Treatment Patterns for Severe Aortic Stenosis in a Large Community-based Health System

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Disclosure of Relevant Financial Relationships

Within the prior 24 months, I have had a relevant financial relationship with a company producing, marketing, selling, re-selling, or distributing healthcare products used by or on patients:

Nature of Financial Relationship	Ineligible Company
Grant/Research Support	Edwards Lifesciences
Consultant Fees/Honoraria	None
Individual Stock(s)/Stock Options	None
Royalties/Patent Beneficiary	None
Executive Role/Ownership Interest	None
Other Financial Benefit	None

All relevant financial relationships have been mitigated.
Faculty disclosure information can be found on the app

Background

Background: Symptomatic severe aortic stenosis (SAS) carries a poor prognosis if untreated. While surgical aortic valve replacement (SAVR) and transcatheter aortic valve replacement (TAVR) have been shown to improve outcomes in this population, they remain underutilized.

Study Design

Study Population

- Retrospective cohort of patients without prior aortic valve (AV) intervention that had an AV area ≤1.0 cm2 by echocardiography(ECHO) between 2017 and 2022.
- Patients who were pregnant during the study period, had missing LVEF or Mean aortic valve gradient were excluded.

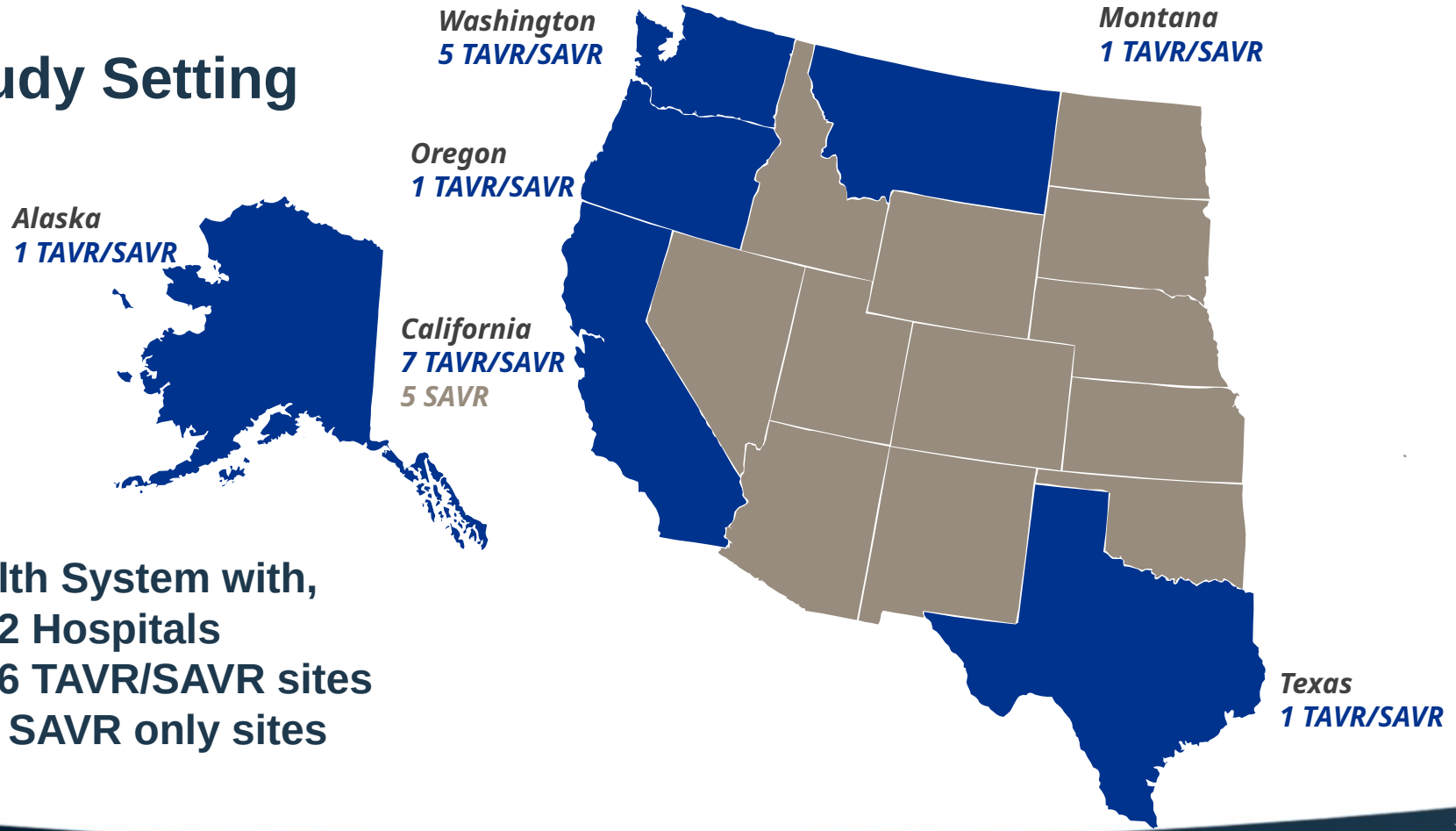
Primary Endpoint

- Treatment intervention rates in patients who met ACC/AHA class 1 indicated/recommended guidelines for severe aortic stenosis (SAS)

Methods

- Aortic Valve Area (AVA), Left ventricular ejection fraction (LVEF), stroke volume, and mean AV gradient were derived from structured and unstructured ECHO data using natural language processing (NLP), and generative artificial intelligence (AI).
- Patients index SAS event was defined as the first ECHO with an AVA ≤1.0 cm^2
- ICD-10 diagnosis codes and NLP were used to determine if symptoms of SAS (e.g., angina, dyspnea, syncope, pre-syncope) were present within 30 days of the index echocardiogram.
- ICD-10 procedure codes, evidence of a prosthetic AV on follow-up echocardiography, and clinical documentation were used to determine whether AVR (TAVR or SAVR) had been performed after the index SAS diagnosis.

Study Setting



Health System with,

- **52 Hospitals**
- **16 TAVR/SAVR sites**
- **5 SAVR only sites**

Feature Extraction – Pattern Matching + ChatGPT

Shortened ECHO Notes → **Pattern Matching** → **ChatGPT** → **Validation**

Pattern Matching

Example 1 - AV Mean Gradient 29.0 mmHg 0 mmHg LVOT Peak Velocity 1.2 m/s 0.7 - 1.1 m/s LVOT Stroke Volume 62.0 cm3 **aortic valve area 0.8 cm2** . AVA Index 0.5 cm2/m2

- **Output 1 – 0.8cm2**

Example 2 - The mean transaortic gradient was 9.0 mmHg. The **aortic valve area by the continuity equation (using VTI) was 0.70 cm2**. No aortic regurgitation seen. Mitral Valve: Mild mitral annular calcification. No stenosis.

- **Output 2 – Null**

ChatGPT

Example 2 - The mean transaortic gradient was 9.0 mmHg. **The aortic valve area by the continuity equation (using VTI) was 0.70 cm2**. No aortic regurgitation seen.

- **Output 2 – 0.70cm2**

Example 3 - AV Mean Gradient 4.0 mmHg LVOT Peak Velocity 1.2 m/s 0.7 - 1.1 m/s LVOT Stroke Volume 70.2 cm3 **AV Area Cont Eq vti 2.2 cm2** AVA Index 1.5 cm2/m2 Mitral E Point Velocity 0.9 m/s

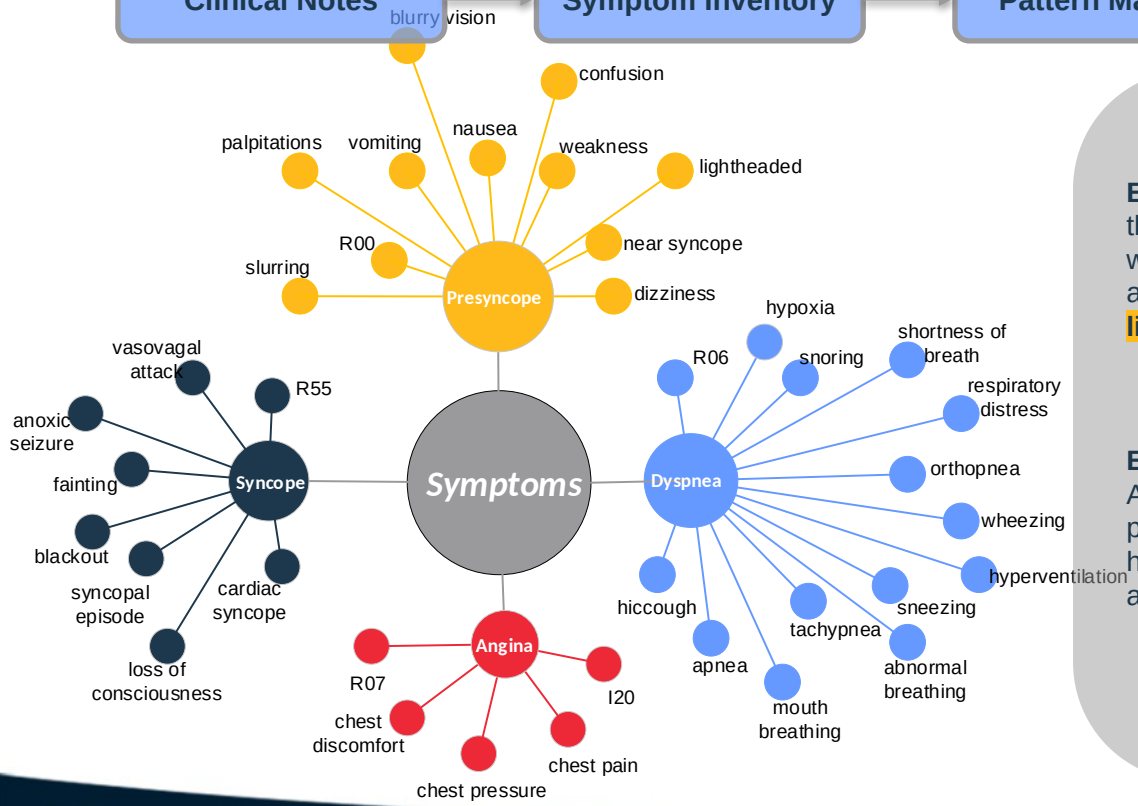
- **Output 3 – 2.2 cm2**

Pros : Low cost – low code – low effort solution. Maximum results extracted with high confidence. Can extract results from multiple note structures.

Example Prompt : You are a data abstractor who is an expert at chart abstraction on clinical notes. You are trying to abstract the measurement of patients' aortic valve area. Does this note contain measurement of aortic valve area? If aortic valve area/AVA is mentioned in the notes, then extract all the measurements and its units you find in the patient note regarding the aortic valve area verbatim.

Symptom extraction - Pattern Matching

Clinical Notes → Symptom Inventory → Pattern Matching → Negation Handling



Example 1 : She says she may have been dehydrated that day. She was on metoprolol succ 12.5 mg qd which was quickly stopped by PCP about one week ago. Since then, she has had a few episodes of **lightheaded**, but **no syncope**.

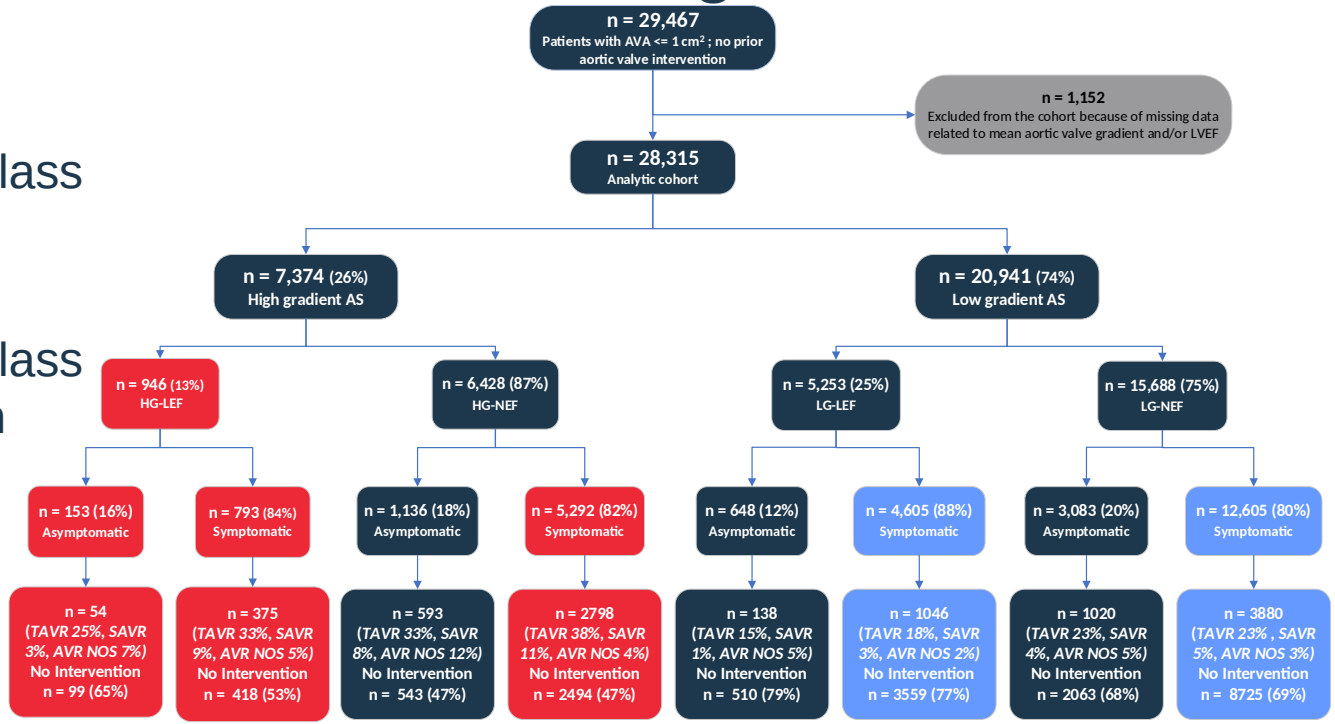
- **Output – Presyncope**

Example 2 : Chief Complaint Patient presents with Atrial Fibrillation Patient presents today to review his progress since his recent diagnosis of A. fib. Patient has **no chest pain, denies palpitation** but **has SOB** and **feels dizzy** sometimes.

- **Output – Dyspnea, Presyncope**

Patient Consort Diagram

- Treatment rate was **52%** for pts with a class 1 **indication**
- Treatment rate was **29%** for pts with a class 1 **recommendation**



HG-LEF=mean aortic valve gradient ш‹б mm Hg and LVEF <50%, HG-NEF=mean aortic valve gradient ш‹б mm Hg and LVEF ш‌б‘, LG-LEF=mean aortic valve gradient <40 mm Hg and LVEF <50%, LG-NEF=mean aortic valve gradient <40 mm Hg and LVEF ш‌б‘

AHA/ACC Indication for AVR Class I Indication **AHA/ACC Indication for AVR Class I Recommendation**

AS=aortic stenosis, AVA=aortic valve area, AVR=aortic valve replacement, HG-LEF=high gradient with low ejection fraction, HG-NEF=high gradient with normal ejection fraction, LG-LEF=low gradient with low ejection fraction, LG-NEF=low gradient with normal ejection fraction, LVEF=left ventricular ejection fraction, NOS=not otherwise specified, SAVR=surgical aortic valve replacement, TAVR=transcatheter aortic valve replacement

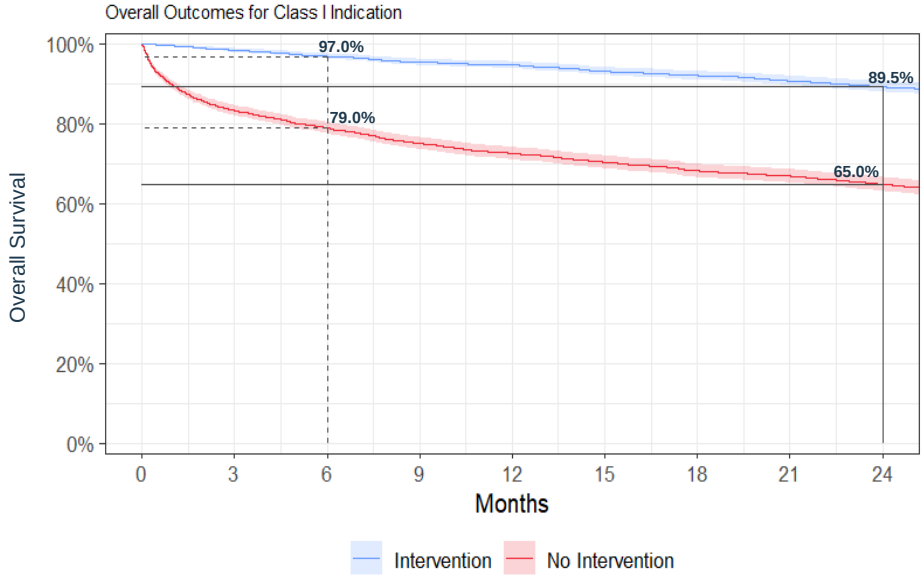
SAS Patient Characteristics

	Overall (N=28315)	AVR (N=9904)	No AVR (N=18411)	P-Value
AHA/ACC Class I				<0.001
AVR Indication	6238 (22.0%)	3227 (51.7%)	3011 (48.3%)	
AVR Recommendation	17210 (60.8%)	4926 (28.6%)	12284 (71.4%)	
SAVR	1799 (6.4%)	1799 (100%)	0 (0%)	NA
TAVR	5483 (19.4%)	5483 (100%)	0 (0%)	NA
Age (years) Median [Min, Max]	80 [19, 108]	77 [19, 101]	82[19, 108]	<0.001
Female	14692 (51.9%)	4353 (29.6%)	10339 (70.4%)	<0.001
Race				<0.001
Black or African American	925 (3.3%)	104 (11.2%)	821 (88.8%)	
White	22820 (80.6%)	8801 (38.6%)	14019 (61.4%)	
Other	4570 (16.1%)	999 (21.9%)	3571 (78.1%)	
Ethnicity				<0.001
Hispanic/Latino	1768 (6.2%)	407 (23.0%)	1361 (77.0%)	
Not Hispanic/Latino	24871 (87.8%)	9193 (37.0%)	15678 (63.0%)	
Unknown	1676 (5.9%)	304 (18.1%)	1372 (81.9%)	
Urban or Rural Residence				<0.001
Rural	1877 (6.6%)	813 (43.3%)	1064 (56.7%)	
Urban	25809 (91.1%)	8856 (34.3%)	16953 (65.7%)	

SAS Patient Characteristics

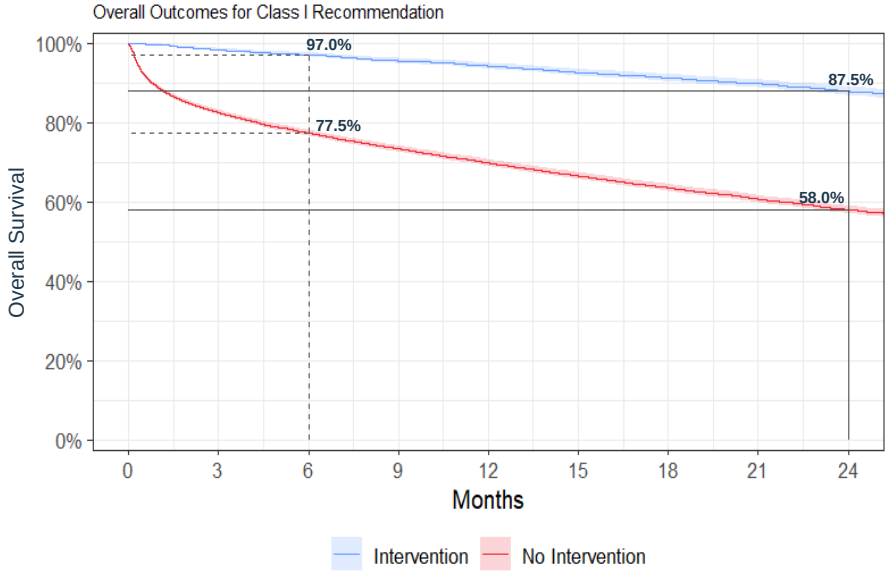
	Overall (N=28315)	AVR (N=9904)	No AVR (N=18411)	P-Value
Insurance Type				<0.001
Public (Medicare/Medicaid)	21528 (76.0%)	7662 (35.6%)	13866 (64.4%)	
Commercial	1239 (4.4%)	534 (43.1%)	705 (56.9%)	
Other	5548 (19.6%)	1708 (30.8%)	3840 (69.2%)	
Hematocrit Median [Min, Max]	36.7 [12.6, 59.9]	38.6 [12.6, 59.9]	35.4 [13.0, 59.9]	<0.001
Comorbidities				
CCI Median [Min, Max]	6.00 [0, 23.0]	5.00 [0, 19.0]	6.00 [0, 23.0]	<0.001
Diabetic	8139 (28.7%)	2597 (31.9%)	5542 (68.1%)	<0.001
Coronary Artery Disease	9215 (32.5%)	3137 (34.0%)	6078 (66.0%)	0.0195
Chronic Kidney Disease	7742 (27.3%)	1884 (24.3%)	5858 (75.7%)	<0.001
Smoker	11174 (39.5%)	4186 (37.5%)	6988 (62.5%)	<0.001
ECHO Setting				<0.001
IP	14173 (50.1%)	3073 (21.7%)	11100 (78.3%)	
OP	13668 (48.3%)	6602 (48.3%)	7066 (51.7%)	
Ordering Provider Gender				<0.001
Female	9051 (32.0%)	2910 (32.2%)	6141 (67.8%)	
Male	17985 (63.5%)	6574 (36.6%)	11411 (63.4%)	
Ordering Provider Specialty				<0.001
Cardiology	12295 (43.4%)	5468 (44.5%)	6827 (55.5%)	
Hospitalist	851 (3.0%)	160 (18.8%)	691 (81.2%)	
Internal Medicine	9767 (34.5%)	2655 (27.2%)	7112 (72.8%)	

Survival by Intervention Status for Class 1 Patients



Number at Risk

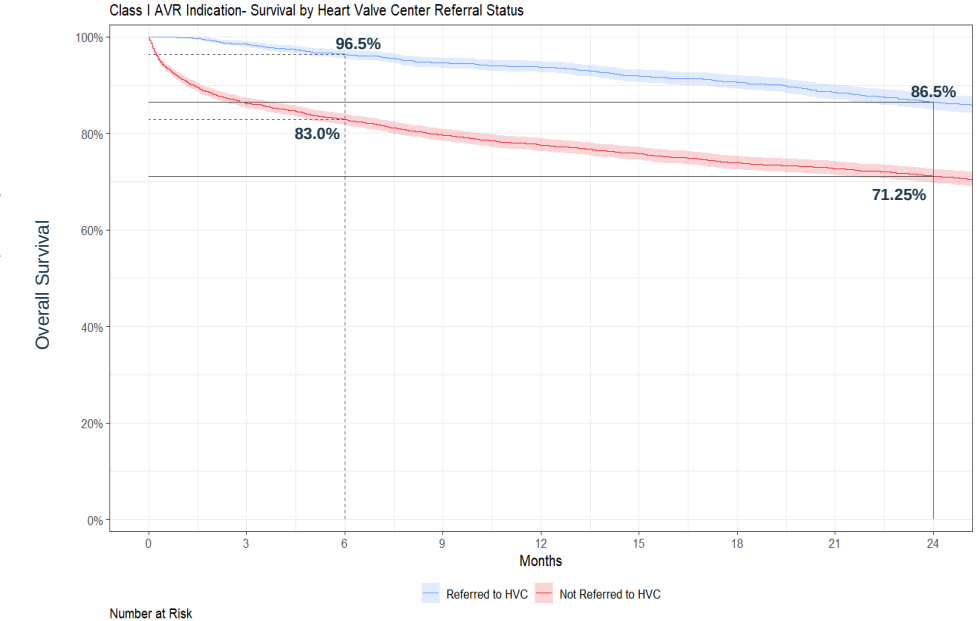
Intervention	2610	2473	2393	2341	2269	2061	1903	1753	1588
No Intervention	3591	2568	2337	2155	2013	1853	1694	1591	1473



Number at Risk

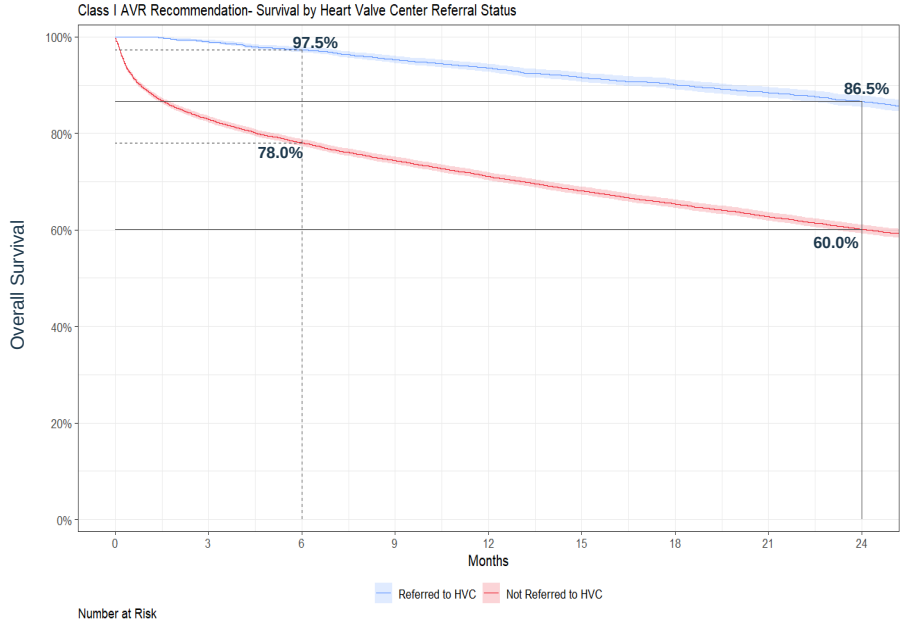
Intervention	3813	3654	3564	3489	3385	3149	2942	2760	2546
No Intervention	13283	9456	8541	7787	7090	6155	5408	4653	4031

Survival by HVC Referral Status



Number at Risk

Referred to HVC	1741	1698	1637	1597	1568	1514	1450	1379	1280
Not Referred to HVC	4461	3363	3123	2933	2781	2613	2455	2329	2157



Number at Risk

Referred to HVC	3323	3263	3188	3102	3025	2935	2857	2739	2557
Not Referred to HVC	13784	9916	9011	8306	7715	7154	6645	6041	5289

Discussion

- Comprehensive and contemporary view of AVR for sAS in a large multi-state community healthcare system
- Gaps in delivery of intervention was observed by
  - Race and ethnicity of patients
  - ECHOs conducted in the OP setting led to more AVR
  - ECHO ordered by non-cardiac specialties
- Comorbidities of CKD and a higher Charlson Comorbidity Index were associated with less likelihood of treatment intervention.
- We propose a plan to increase referrals to heart valve clinics