

# Utilizing Artificial Intelligence to Predict the Progression from Moderate to Severe Aortic Stenosis

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## BACKGROUND

- Aortic Stenosis (AS) is a progressive disease characterized by narrowing and stiffening of the aortic valve (AV)<sup>1</sup>
- AS warrants continuous surveillance due to the risk of sudden death, heart failure, and need for AV replacement
- However, AS progression can vary greatly among patients<sup>2</sup>
- Presently, there are no accurate predictive modeling tools for AS progression
- Here we report on the development and validation of the Disease Progression Algorithm, a predictive model designed to estimate the proportion of the patient population diagnosed with severe AS at a given time after an initial diagnosis of moderate AS

## METHODS

### Study Population

- A total of 719,321 echocardiographic (echo) studies collected from 32 institutions were obtained from the CardioCare Research Database
- Natural language processing (NLP) was used to analyze and restrict the dataset to echo studies that:
  - (1) were obtained from a patient  $\geq 18$  years of age;
  - (2) delivered an AS diagnosis of severe, moderate, mild, or none;
  - (3) had no reference to a prosthetic valve
- The remaining echo studies were ordered by patient and further restricted to include:
  - (4) patients who had an initial diagnosis of moderate AS
  - (5) patients with AV area (AVA), jet velocity (JV), and mean pressure gradient (MPG) measurements successfully extracted from their first echo study
- The resulting 14,439 echo studies from 11,127 patients were split into two datasets: 7,760 patients in the training dataset and 3,367 patients in the testing dataset

### Algorithm Development and Validation

- The algorithm was developed using a Cox Proportional Hazards model<sup>3</sup> with the input variables AVA, JV, MPG, and time since diagnosis
- Estimates of actual disease progression (observed progression) were obtained through Kaplan-Meier analysis<sup>4</sup>
- Algorithm performance was assessed by comparing predicted and observed progressions from moderate to severe AS

FIGURE 1. Overall Predicted vs Observed Progression from Moderate to Severe AS Diagnoses

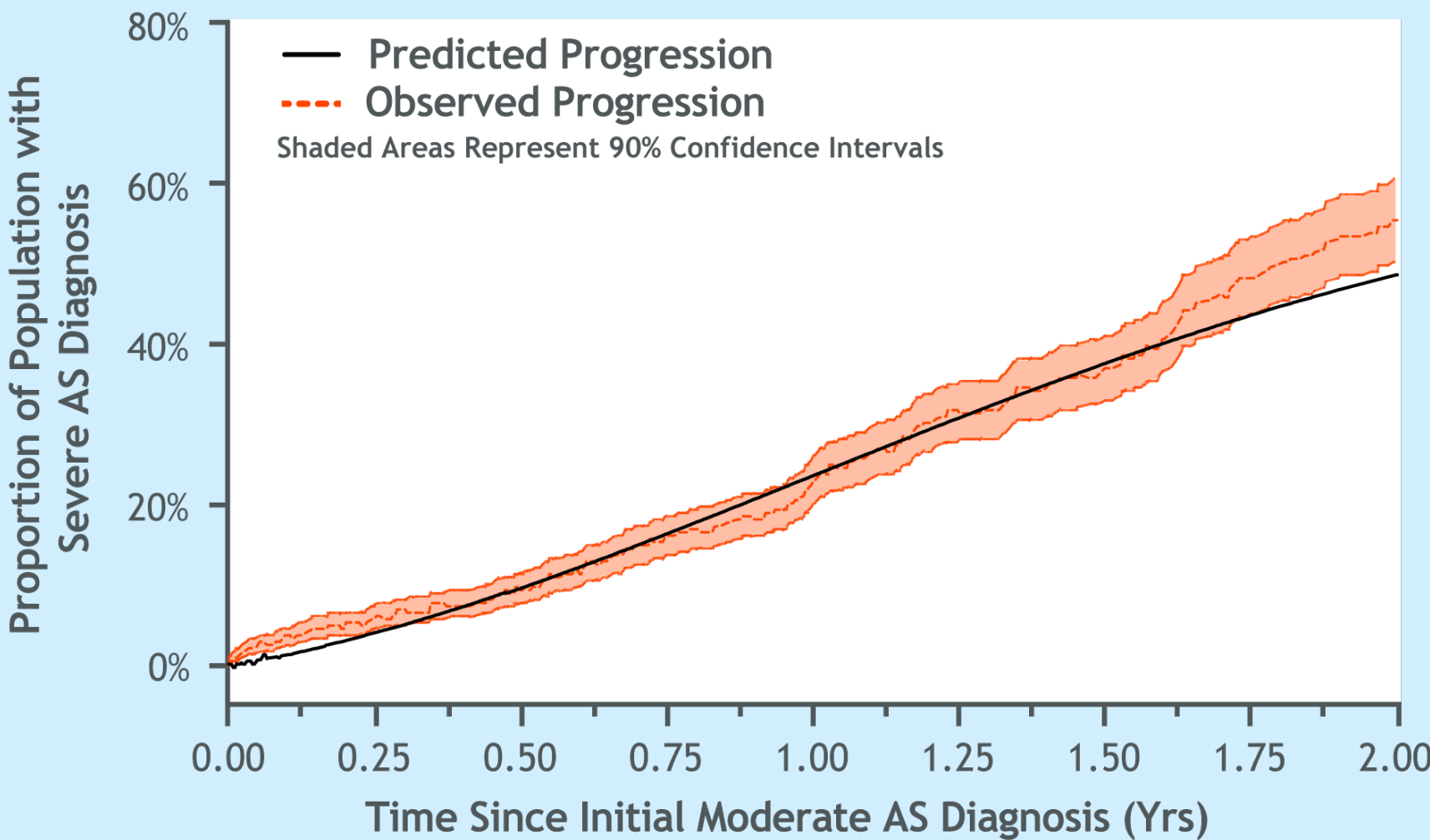
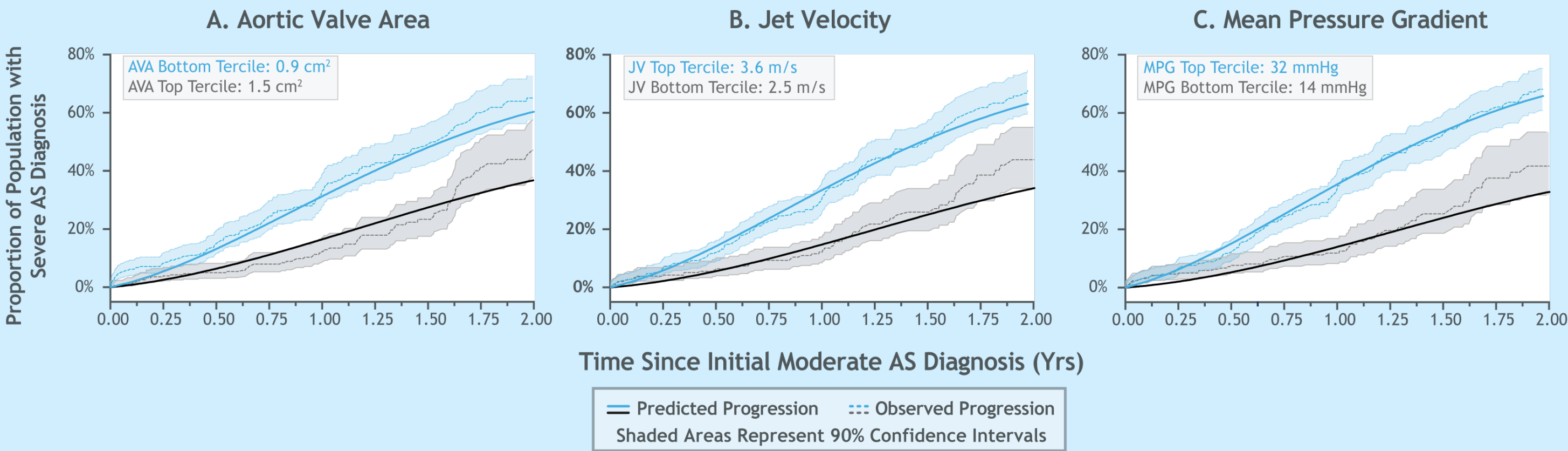


FIGURE 2. Predicted vs Observed Progression from Moderate to Severe AS Diagnoses by Valve Measurement



## CONCLUSIONS

The Disease Progression Algorithm generated accurate predictions for the likelihood of a patient with moderate AS progressing to severe AS. This algorithm represents a useful tool for identifying patients with moderate AS who may require careful follow-up due to their risk for developing severe AS

## RESULTS

### Comparison of Overall Predicted vs Observed Progression from Moderate to Severe AS

- The proportion of the patient population with a severe AS diagnosis at year one was predicted to be 23.6%, compared to 22.7% in the observed population (Figure 1)
- The patient population with a severe AS diagnosis at year two demonstrated a predicted proportion of 48.6% and an observed progression to severe AS of 55.4% (Figure 1)

### Stratification of Predicted vs Observed Progression from Moderate to Severe AS by Valve Measurement

- The average error between predicted and observed progression over the terciles of AVA, JV, and MPG measurements (Figure 2A-C) between 1-2-years after initial echo was 3.3% points  $\pm$  2.3% points (90% confidence)

## LIMITATIONS

- Clinician variability in interpreting echo findings
- Understanding the clinical impact of a prediction for AS progression may be limited by the ability to track actual patient outcomes
- Longitudinal studies should be completed to track the actual progression of AS in patients for comparison to the prediction provided by the algorithm

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