

Pulmonary hypertension after pulmonary embolism in a public multimodal dataset: outcome definition and the value of the index CTPA

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Background

Prognostic models after pulmonary embolism (PE) increasingly use code-based outcomes. The INSPECT pulmonary hypertension (PH) label was validated for ever-PH, not timing. We examined how the PH definition shapes results, and how well the index CT pulmonary angiography (CTPA) predicts newly coded PH within 12 months.

Methods

INSPECT (Stanford): first PE-positive CTPA per patient (development split), impressions, and electronic health records (EHR). We rebuilt the dataset's 12-month PH label from its 29 diagnosis codes (96.3% agreement) and compared it with a restricted outcome excluding chronic-PE codes and patients with PH coded before the index scan. We recorded catheterization or PH-specific therapy within 180 days. COLIPRI chest-CT image embeddings and the coded EHR history before the CTPA (Qwen3-Embedding-8B, plus age and sex) were entered into logistic models, alone and together (nested five-fold cross-validation), under both definitions.

Results

Of 2,654 patients (73 with prior PH excluded), 393 (14.8%) had PH under the shipped label and 101 (3.8%) under the restricted outcome (90 positive under both). Catheterization or PH-specific therapy was recorded for 13.9% of restricted versus <3.3% of 303 shipped-only events. Under the shipped label, the coded history outperformed imaging (AUROC 0.70 vs 0.63; difference +0.068, 95% CI 0.035–0.104). Under the restricted outcome, both reached 0.66 (difference –0.001, –0.067 to 0.062; Table 1).

Conclusions

Code-based PH outcomes after PE are highly sensitive to definition: excluding chronic-PE codes and prior PH reduced positive labels by three quarters; PH-related care was rarely recorded among excluded labels, highlighting uncertainty about incident PH. The apparent advantage of coded history over imaging depended on the shipped label; with the restricted outcome, both showed modest discrimination with similar point estimates. Limitations: single center; coded, not catheter-confirmed, PH.

Table 1. AUROC (95% CI) for newly coded PH within 12 months, by outcome definition

Outcome (events)	CTPA image	EHR + age, sex	Both
Restricted (101)	0.66 (0.61–0.72)	0.66 (0.61–0.71)	0.67 (0.62–0.72)
Shipped (393)	0.63 (0.60–0.66)	0.70 (0.67–0.73)	0.72 (0.69–0.74)

Same 2,654 patients and folds; out-of-fold predictions. AUROC, area under the receiver operating characteristic curve. Restricted outcome excludes chronic-PE codes (ICD-10 I27.82, ICD-9 416.2) and prior PH. Shipped-only (303): positive under the shipped label but not the restricted outcome; 11 restricted positives were not shipped positives (label reconstruction). PH-related care indicators: right-heart catheterization or PH-specific therapy (PDE5 inhibitor only with a PH code) within 180 days. At 80% sensitivity (restricted), models flagged 63.1% (image), 58.0% (EHR), and 61.4% (both).

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