Predicting 5-Year Mortality After Prosthetic Joint Infection Using a 30-Item Accumulated Frailty Index in a 13,371-Patient Multicenter Cohort

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INTRODUCTION

- Prosthetic joint infection (PJI) is a serious complication of total hip and knee arthroplasty, causing significant long-term morbidity, cost, and mortality
- As joint replacement volume rises, the clinical burden of PJI is projected to grow
- PJI carries elevated short- and long-term mortality risk — prior studies report 26–30% five-year mortality following infection
- Current risk tools (ASA class, Charlson Comorbidity Index) offer limited individualized prognostic value once infection has occurred
- Frailty may provide a more clinically meaningful alternative, capturing cumulative physiologic vulnerability, functional decline, medication burden, and healthcare utilization

Objective: This study aimed to develop a prognostic model for 5-year all-cause mortality following PJI, using age and a 30-item Accumulated Frailty Index (AFI-Core30) as key predictors to support more objective patient counseling, perioperative planning, and treatment decision-making.

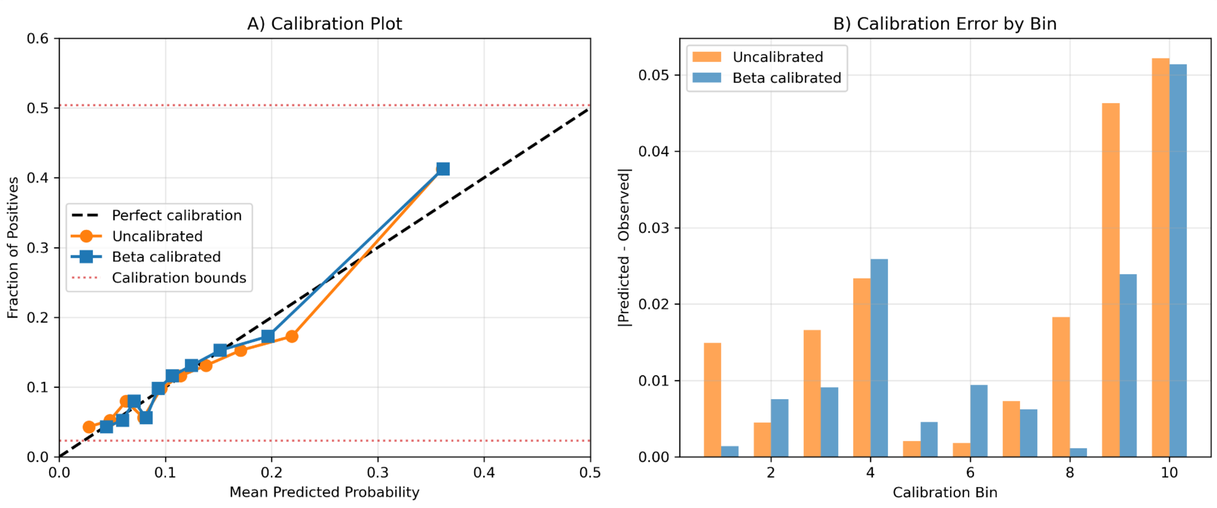
METHODS

- Retrospective multicenter cohort study using de-identified TriNetX electronic health record data
- Included adults with prior total hip or knee arthroplasty who developed prosthetic joint infection before 2021
- PJI was identified using diagnosis codes specific to infected internal joint prostheses, with the earliest post-arthroplasty infection used as the index event
- Frailty was measured using AFI-Core30, a 30-item accumulated frailty index based on comorbidities, physiologic/laboratory deficits, medication exposure, and functional or healthcare utilization variables
- The primary outcome was 5-year all-cause mortality after the index PJI diagnosis
- Logistic regression and a generalized additive model with an 80% training and 20% validation split were used to estimate mortality risk and assess model performance

RESULTS: MORTALITY AND RISK STRATIFICATION

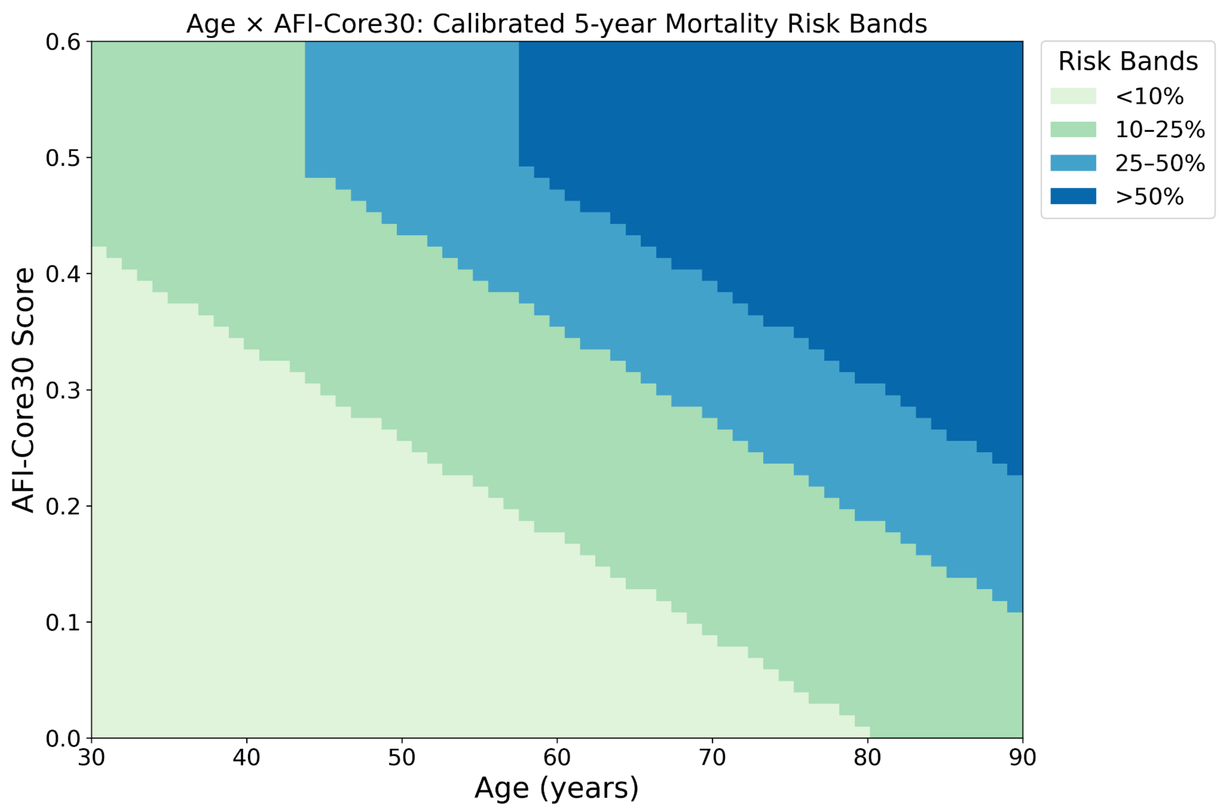
- Overall 5-year all-cause mortality was 13.1% after PJI.
- Mortality increased substantially with frailty status: 7.1% in non-frail patients, 12.9% in pre-frail patients, and 30.2% in frail patients.
- Both AFI-Core30 and age independently predicted 5-year mortality, with higher frailty and older age associated with increased odds of death (OR per 0.1 AFI increase = 1.84, 95%-CI: 1.74-1.95, $p < 0.001$; OR per 10-year increase in age = 1.65, 95%-CI: 1.56-1.74, $p < 0.001$)
- The model demonstrated good predictive performance, with AUROC 0.712 and Brier score 0.103
- Calibrated risk estimates ranged from 2.6% in younger, non-frail patients to 50.4% in older, frail patients, supporting individualized mortality risk prediction after PJI.

Figure 1. Calibration Assessment of AFI-Core30 Plus Age Model



Calibration analysis showed close agreement between predicted and observed 5-year mortality risk.

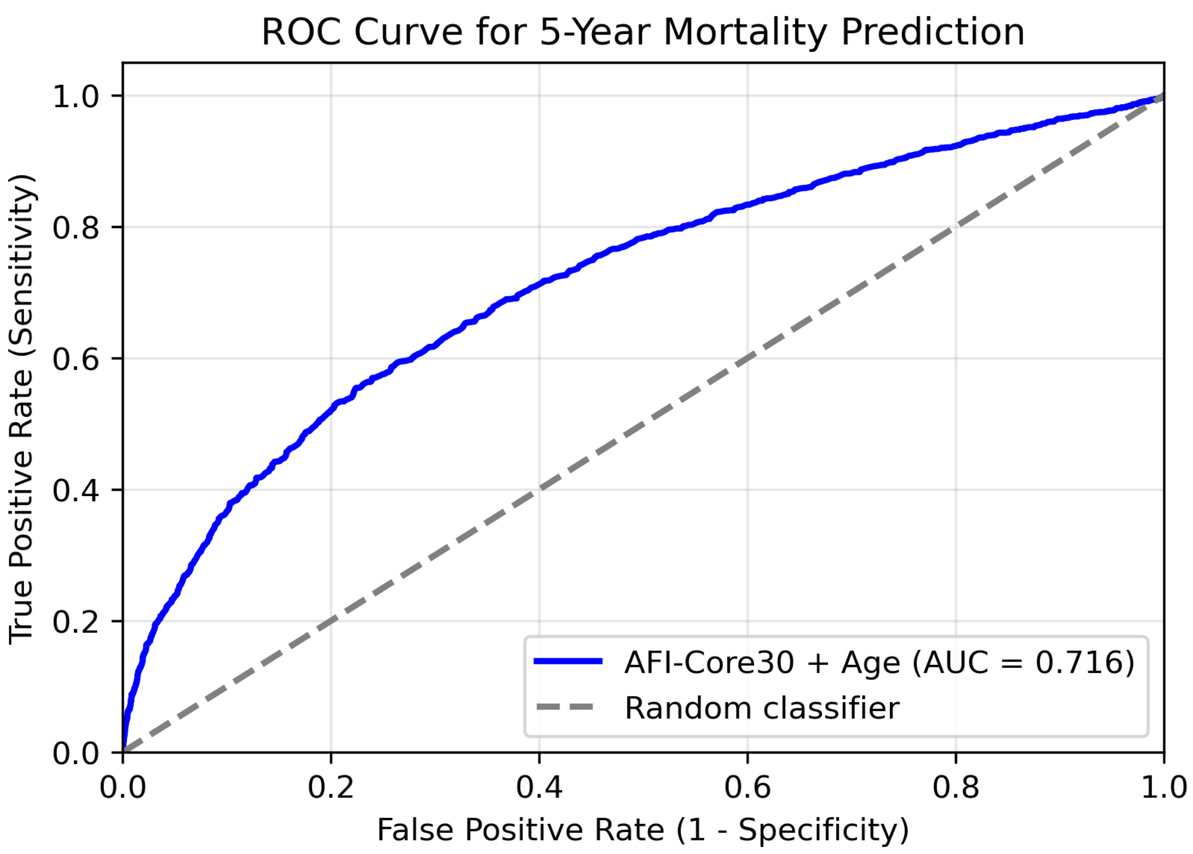
Figure 2. AFI-Core30 and Age-Stratified 5-Year Mortality Risk Bands after PJI



Mortality risk increased with both older age and higher AFI-Core30 score, forming clinically interpretable risk bands.

RESULTS: MODEL DISCRIMINATION

Figure 3. ROC Curve for 5-Year Mortality Prediction



The AFI-Core30 + age model demonstrated good discrimination for 5-year mortality prediction after PJI.

CONCLUSION

- AFI-Core30 and age independently predicted 5-year mortality after PJI, showing that frailty provides prognostic information beyond age or comorbidity burden alone.
- The AFI-Core30 plus age model demonstrated good discrimination and strong calibration, allowing routinely available EHR data to be translated into individualized mortality estimates.
- AFI-Core30 may better capture cumulative vulnerability because it incorporates comorbidities, physiologic/laboratory abnormalities, medication exposure, and functional or healthcare utilization indicators.
- Clinically, this framework may support individualized care, including perioperative optimization, geriatric co-management, nutritional support, rehabilitation planning, and more intensive follow-up for higher-risk patients.
- Although limited by reliance on coded EHR data and all-cause mortality, this model provides a scalable framework for individualized risk stratification; future work should validate the model and test frailty-guided care pathways.