Stress Testing in Women

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Disclosures: None

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Purposes of Stress Testing

- Diagnosis (probability) CAD
- Prognosis (risk stratification)
- Other

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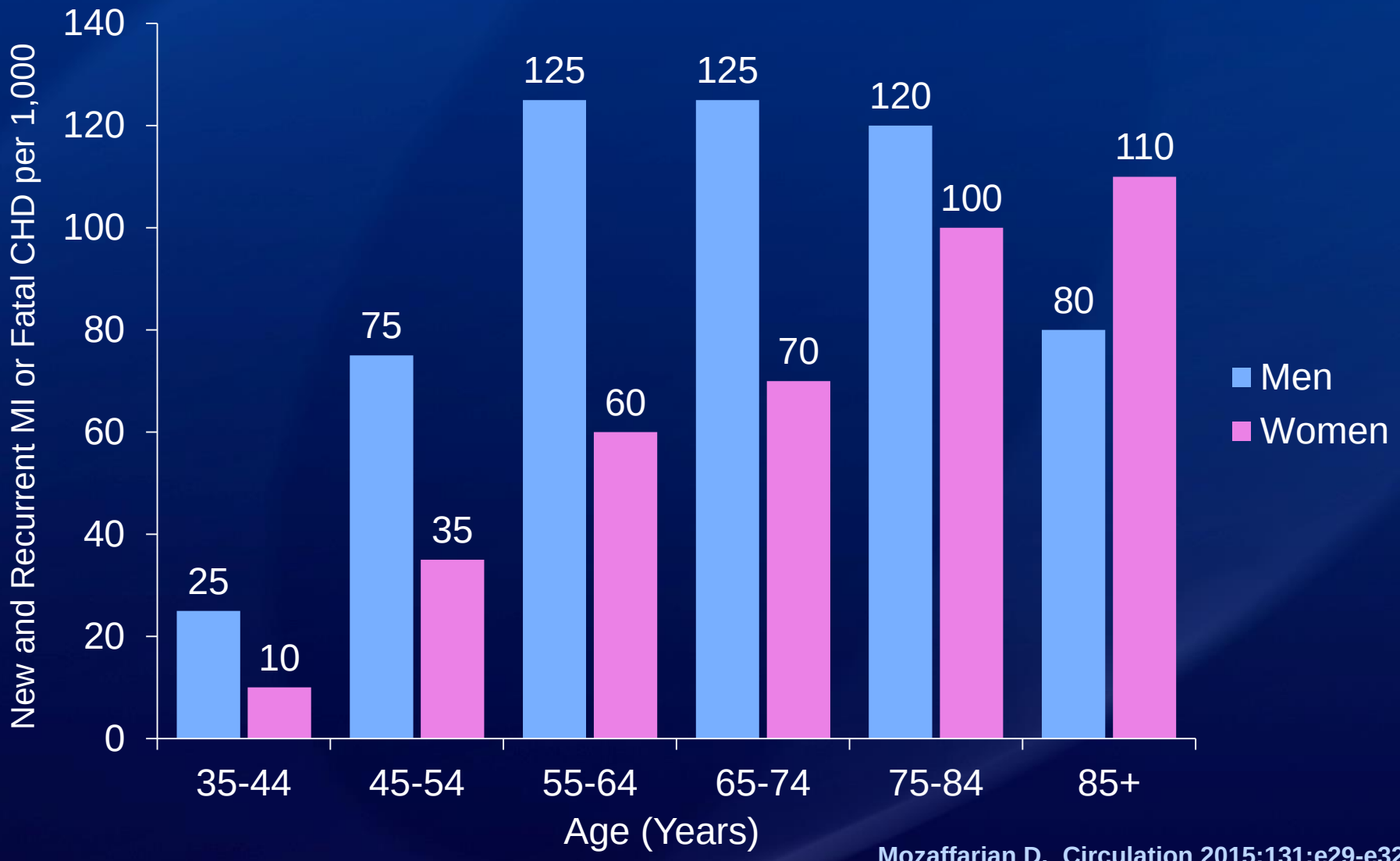
Factors Affecting Diagnostic Accuracy Exercise ECG

- Prevalence CAD in population (Sp = $\frac{TN}{TN + FP}$)
- Exercise performance
- Resting ECG
- Medications
- Gender specific
  - Hormone status (digoxin)
  - Abnormal coronary tone
  - Microvascular disease

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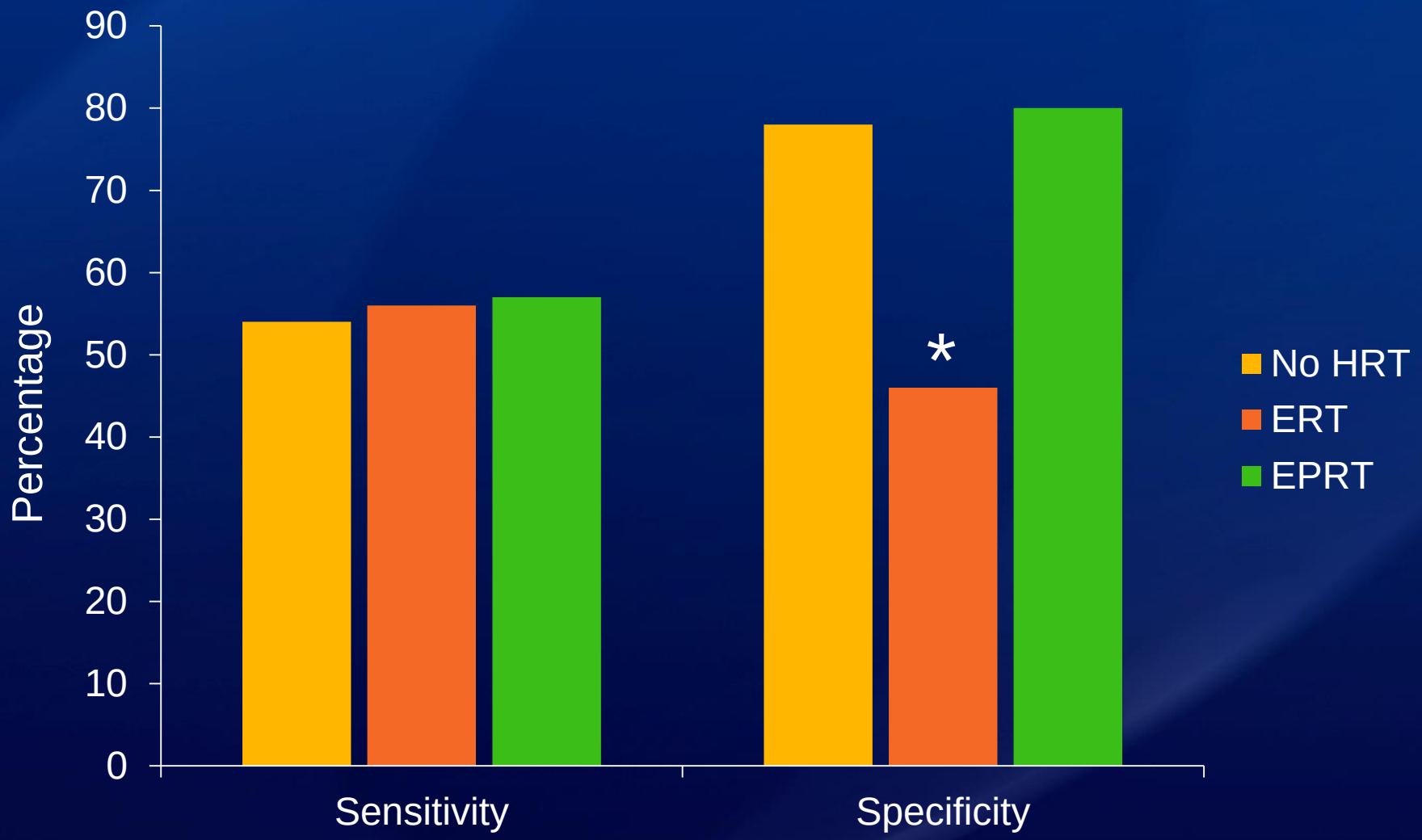
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MI/CD By Age and Sex
ARIC and CHS



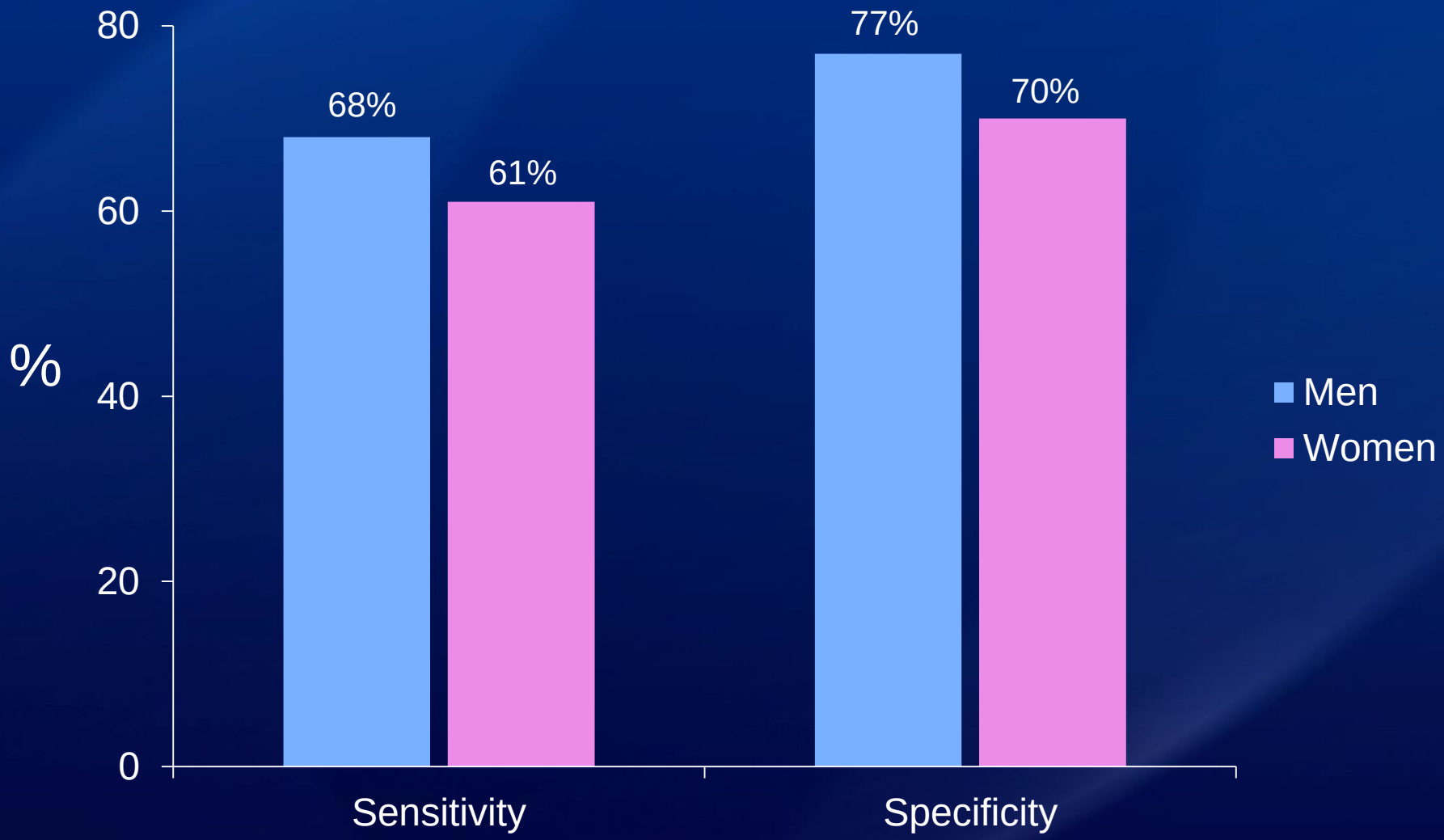
Mozaffarian D. Circulation 2015;131:e29-e322

Effect Hormone Therapy Exercise ECG



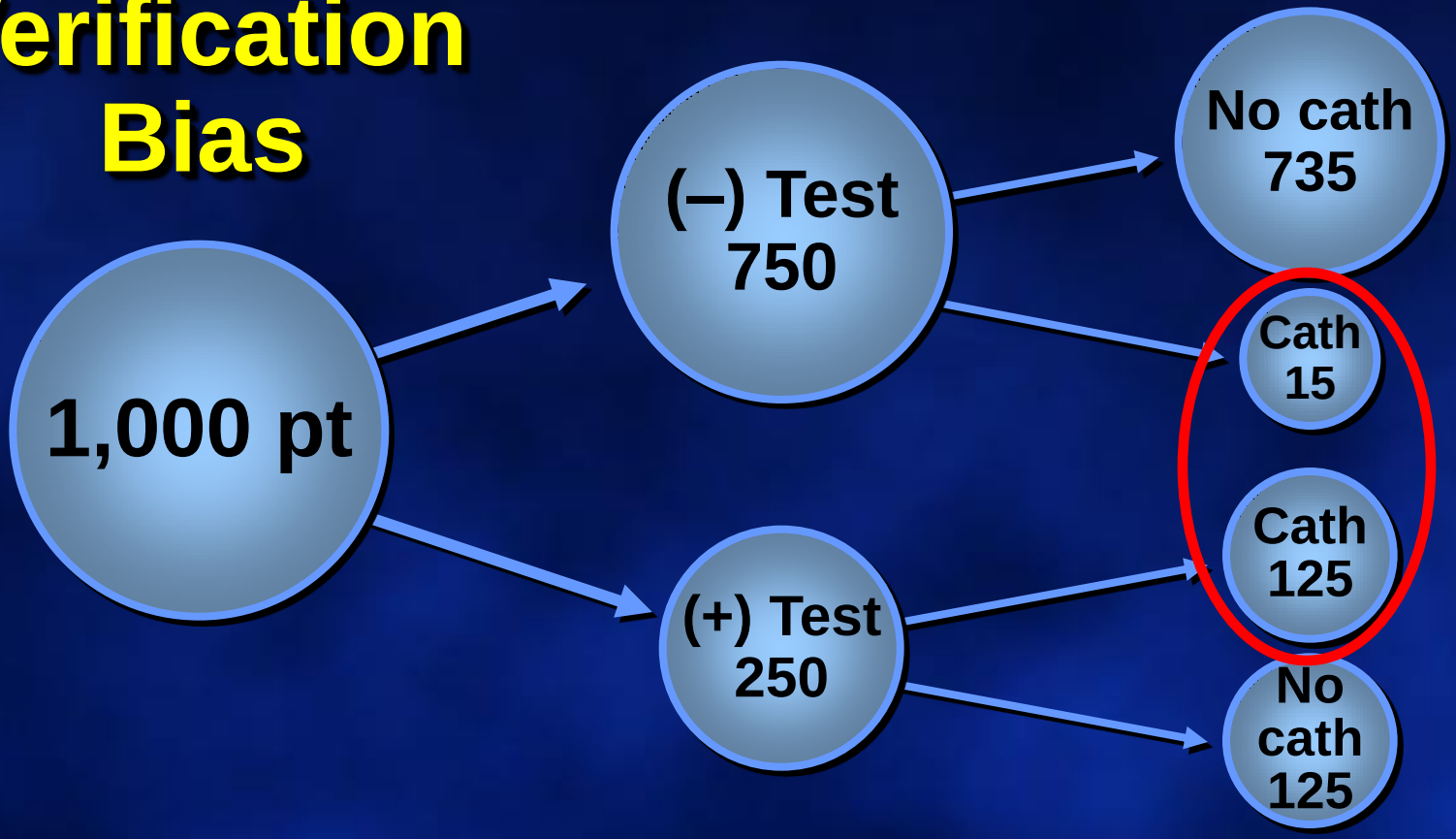
Bokhari S. JACC 2002;40:1092

Meta-Analysis Exercise ECG



Gianrossi R. Circ 1989;80:87
Kwok Y. AJC 1999;83:660

Verification Bias

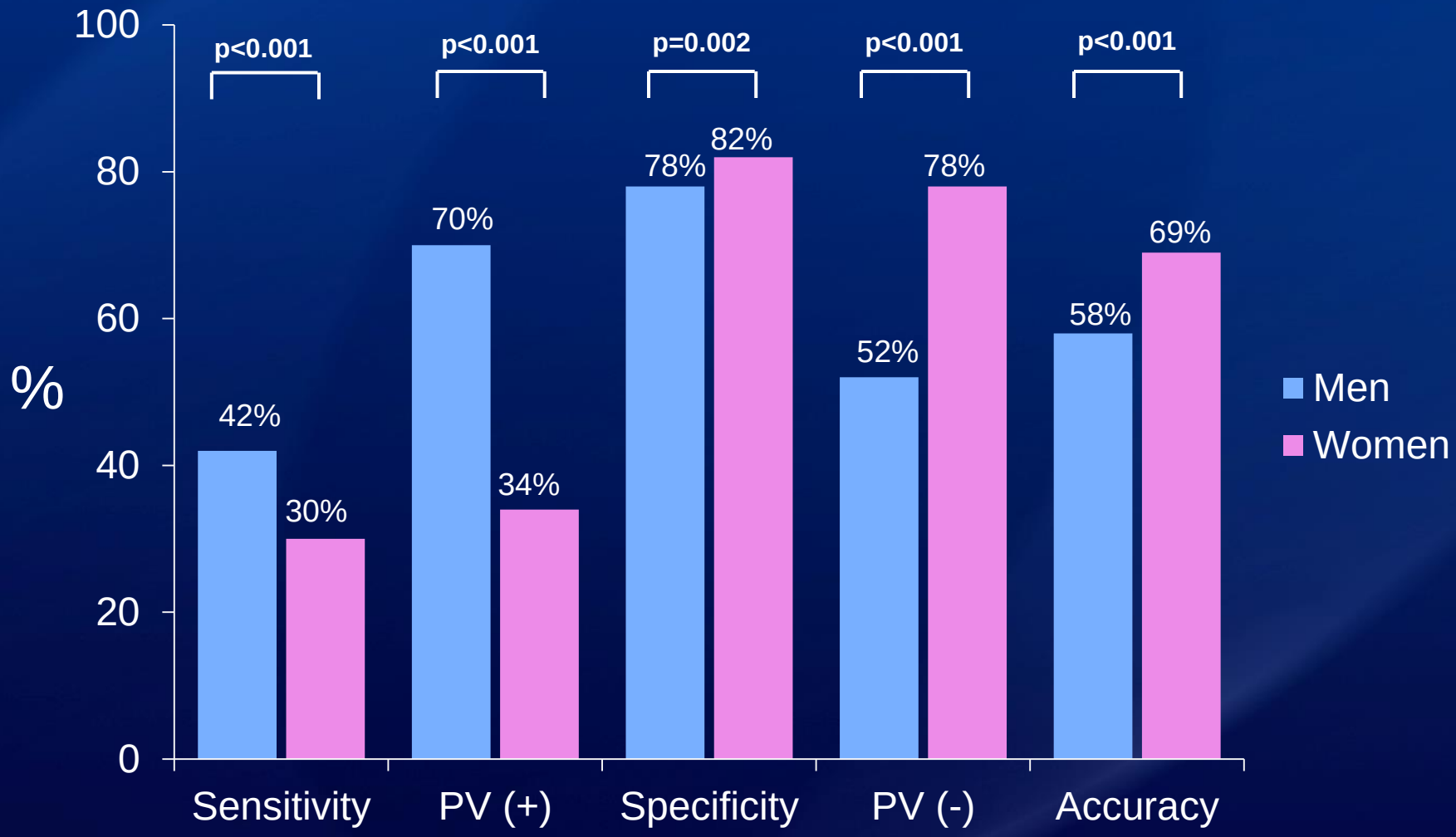


$$Se = \frac{TP}{TP + FN}$$

$$Sp = \frac{TN}{TN + FP}$$

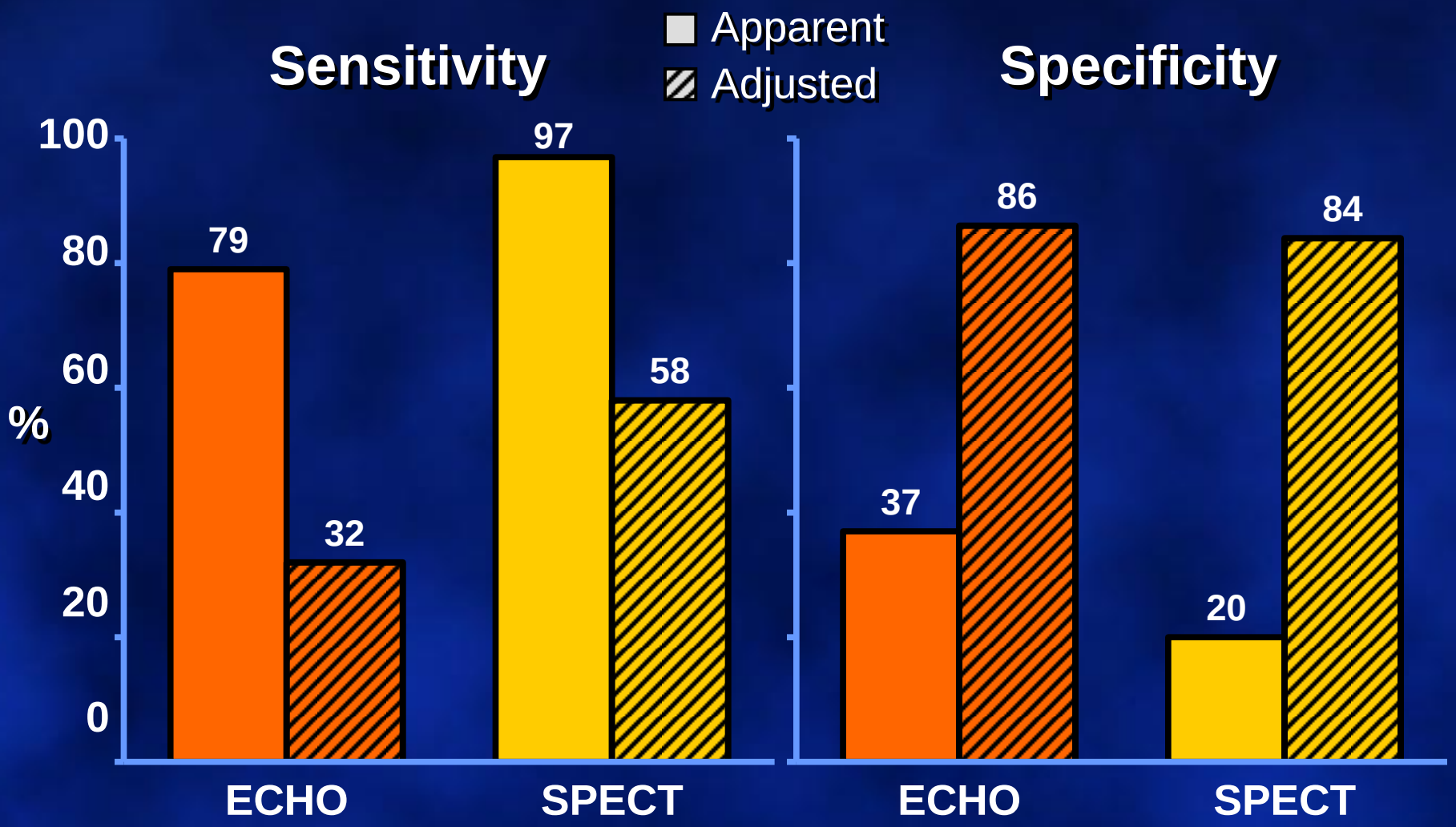
Begg CB and Greenes RA: Biometrics 39:207, 1983
Diamond GA: AJC 5:1175, 1986

Exercise ECG
MPI Reference Standard



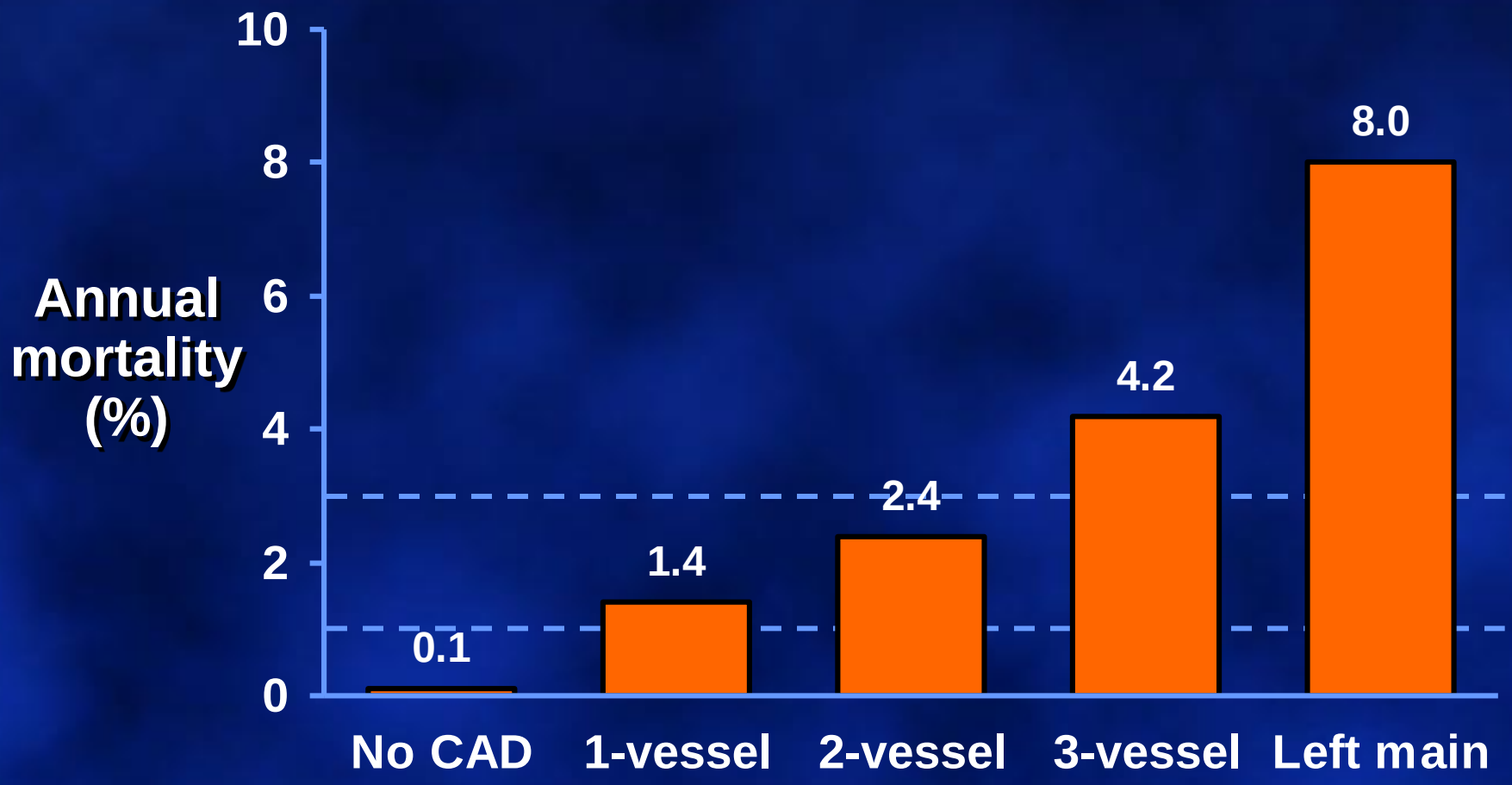
Miller TD. AJC 2001;87:868

Impact of Verification Bias – Women



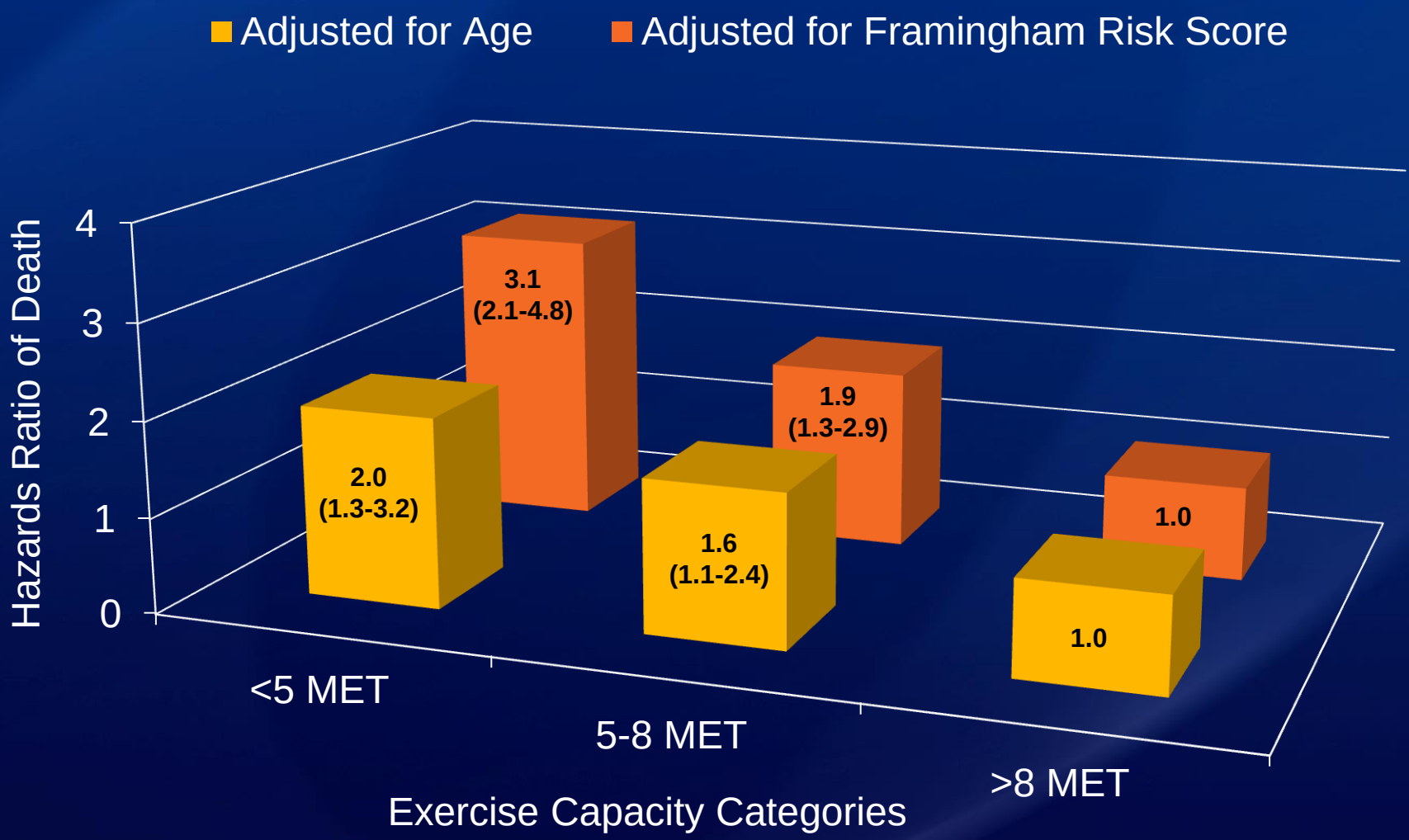
Roger VL. Circ 1997;95:405
Miller TD. AJM 2002;112:290

CAD Prognostic Index



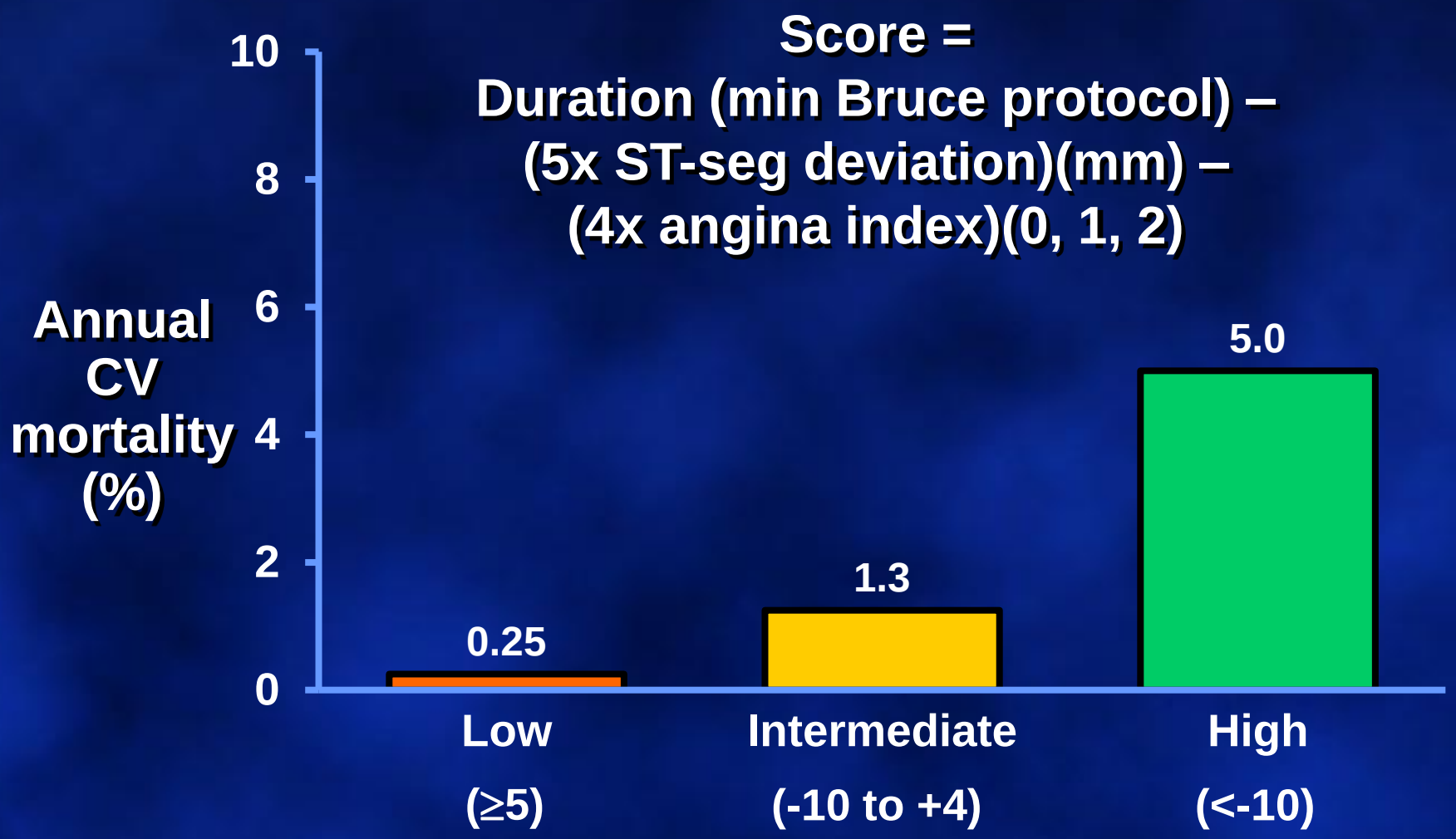
Califf RM: JACC 27:964, 1996

Prognostic Value Exercise Capacity
St. James WTH Project



Gulati M. Circulation 2003;108;1554

Duke Treadmill Score

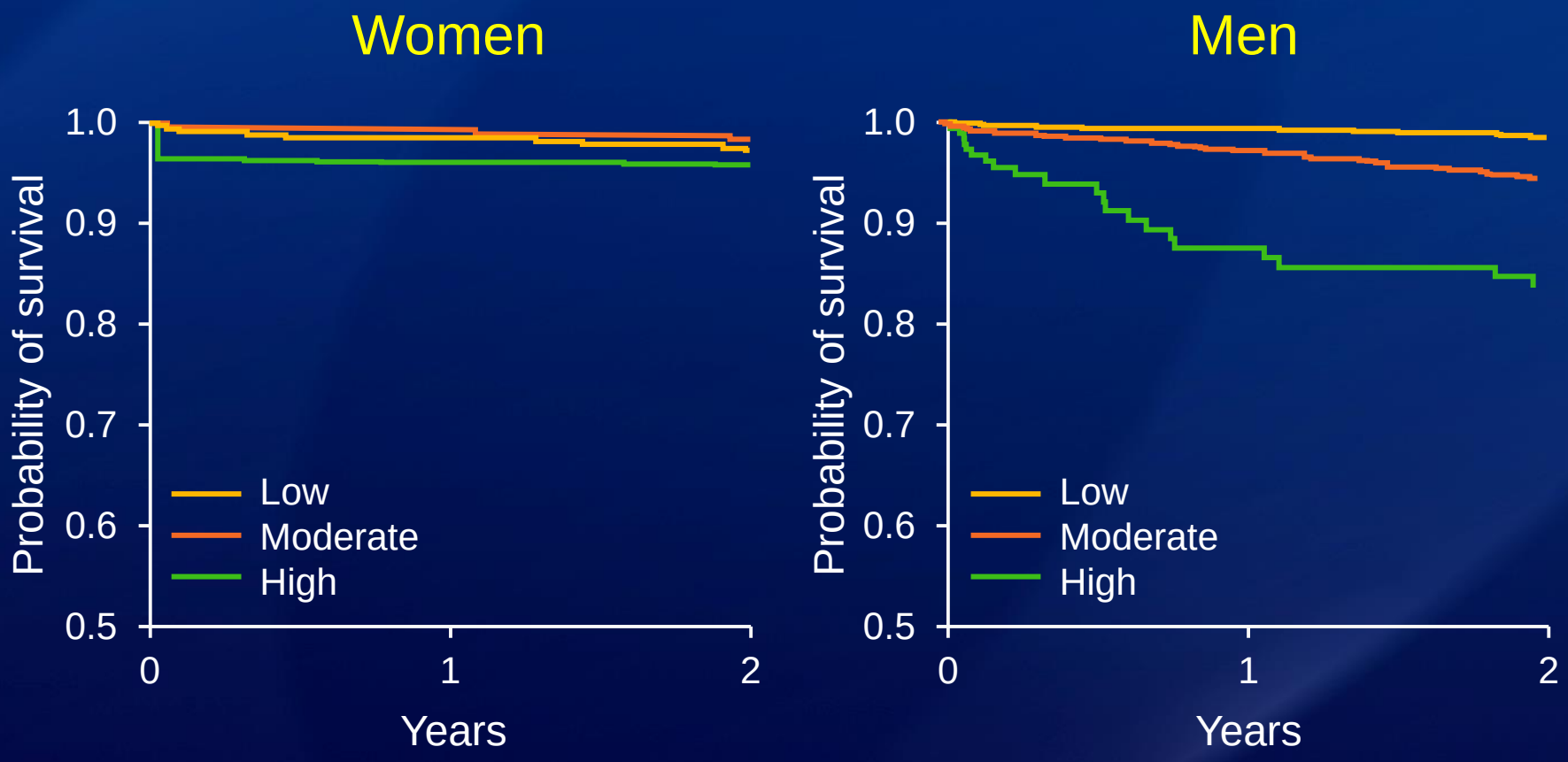


Mark DB: NEJM 325:849, 1991

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Duke Treadmill Score



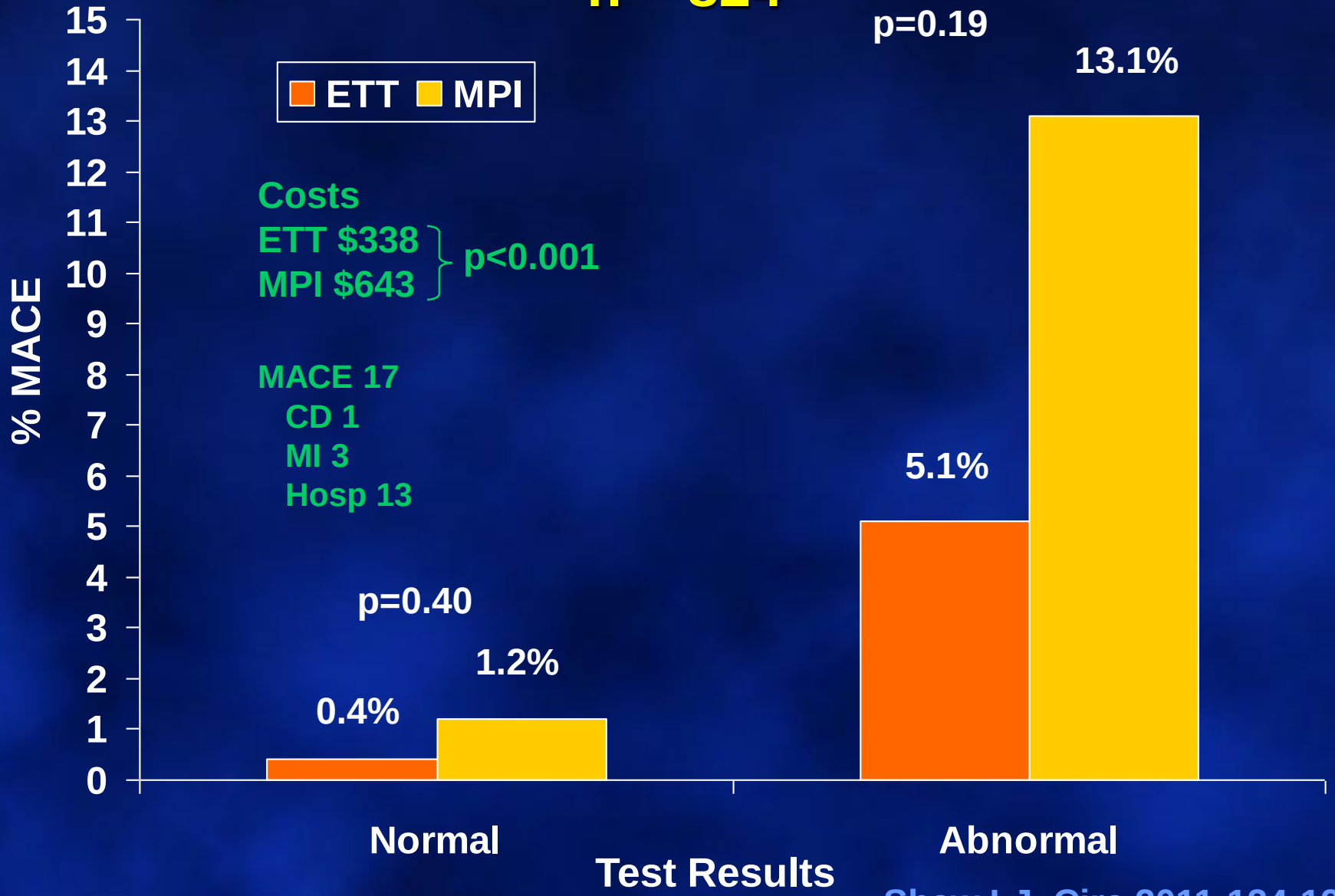
Alexander K. J Am Coll Cardiol1998;32:1657

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WOMEN Trial

n = 824

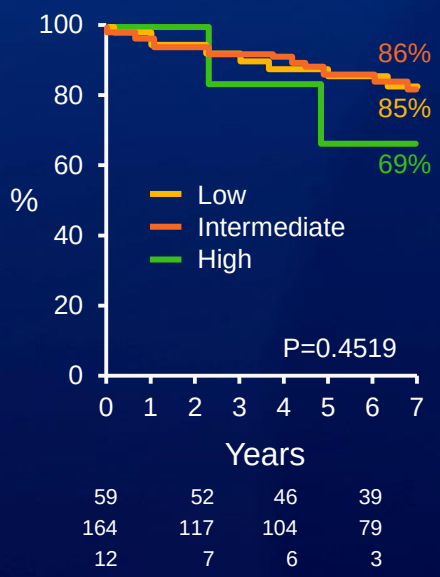


Shaw LJ. Circ 2011;124:1239

Risk Stratification in the Elderly (Age ≥75)

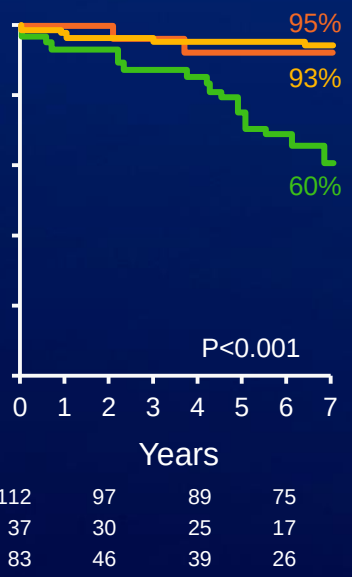
Cardiac Survival

Duke Score



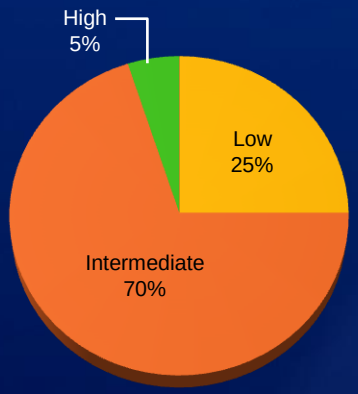
Kwok JMF. JACC 2002;39:1475

SPECT



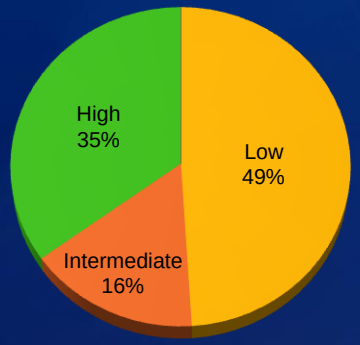
Valeti US. Circ 2005;111:1771

Duke Score



Kwok JMF. JACC 2002;39:1475

SPECT



Valeti US. Circ 2005;111:1771

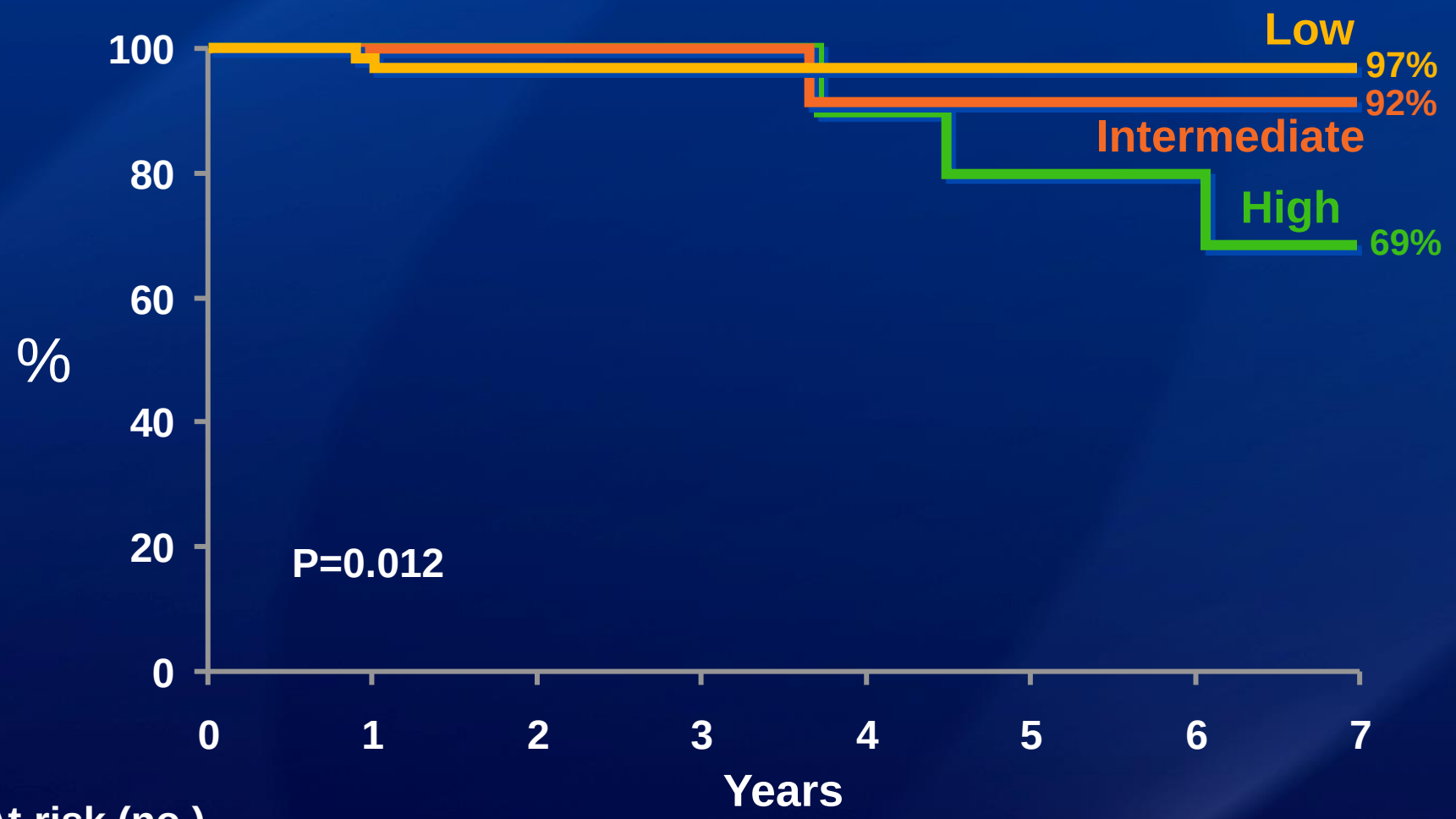
Annual cardiac mortality (%)

	Duke score	SPECT
Low	2.0	0.8
Intermediate	2.0	1.0
High	4.8	5.8

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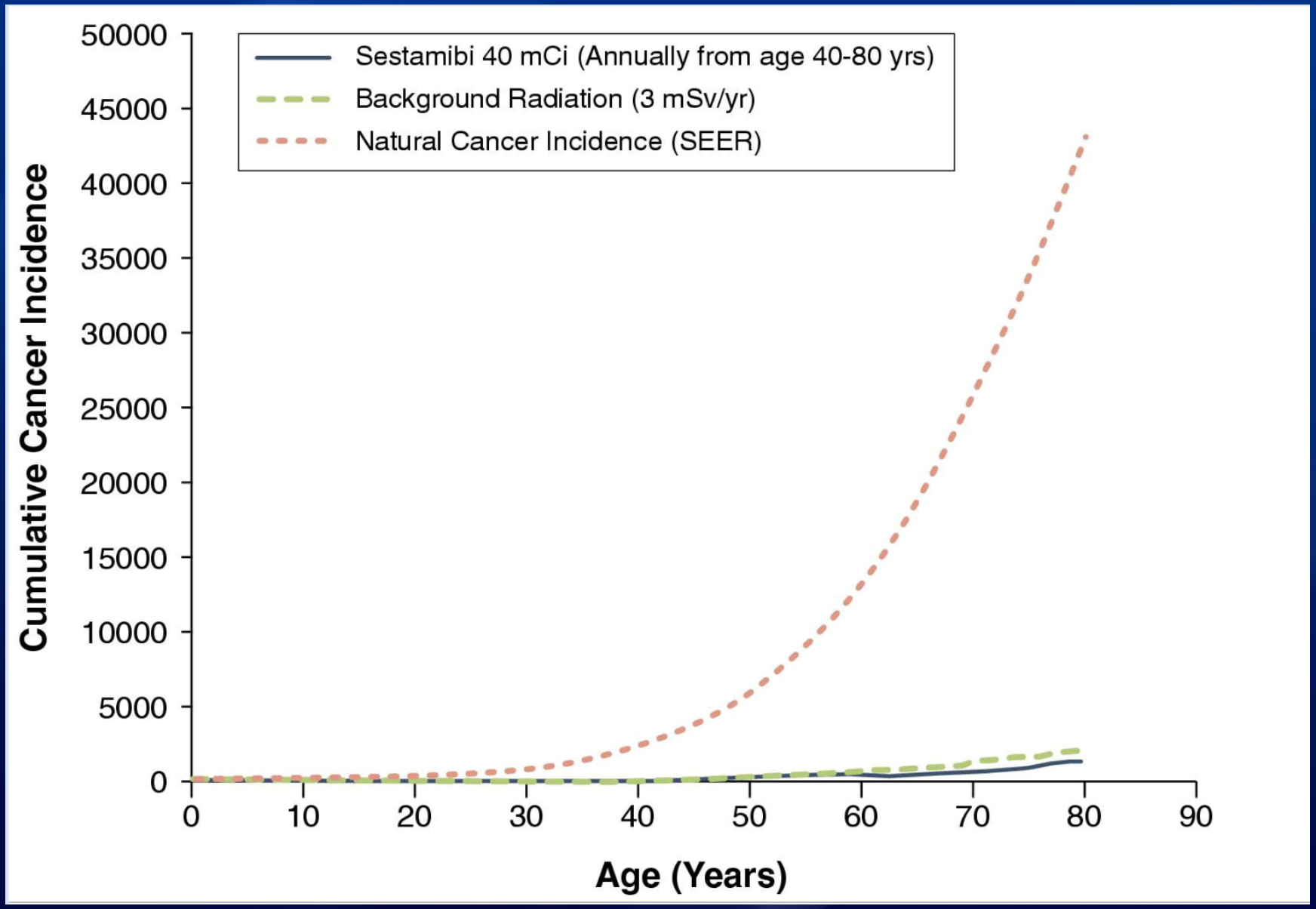
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Survival Free of CD
SSS Women



At risk (no.)								
Low	69	64	60	60	60	57	48	22
Intermediate	15	14	12	12	11	11	8	4
High	19	10	10	10	9	8	7	3

Cancer Incidence in Women



Gerber TC. JACC Cardiovasc Imaging 2010;3:528

Conclusions

- Standard ETT and stress imaging modest value diagnosis CAD
- Most important role of stress testing risk stratification CAD
- Apply all available information to patient management and not just ischemia
- Approach standard ETT when appropriate as initial test most cost effective

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Recommendations
Individual Stress Modalities

Variable	**ETT**	**Imaging***
Pre-test prob CAD	Intermediate	High**
Able to exercise***	Yes	No
Interpretable ECG****	Yes	No
Prior false (+), indeterminate ETT	No	Yes

* Pre-menopausal — no radiation
** Includes elderly (> age 75 yrs)
*** 5 METs
**** Paced, LBBB, WPW, ≥ 0.5 mm ST ↓

Mieres JH. Circ 2014;130:350