Epidemiology of Thromboembolic Disease

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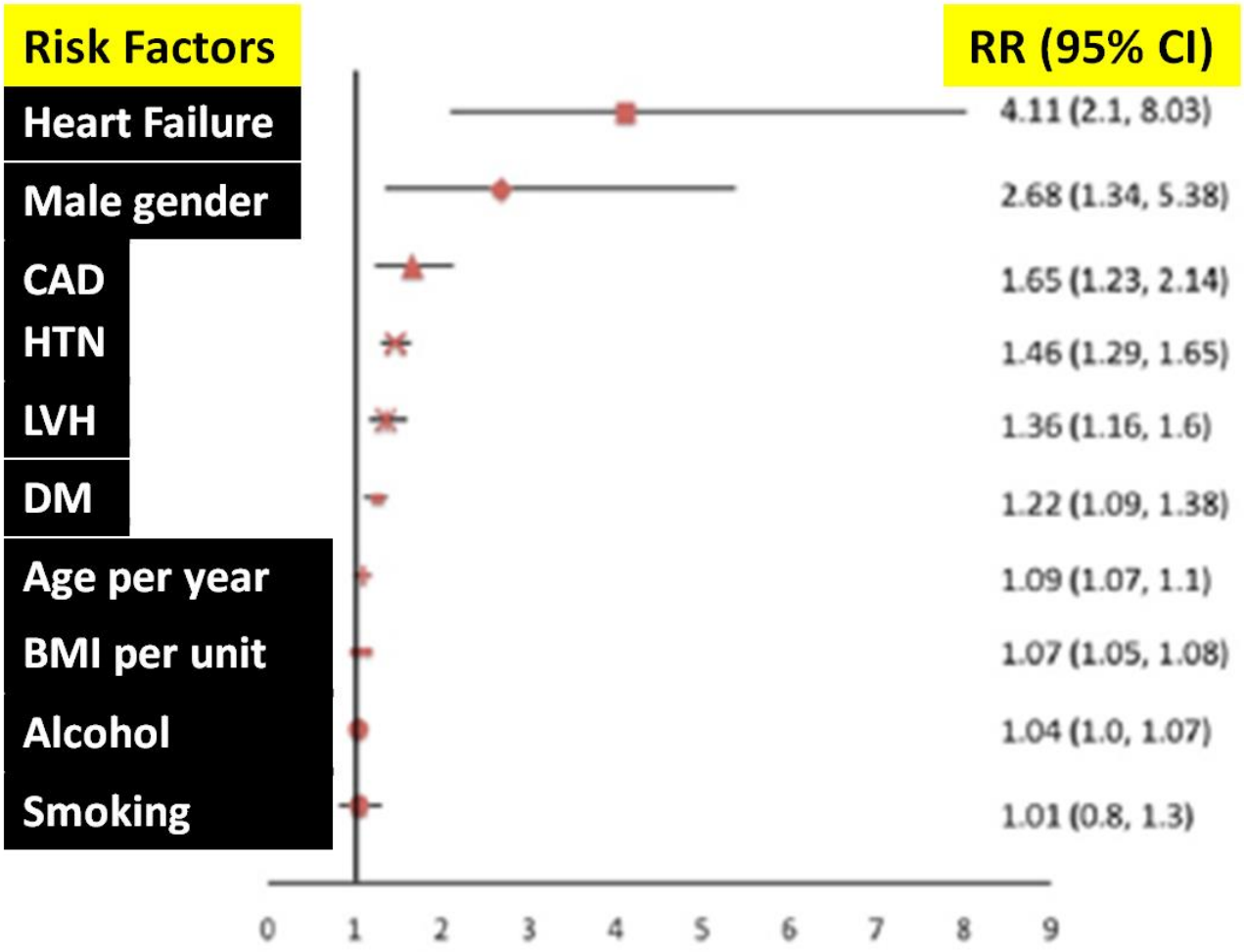
Epidemiology of Stroke

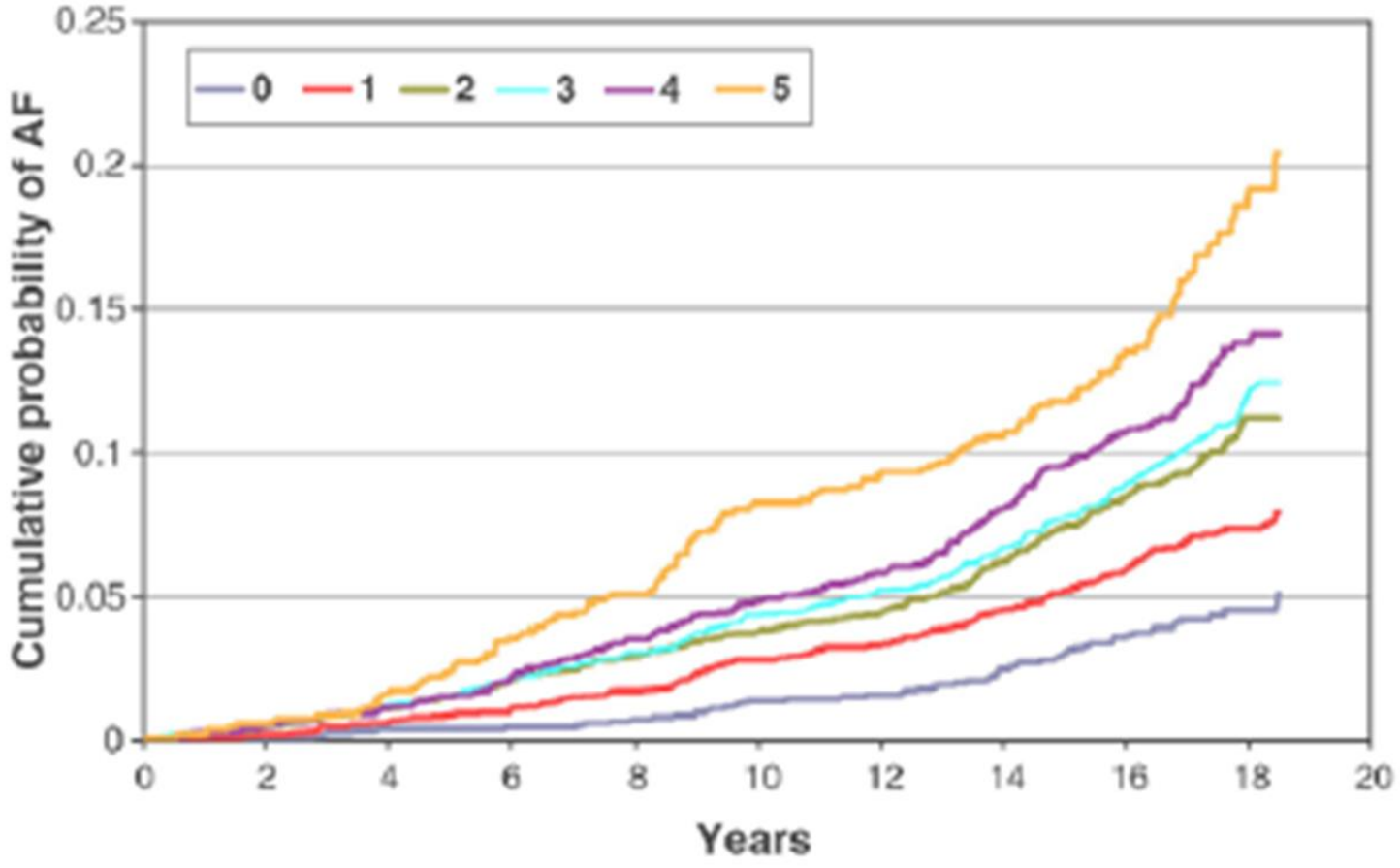
- 15-25% of all strokes in the United States (75,000/y) can be attributed to AF
- Known risk factors for stroke
  - age, female sex
  - hypertension, diabetes, heart failure
  - prior history of stroke/transient ischemic attack (TIA)/thromboembolism
  - coronary artery disease, peripheral arterial disease,
  - valvular heart disease (rheumatic valvular disease).
- Anticoagulation with warfarin decreases the risk of stroke by 50-80%.

Risk Factors for Atrial Fibrillation



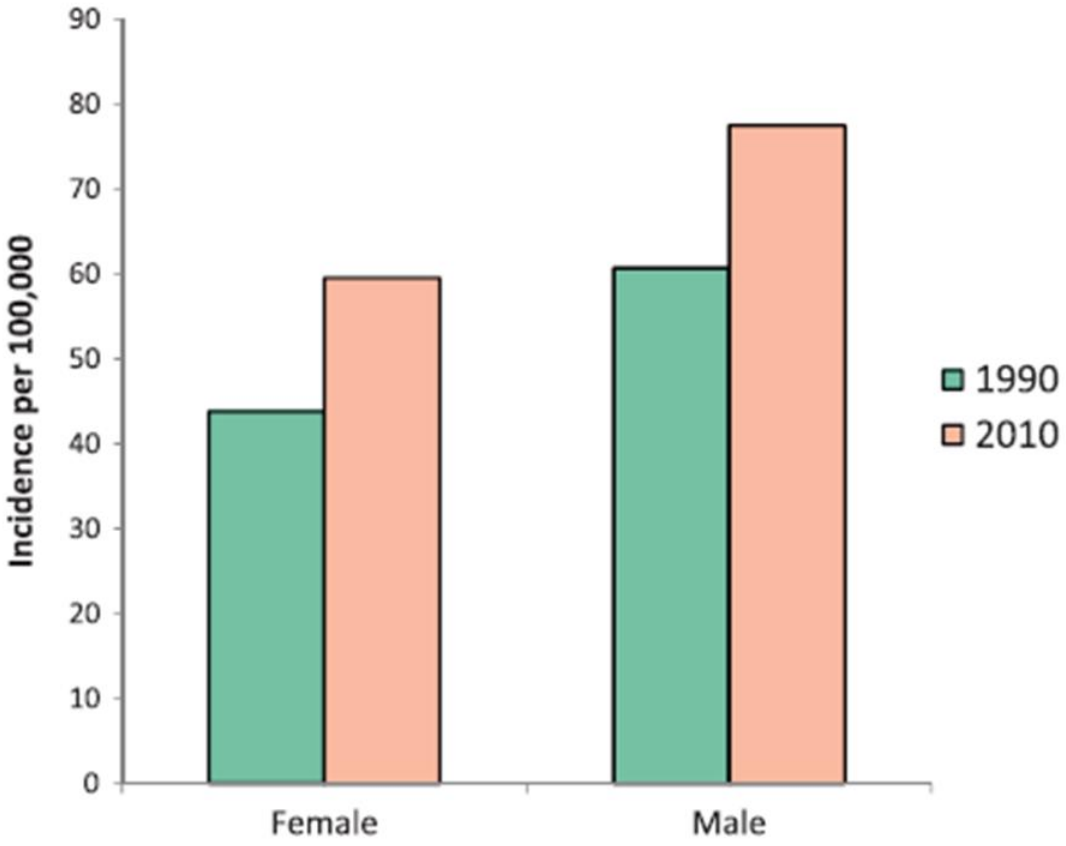
Circulation 2017;136:583–596

Atrial Fibrillation Risk Factors are Cumulative



Circulation 2017;136:583–596

Increasing Incidence of Atrial Fibrillation



Circulation 2014;129:837-847

Stroke Risk Assessment

$CHADS_2$ Score

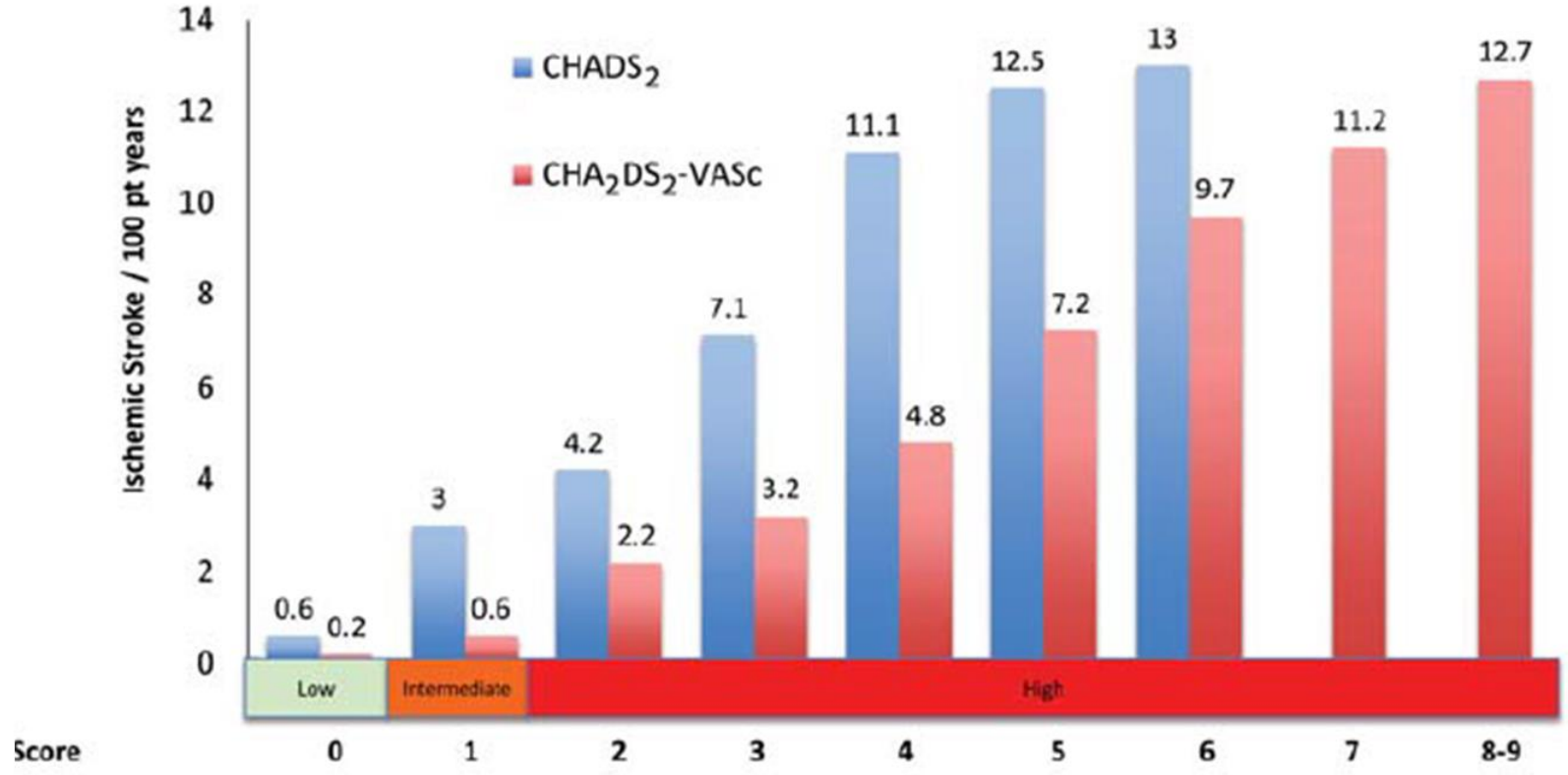
Risk Factor	Score
Congestive heart failure	1
Hypertension	1
Age ≥75 y	1
Diabetes	1
Stroke or TIA history	2
MAXIMUM	6

CHA_2DS_2-VASc Score

Risk Factor	Score
Congestive heart failure/LV dysfunction	1
Hypertension	1
Age ≥75 y	2
Diabetes	1
Stroke/TIA/TE history	2
Vascular disease	1
Age 65-74 years	1
Sex category, female	1
MAXIMUM	9

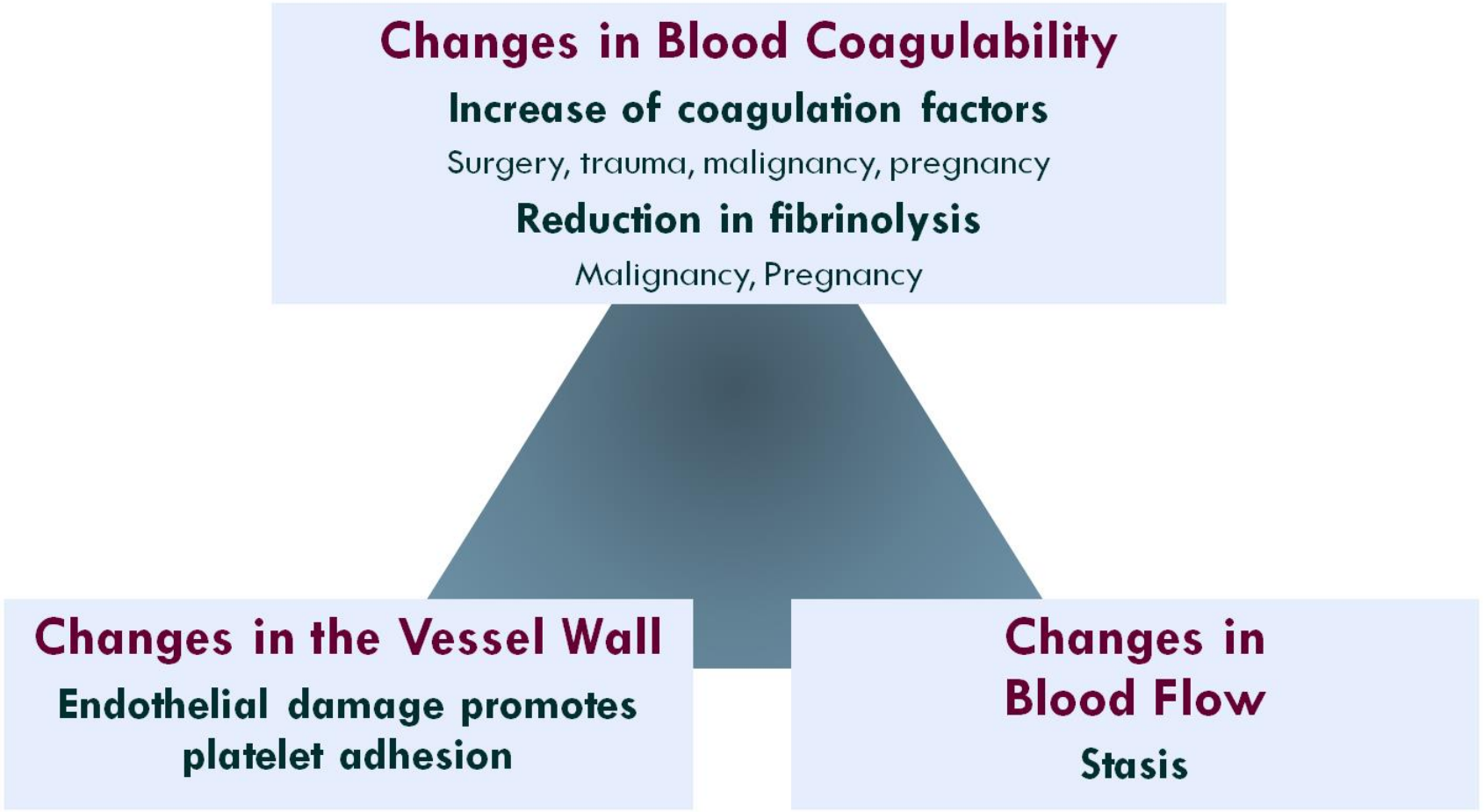
Gage BF et al. *JAMA*. 2001;285:2864-2870.
Lip GY et al. *Chest*. 2010;137:263-272.

$CHADS_2$ & $CHA_2DS_2VAS_C$ Stroke Risk



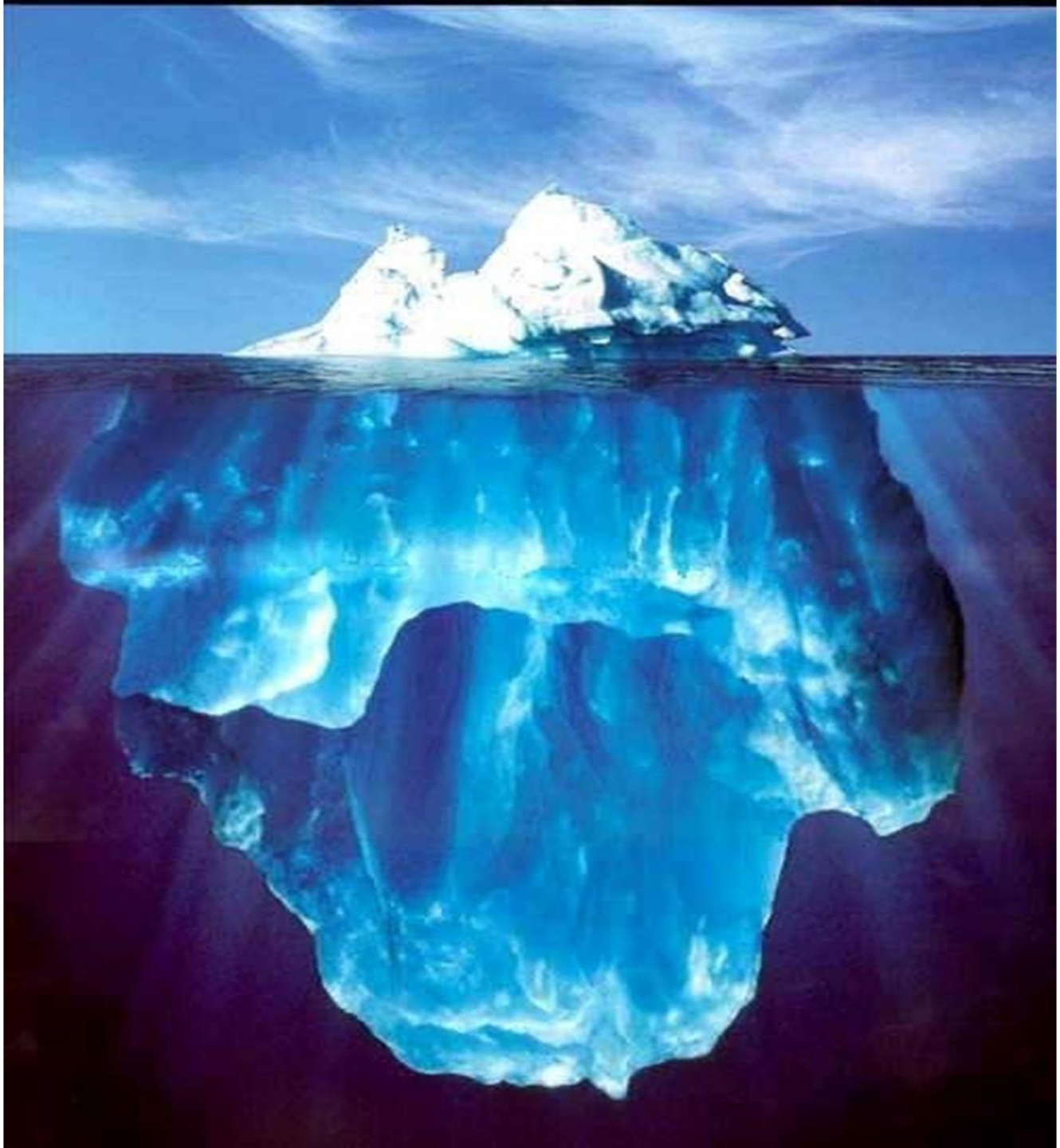
European Heart Journal (2012) **33**, 1431–1433
doi:10.1093/eurheartj/ehs031

Virchow's Triad

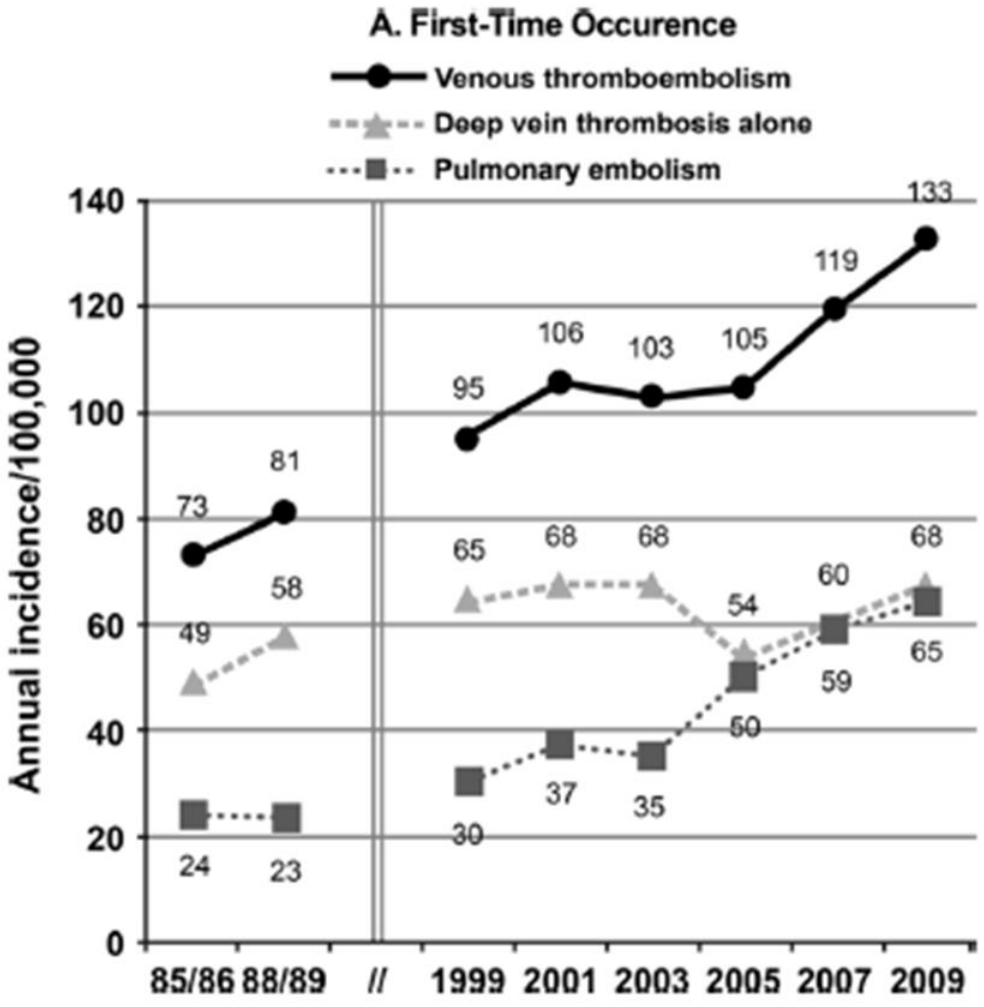


Epidemiology of VTE

- Estimated Annual Incidence
  - 104 – 183 per 100,000 person-years
  - Similar to stroke
- Hospitalized patients have a higher incidence
- Annual cases per year (estimates)
  - 600,000 – 900,000 nonfatal VTE
    - Up to 100,000 deaths
  - Post-thrombotic syndrome in up to 50%

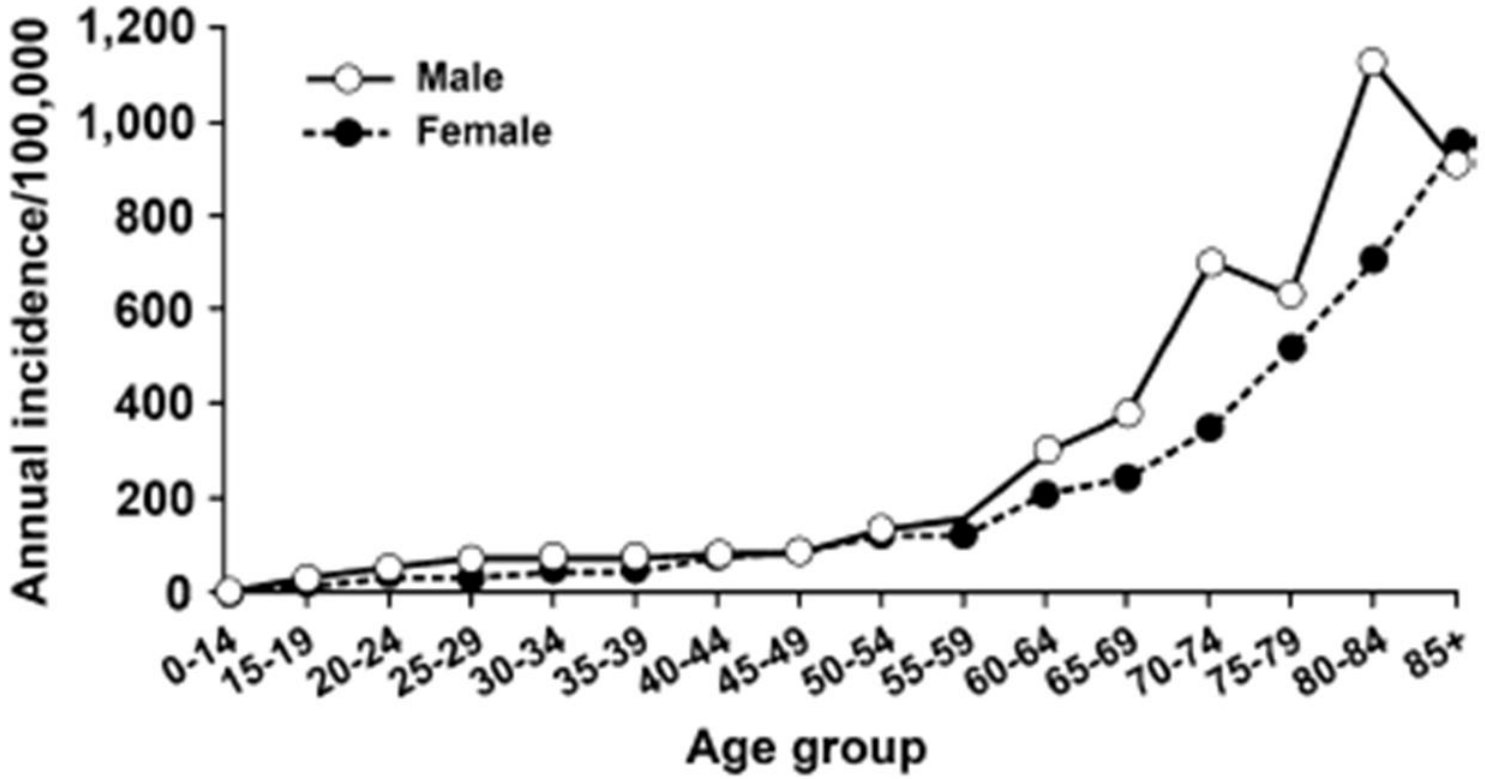


VTE Incidence



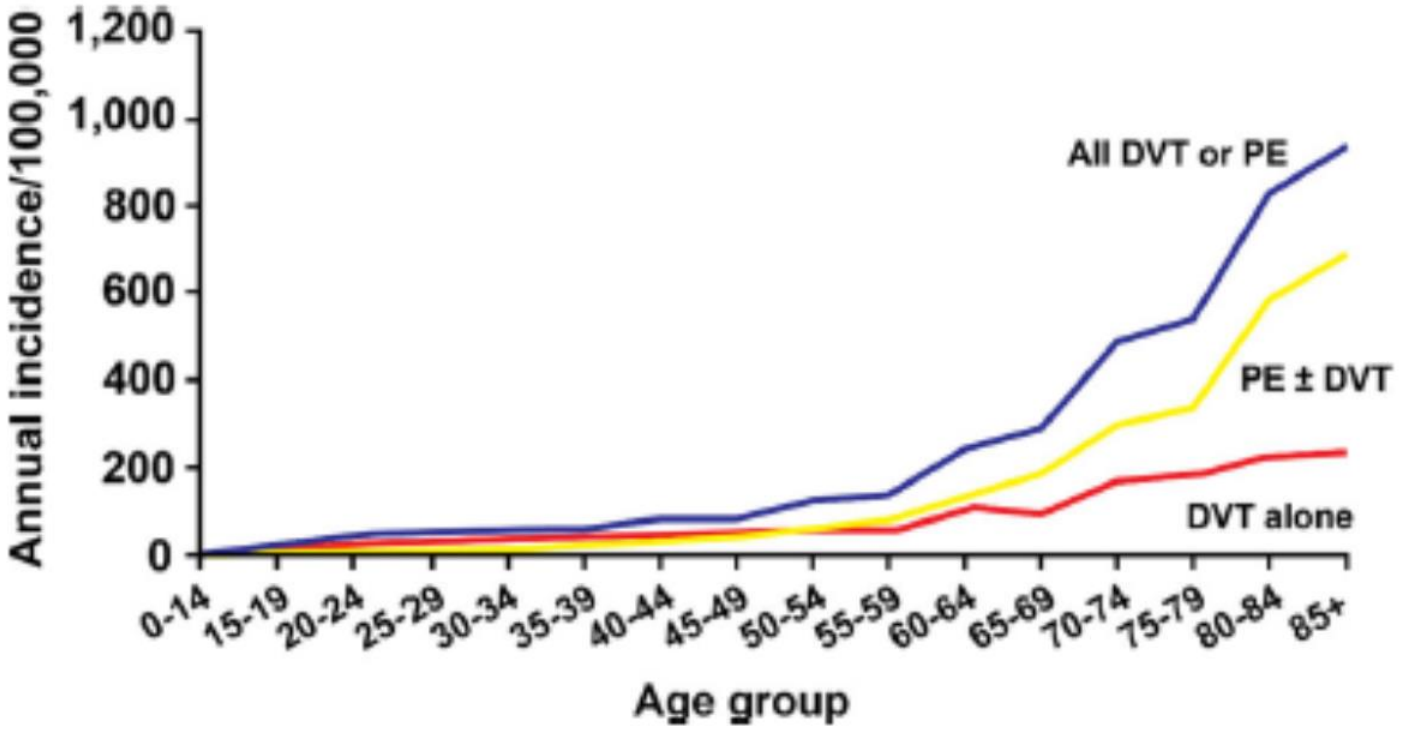
Huang Am J Med 2014;127(829–839)

Incidence of VTE by Age and Gender



Silverstein et al Arch Intern Med 1998;158:585-593

Incidence of VTE by Age and Type



Silverstein et al Arch Intern Med 1998;158:585-593

Mortality

- Survival after VTE is worse than in an age, gender and ethnicity matched population
- Early death risk is 18 fold higher is patients experiencing a PE
  - Nearly 25% of patients present with sudden death
  - PE is an independent predictor of reduced survival up to 3 months after the event
  - Reduced early survival predictors:
    - Age, male, lower BMI, Hospital/ NH at onset, CHF, Lung disease, serious neurologic disease, active cancer
    - Presentation with syncope and hypotension

Mortality

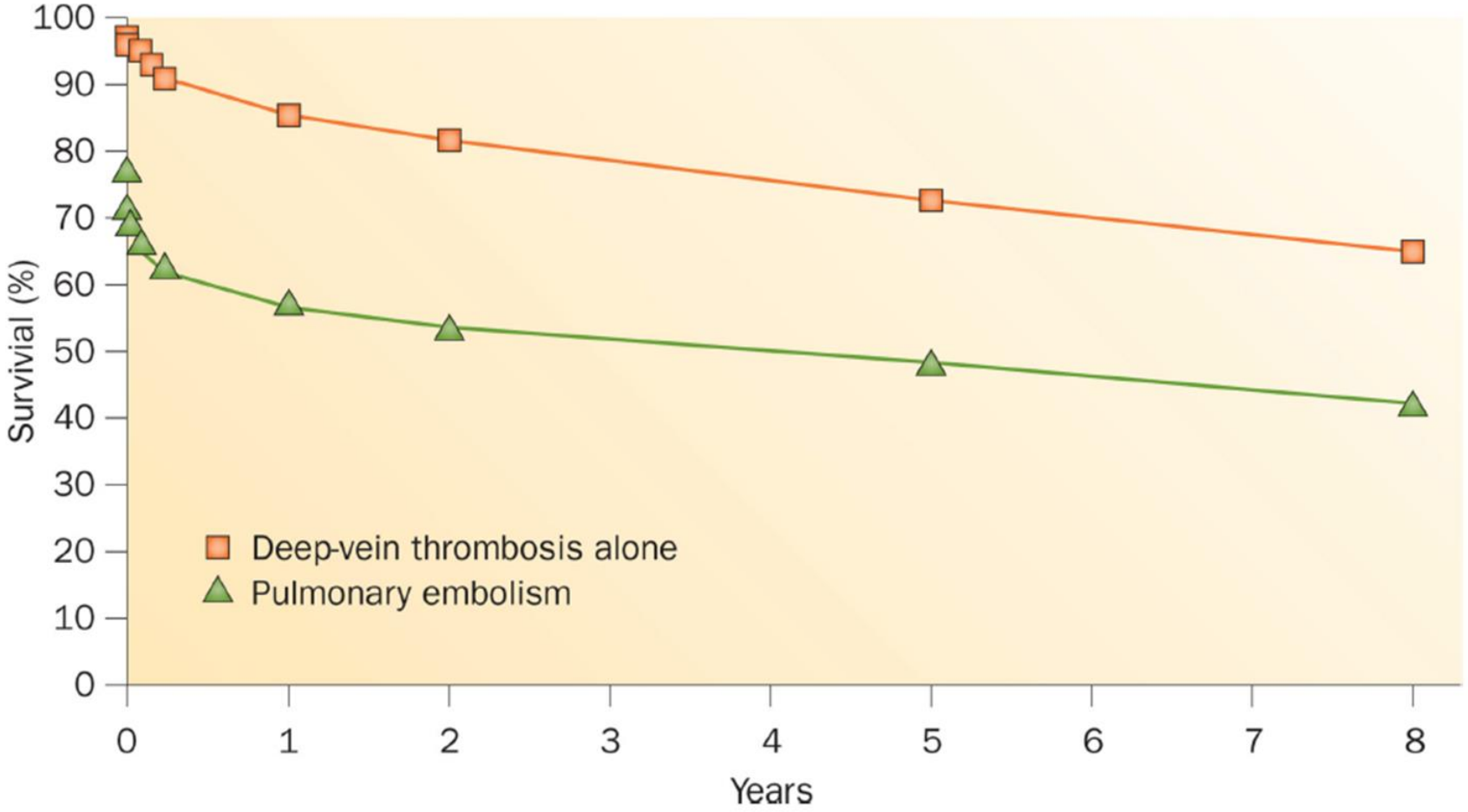
DVT vs PE

Time	Deep vein thrombosis alone	Pulmonary embolism
0 days	97.0	76.5
7 days	96.2	71.1
14 days	95.7	68.7
30 days	94.5	66.8
90 days	91.9	62.8
1 year	85.4	57.4
2 years	81.4	53.6
5 years	72.6	47.4
8 years	65.2	41.5

Heit et al Arch Intern Med 1999;159:445-453

Mortality

DVT vs PE



Heit et al Arch Intern Med 1999;159:445-453

Independent Predictors of VTE

Baseline characteristic	Odds ratio	95 % CI
Body mass index (kg/m^2)	1.08	1.05, 1.11
Major surgery	18.95	9.22, 38.97
Hospitalization for acute medical illness	5.07	3.12, 8.23
Nursing home confinement	4.63	2.77, 7.74
Trauma/fracture	4.56	2.46, 8.46
Active cancer	14.64	7.73, 27.73
Neurologic disease with leg paresis	6.10	1.97, 18.89
Pregnancy or postpartum	4.24	1.30, 13.84
Oral contraceptives	4.03	1.83, 8.89
Estrogen alone	1.81	1.06, 3.09
Non-contraceptive estrogen plus progestin	2.53	1.38, 4.63

Barsoum Thromb Res 2010; 126:373–378

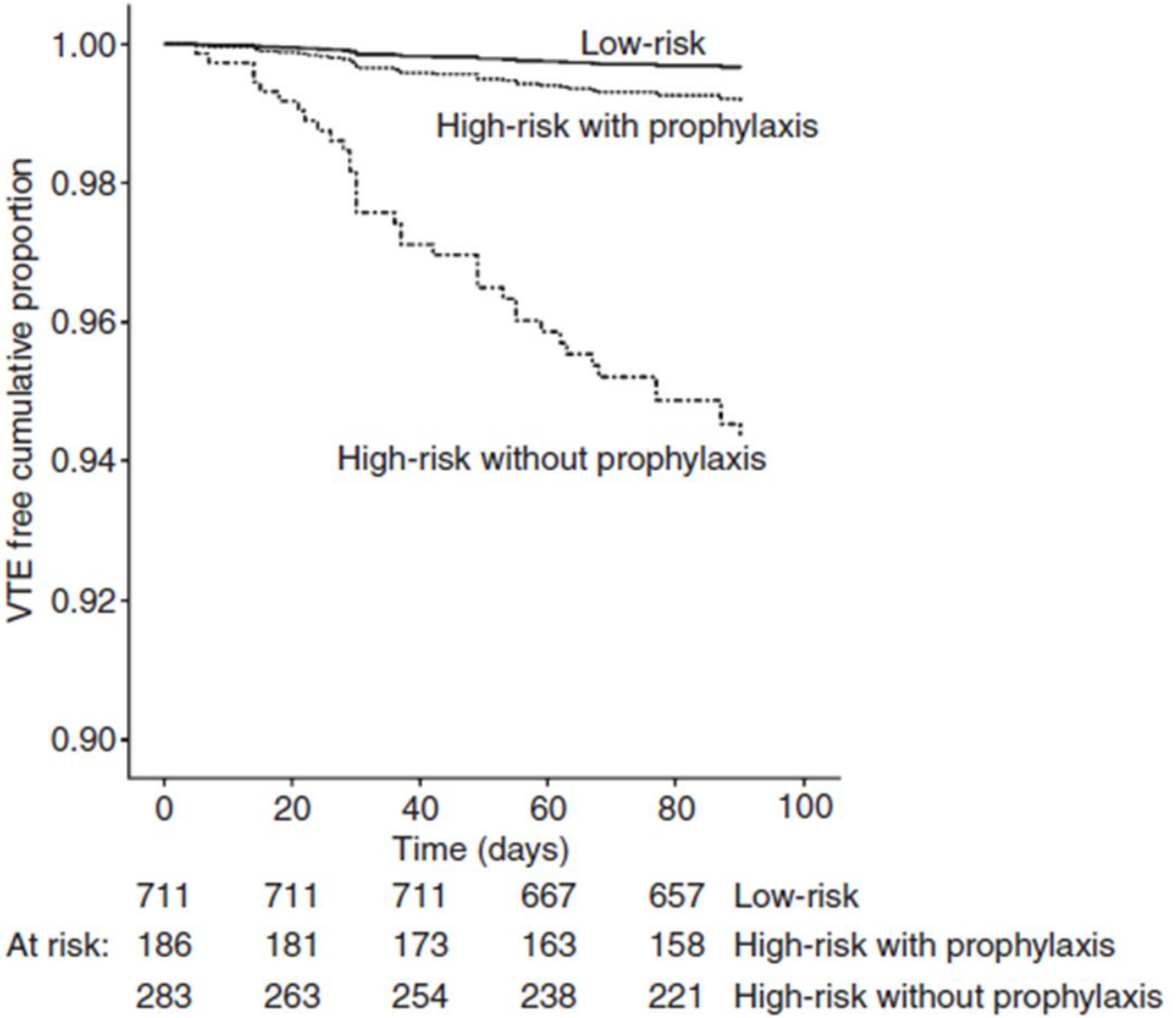
Which of the following is not a VTE Risk assessment Model?

a) Caprini
b) Padua
c) Improve
d) Simmons

Which of the following is not a VTE Risk assessment Model?

a) Caprini
b) Padua
c) Improve
d) Simmons

Padua
Risk Score



Barber et al J Thromb Haemost 2010;11:2450-7

VTE Risk Assessment

Paudua Risk Assessment in Medical Patients

Characteristic	Score
Active Cancer	3
Previous VTE (excluding superficial)	3
Reduced mobility (in bed more than 2/3 of day with BRP)	3
Thrombophilic condition	3
Recent trauma or surgery	2
Age > 70	1
Heart or respiratory failure	1
Acute MI or Ischemic stroke	1
Acute infection or hematologic disorder	1
Obesity (BMI > 30)	1
Ongoing hormonal treatment	1

High risk score ≥ 4

Barber et al J Thromb Haemost 2010;11:2450-7

VTE Risk Assessment
Improve

VTE Risk Factors	Score
Previous VTE	3
Thrombophilia	2
Lower limb paralysis	2
Cancer	2
Immobilization	1
ICU / CCU stay	1
Age > 60 years	1

Risk Category	Points
Low	0 – 1
Moderate	2 – 3
High	≥ 4

Spyropoulos Chest 2011;140: 706–714.

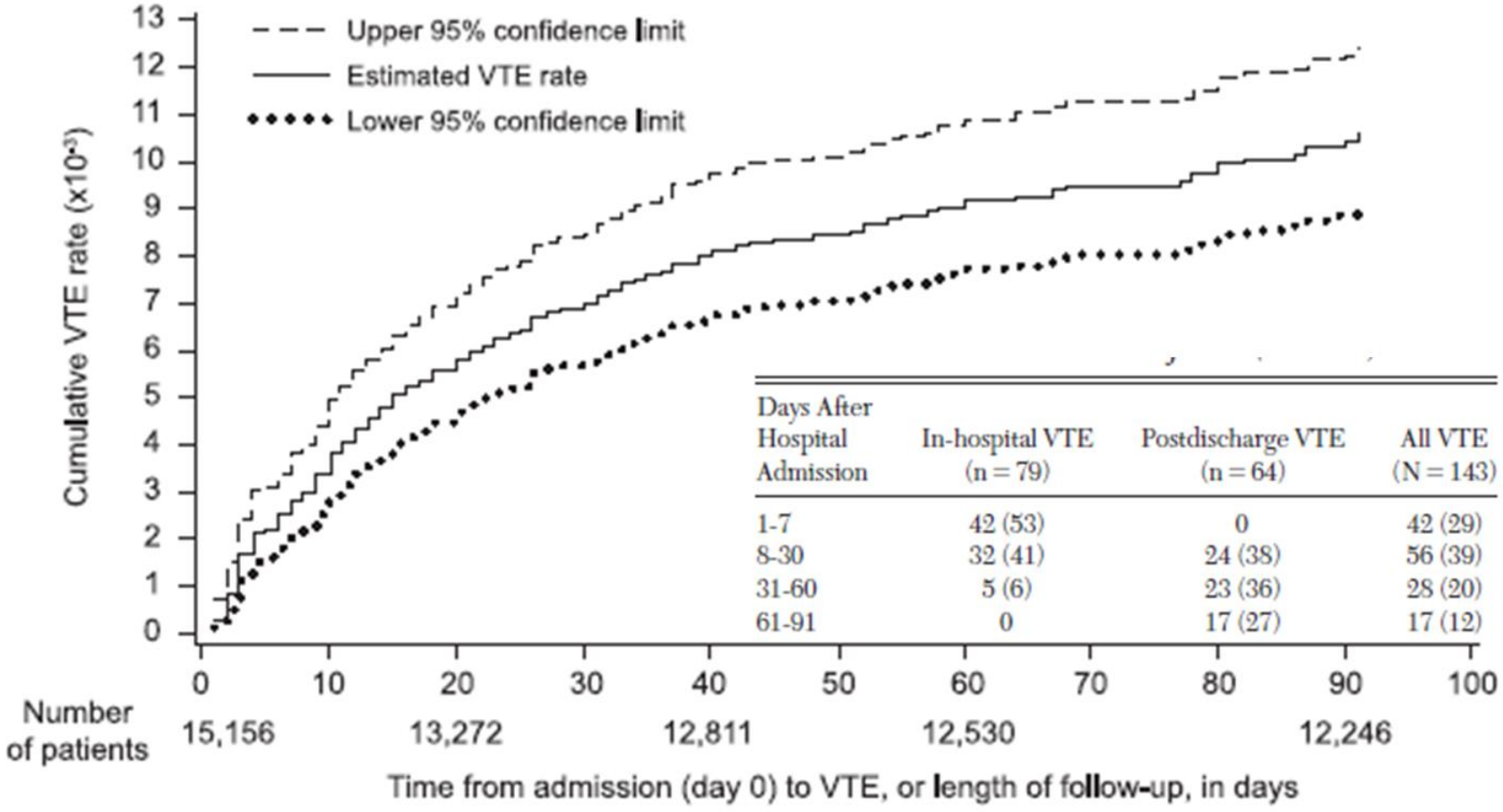
IMPROVE Bleeding Risk

Bleeding Risk Factors	Score
Renal Dysfunction	
GFR 30 – 59 ml/min	1
GFR < 30 ml/min	2.5
Age	
40 – 80	1.5
> 80	3.5
Bleeding Risk	
Hepatic Failure INR > 1.5	2.5
Platelets < 50 x 10^9	4
Bleeding History in previous 3 months	4
Active GI Ulcer	4.5
Other	
Male Gender	1
Current Cancer	2
Rheumatic Disease	2
CV Catheter	2
ICU / CCU stay	2.5

High risk score ≥ 7

Chest 2011;139: 69 - 70.

VTE Risk Post Discharge



Days After Hospital Admission	In-hospital VTE (n = 79)	Postdischarge VTE (n = 64)	All VTE (N = 143)
1-7	42 (53)	0	42 (29)
8-30	32 (41)	24 (38)	56 (39)
31-60	5 (6)	23 (36)	28 (20)
61-91	0	17 (27)	17 (12)

Spyropoulos Chest 2011;140: 706–714.

VTE Risk

Non- Orthopedic Surgical Populations

Risk Category	Surgery	Caprini Score	Risk w/o Px %
Very Low	Same-day surgery	0 – 2	< 0.5
Low	Spinal w/o malignancy	1 - 2	1.5
Moderate	GYN (non-cancer), Cardiac, Thoracic Spinal Surgery	3 - 4	3.0
High	Bariatric Pneumonectomy TBI/SCI, Craniotomy GYN cancer Major Trauma Orthopedic	≥ 5	6.0+

Risk Level for general surgery including urologic, GI, vascular, breast and thyroid dependent on Caprini Score

CHEST 2012; 141(2)(Suppl):e227S–e277S

Surgical Patients
Caprini Risk Assessment

1 Point	2 Points	3 Points	5 Points
Age 41-60 y	Age 61-74 y	Age ≥ 75 y	Stroke (< 1 mo)
Minor surgery	Arthroscopic surgery	History of VTE	Elective arthroplasty
BMI > 25 kg/m²	Major open surgery (> 45 min)	Family history of VTE	Hip, pelvis, or leg fracture
Swollen legs	Laparoscopic surgery (> 45 min)	Factor V Leiden	Acute spinal cord injury (< 1 mo)
Varicose veins	Malignancy	Prothrombin 20210A	
Pregnancy or postpartum	Confined to bed (> 72 h)	Lupus anticoagulant	
History of unexplained or recurrent spontaneous abortion	Immobilizing plaster cast	Anticardiolipin antibodies	
Oral contraceptives or hormone replacement	Central venous access	Elevated serum homocysteine	
Sepsis (< 1 mo)		Heparin-induced thrombocytopenia	
Serious lung disease, including pneumonia (< 1 mo)		Other congenital or acquired thrombophilia	
Abnormal pulmonary function			
Acute myocardial infarction			
Congestive heart failure (< 1 mo)			
History of inflammatory bowel disease			
Medical patient at bed rest			

Risk Category	**Points**
Very Low	0 – 1
Low	2
Moderate	3 – 4
High	≥ 5

Ann Surg 2010;251:344-350

VTE Risk
Malignancy

- 20% of all incident VTE occurring in the community
  - Brain, pancreas, ovarian, colon, gastric, lung, renal, bone and metastatic disease
  - Chemotherapy-related
    - Especially pancreatic, gastric
    - BMI $\geq$ 35, Platelets $\geq$ 350, ESAs
- Screening for occult cancer
  - CT of abdomen and pelvis only in patients with suggestive features

Heit et al Nat Rev Cardiol. 2015 August ; 12(8): 464–474

Risk of Recurrence

Independent Risk Factors

- Age
- BMI
- Active cancer
- Neurologic disease with leg paresis
- Idiopathic VTE
- Persistent Lupus AC and APhLA

Reduced Risk

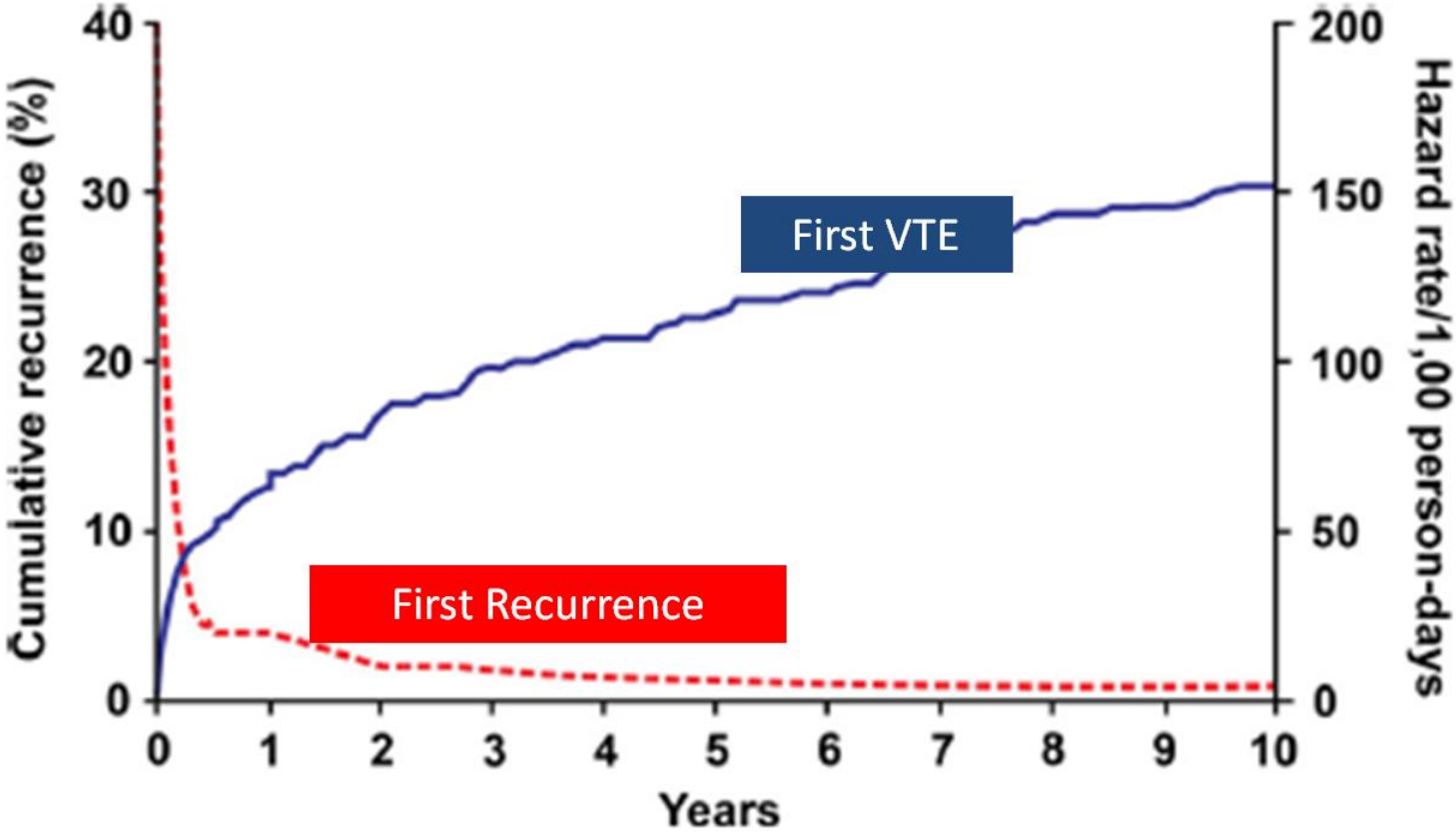
- Pregnancy, OC, hormone therapy and GYN surgery
- Statins reduce the risk of recurrent PE

No impact on recurrence

- Recent surgery or trauma have no predictive value
- Immobilization
- Tamoxifen
- Failed prophylaxis

Heit et al Nat Rev Cardiol. 2015 August ; 12(8): 464–474

VTE Recurrence



Heit Arch Intern Med 2000;160:761-768

Conclusions

- Thromboembolic events are a common occurrence in certain at risk populations
- Consequences of TE can result in significant morbidity and mortality
- Risk assessment identifies individuals with at greatest need for prophylactic therapies as well at risk for bleeding