Diagnosing and Treating Pulmonary Embolus using HL7 FHIR and the OMG’s Business Process Modeling Standards

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Part of Intermountain’s Venous Thromboembolism Care Process Model

**Electronic Pulmonary Embolus Workflow**

**Care Process Model**

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**Diagnosis and Management of Venous Thromboembolism (VTE)**

This care process model (CPM) was created by the Intensive Medicine Clinical Program at Intermountain Healthcare. Groups represented on this team include Emergency Medicine, Thrombosis, Pulmonary/Critical Care, Pharmacy, Radiology, Medical Informatics, and others. This CPM provides expert advice for the management of VTE using current national practice guidelines, including those of the American College of Chest Physicians, the American College of Physicians, the American College of Emergency Physicians, the European Society of Cardiology, and the International Society on Thrombosis and Haemostasis.

**Why Focus ON VTE?**
- Prevalence: VTE is the third most common cause of cardiovascular death in the U.S., after heart attack and stroke. As many as two million people in the U.S. are diagnosed with DVT each year, and half a million or more are affected by PE. As many as one-fifth of PE cases are expected to be fatal, leading to 100,000 deaths each year.281
- Difficulty of management: VTE symptoms are often nonspecific and can range from mild to life-threatening. Medications for VTE carry a risk of bleeding, and there are a large number of medications to choose from.
- Cost: Patients with suspected VTE often undergo unnecessary imaging tests. These tests drive up healthcare costs and expose patients to unnecessary medical risk.

**Program Goals and Measures**

**Algorithm 1: Pulmonary Embolism (PE) Diagnosis**

Non-pregnant* patient presents with suspected PE

- **Calculate PERC score (a)**
  - PERC score 
    - >0: PE unlikely
    - 0: PE likely

- **Calculate RGS (b)**
  - RGS score
    - (0-10)
    - (11-19)

- **Test D-dimer**
  - Cutoff values:
    - Age ≤ 50: ≤ 500 ng/mL
    - Age 51 or older: ≤ 1000 ng/mL
  - If D-dimer below cutoff value:
    - YES
  - If D-dimer ≥ cutoff value:
    - NO

- **Exclude PE, and consider a different diagnosis**

- **Perform CTPA**
  - PE unlikely
  - PE likely

- **Perform V/Q scan (c)**
  - PE unlikely
  - PE likely

*For pregnant patients, see Intermountain's Algorithm of Suspected Pulmonary Embolism in Pregnancy CPM.
BPMN— an Example: Pulmonary Embolism Diagnosis and Treatment

• A Clinical Workflow for Evidence-Based Diagnosis and Treatment
• Implemented and Tested Using OMG’s Business Process Model and Notation (BPMN) Standard for Workflows
• Connect to a simulated EHR using FHIR/SMART Standards
  • Developed using the Logica Sandbox as an EHR
• Provides a testbed for FHIR/SMART/BPMN support of complex clinical processes
An Environment for Developing Interoperable Applications

- Hosting EHR (Logica Sandbox)
  - EHR-Based Resources
  - Data Management Tools
    - Clinical Database

- Web Application Environment (Intermountain)
  - BPMN Engine
  - Data/Terminology Services
  - DMN Engine
  - CMMN Engine
  - SMART User Interface Generator

- FHIR Services
  - FHIR Data Read Services
  - FHIR Data Write Services
  - FHIR Patient ID Services
  - FHIR Order-Com Services
  - Security Management Services
  - Etc.
Demonstration
An Environment for Developing Interoperable Applications

Hosting EHR (Logica Sandbox)
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Web Application Environment (Intermountain)
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- Case

Electronic Pulmonary Embolus Workflow

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