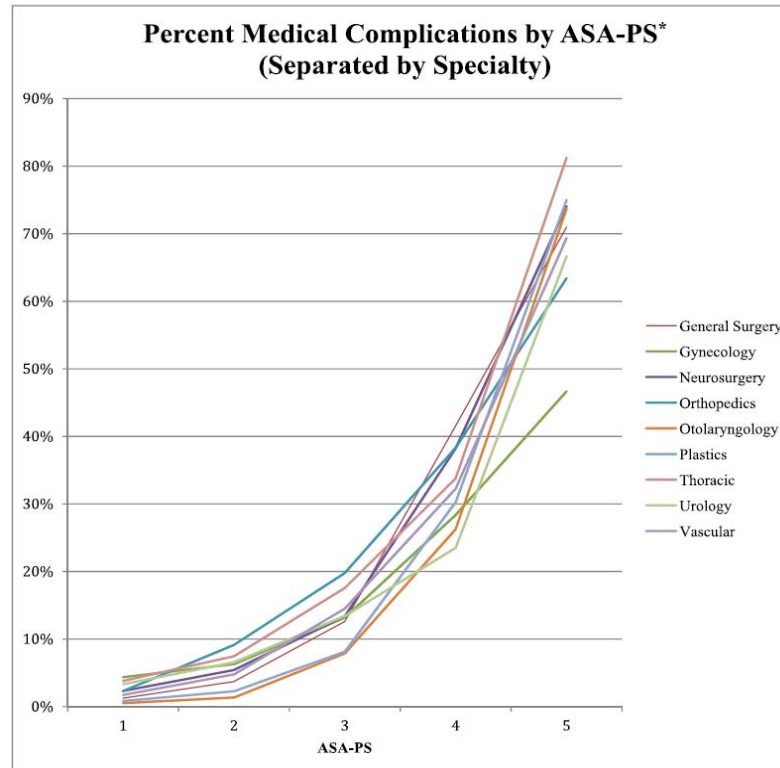
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**-Not surgery specific**  
**-No comparison**



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# Measures of Risk

## Traditional



### REVISED CARDIAC RISK INDEX

#### Independent Predictors of Post Operative cardiac complications

1. Intrathoracic, intraperitoneal, or infrainguinal vascular surgery
2. History of ischemic heart disease
3. History of congestive heart failure
4. Insulin treatment for diabetes mellitus
5. Serum creatinine level > 2mg/dL
6. History of cerebrovascular disease

Scoring (no. of predictors present)	Risk of major cardiac complications
None	0.4%
One	0.9%
Two	7.0%
More than two	11%

# Measures of Risk

## RCRI

REVIEW

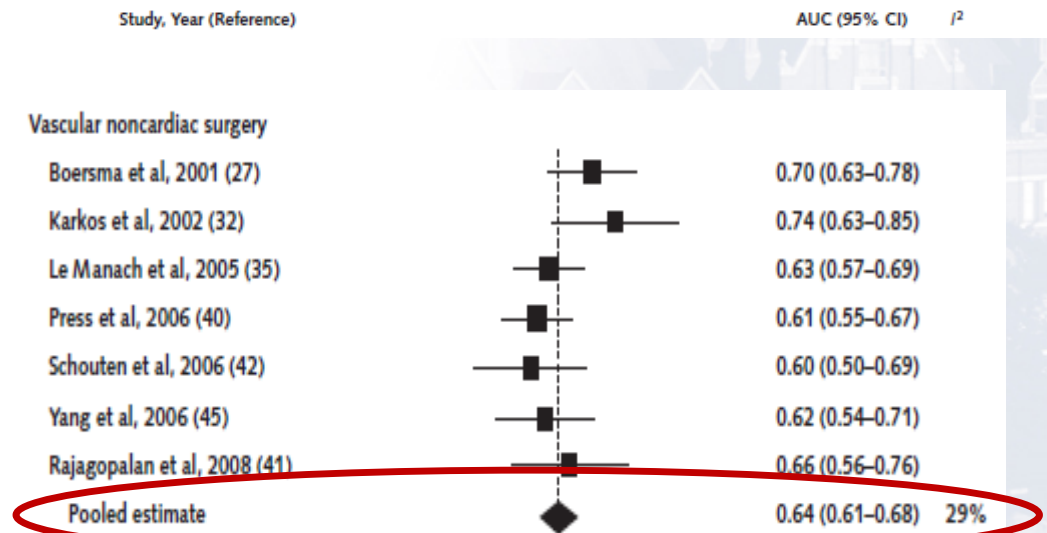
Annals of Internal Medicine

### Systematic Review: Prediction of Perioperative Cardiac Complications and Mortality by the Revised Cardiac Risk Index

Meredith K. Ford, MD, MSc; W. Scott Beattie, MD, PhD; and Duminda N. Wijeyesundera, MD

- 24 studies
- RCRI good for everything but vascular surgery

Figure 2. AUC for predicting perioperative cardiac events and all-cause mortality.



# Measures of Risk

## CSHA Frailty Index

A global clinical measure of fitness and frailty in elderly people

Kenneth Rockwood, Xiaowei Song, Chris MacKnight, Howard Bergman, David B. Hogan, Ian McDowell, Arnold Mitnitski CMAJ • AUG. 30, 2005; 173 (5)

- Canadian Study on Health and Aging
  - 2305 elderly patients
- 70 measures
- Purpose: “Develop a tool that would be both predictive and easy to use”

### Box 1: The CSHA Clinical Frailty Scale

- 1 *Very fit* — robust, active, energetic, well motivated and fit; these people commonly exercise regularly and are in the most fit group for their age
- 2 *Well* — without active disease, but less fit than people in category 1
- 3 *Well, with treated comorbid disease* — disease symptoms are well controlled compared with those in category 4
- 4 *Apparently vulnerable* — although not frankly dependent, these people commonly complain of being “slowed up” or have disease symptoms
- 5 *Mildly frail* — with limited dependence on others for instrumental activities of daily living
- 6 *Moderately frail* — help is needed with both instrumental and non-instrumental activities of daily living
- 7 *Severely frail* — completely dependent on others for the activities of daily living, or terminally ill

Note: CSHA = Canadian Study of Health and Aging.



# Measures of Risk

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Table 2: Cox proportional hazard ratios (HR) for time until death and until the requirement for institutional care

Factor	Death, HR (95% CI)	Entry into institution, HR (95% CI)
Age	1.08 (1.07–1.08)	1.15 (1.10–1.13)
Sex	0.83 (0.78–0.89)	1.38 (1.21–1.58)
Education level*	0.98 (0.97–0.99)	0.98 (0.97–0.99)
Modified Mini-Mental State Examination	0.84 (0.82–0.86)	0.65 (0.60–0.70)
Cumulative Illness Rating Scale	1.14 (1.11–1.17)	1.22 (1.16–1.27)
CSHA measuring tools		
Rules-based definition of frailty	1.17 (1.13–1.20)	1.27 (1.19–1.35)
Frailty Index	1.26 (1.24–1.29)	1.56 (1.48–1.65)
Function Scale	1.16 (1.13–1.20)	1.29 (1.20–1.39)
Clinical Frailty Scale	1.30 (1.27–1.33)	1.46 (1.39–1.53)

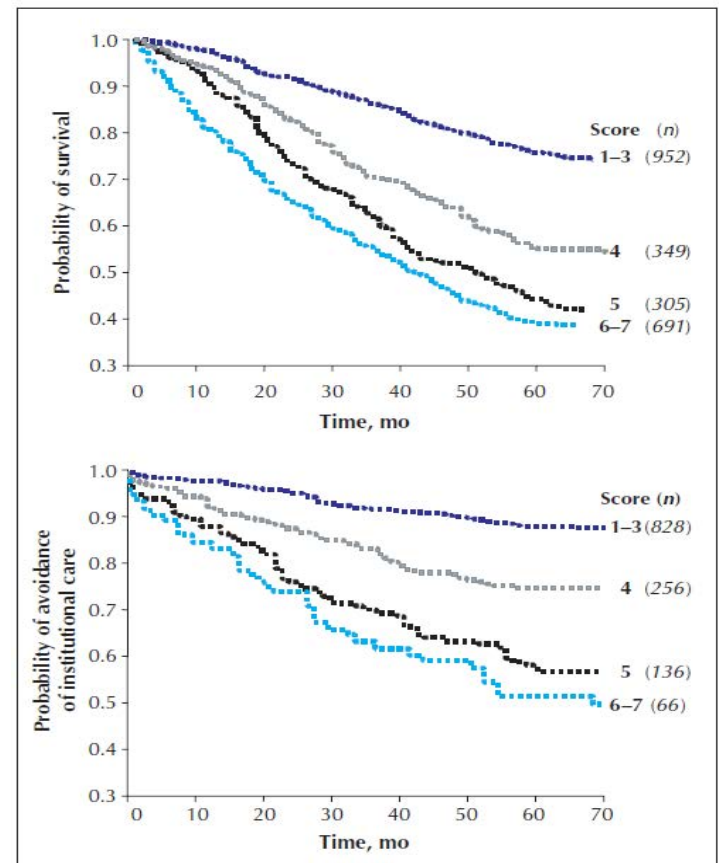
Note: CI = confidence interval, CSHA = Canadian Study of Health and Aging. All scales were adjusted for age, sex and number of years of education, and recategorized into 7-level scales to compare with the Clinical Frailty Scale.

\*Univariate estimate.

Heart and Vascular Institute



Pearson Coefficient 0.80.  $P < 0.01$



# Measures of Risk

## CSHA Frailty Index

- Changes in everyday activities
- Head and neck problems
- Poor muscle tone in neck
- Bradykinesia, facial
- Problems getting dressed
- Problems with bathing
- Problems carrying out personal grooming
- Urinary incontinence
- Toileting problems
- Bulk difficulties
- Rectal problems
- Gastrointestinal problems
- Problems cooking
- Sucking problems
- Problems going out alone
- Impaired mobility
- Musculoskeletal problems
- Bradykinesia of the limbs
- Poor muscle tone in limbs
- Poor limb coordination
- Poor coordination, trunk
- Poor standing posture
- Irregular gait pattern

- Falls
- Mood problems
- Feeling sad, blue, depressed
- History of depressed mood
- Tiredness all the time

**70 Data Points**

- Impairment of loss
- Impaired vibration
- Tremor at rest
- Postural tremor
- Intention tremor
- History of Parkinson disease
- Family history of degenerative disease

- Seizures, partial complex
- Seizures, generalized
- Syncope or blackouts
- Headache
- Cerebrovascular problems
- History of stroke
- History of diabetes mellitus
- Arterial hypertension
- Peripheral pulses
- Cardiac problems
- Myocardial infarction
- Arrhythmia
- Congestive heart failure
- Lung problems
- Respiratory problems
- History of thyroid disease
- Thyroid problems
- Skin problems
- Malignant disease
- Breast problems
- Abdominal problems
- Presence of snout reflex
- Presence of palmomental reflex
- Other medical history

# Measures of Frailty

## mFI

- Modified Frailty Index
  - 11 data points
  - Time efficient, easy to use

<u>General</u>	<u>PAD</u>	<u>CAD</u>	<u>CVD</u>	<u>Comorbid Dz</u>
Impaired sensorium	CLI	Recent MI/angina	TIA/Stroke	HTN
Dependent Functional Status	Prior revasc/ amputation	Prior CABG/PCI		Diabetes
		CHF		COPD/Pneumonia

# Purpose

To compare the utility of this modified Frailty Index to predict adverse outcomes against other recognized and commonly used risk indices in vascular surgery populations

# Methods

From the Society for Vascular Surgery

## Validation of a modified Frailty Index to predict mortality in vascular surgery patients

Bryan A. Ehlert, MD,<sup>a</sup> Alireza Najafian, MD,<sup>b</sup> Kristine C. Orion, MD,<sup>a</sup> Mahmoud B. Malas, MD, MS,<sup>a</sup> James H. Black III, MD,<sup>a</sup> and Christopher J. Abularrage, MD,<sup>a</sup> *Baltimore, Md*  
(*J Vasc Surg* 2016;63:1595-601.)

- ACS-NSQIP database
  - Carotid revascularization
  - Aortic aneurysm repair
  - Lower extremity revascularization
- Patient populations: Open & Endo

# Methods

From the Society for Vascular Surgery

## Validation of a modified Frailty Index to predict mortality in vascular surgery patients

Bryan A. Ehlert, MD,<sup>a</sup> Alireza Najafian, MD,<sup>b</sup> Kristine C. Orion, MD,<sup>a</sup> Mahmoud B. Malas, MD, MS,<sup>a</sup> James H. Black III, MD,<sup>a</sup> and Christopher J. Abularrage, MD,<sup>a</sup> *Baltimore, Md*  
(*J Vasc Surg* 2016;63:1595-601.)

- Comparative indices
  - Lee Cardiac Risk Index (LCRI)
  - American Society of Anesthesiologists (ASA)

# Methods

- Study endpoints
  - Primary: 30-day mortality
  - Secondary: Clavien-Dindo Class IV complications
    - Septic shock
    - Cardiac arrest
    - ARF with hemodialysis
    - Unplanned intubation
    - Graft failure
    - Myocardial infarction
    - Pulmonary embolism
    - Ventilation >48 hours
    - Coma/stroke
- Receiver operating characteristic
  - Area Under Curve analysis

# 30d Morbidity & Mortality



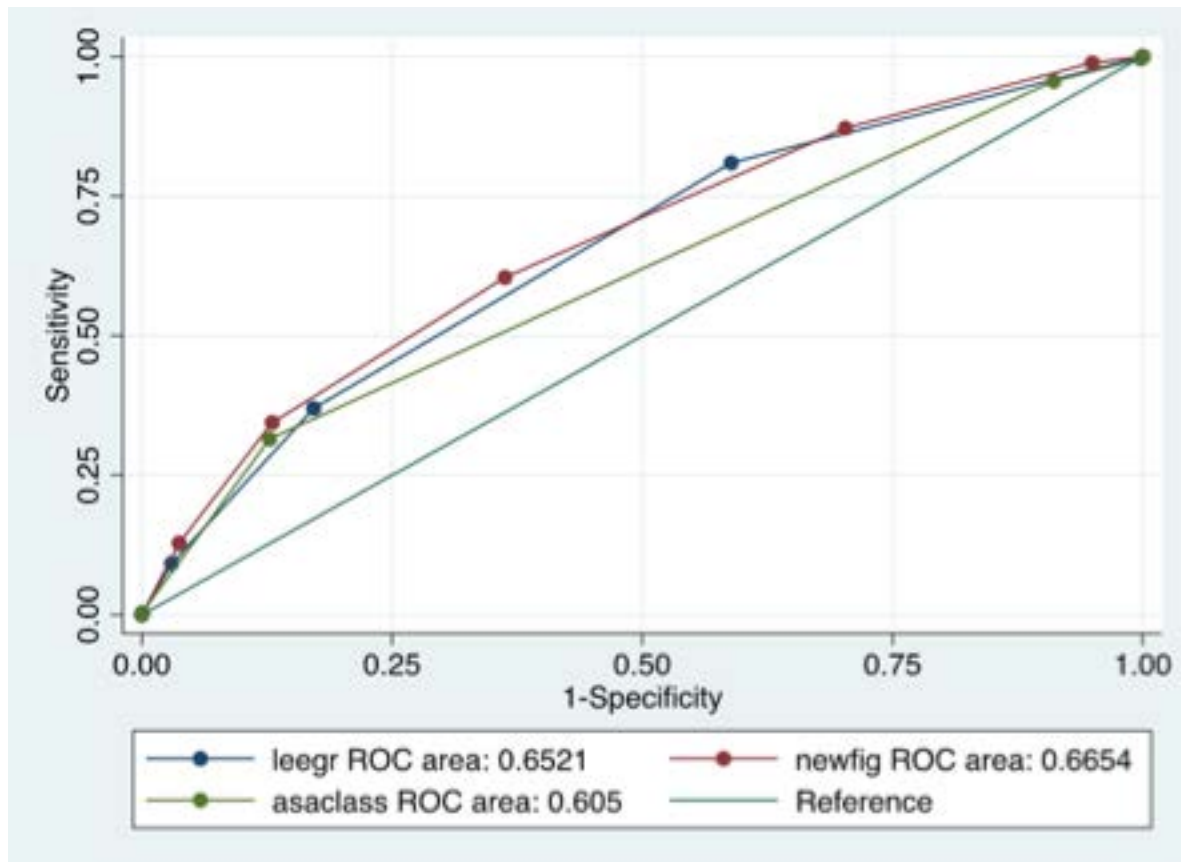
Table II. Morbidity and mortality of the open and endovascular cohorts

Outcome	AAA		P	PAD		P	Carotid stenosis		P
	Open (n = 5621), No. (%)	EVAR (n = 15,354), No. (%)		LEB (n = 8367), No. (%)	PVI (n = 1833), No. (%)		CEA (n = 40,803), No. (%)	CAS (n = 128), No. (%)	
Mortality	196 (3)	223 (1)	< .001	159 (2)	21 (1)	.02	273 (<1)	0 (0)	.35
Clavien-Dindo class IV complications	800 (14)	541 (4)	<.001	455 (5)	32 (2)	<.001	835 (2)	3 (2)	.81

AAA, Abdominal aortic aneurysm; CAS, carotid artery stenting; CEA, carotid endarterectomy; EVAR, endovascular aortic aneurysm repair; LEB, lower extremity bypass; PAD, peripheral arterial disease; PVI, peripheral vascular intervention.

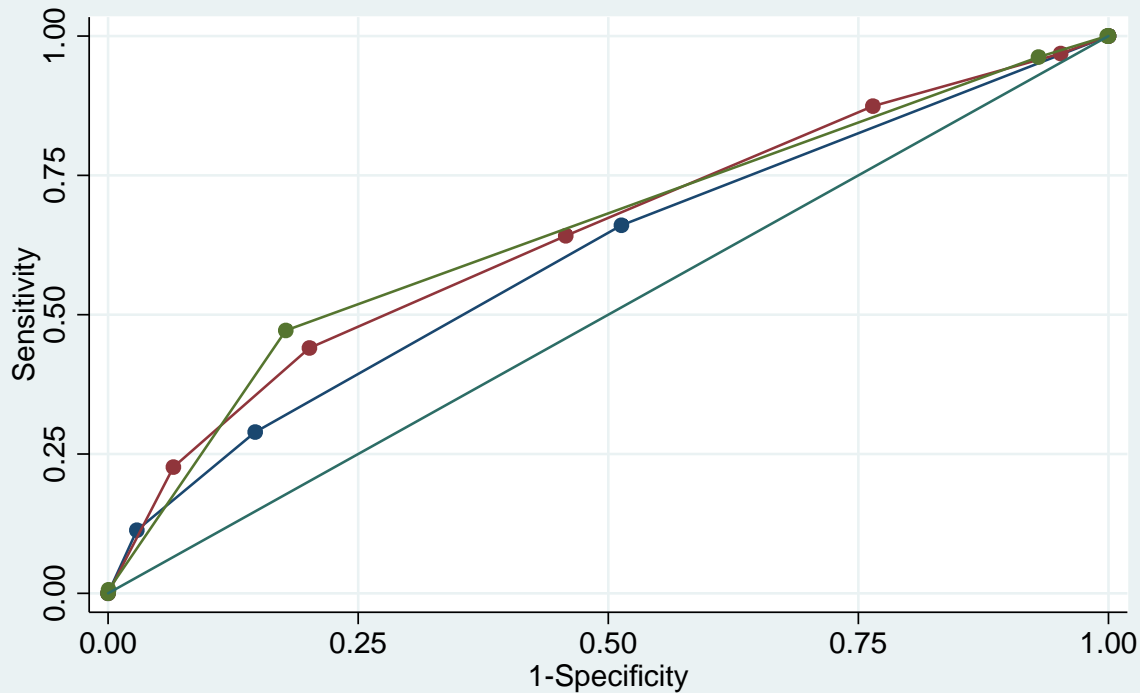


# Carotid Endarterectomy Mortality



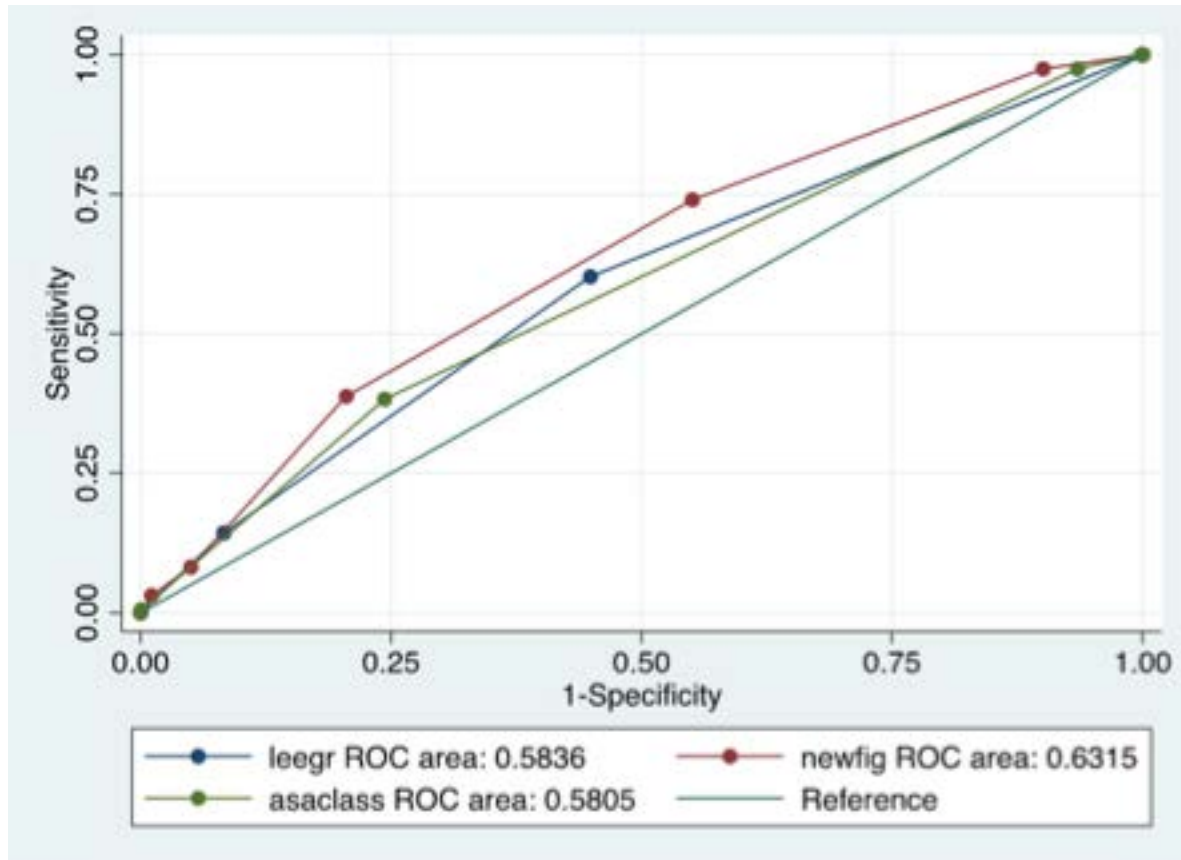
*P-value = 0.002*

# Open LEB Mortality



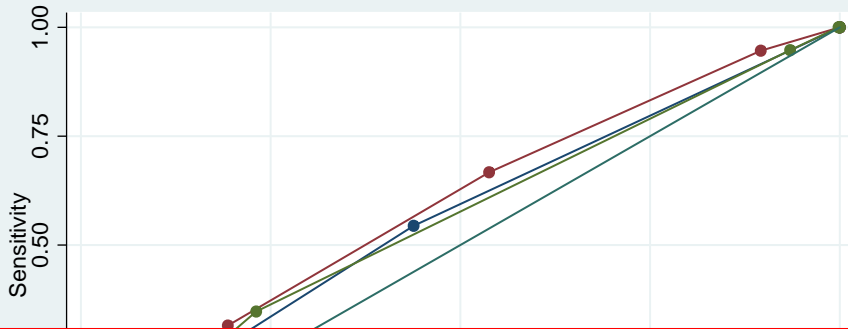
*P-value = 0.08*

# Open Aneurysm Mortality



*P-value = 0.02*

# Aneurysm Morbidity

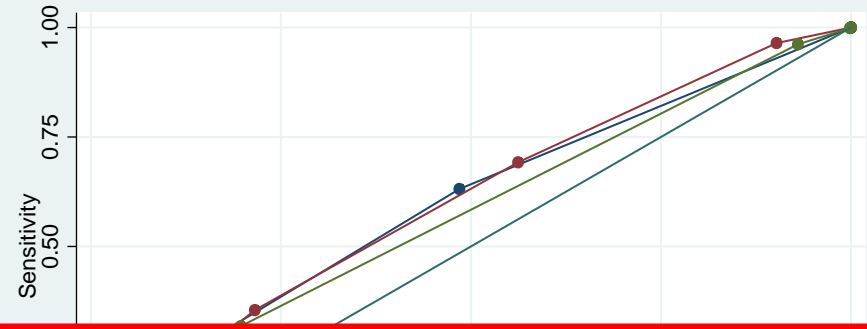


***CHF***

***OR 2.51, P=.01***

Open AAA

*P*-value = <0.01



***Dep FS***

***OR 2.96, P<.0001***

EVAR

*P*-value = 0.01

# Frailty in Practice

## Online Calculators

- Procedure
  - Fem-Pop with vein
- Patient
  - 72 yo, Male, 6 ft, 200 lbs, smoker
- Comorbidities
  - IDDM, HTN, ESRD on HD
- ASA3

# Measures of Frailty Online Calculators



## Surgical Risk Calculator



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Inspiring Quality. Highest Standards. Better Outcomes

[Risk Calculator Home Page](#) [About](#) [FAQ](#) [ACS Website](#) [ACS NSQIP Website](#)

### Enter Patient and Surgical Information

Procedure

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"


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 <input type="text" value="65-74 years"/>	Diabetes <input type="checkbox"/> Insulin <input type="text"/>
Sex <input type="text" value="Male"/>	Hypertension requiring medication <input type="checkbox"/> Yes <input type="text"/>
Functional Status <input type="text" value="Independent"/>	Congestive Heart Failure in 30 days prior to surgery <input type="checkbox"/> No <input type="text"/>
Emergency Case <input type="checkbox"/> No <input type="text"/>	Dyspnea <input type="checkbox"/> No <input type="text"/>
ASA Class <input type="text" value="Severe systemic disease"/>	Current Smoker within 1 Year <input type="checkbox"/> Yes <input type="text"/>
Steroid use for chronic condition <input type="checkbox"/> No <input type="text"/>	History of Severe COPD <input type="checkbox"/> No <input type="text"/>
Ascites within 30 days prior to surgery <input type="checkbox"/> No <input type="text"/>	Dialysis <input type="checkbox"/> Yes <input type="text"/>
Systemic Sepsis within 48 hours prior to surgery <input type="checkbox"/> None <input type="text"/>	Acute Renal Failure <input type="checkbox"/> No <input type="text"/>
Ventilator Dependent <input type="checkbox"/> No <input type="text"/>	BMI Calculation: Height: <input type="text" value="70"/> in / <input type="text" value="178"/> cm Weight: <input type="text" value="200"/> lb / <input type="text" value="90"/> kg
Disseminated Cancer <input type="checkbox"/> No <input type="text"/>	


Step 2 of 4

# Measures of Frailty Online Calculators



**ACS  
NSQIP<sup>®</sup>**

## Surgical Risk Calculator



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Risk Calculator Home Page
About
FAQ
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**Procedure:** 35556 - Bypass graft, with vein, femoral-popliteal  
**Risk Factors:** 65-74 years, ASA Severe systemic disease, Diabetes (Insulin), HTN, Smoker, Dialysis, Over Weight

Change Patient Risk Factors

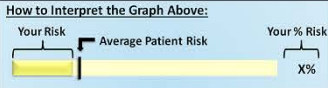
Note: *Your Risk* has been rounded to one decimal point.

Outcomes ⓘ	Your Risk	Average Risk	Chance of Outcome
Serious Complication	22.7%	16.4%	Above Average
Any Complication	26.3%	20.0%	Above Average
Pneumonia	1.3%	0.9%	Above Average
Cardiac Complication	5.1%	1.7%	Above Average
Surgical Site Infection	10.8%	7.7%	Above Average
Urinary Tract Infection	0.6%	0.9%	Below Average
Venous Thromboembolism	0.8%	0.8%	Average
Renal Failure	This outcome is inapplicable to patients with pre-op renal failure or dialysis.		
Readmission	18.7%	12.5%	Above Average
Return to OR	12.4%	9.8%	Above Average
Death	1.5%	0.7%	Above Average
Discharge to Nursing or Rehab Facility	24.9%	13.2%	Above Average

**Predicted Length of Hospital Stay: 6 days**

ⓘ Appropriate Potential Surgical and Non-operative Treatment Options Are Also Available and Should Be Discussed

**How to Interpret the Graph Above:**



Your Risk: \_\_\_\_\_ Average Patient Risk: \_\_\_\_\_

**Surgeon Adjustment of Risks ⓘ**

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

# Summary

- Applicability of mFI
  - Simplified definition of frailty
  - Based on objective data
  - Not limited to single organ system
- Predicts significant morbidity in AAA populations
- Utility as preoperative mortality risk assessment
  - Superior compared to other established indices
  - Low yield in endovascular populations



# Summary

- Frailty indices in practice
  - Better than traditional measures of risk
  - Time consuming
  - Not really modifiable
    - Patient's frailty cannot be changed
  - Online calculators simplify the process
  - Utility
    - Complex patients undergoing complex procedures
    - Patient education

