University of Michigan Health System

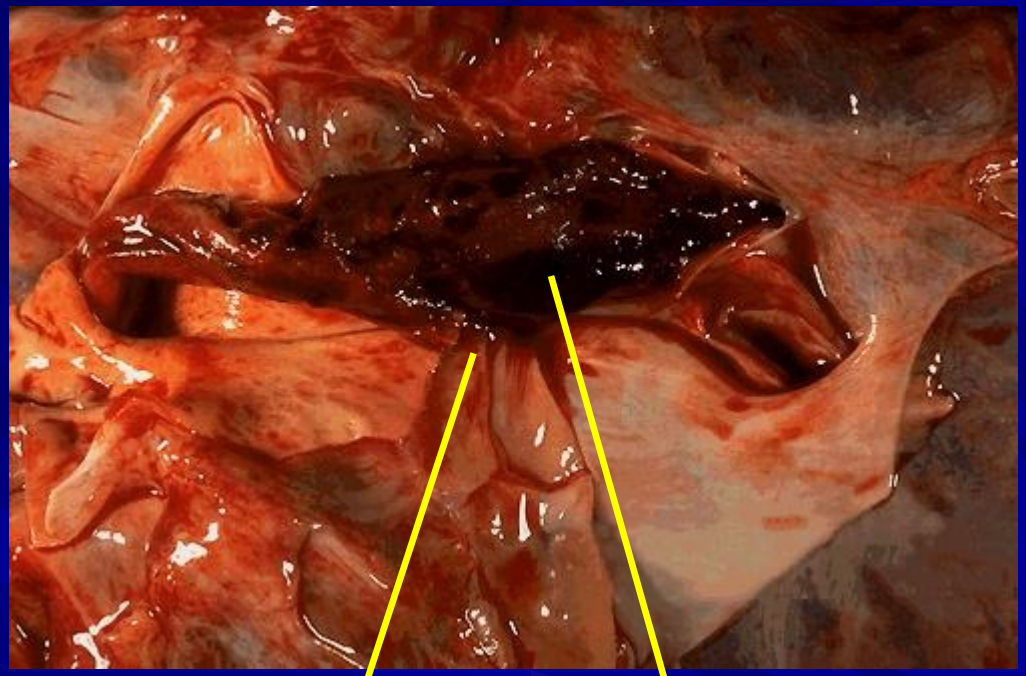
Risk Modeling Using Large Datasets

An examination of VTE after outpatient surgery

Christopher Pannucci MD MS, Amy Shanks MS, Marc Moote PA-C, Vinita Bahl DMD, Paul Cederna MD, Norah Naughton MD, Thomas Wakefield MD, Peter Henke MD, Darrell Campbell MD, Sachin Kheterpal MD MBA

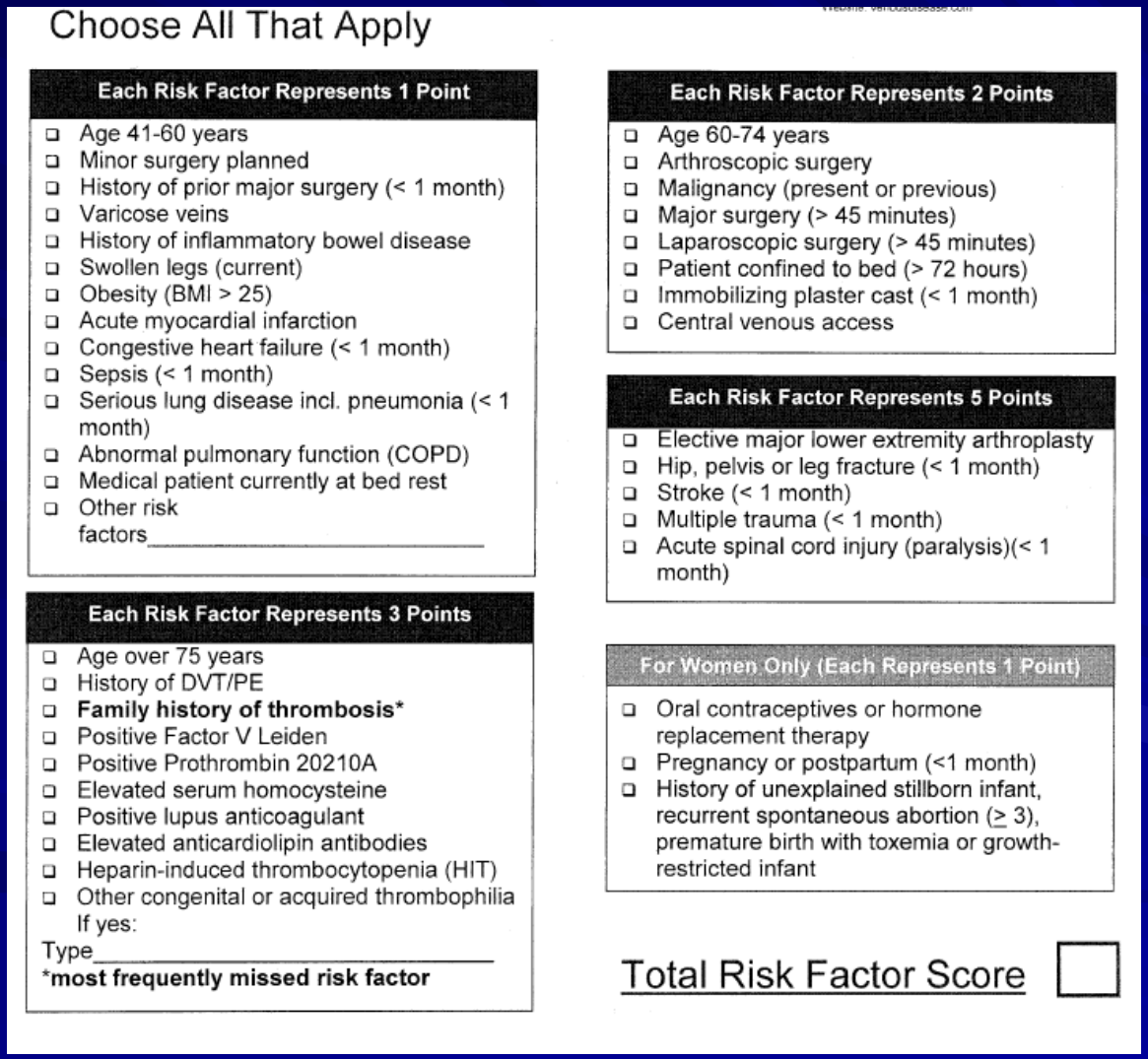
VTE: Morbidity and Mortality

- 1:10 patients with symptomatic PE will die in 60 minutes
- Survivors predisposed to right heart failure and/or the post-thrombotic syndrome



Kearon 2003, Galson 2008, Wakefield 2008

Caprini Risk Model



Choose All That Apply

Each Risk Factor Represents 1 Point

- ❑ Age 41-60 years
- ❑ Minor surgery planned
- ❑ History of prior major surgery (< 1 month)
- ❑ Varicose veins
- ❑ History of inflammatory bowel disease
- ❑ Swollen legs (current)
- ❑ Obesity (BMI > 25)
- ❑ Acute myocardial infarction
- ❑ Congestive heart failure (< 1 month)
- ❑ Sepsis (< 1 month)
- ❑ Serious lung disease incl. pneumonia (< 1 month)
- ❑ Abnormal pulmonary function (COPD)
- ❑ Medical patient currently at bed rest
- ❑ Other risk factors_____

Each Risk Factor Represents 3 Points

- ❑ Age over 75 years
- ❑ History of DVT/PE
- ❑ **Family history of thrombosis***
- ❑ Positive Factor V Leiden
- ❑ Positive Prothrombin 20210A
- ❑ Elevated serum homocysteine
- ❑ Positive lupus anticoagulant
- ❑ Elevated anticardiolipin antibodies
- ❑ Heparin-induced thrombocytopenia (HIT)
- ❑ Other congenital or acquired thrombophilia

If yes:

Type_____

***most frequently missed risk factor**

Each Risk Factor Represents 2 Points

- ❑ Age 60-74 years
- ❑ Arthroscopic surgery
- ❑ Malignancy (present or previous)
- ❑ Major surgery (> 45 minutes)
- ❑ Laparoscopic surgery (> 45 minutes)
- ❑ Patient confined to bed (> 72 hours)
- ❑ Immobilizing plaster cast (< 1 month)
- ❑ Central venous access

Each Risk Factor Represents 5 Points

- ❑ Elective major lower extremity arthroplasty
- ❑ Hip, pelvis or leg fracture (< 1 month)
- ❑ Stroke (< 1 month)
- ❑ Multiple trauma (< 1 month)
- ❑ Acute spinal cord injury (paralysis)(< 1 month)

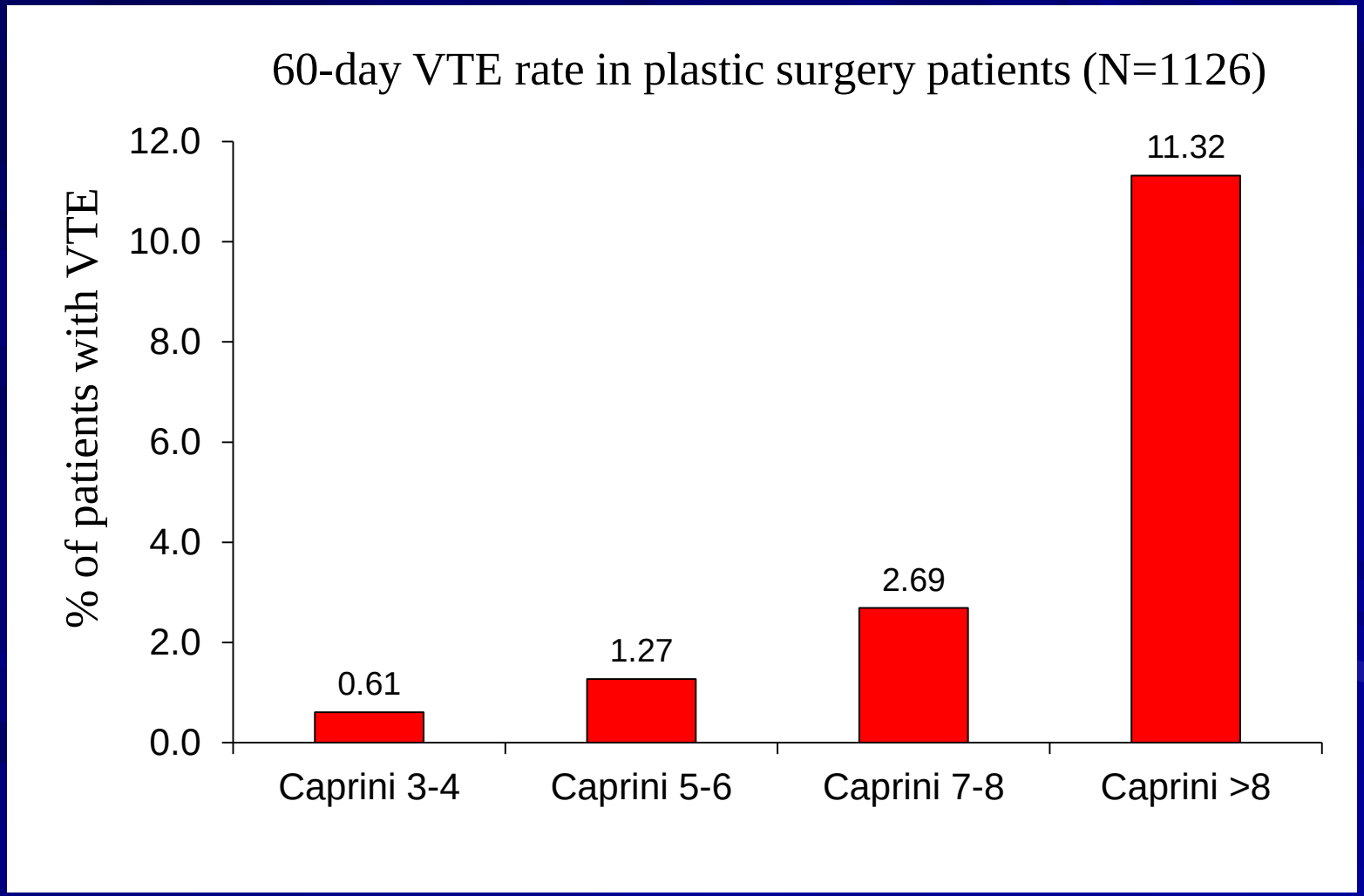
For Women Only (Each Represents 1 Point)

- ❑ Oral contraceptives or hormone replacement therapy
- ❑ Pregnancy or postpartum (<1 month)
- ❑ History of unexplained stillborn infant, recurrent spontaneous abortion (≥ 3), premature birth with toxemia or growth-restricted infant

Total Risk Factor Score ☐

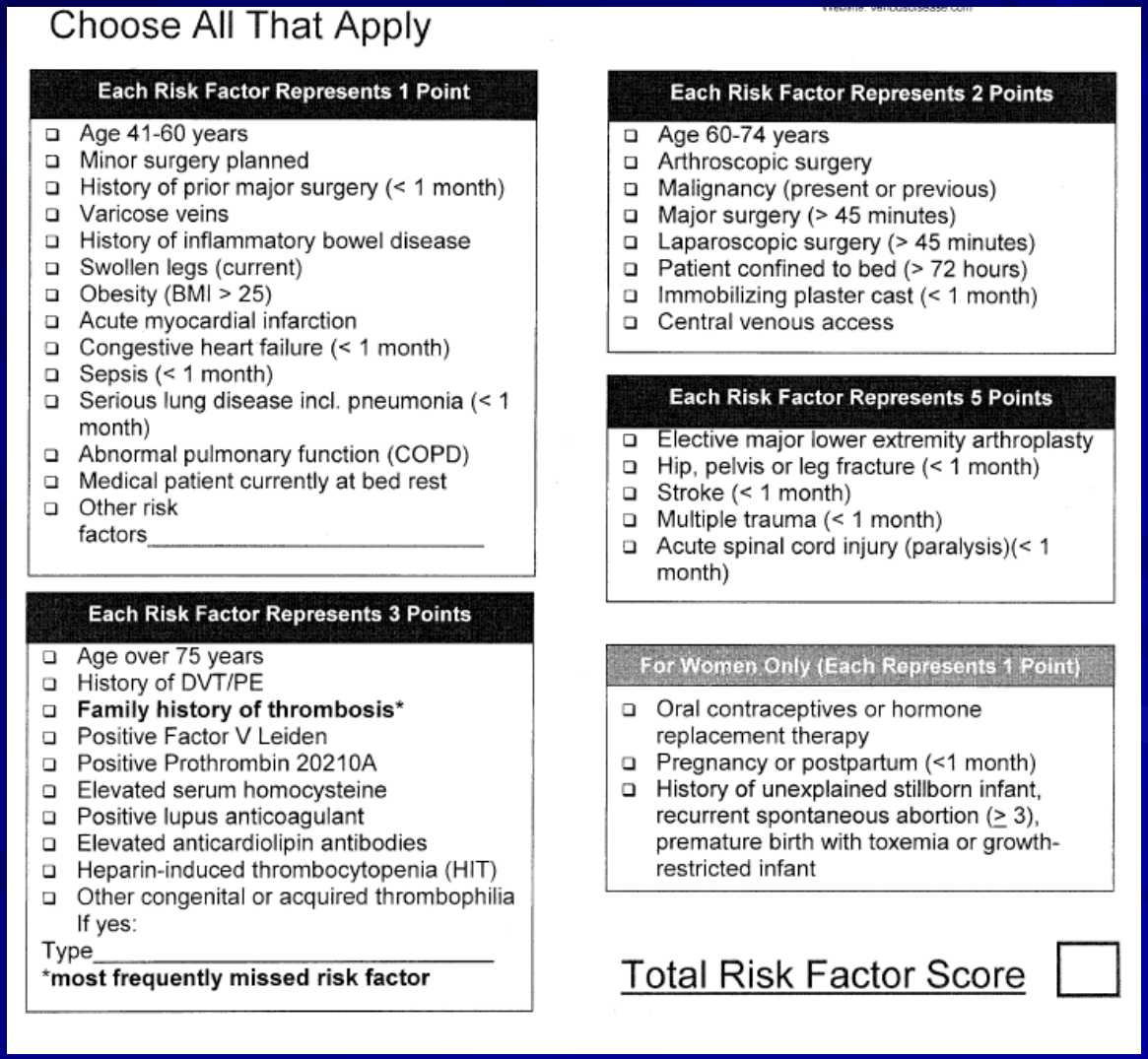
Caprini 2005

VTE without chemoprophylaxis



Pannucci 2011

Caprini Risk Model



Choose All That Apply

Each Risk Factor Represents 1 Point

- ❑ Age 41-60 years
- ❑ Minor surgery planned
- ❑ History of prior major surgery (< 1 month)
- ❑ Varicose veins
- ❑ History of inflammatory bowel disease
- ❑ Swollen legs (current)
- ❑ Obesity (BMI > 25)
- ❑ Acute myocardial infarction
- ❑ Congestive heart failure (< 1 month)
- ❑ Sepsis (< 1 month)
- ❑ Serious lung disease incl. pneumonia (< 1 month)
- ❑ Abnormal pulmonary function (COPD)
- ❑ Medical patient currently at bed rest
- ❑ Other risk factors_____

Each Risk Factor Represents 3 Points

- ❑ Age over 75 years
- ❑ History of DVT/PE
- ❑ **Family history of thrombosis***
- ❑ Positive Factor V Leiden
- ❑ Positive Prothrombin 20210A
- ❑ Elevated serum homocysteine
- ❑ Positive lupus anticoagulant
- ❑ Elevated anticardiolipin antibodies
- ❑ Heparin-induced thrombocytopenia (HIT)
- ❑ Other congenital or acquired thrombophilia

If yes:

Type_____

***most frequently missed risk factor**

Each Risk Factor Represents 2 Points

- ❑ Age 60-74 years
- ❑ Arthroscopic surgery
- ❑ Malignancy (present or previous)
- ❑ Major surgery (> 45 minutes)
- ❑ Laparoscopic surgery (> 45 minutes)
- ❑ Patient confined to bed (> 72 hours)
- ❑ Immobilizing plaster cast (< 1 month)
- ❑ Central venous access

Each Risk Factor Represents 5 Points

- ❑ Elective major lower extremity arthroplasty
- ❑ Hip, pelvis or leg fracture (< 1 month)
- ❑ Stroke (< 1 month)
- ❑ Multiple trauma (< 1 month)
- ❑ Acute spinal cord injury (paralysis)(< 1 month)

For Women Only (Each Represents 1 Point)

- ❑ Oral contraceptives or hormone replacement therapy
- ❑ Pregnancy or postpartum (<1 month)
- ❑ History of unexplained stillborn infant, recurrent spontaneous abortion (≥ 3), premature birth with toxemia or growth-restricted infant

Total Risk Factor Score ☐

Caprini 2005

University of Michigan Health System

- “Efforts should be made to maximize the number of risk factors in the risk model rather than limiting the number of risk factors assessed…this will capture a greater number of patients at risk for VTE and maximize the sensitivity of the model”

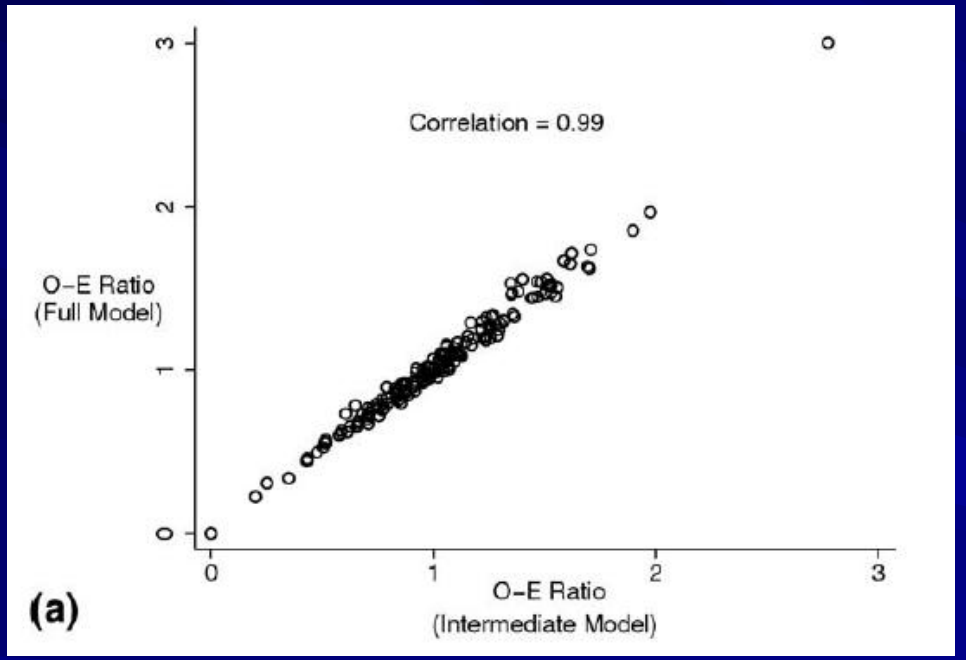
Mahan 2010

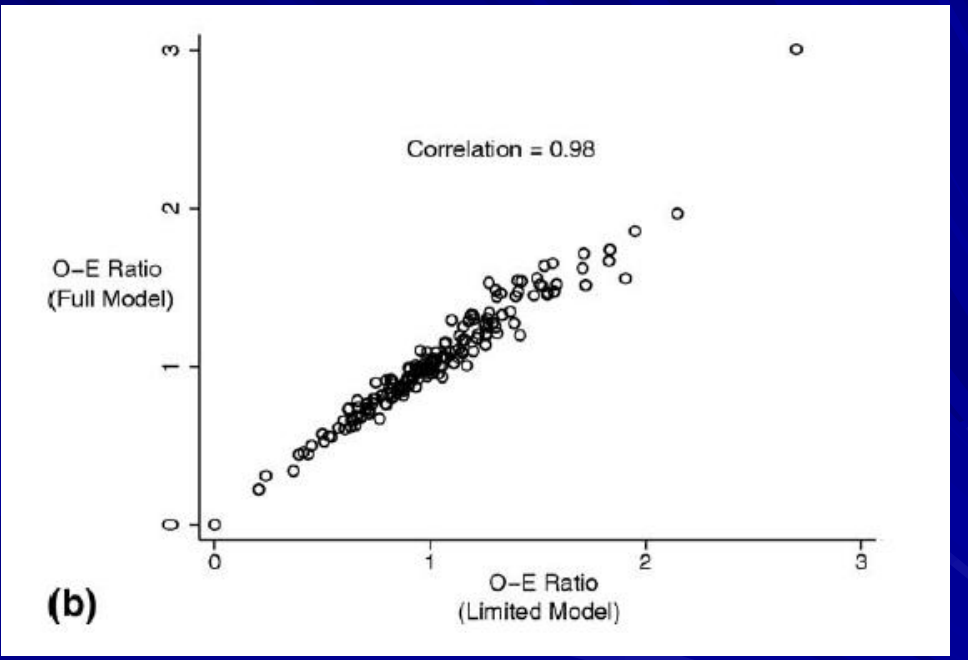
University of Michigan Health System

Evaluating parsimonious risk-adjustment models for comparing hospital outcomes with vascular surgery

Nicholas H. Osborne, MD, MS,[a] Clifford Y. Ko, MD, MS, MSHS,[b,c] Gilbert R. Upchurch Jr, MD,[a] and Justin B. Dimick, MD, MPH,[a] *Ann Arbor, Mich; Los Angeles, Calif; and Chicago, Ill*

University of Michigan Health System





Osborne 2010

University of Michigan Health System

Less is More?

University of Michigan Health System

(734) 936-5885

Kevin C. Chung, MD, MS
(734) 936-5885

Steven C. Haase, MD
(734) 615-3435

Steven J. Kasten, MD
(734) 763-8063

M. Haskell Newman, MD
Professor Emeritus of Surgery
(734) 936-5895

Riley S. Rees, MD
(734) 615-3435

Edwin G. Wilkins, MD, MS
(734) 936-5890

Dennis R. Claflin, PhD
(734) 615-2598

Cynthia L. Marcelo, PhD
(734) 763-6721

Melanie G. Urbanchek, PhD
(734) 936-2817

University of Michigan
734 936 5895 (office)
734 763 5354 (fax)

enclosures

DEAR CHRISTOPHER,

I appologize. For a delay IN getting this back to you. I was IN the hospital again for blood clots related to TAMOXIFEN. Im doing better.

Thank You

[redacted]

VTE in Outpatient Surgery

- Previous studies: VTE incidence is low
  - 0.001% to 0.043%
- High volume of low risk patients→may flood the denominator

Engbaek 2006; Riber 1996; Keyes 2008; Bryson 2004; Fleisher 2009

VTE in Outpatient Surgery

- Does a high risk subgroup exist?
- Can VTE risk be quantified in outpatient surgery?

VTE in Outpatient Surgery

- Project Goals
  - Identify independent risk factors for VTE in outpatient surgery patients
  - Create and validate a risk model specific to the outpatient surgery population

VTE in Outpatient Surgery

- Cross-section of general, vascular, urology, plastic, orthopaedic, gynecologic procedures
- Trained nurses perform retrospective chart review AND make followup patient contact at POD 30

Variables

- Gender
- Age
- BMI
- Current smoker
- Active cancer
- CHF
- COPD
- Total OR time
- DM requiring meds
- Peripheral vascular dz
- Renal failure on HD
- General anesthesia
- Current pregnancy
- Prior OR (30 days)

Caprini 2005; Caprini 2010; Davison 2004; Geerts 2008

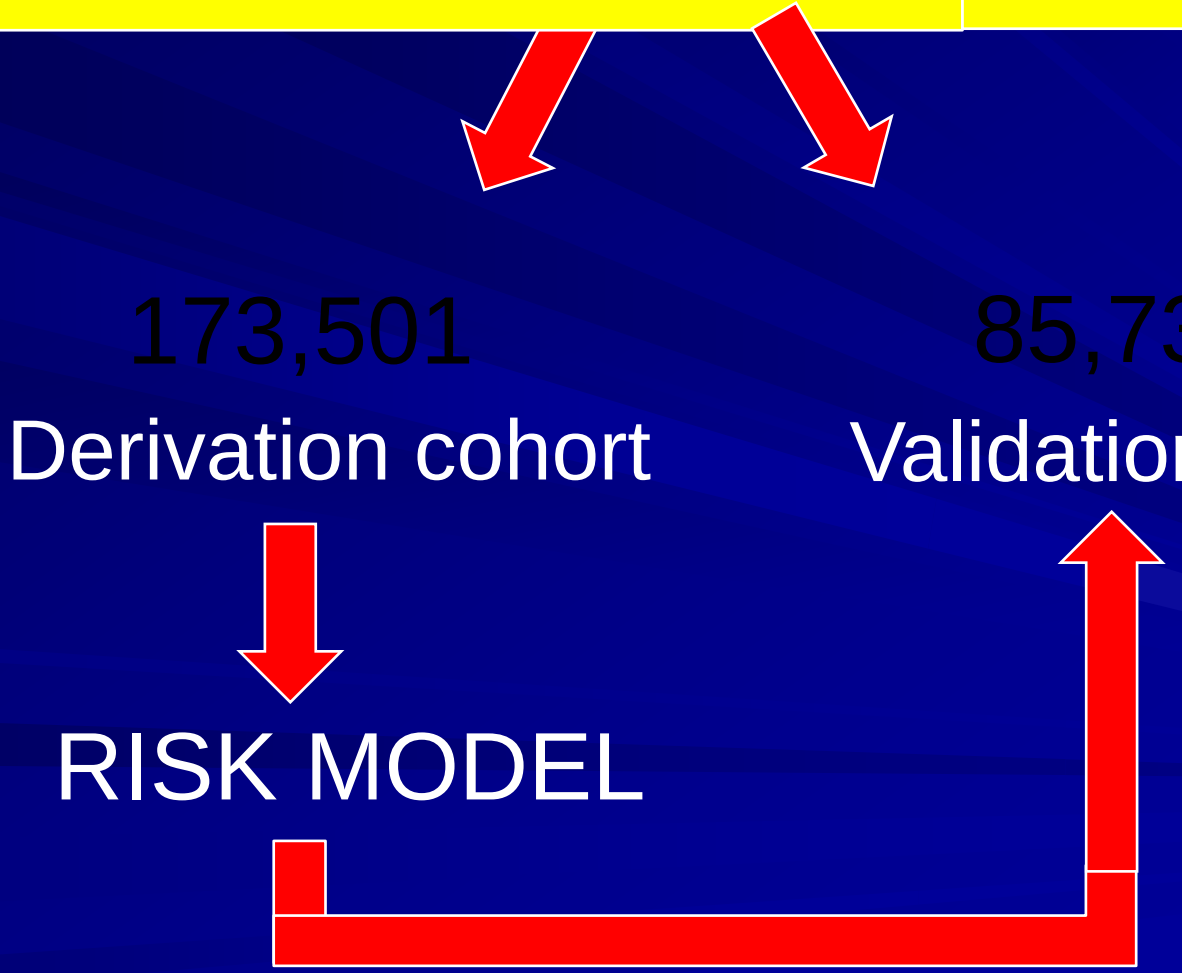
Variables II

- Arthroscopic surgery
  - Hip, knee, shoulder, elbow
- Abdominal laparoscopy
- Saphenofemoral junction surgery
  - GSV ablation or direct ligation
- Short vein surgery
  - Short saphenous vein, perforator veins, or varicose veins

Lawrence 2010; Knipp 2009; Caprini 2005; Caprini 2010; Geerts 2008

2005-2009 NSQIP data

259,231 outpatient surgery patients



VTE in Outpatient Surgery

- N=**173,501** adult patients having outpatient surgery
  - DVT: 0.12%
  - PE 0.038%
  - VTE (DVT or PE): 0.15%
    - 1 in 667
  - Median time-to-event: Post-op day 8

Independent predictors

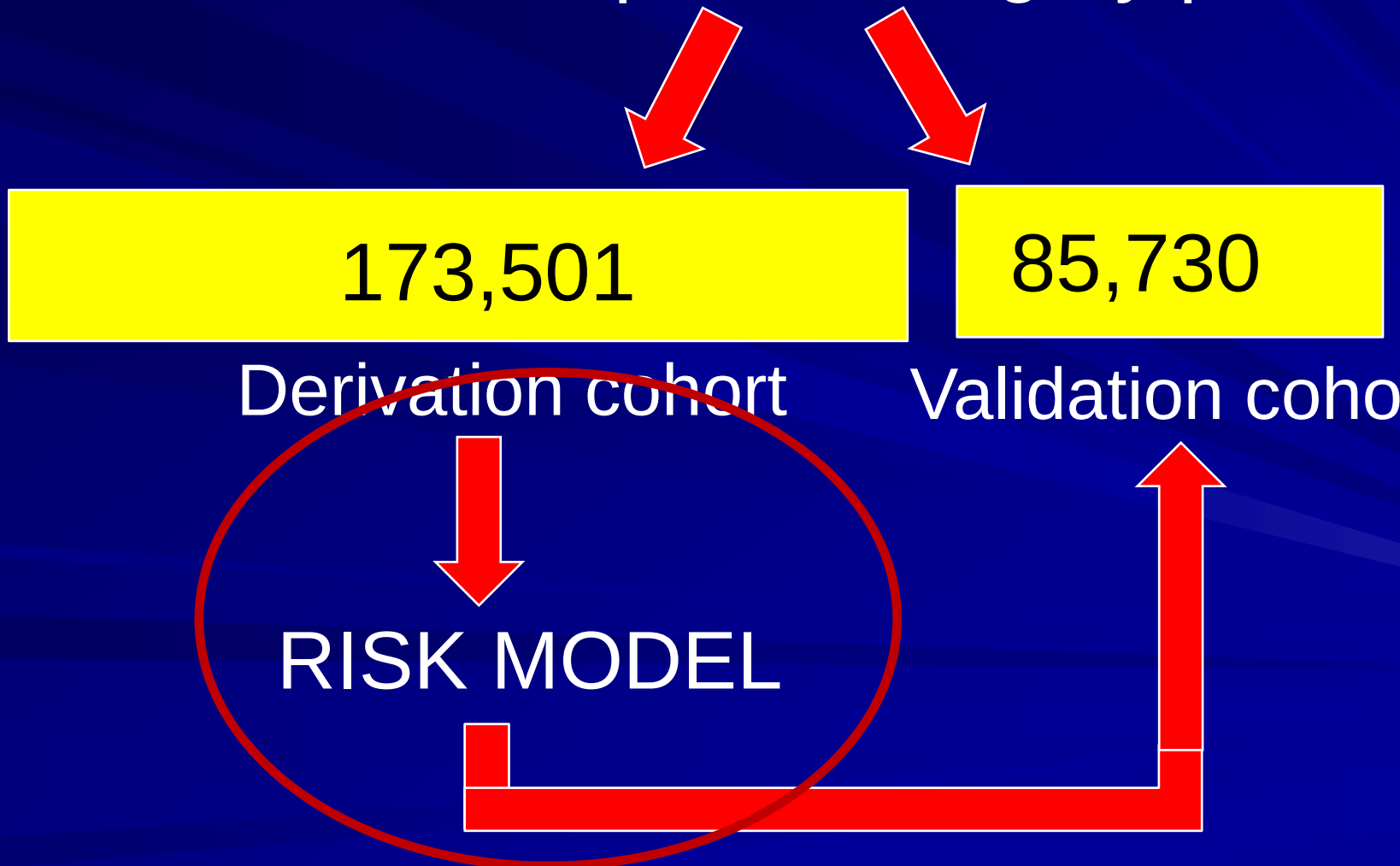
Risk Factor	Adjusted Odds Ratio (95% Confidence Interval)	p value
Age		
<40 years	Reference	---
41-60 years	**1.72 (1.15-2.57)**	**0.008**
>60 years	**2.48 (1.64-3.77)**	**<0.001**
Body mass index		
<25	Reference	---
25-40	1.15 (0.85-1.57)	0.358
>40	**1.81 (1.12-2.92)**	**0.015**
Total operative time		
<60 minutes	Reference	---
60-120 minutes	1.21 (0.92-1.60)	0.175
>120 minutes	**1.69 (1.06-2.67)**	**0.027**

Independent predictors II

Risk Factor	Adjusted Odds Ratio (95% Confidence Interval)	p value
Current pregnancy	7.80 (1.06-57.54)	0.044
Active cancer	3.66 (1.49-8.99)	0.005
Arthroscopic surgery	5.16 (3.33-7.99)	<0.001
Saphenofemoral junction surgery	13.20 (9.31-18.73)	<0.001
Short vein surgery	15.61 (10.23-23.83)	<0.001

2005-2009 NSQIP data

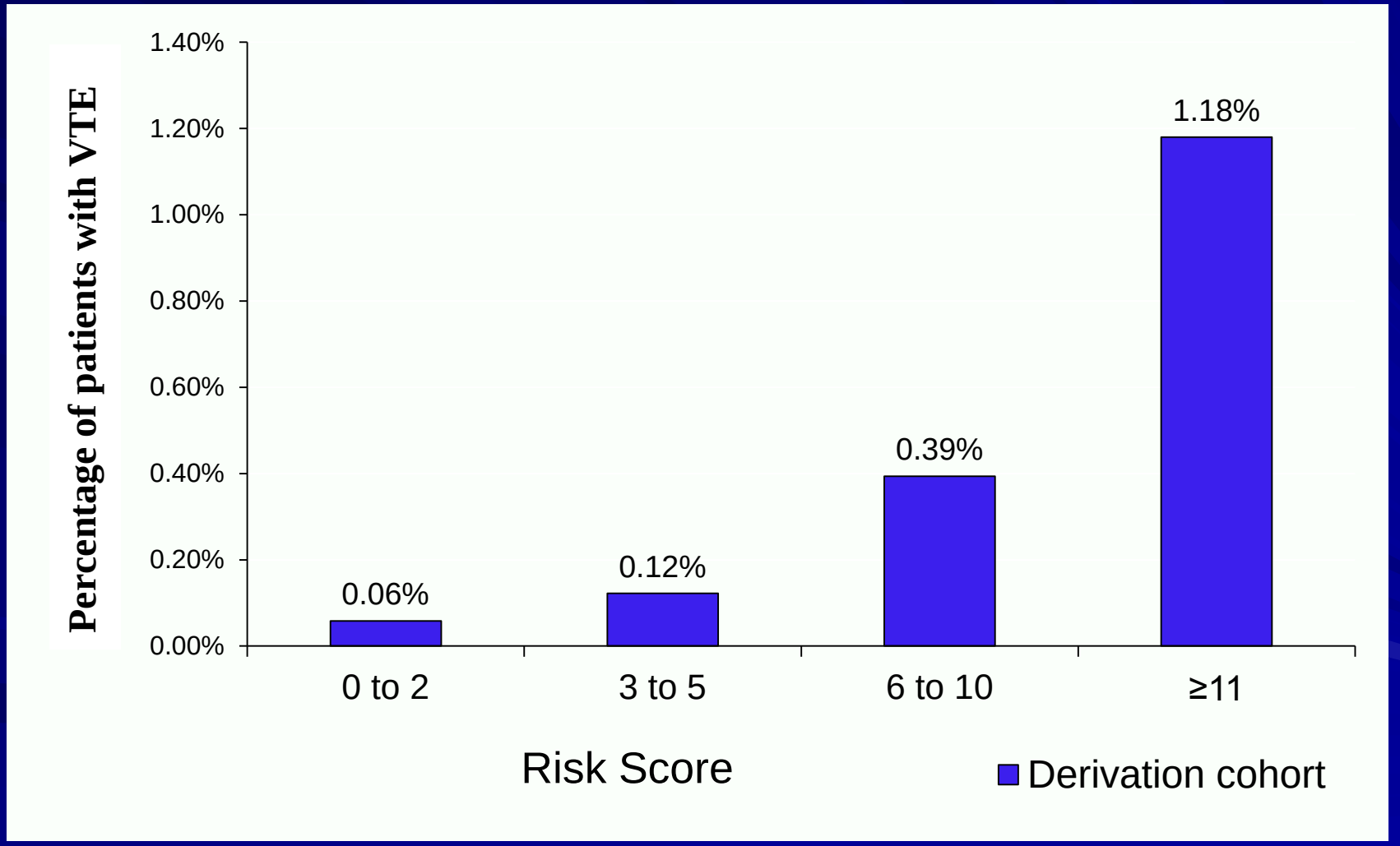
259,231 outpatient surgery patients



Weighted Risk Model

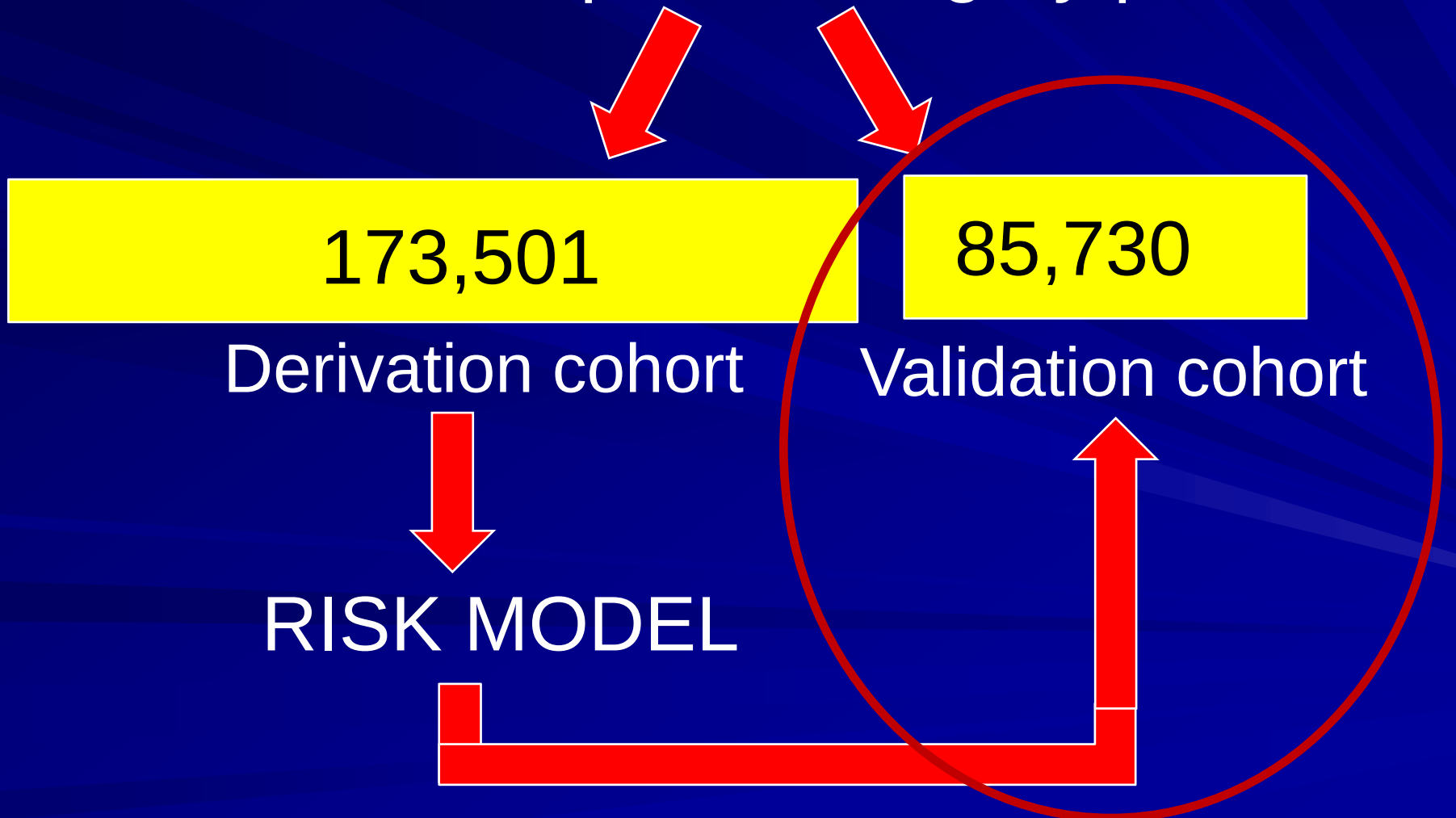
Two Point Factors	Three Point Factors	Five Point Factors
☐ Age 40-59 ☐ OR time >120 minutes ☐ BMI >40	☐ Age ≥60	☐ Active cancer
Six Point Factors	**Eight Point Factors**	**Ten Point Factors**
☐ Arthroscopic surgery	☐ Current pregnancy	☐ Sapheno-femoral junction surgery
Eleven Point Factors	**TOTAL SCORE _____**	
☐ Short vein surgery		

Derivation cohort (N=173,501)

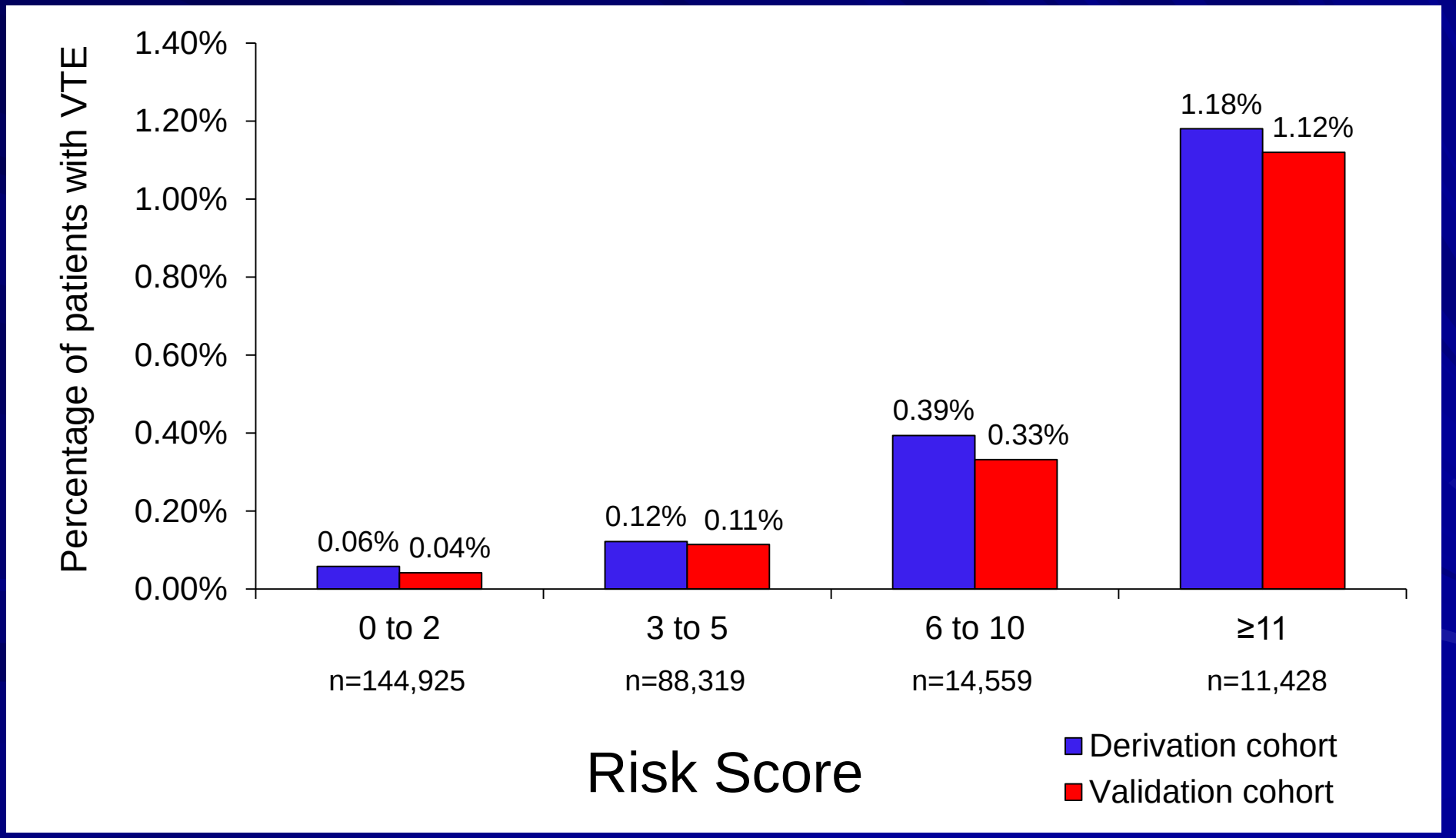


2005-2009 NSQIP data

259,231 outpatient surgery patients



Validation cohort (N=85,730)



University of Michigan Health System

(734) 936-5885

Kevin C. Chung, MD, MS
(734) 936-5885

Steven C. Haase, MD
(734) 615-3435

Steven J. Kasten, MD
(734) 763-8063

M. Haskell Newman, MD
Professor Emeritus of Surgery
(734) 936-5895

Riley S. Rees, MD
(734) 615-3435

Edwin G. Wilkins, MD, MS
(734) 936-5890

Dennis R. Claflin, PhD
(734) 615-2598

Cynthia L. Marcelo, PhD
(734) 763-6721

Melanie G. Urbanchek, PhD
(734) 936-2817

University of Michigan
734 936 5895 (office)
734 763 5354 (fax)

enclosures

Prior literature:
0.001% to 0.043%

DEAR CHRISTOPHER,

I apologize. For a delay IN getting this back to you. I was IN the hospital again for blood clots related to TAMOXIFEN. Im doing better.

Thank You

[redacted]

Weighted Risk Model

Two Point Factors	Three Point Factors	Five Point Factors
☒ Age 40-59 ☒ OR time >120 minutes ☒ BMI >40	☐ Age ≥60	☒ Active cancer
Six Point Factors	**Eight Point Factors**	**Ten Point Factors**
☐ Arthroscopic surgery	☐ Current pregnancy	☐ Sapheno-femoral junction surgery
Eleven Point Factors	**TOTAL SCORE 11**	
☐ Short vein surgery		

University of Michigan Health System

(734) 936-5885

Kevin C. Chung, MD, MS
(734) 936-5885

Steven C. Haase, MD
(734) 615-3435

Steven J. Kasten, MD
(734) 763-8063

M. Haskell Newman, MD
Professor Emeritus of Surgery
(734) 936-5895

Riley S. Rees, MD
(734) 615-3435

Edwin G. Wilkins, MD, MS
(734) 936-5890

Dennis R. Claflin, PhD
(734) 615-2598

Cynthia L. Marcelo, PhD
(734) 763-6721

Melanie G. Urbanchek, PhD
(734) 936-2817

University of Michigan
734 936 5895 (office)
734 763 5354 (fax)

enclosures

Prior literature:
0.001% to 0.043%

DEAR CHRISTOPHER,

I apologize. For a delay IN getting this back to you. I was IN the hospital again for blood clots related to Tamoxifen. Im doing better.

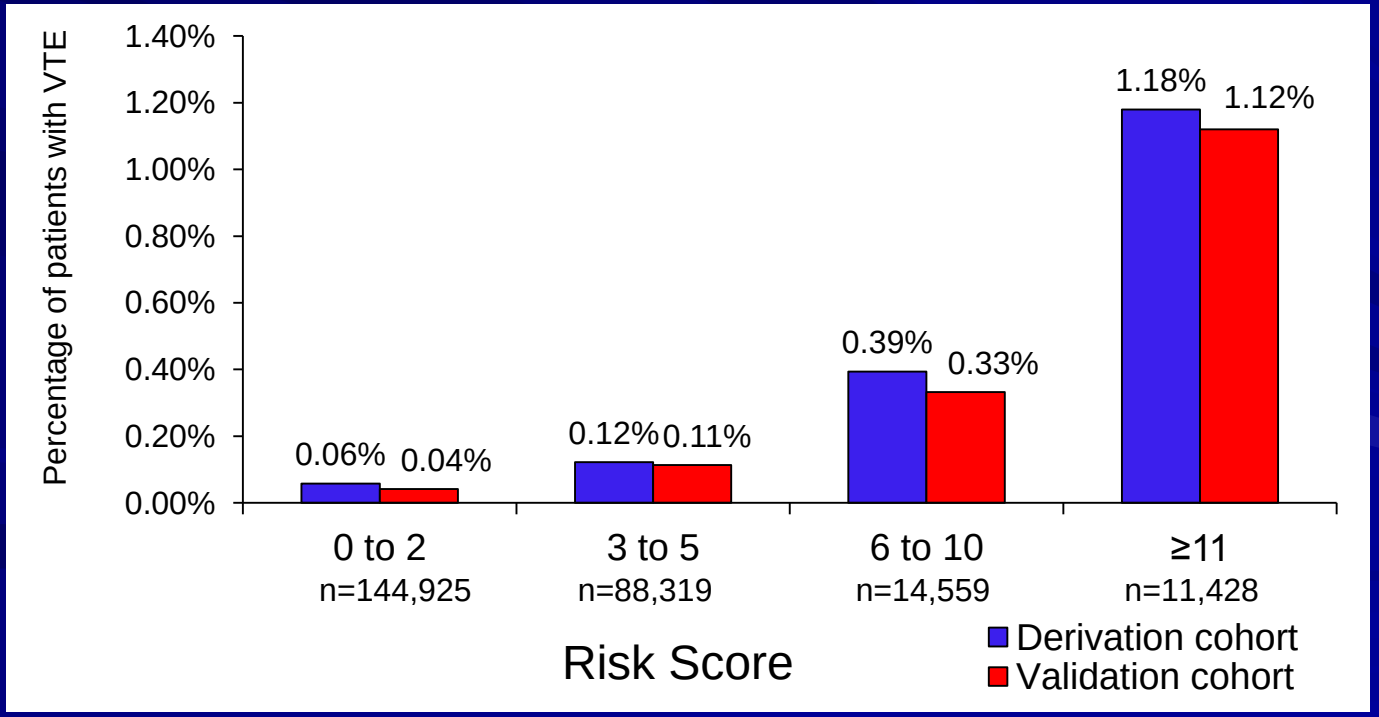
NOW: 1.1%

Thank You

[redacted]

Conclusions

- Outpatient surgery patients have a wide range of VTE risk



Conclusions

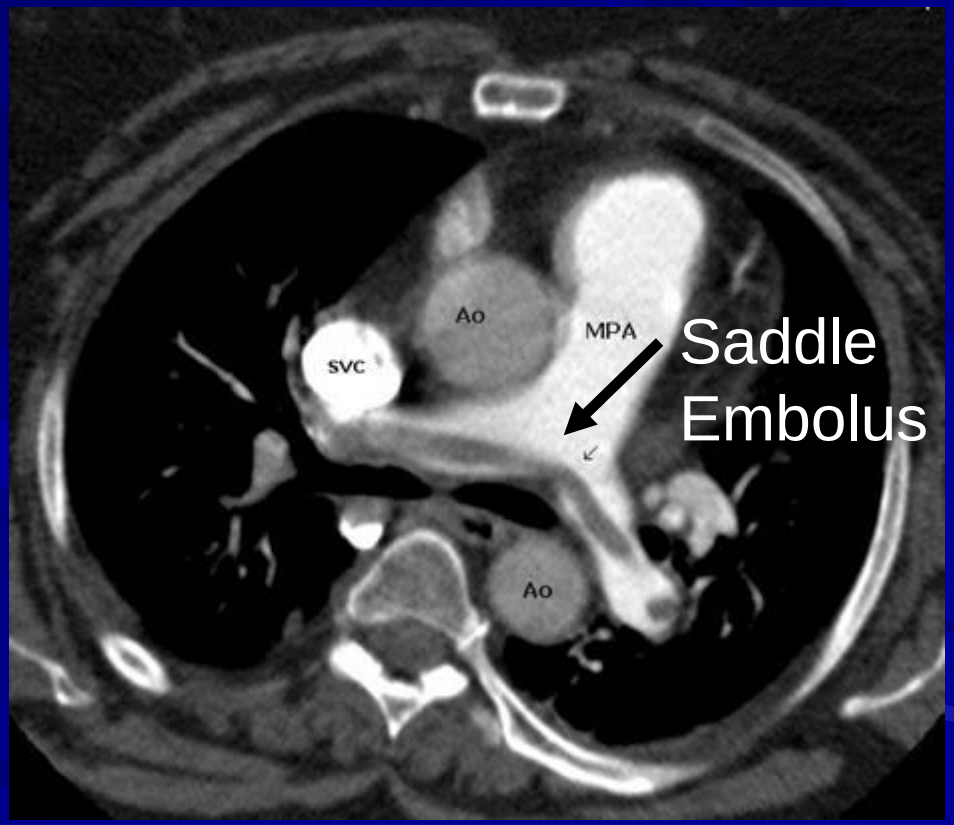
- The NSQIP-derived weighted risk model provides excellent risk stratification

Two Point Factors	Three Point Factors	Five Point Factors
☐ Age 40-59 ☐ OR time >120 minutes ☐ BMI >40	☐ Age ≥60	☐ Active cancer
Six Point Factors	**Eight Point Factors**	**Ten Point Factors**
☐ Arthroscopic surgery	☐ Current pregnancy	☐ Sapheno-femoral junction surgery
Eleven Point Factors	**TOTAL SCORE _____**	
☐ Short vein surgery		

University of Michigan Health System

Thank You.

- "Given that DVT is often clinically silent and PE may be rapidly fatal, prevention is the most effective strategy to reduce the burden of VTE"
  - Arnold et al, 2001



www.radpod.org