

# Supplementary Appendix A

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## 1. Case definitions

### 1.1 Case Definition of Deep Vein Thrombosis (DVT)

1. Definite
  - (a) Imaging is confirmatory
    - OR–
  - (b) Autopsy
    - OR–
  - (c) Venous thrombectomy confirms thrombus present
2. Probable
  - (a) Imaging is indeterminate—AND—review of records shows mention of DVT or suspected DVT—AND—treatment given:
    - 1) Anticoagulant
      - OR–
    - 2) DVT-related procedure: vena cava filter OR thrombolysis (systemic or catheter directed)
3. Possible: at least 2 of the following,
  - (a) ICD-9 CM code
    - OR–
  - (b) DVT-related CPT code
    - OR–
  - (c) ICD-10 CM code
    - OR–
  - (d) POA indicator listed as “Y” for DVT

**Definition of “imaging confirmatory”:** for any of the diagnostic tests of ultrasound, computed tomography venography (CTV), traditional contrast venography, or magnetic resonance imaging (MRI), if any of the text reports states (or similar language): (1) thrombus or thrombosis is present OR, (2) there are noncompressible venous segment(s), OR (3) a filling defect or intraluminal filling defect is present.

**Definition of anticoagulant treatment:** treatment for more than 72 hours with therapeutic regimens of one or a combination of the following medications: heparin, enoxaparin (Lovenox), dalteparin (Fragmin), fondaparinux (Arixtra), tinzaparin (Innohep), warfarin (Coumadin), dabigatran (Pradaxa), rivaroxaban (Xarelto), apixaban (Eliquis), edoxaban (Lixiana), argatroban, lepirudin (Refludan), bivalirudin (Angiomax).

**Medications qualifying as thrombolysis/thrombolytic treatment:** alteplase (Activase, Cathflo Activase, tissue plasminogen activator, TPA), reteplase (Retevase), tenecteplase (TNKase), urokinase (Abbokinase), streptokinase (Streptase).

## 1.2 Case Definition of Pulmonary Embolism

1. Definite:
  - (a) Imaging is confirmatory  
–OR–
  - (b) Autopsy  
–OR–
  - (c) Pulmonary embolectomy confirms embolism present
2. Probable:
  - (a) Imaging is indeterminate or not available/not done—AND—review of records shows mention of PE or suspected PE—AND—treatment given:
    - 1) Anticoagulant  
–OR–
    - 2) PE-related procedure: vena cava filter OR thrombolysis (systemic or catheter directed)  
–OR–
  - (b) Death certificate—contributing cause of death
3. Possible: at least 2 of the following,
  - (a) ICD-9 CM code  
–OR–
  - (b) PE-related CPT code  
–OR–
  - (c) ICD-10 CM code  
–OR–
  - (d) POA code indicator listed as “Y” for PE

**Definition of “imaging confirmatory”:** for any of the diagnostic tests of computed tomography angiography (CTA), ventilation perfusion (VQ) scan, pulmonary angiogram, or magnetic resonance imaging (MRI), if any of the text reports states (or similar language): (1) pulmonary embolism, embolism, clot, thrombus, OR (2) a filling defect or intraluminal filling defect is present, OR (3) high probability VQ scan, large perfusion defect with ventilation mismatch, or segmental perfusion defect with ventilation mismatch.

**Definition of anticoagulant treatment:** Same as above for DVT.

**Medications qualifying as thrombolysis/thrombolytic treatment:** Same as above for DVT.

## 2.1 DVT-related ICD-9 codes, CPT codes, and ICD-10 codes

### a. ICD-9 CM codes for DVT

ICD-9 CM codes	Definition
451.0	Phlebitis and thrombophlebitis of superficial vessels of lower extremities
451.11	Phlebitis and thrombophlebitis of femoral vein (deep) (superficial)
451.19	Phlebitis and thrombophlebitis of deep veins of lower extremities, other
451.20	Phlebitis and thrombophlebitis of lower extremities, unspecified
451.81	Phlebitis and thrombophlebitis of iliac vein
451.83	Phlebitis and thrombophlebitis of deep veins of upper extremities
451.84	Phlebitis and thrombophlebitis of upper extremities, unspecified
451.89	Phlebitis and thrombophlebitis of other sites
451.90	Phlebitis and thrombophlebitis of unspecified site
453.1	Thrombophlebitis migrans
453.3	Embolism and thrombosis of renal vein
453.20	Other venous embolism and thrombosis of inferior vena cava

## a. (Continued)

ICD-9 CM codes	Definition
453.40	Acute venous embolism and thrombosis of unspecified deep vessels of lower extremity
453.41	Acute venous embolism and thrombosis of deep vessels of proximal lower extremity
453.42	Acute venous embolism and thrombosis of deep vessels of distal lower extremity
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
453.71	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
453.81	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
453.90	Other venous embolism and thrombosis of unspecified site
459.10	Postphlebotic syndrome without complications
459.11	Postphlebotic syndrome with ulcer
459.12	Postphlebotic syndrome with inflammation
459.13	Postphlebotic syndrome with ulcer and inflammation
459.19	Postphlebotic syndrome with other complication
671.30	Deep phlebothrombosis, antepartum, unspecified as to episode of care or not applicable
671.31	Deep phlebothrombosis, antepartum, delivered, with or without mention of antepartum condition
671.33	Deep phlebothrombosis, antepartum, antepartum condition or complication
671.40	Deep phlebothrombosis, postpartum, unspecified as to episode of care or not applicable
671.42	Deep phlebothrombosis, postpartum, delivered, with mention of postpartum complication
671.44	Deep phlebothrombosis, postpartum, postpartum condition or complication
671.50	Other phlebitis and thrombosis complicating pregnancy and the puerperium, unspecified as to episode of care or not applicable
671.51	Other phlebitis and thrombosis complicating pregnancy and the puerperium, delivered, with or without mention of antepartum condition
671.52	Other phlebitis and thrombosis complicating pregnancy and the puerperium, delivered, with mention of postpartum complication
671.53	Other phlebitis and thrombosis complicating pregnancy and the puerperium, antepartum condition or complication
671.54	Other phlebitis and thrombosis complicating pregnancy and the puerperium, postpartum condition or complication

(Continued)

## a. (Continued)

ICD-9 CM codes	Definition
671.90	Unspecified venous complication in pregnancy and the puerperium, unspecified as to episode of care or not applicable
671.91	Unspecified venous complication of pregnancy and the puerperium, delivered, with or without mention of antepartum condition
671.92	Unspecified venous complication of pregnancy and the puerperium, delivered, with mention of postpartum complication
671.93	Unspecified venous complication of pregnancy and the puerperium, antepartum condition or complication
671.94	Unspecified venous complication of pregnancy and the puerperium, postpartum condition or complication
V12.51	Personal history of venous thrombosis and embolism
V12.52	Personal history of thrombophlebitis
V12.59	Personal history of other diseases of circulatory system
V58.61	Long-term (current) use of anticoagulants
V58.63	Long-term (current) use of antiplatelet/antithrombotic

## b. ICD-9 Procedure codes for DVT

ICD-9 CM Procedure codes	Definition
00.03	Therapeutic ultrasound of peripheral vascular vessels; antirestenotic ultrasound; intravascular non-ablative ultrasound
00.22	Intravascular imaging of intrathoracic vessels; aorta and aortic arch; intravascular ultrasound (IVUS), intrathoracic vessels; vena cava (superior) (inferior)
00.23	Intravascular imaging of peripheral vessels; imaging of: vessels of arm(s); vessels of leg(s); intravascular ultrasound (IVUS), peripheral vessels
00.28	Intravascular imaging, other specified vessel(s)
00.29	Intravascular imaging, unspecified vessel(s)
38.0 (0–9)	Incision of vessel; embolectomy; thrombectomy
38.2	Diagnostic procedures on blood vessels
38.22	Percutaneous angiography
38.7	Interruption of the vena cava; insertion of implant or sieve in vena cava; ligation of vena cava (inferior) (superior); plication of vena cava; Greenfield filter
88.01	Computerized axial tomography of abdomen
88.02	Other abdomen tomography
88.6 <sup>a</sup>	Phlebography; includes: angiography of veins; radiography of veins (by fluoroscopy); retrograde phlebography; venipuncture for injection of contrast material; venography using contrast material
88.61	Phlebography of veins of head and neck using contrast material
88.62	Phlebography of pulmonary veins using contrast material
88.63	Phlebography of other intrathoracic veins using contrast material
88.64	Phlebography of the portal venous system using contrast material; splenoportogram (by splenic arteriography)
88.65	Phlebography of other intra-abdominal veins using contrast material
88.66	Phlebography of femoral and other lower extremity veins using contrast material
88.67	Phlebography of other specified sites using contrast material
88.68	Impedance phlebography
88.76	Diagnostic ultrasound of abdomen and retroperitoneum

**b.** (Continued)

ICD-9 CM Procedure codes	Definition
88.77	Diagnostic ultrasound of peripheral vascular system; deep vein thrombosis ultrasonic scanning
88.78	Diagnostic ultrasound of gravid uterus; intrauterine cephalometry: echo ultrasonic; placental localization by ultrasound
88.79	Other diagnostic ultrasound; ultrasonography of: multiple sites, nongravid uterus, total body
88.92	Magnetic resonance imaging of chest and myocardium; for evaluation of hilar and mediastinal lymphadenopathy
88.95	Magnetic resonance imaging of pelvis, prostate, and bladder
99.10	Injection or infusion of thrombolytic agent; alteplase; anistreplase; reteplase; streptokinase; tenecteplase; tissue plasminogen activator (TPA); urokinase

<sup>a</sup>Requires fourth digit that shows location.

**c.** CPT codes for DVT

CPT codes	Definition
01522	Anesthesia for procedures on veins of lower leg; venous thrombectomy, direct or with catheter
34401	Thrombectomy, direct or with catheter; vena cava, iliac vein, by abdominal incision
34421	Thrombectomy, direct or with catheter; vena cava, iliac, femoropopliteal vein, by leg incision
34451	Thrombectomy, direct or with catheter; vena cava, iliac, femoropopliteal vein, by abdominal and leg incision
34471	Thrombectomy, direct or with catheter; subclavian vein, by neck incision
34490	Thrombectomy, direct or with catheter; axillary and subclavian vein, by arm incision
37187	Percutaneous transluminal mechanical thrombectomy, vein(s), including intraprocedural pharmacological thrombolytic injections and fluoroscopic guidance
37188	Percutaneous transluminal mechanical thrombectomy, vein(s), including intraprocedural pharmacological thrombolytic injections and fluoroscopic guidance, repeat treatment on subsequent day during course of thrombolytic therapy
37191	Insertion of intravascular vena cava filter, endovascular approach inclusive of vascular access, vessel selection, and all radiological supervision and interpretation, intraprocedural roadmapping, and imaging guidance (ultrasound and fluoroscopy), when performed
37201	Transcatheter therapy, infusion for thrombolysis other than coronary
37209	Exchange of a previously placed intravascular catheter during thrombolytic therapy

**2.2 PE-related ICD-9 codes, CPT codes, and ICD-10 codes****a.** ICD-9 CM codes for PE

ICD-9 CM codes	Description
415.0	Acute cor pulmonale
415.11	Iatrogenic pulmonary embolism and infarction
415.12	Septic pulmonary embolism
415.13	Saddle embolus of pulmonary artery
415.19	Other pulmonary embolism and infarction
453.89	Acute venous embolism and thrombosis of other specified veins
453.90	Other venous embolism and thrombosis of unspecified site (embolism of vein, thrombosis [vein])
634.60	Spontaneous abortion, complicated by embolism, unspecified
634.61	Spontaneous abortion, complicated by embolism, incomplete
634.62	Spontaneous abortion, complicated by embolism, complete

(Continued)

## a. (Continued)

ICD-9 CM codes	Description
635.60	Legally induced abortion, complicated by embolism, unspecified
635.61	Legally induced abortion, complicated by embolism, incomplete
635.62	Legally induced abortion, complicated by embolism, complete
636.60	Illegally induced abortion, complicated by embolism, unspecified
636.61	Illegally induced abortion, complicated by embolism, incomplete
636.62	Illegally induced abortion, complicated by embolism, complete
637.60	Legally unspecified abortion, complicated by embolism, unspecified
637.61	Legally unspecified abortion, complicated by embolism, incomplete
637.62	Legally unspecified abortion, complicated by embolism, complete
638.60	Failed attempted abortion, complicated by embolism
639.60	Embolism following abortion or ectopic and molar pregnancies
671.32	Obstetrical pyemic and septic embolism with delivery with postpartum complication
673.20	Obstetrical blood-clot embolism, unspecified as to episode of care or not applicable
673.21	Obstetrical blood-clot embolism, delivered, with or without mention of antepartum condition
673.22	Obstetrical blood-clot embolism, delivered, with mention of postpartum complication
673.23	Obstetrical blood-clot embolism, antepartum condition or complication
673.24	Obstetrical blood-clot embolism, postpartum condition or complication
673.30	Obstetrical pyemic and septic embolism unspecified as to episode of care
673.31	Obstetrical pyemic and septic embolism with delivery with or without antepartum condition
673.33	Obstetrical pyemic and septic embolism antepartum
673.34	Obstetrical pyemic and septic embolism postpartum
673.80	Other obstetrical pulmonary embolism unspecified as to episode of care
673.81	Other obstetrical pulmonary embolism with delivery with or without antepartum condition
673.82	Other obstetrical pulmonary embolism with delivery with postpartum complication
673.83	Other obstetrical pulmonary embolism antepartum
673.84	Other obstetrical pulmonary embolism postpartum
V12.51	Personal history of venous thrombosis and embolism
V12.55	Personal history of pulmonary embolism
V12.59	Personal history of other diseases of circulatory system
V58.61	Long-term (current) use of anticoagulants
V58.63	Long-term (current) use of antiplatelet/antithrombotic

## b. ICD-9 Procedure codes for PE

ICD-9 CM Procedure codes	Definition
38.0 (0–9)	Incision of vessel; embolectomy; thrombectomy
38.7	Interruption of the vena cava; Insertion of implant or sieve in vena cava; ligation of vena cava (inferior) (superior); plication of vena cava; Greenfield filter
88.01	Computerized axial tomography of abdomen
88.02	Other abdomen tomography
88.6 <sup>a</sup>	Phlebography; includes: angiography of veins; radiography of veins (by fluoroscopy); retrograde phlebography; venipuncture for injection of contrast material; venography using contrast material
88.61	Phlebography of veins of head and neck using contrast material
88.62	Phlebography of pulmonary veins using contrast material

**b.** (Continued)

ICD-9 CM Procedure codes	Definition
88.63	Phlebography of other intrathoracic veins using contrast material
88.64	Phlebography of the portal venous system using contrast material; Splenoportogram (by splenic arteriography)
88.65	Phlebography of other intra-abdominal veins using contrast material
88.66	Phlebography of femoral and other lower extremity veins using contrast material
88.67	Phlebography of other specified sites using contrast material
88.68	Impedance phlebography
88.76	Diagnostic ultrasound of abdomen and retroperitoneum
88.77	Diagnostic ultrasound of peripheral vascular system; deep vein thrombosis ultrasonic scanning
88.78	Diagnostic ultrasound of gravid uterus; intrauterine cephalometry; echo ultrasonic; placental localization by ultrasound
88.79	Other diagnostic ultrasound; ultrasonography of: multiple sites, nongravid uterus, total body
88.92	Magnetic resonance imaging of chest and myocardium; for evaluation of hilar and mediastinal lymphadenopathy
88.95	Magnetic resonance imaging of pelvis, prostate, and bladder
99.10	Injection or infusion of thrombolytic agent; alteplase; anistreplase; reteplase; streptokinase; tenecteplase; tissue plasminogen activator (TPA); urokinase

<sup>a</sup>Requires fourth digit that shows location.

**c.** CPT codes for PE

CPT codes	Description
33310	Cardiotomy, exploratory (includes removal of foreign body, atrial or ventricular thrombus); without cardiopulmonary bypass
33315	Cardiotomy, exploratory (includes removal of foreign body, atrial or ventricular thrombus); with cardiopulmonary bypass
33910	Pulmonary artery embolectomy, with cardiopulmonary bypass
33915	Pulmonary artery embolectomy, without cardiopulmonary bypass
37187	Percutaneous transluminal mechanical thrombectomy, vein(s), including intraprocedural pharmacological thrombolytic injections and fluoroscopic guidance
37188	Percutaneous transluminal mechanical thrombectomy, vein(s), including intraprocedural pharmacological thrombolytic injections and fluoroscopic guidance, repeat treatment on subsequent day during course of thrombolytic therapy
37191	Insertion of intravascular vena cava filter, endovascular approach inclusive of vascular access, vessel selection, and all radiological supervision and interpretation, intraprocedural roadmapping, and imaging guidance (ultrasound and fluoroscopy), when performed
37201	Transcatheter therapy, infusion for thrombolysis other than coronary

**d.** ICD-10 codes for PE

ICD-10 codes	Definition
I26	Pulmonary embolism
I73 <sup>a</sup>	Other peripheral vascular disease
I80	Phlebitis and thrombophlebitis
I81 <sup>a</sup>	Portal vein thrombosis
I82 <sup>a</sup>	Other venous embolism and thrombosis

<sup>a</sup>Included as a VTE-related death, but not included as a PE-related death.

**3. Provoking Categorization**

Persistent	Transient	Time
Active cancer <sup>a</sup>	History of hospitalization	2 mo
Inflammatory bowel disease	Immobilization	3 mo
Antiphospholipid syndrome	Surgery	
Systemic lupus erythematosus	Trauma	
	Central venous catheterization	
	Congestive heart failure	
	Myocardial infarction	
	Stroke	
	Pregnancy: vaginal	
	Pregnancy: cesarean	3 mo
	Select medications <sup>b</sup>	2 mo

<sup>a</sup>Metastatic or diagnosed within 6 months of VTE diagnosis.

<sup>b</sup>Estrogen- and progesterone-containing drugs, raloxifene, tamoxifen, erythropoietin, romiplostim, oprelvekin, eltrombopag, thalidomide, and lenalidomide.

**4. Thrombophilic and prothrombotic conditions**

Known thrombophilic or prothrombotic conditions included antiphospholipid antibody syndrome, antithrombin deficiency, activated protein C resistance, disseminated intravascular coagulation, factor V Leiden, family history of VTE, inflammatory bowel disease, protein C deficiency, protein S deficiency, prothrombin 20210, sickle cell disease, systemic lupus erythematosus, and thalassemia.