

Impression-Based Imaging Severity Stratification in Adult Acute Chest Syndrome Using Structured Radiology Report Classification

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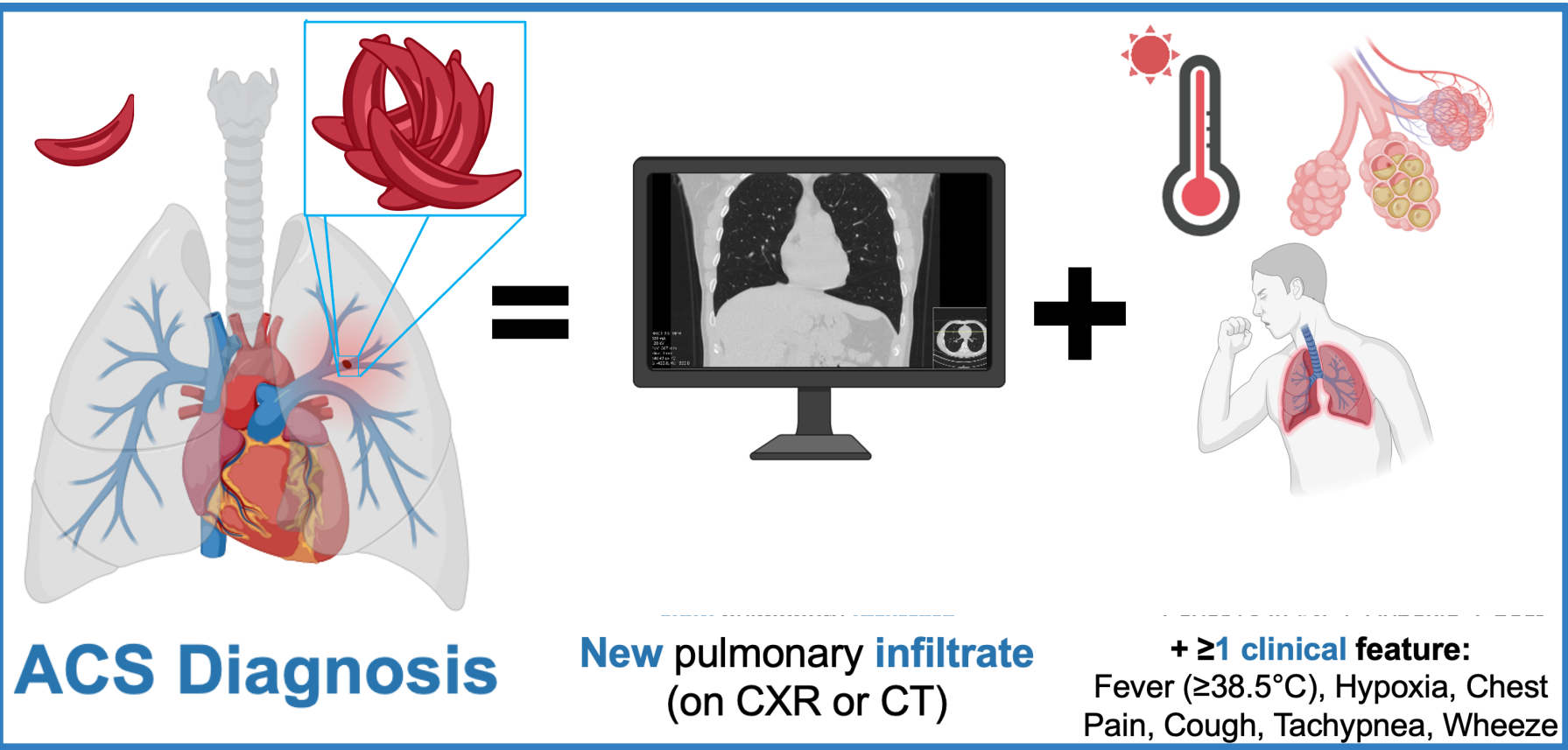
BACKGROUND

Acute chest syndrome (ACS) is the leading cause of mortality in adults with sickle cell disease (SCD), yet radiographic severity remains inconsistently defined in clinical practice.

Adult patients frequently show overlapping acute and chronic pulmonary abnormalities, limiting applicability of existing pediatric classification systems.

No validated, structured imaging classification framework exists for adult ACS.

Objective: Develop a structured, impression-based NLP classification system for adult ACS and evaluate associations between imaging patterns and clinical outcomes.



METHODS

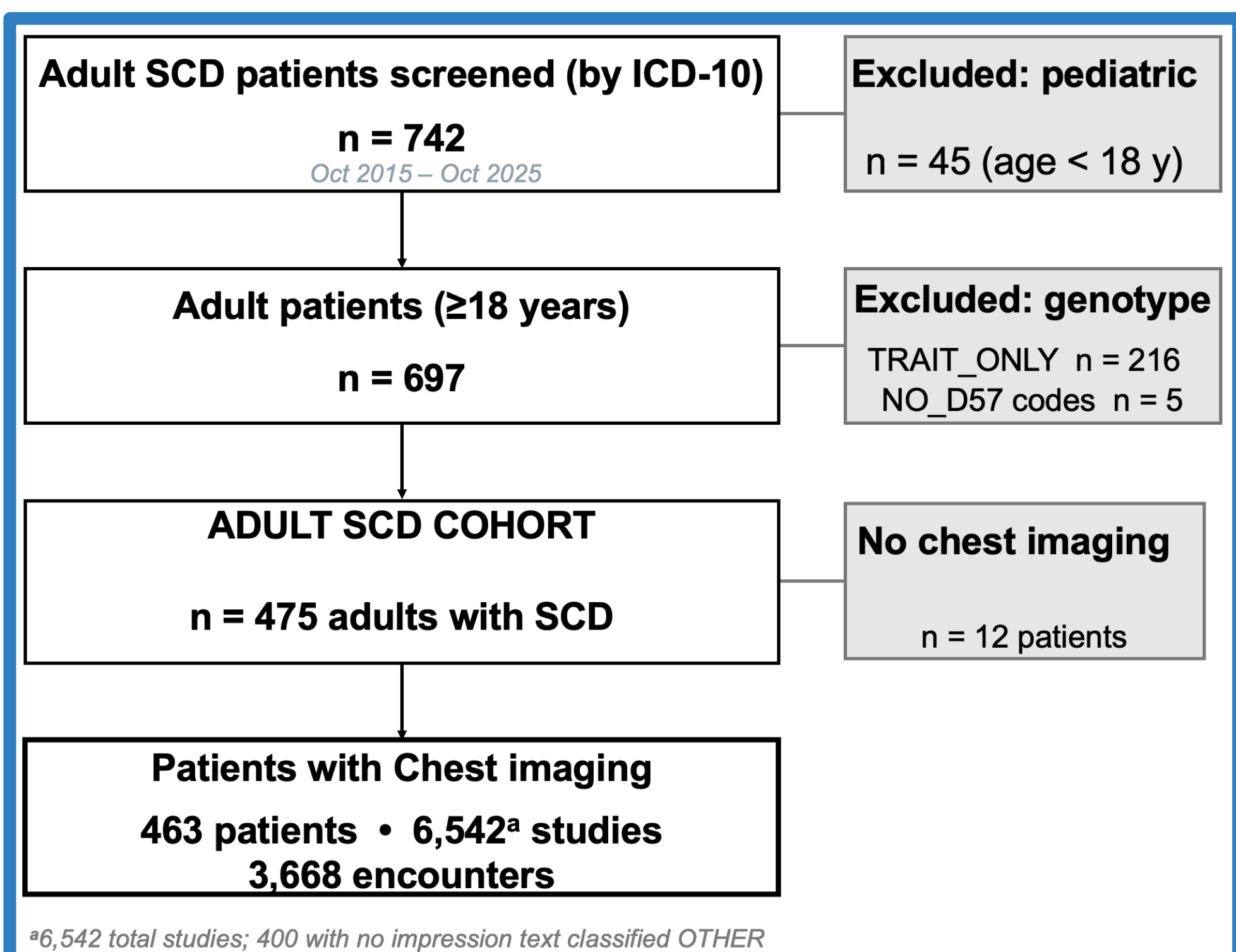
Study Design: Retrospective cohort, Oct 2015-2025, single academic center (UCLA)

Cohort: 475 adult SCD patients (ICD-10 confirmed), 463 with chest imaging

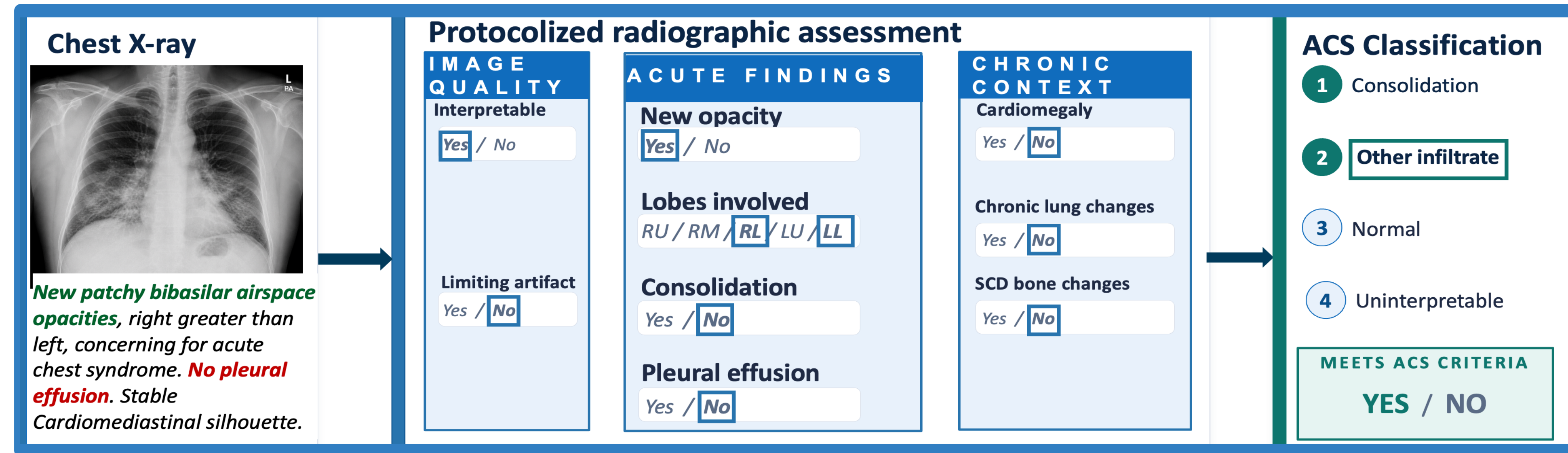
NLP Architecture 3-stage rule-based pipeline:

- Library 1:** 127 domain terms (Fleischner Society 2024)
- Library 2:** Negation and uncertainty modifiers (NegEx/ConText)
- Library 3:** Temporal qualifiers (=72h window)
- Output:** ACS_SURE → UNSURE → CHRONIC_SURE → OTHER → INDETERMINATE

Validation: Inter-rater reliability (Calibration and Validation, 2 independent readers)



PROPOSED REPORTING TOOL DESIGN



VALIDATION

Inter-rater reliability (Pool 0 calibration, n=40 studies):
 $\kappa = 0.856$ ACS classification (almost perfect, 95% CI 0.664-1.048)
 $\kappa = 0.807$ Chronic burden classification (almost perfect, 95% CI 0.550-1.064)

Pre-specified threshold: ≥ 0.70

All post-correction disagreements were adjacent (Unsure boundary only), confirming classifier boundary clarity.

CONCLUSION

Structured NLP classification of radiology impressions enables reproducible stratification of acute and chronic lung findings in adults with SCD.

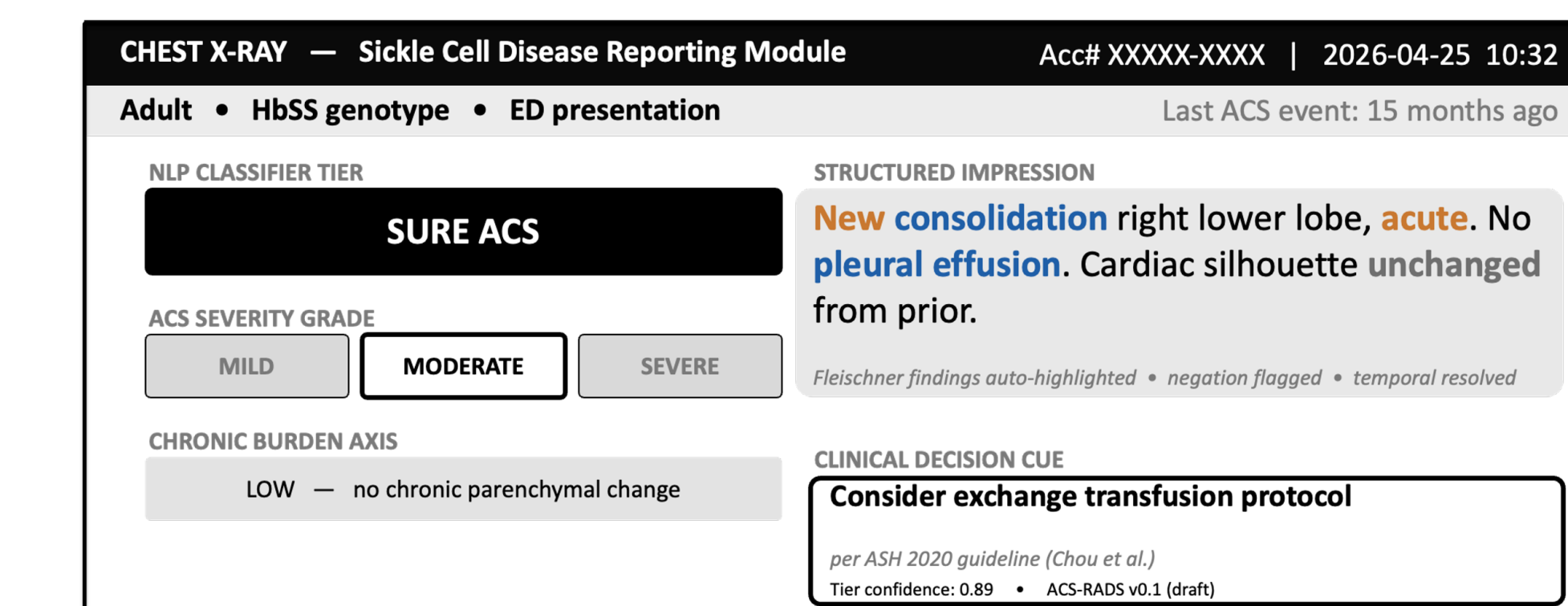
40.4% of patients demonstrated radiographic ACS evidence, suggesting significant undercapture by ICD-10 coding alone.

Substantial-to-almost-perfect inter-rater agreement confirms classifier validity as a foundation for severity modeling and care-equity research in ACS.

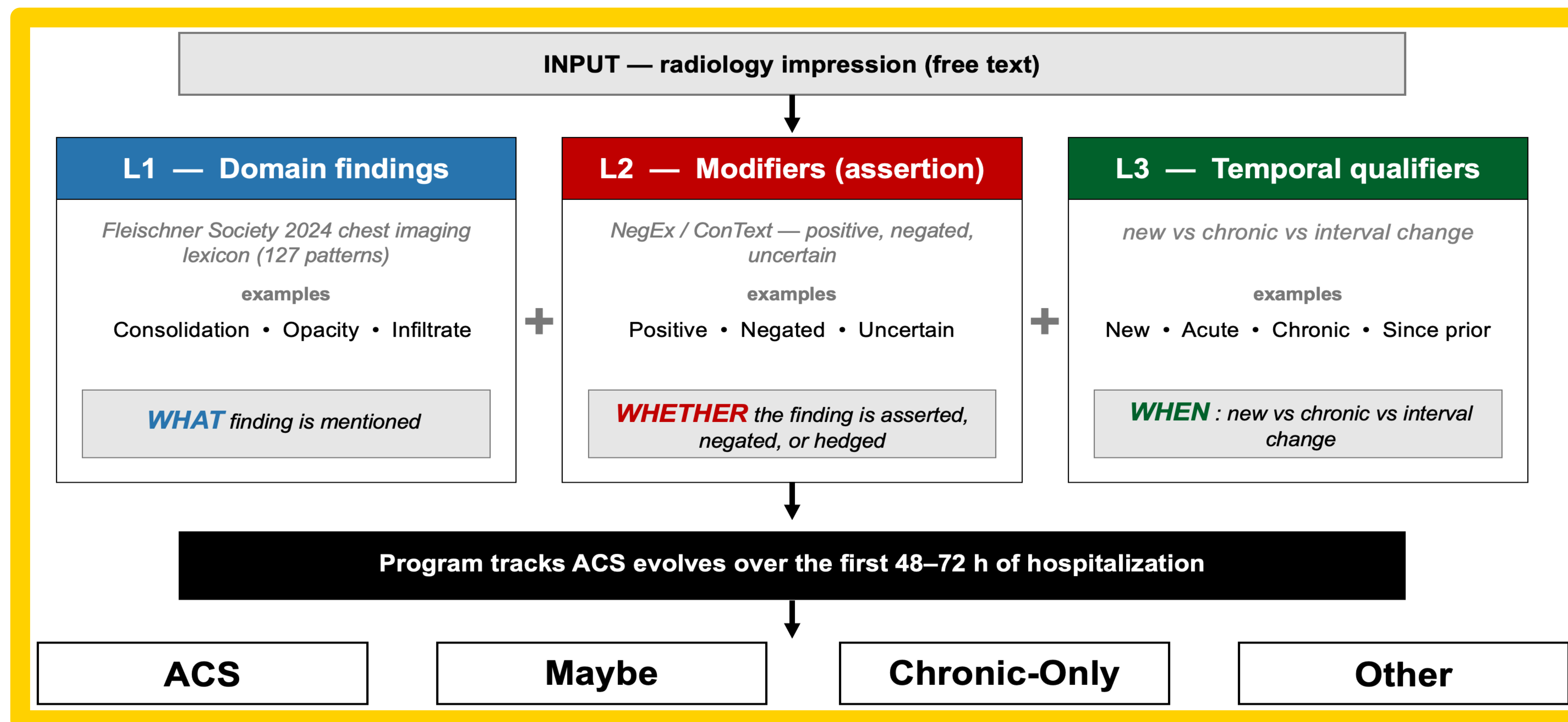
FUTURE DIRECTION

Characterize imaging severity to clinical outcomes (mortality, ICU, transfusion)

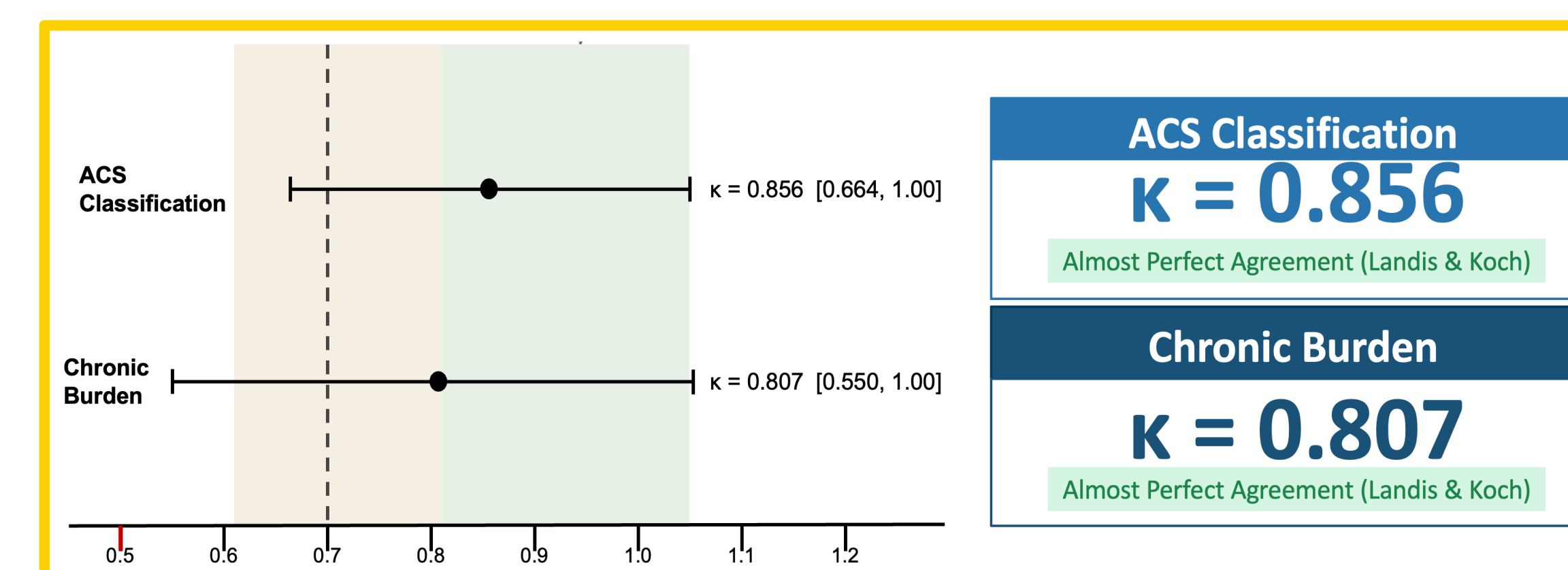
Apply framework and create a standardized report (see below) to support real-time ACS detection in resource-limited settings.



RESULTS



ENCOUNTER-LEVEL (N = 3,668)		PATIENT-LEVEL (N = 463)	
ACS_SURE: 460 (12.5%)	UNSURE: 1,124 (30.6%)	ACS_SURE: 187 (40.4%)	UNSURE: 130 (28.1%)
CHRONIC_SURE: 789 (21.5%)	OTHER: 1,295 (35.3%)	CHRONIC_SURE: 48 (10.4%)	OTHER: 98 (21.2%)
687 (10.5%)	2,094 (32.0%)	1,685 (25.8%)	2,076 (31.7%)



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