



Postoperative Venous Thromboembolism: Improved Coding after New ICD-9-CM Codes but Continuing Opportunities to Improve Care

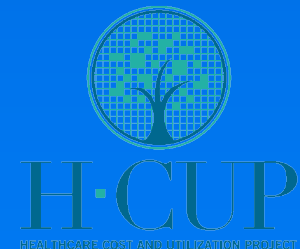
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AHRQ Patient Safety Indicators

- Designed for use with widely available administrative (discharge) data sets
- Reflect aspects of quality of care inside hospitals, focusing on potentially avoidable complications and related iatrogenic events.
- Can be used to help hospitals to identify potential adverse events for further study, and to inform other stakeholders about potential quality problems
- 19 indicators for complications occurring in-hospital; 6 indicators also have area level analogs designed to detect patient safety events on a regional level
- Predictive validity clearly established through correlations with LOS, charges, mortality



PSI 12 – Postoperative DVT/PE

Early criterion validity findings

UHC Cohort (n=450)	Coding	Clinical
Sensitivity	80% (46-100%)	100%
Specificity	99.5% (99.3-99.6%)	98.6% (98.6-99.2%)
Positive Predictive Value	72% (67-79%)	44% (37-51%)
Negative Predictive Value	99.6% (98.9-100%)	100%
VA Cohort (n=112)		
Positive Predictive Value		43% (34-53%)
AHRQ Cohort (n=121)		
Positive Predictive Value	84% (72-95%)	47% (42-52%)

University HealthSystem Consortium cohort includes 505 flagged, randomly sampled surgical cases from 33 volunteer hospitals in 21 states; 450 cases were fully abstracted and submitted to UHC.





Background

- Previous validation studies showed poor predictive value due to:
 - High prevalence of DVT present on admission or chronic DVT
 - Use of nonspecific codes for upper extremity, thoracic, and superficial venous thromboses
 - Preoperative but post-admission DVT in acutely ill patients
- POA reporting introduced for all Medicare claims and many statewide data programs
- New ICD-9-CM codes implemented in FY 2010 update to capture superficial, upper extremity, and chronic venous thromboses



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- **Are the problems fixable or is PSI 12 irredeemable?**

453.4 Acute venous embolism and thrombosis of deep vessels of lower extremity

453.40 Acute venous embolism and thrombosis of unspecified deep vessels of lower extremity

Deep vein thrombosis NOS

453.41 Acute venous embolism and thrombosis of deep vessels of proximal lower extremity

Femoral, Iliac, Popliteal, Thigh, Upper leg NOS

453.42 Acute venous embolism and thrombosis of deep vessels of distal lower extremity

Calf, Lower leg NOS, Peroneal, Tibial

453.5 Chronic venous embolism and thrombosis of deep vessels of lower extremity

Excludes: personal history of venous thrombosis and embolism (V12.51)

453.50 Chronic venous embolism and thrombosis of unspecified deep vessels of lower extremity

453.51 Chronic venous embolism and thrombosis of deep vessels of proximal lower extremity

453.52 Chronic venous embolism and thrombosis of deep vessels of distal lower extremity

453.6 Venous embolism and thrombosis of superficial vessels of lower extremity

453.7 Chronic venous embolism and thrombosis of other specified vessels

Excludes: personal history of venous thrombosis and embolism (V12.51)

453.71 Chronic venous embolism and thrombosis of superficial veins of upper extremity

453.72 Chronic venous embolism and thrombosis of deep veins of upper extremity

453.73 Chronic venous embolism and thrombosis of upper extremity, unspecified

453.74 Chronic venous embolism and thrombosis of axillary veins

453.75 Chronic venous embolism and thrombosis of subclavian veins

453.76 Chronic venous embolism and thrombosis of internal jugular veins

453.77 Chronic venous embolism and thrombosis of other thoracic veins

453.79 Chronic venous embolism and thrombosis of other specified veins

453.8 Acute venous embolism and thrombosis of other specified veins

Excludes: cerebral, coronary, intracranial sinus, nonpyogenic, mesenteric, portal, precerebral, pulmonary

453.81 Acute venous embolism and thrombosis of superficial veins of upper extremity

453.82 Acute venous embolism and thrombosis of deep veins of upper extremity

453.83 Acute venous embolism and thrombosis of upper extremity, unspecified

453.84 Acute venous embolism and thrombosis of axillary veins

453.85 Acute venous embolism and thrombosis of subclavian veins

453.86 Acute venous embolism and thrombosis of internal jugular veins

453.87 Acute venous embolism and thrombosis of other thoracic veins

453.89 Acute venous embolism and thrombosis of other specified veins

453.9 Of unspecified site (embolism of vein, thrombosis (vein))



Methods

- Two parallel studies were conducted to update previous PPV estimates for PSI 12 and to identify actionable opportunities to improve care:
 - 7 volunteer hospitals recruited through AHRQ QI listserve, including flagged cases only
 - 15 academic health systems recruited through UHC, including both flagged and unflagged cases with TKA surgery
- AHRQ PSI 12 Version 4.1 software was applied to eligible cases from participating hospitals, using “present on admission” (POA) flags.
 - Hospital’s own data (AHRQ) or Clinical Database (UHC)



Methods

- Flagged cases were reviewed by trained QI nurses at each hospital, using detailed chart abstraction tool and guidelines.
- Detailed review of discrepant cases to identify possible reasons for the discrepancy:
 - Present on admission (note one hospital did not apply denominator exclusions)
 - Location of thrombosis (upper extremity and superficial thromboses are clinical FPs)
 - Chronic vs. acute embolism (based on radiographic criteria)
- Records from volunteer hospitals in AHRQ study were sampled in sequential reverse order from 6/30/2010 back to 10/1/2009, up to N=30



Case Control Study

■ Cases (up to 20):

- Uni-TKA or Bilat-TKA
- Oct 2008 to Mar 2010
- >40 yrs
- PSI-12 code for VTE within 90 days

■ Controls (up to 40):

- Uni-TKA or Bilat-TKA
- Oct 2008 to Mar 2010
- >40 yrs
- NO PSI-12 code for VTE within 90 days

- No TKA or THA within 90 days prior
- No VTE as principal ICD-9-CM diagnosis
- No VTE as POA
- No pregnancy, childbirth, or puerperium



Analysis

- $TP / (TP + FP) = PPV$
- Classified FDA-approved pharmacologic prophylaxis as receipt of the recommended dose at the recommended starting time (per package insert) before or after surgery, and continued until at least the day of discharge
- Patients who were diagnosed with VTE on the day of surgery or the day after surgery were not included in the case control analysis
- Other risk factors assessed included age, obesity (BMI), type of TKA, race/ethnicity, date of ambulation, personal or family history of VTE, and comorbid conditions
- Analysis adjusted for conditional stratified sampling of controls without VTE



Findings: 7 volunteer hospitals

- From a total of 171 audited charts, 15 cases were excluded post hoc (because hospital did not properly apply POA)
- 30 cases were False Positive:
 - 15 cases were POA
 - 8 cases with upper extremity VT
 - 1 case with SVC (central VT)
 - 3 cases with superficial VT
 - 3 cases were chronic
- Overall PPV = 81%



Findings: AMCs with TKA patients PSI-12 flagged cases

**126 VTE flagged
by PSI 12
(+4 Readmission)**

Chart
Abstraction →

**125 cases
True Positive
postop lower
ext DVT or PE**

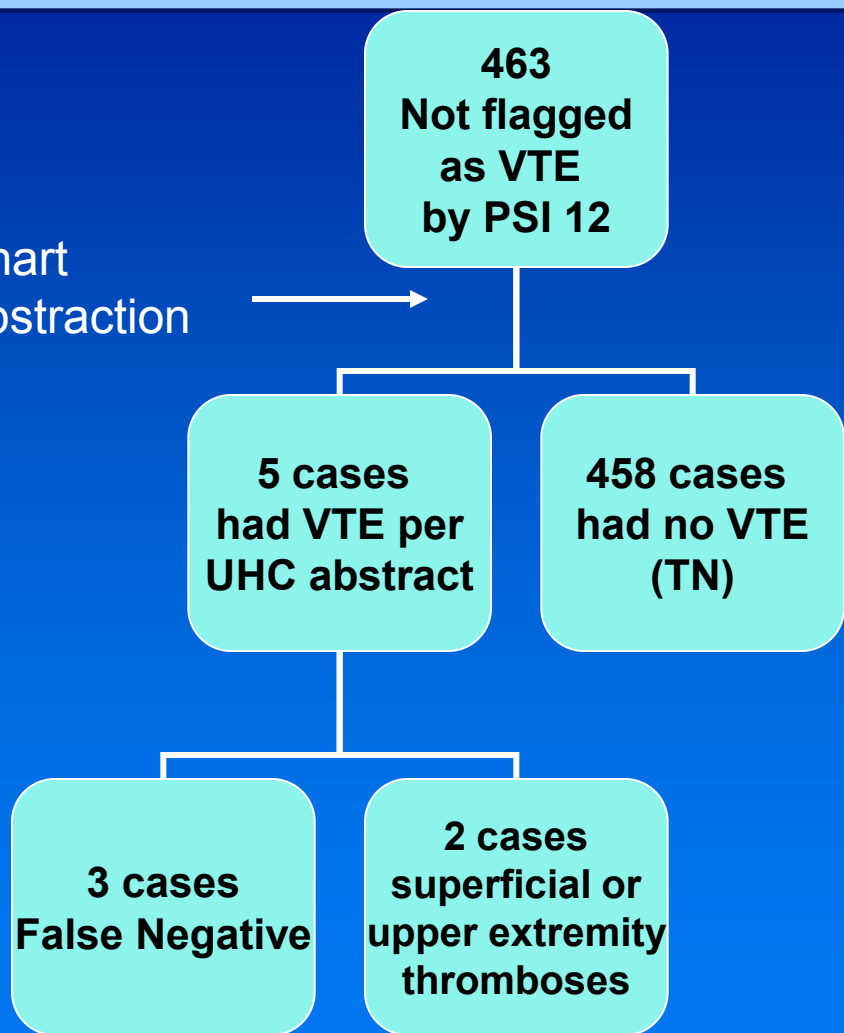
**1 case clinical
False Positive
(superficial)
saphenous Vein**

■ Positive Predictive Value
= $TP / (TP + FP)$
= $125 / (125 + 1)$
= 0.992



Findings: AMCs with TKA patients PSI-12 unflagged controls

Chart
Abstraction



■ Negative Predictive Value
 $= \text{TN} / (\text{FN} + \text{TN})$
 $= 458 / (458+3) = 0.993$



Multivariable Analysis

- Multivariate Adjusted Odds Ratios and 95% Confidence Intervals
 - Outcome: Any VTE Event Diagnosed Day 2 of Surgery or Later
 - Excluded One Hospital That Screened TKA Patients Routinely For VTE

Predictive Factor	Odds Ratio (95% CI)	P value
Age	1.02 (0.99 – 1.05)	0.20
Gender (ref: male)	1.7 (0.9 – 2.9)	0.90
Ambulation (ref: no ambulation)		
• Taking steps day 1 or 2	0.3 (0.1 – 0.9)	0.005
• Taking steps after day 2	0.7 (0.2 – 2.1)	0.56
Type of TKA (ref: unilateral TKA)		
• Bilateral TKR	4.2 (1.9 – 9.1)	0.004
Recommended pharmacologic prophylaxis (ref: only mechanical)	0.5 (0.3 – 0.8)	0.01
BMI \geq 35 (ref: BMI < 35)	0.9 (0.5 – 1.6)	0.66



Interaction terms

- None of the interactions between obesity, type of prophylaxis, type of surgery or time to ambulation were significant (but analysis was underpowered)
 - There was no significant difference in the effect of LMWH among extremely obese versus non/less obese patients
 - There was no significant difference in the effect of use of any medical prophylaxis among extremely obese versus non/less obese patients



Summary

- PPV was substantially higher than previously reported (81% versus 43-47%) in PSI-12 flagged cases from volunteer hospitals
- PPV was especially high in a subset of surgical cases with low prior probability of VTE (99.2%)
- Continuing evidence of high sensitivity (99.3% NPV among high-risk patients)
- In the setting of 100% TJC SCIP compliance:
 - VTE after TKA was associated with not receiving pharmacologic thromboprophylaxis at FDA-approved doses and initiation schedule
 - Bilateral TKA was associated with higher odds of VTE.
 - Early mobilization was associated with lower odds of VTE.
 - Medical prophylaxis was as effective in morbidly obese as in less obese patients



Limitations and implications

- Volunteer hospitals in AHRQ sample
- Academic medical centers in UHC sample
- UHC sample limited to TKA (high-risk) patients
- Hospital abstractors may have covered up false negative (unreported) cases
- ICD-9-CM changes and associated coder training can substantially improve criterion validity of PSIs, in the right circumstances
- Actionable opportunities to improve care to prevent VTE persist despite 100% compliance with existing TJC process measures
- Value of outcome measure confirmed



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Questions and Discussion

