

# **Innovation in the Cath Lab**

## ***Where do we go from here?***

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# Disclosures

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## **Institutional Research Grants**

- Edwards Lifesciences
- Boston Scientific
- Corvia
- Philips
- I-Rhythm
- ANCORA
- Abbott Vascular
- Medtronic
- CathWorks
- Zoll/Therox
- JenaValve

## **Consulting/Speaking/Advisory Boards**

- Medtronic
- Boston Scientific
- Zoll/Therox
- Edwards Lifesciences
- Abbott Vascular
- Elixir Medical

# INNOVATION IN THE CATH LAB: WHERE DO WE GO FROM HERE?

## 1 Aortic Regurgitation

- Dedicated TAVR Systems for AR
- ALIGN AR Trial

## 3 New Valve/Leaflet Designs

- DurAVR concept
- FOLDAX polymer leaflets
- SIEGEL valve

## 2 Leaflet Modification without Electrosurgery

- SHORTCUT Device and beyond

## 4 Unanswered Questions

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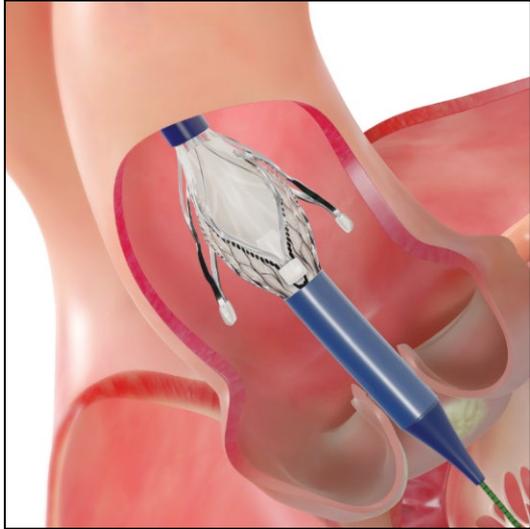
# TAVR in Aortic Regurgitation

## *Unmet Need*

- Moderate/Severe AR is common in older patients → prevalence 4.5% in New Ulm (Minnesota) study
- Severe AR is bad → Mortality ~10% per year with severe, symptomatic AR (~25% with NYHA III/IV symptoms)
- AR is undertreated → <25% of patients with severe, symptomatic AR undergo SAVR
- Off-label TAVR with currently approved devices suboptimal → high rates of embolization and PVR

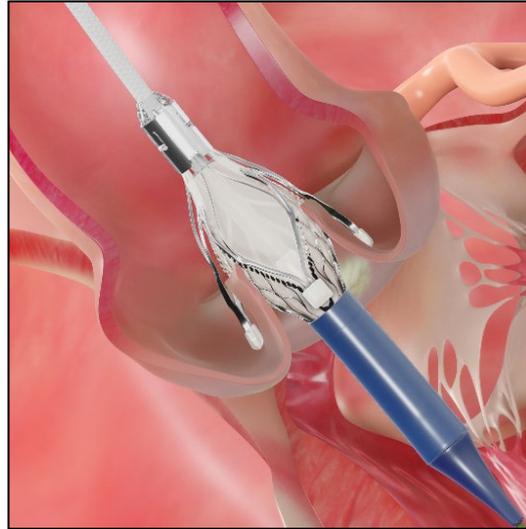
# Aortic Regurgitation

## *TRILOGY and ALIGN AR*



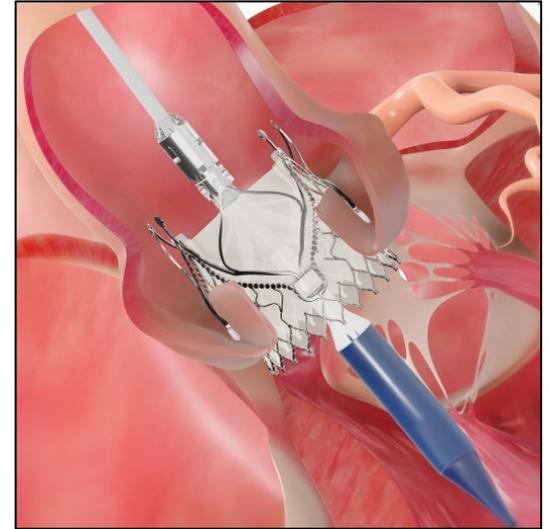
### **Alignment**

Aligns THV with native cusps



### **Positioning/Anchoring**

Locators “clip” onto native leaflets forming a natural seal and stable securement



### **Deployment**

Large open cells provide access to low coronaries; flared sealing ring conforms to annulus

# Aortic Regurgitation

*TRILOGY and ALIGN AR (n = 180 pts)*

## ALIGN AR Study Design

Multicenter, Non-blinded, Single Arm Evaluation of Patients with Symptomatic  $\geq 3+$  Aortic Regurgitation at High Risk for SAVR

Trilogy THV Implantation

Clinical Evaluation, Echocardiography, Functional and QoL Assessment at 30 Days, 6 Months, 1 Year and Annually up to 5 Years

30 Day Primary Safety Endpoint

1 Year Primary Efficacy Endpoint

Comparison with Prespecified Performance Goal

# Aortic Regurgitation

## TRILOGY and ALIGN AR

### Primary Efficacy Endpoint at 1 Year\*

Enrolled Population

N=180

25% prespecified non-inferiority margin

Rate  
7.8%

Upper 1-sided  
97.5% CI  
12.3%



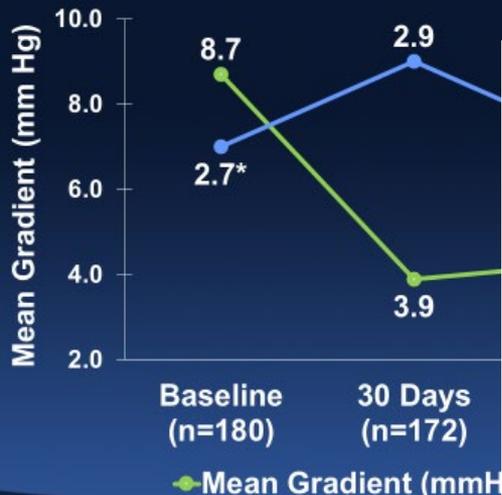
$P_{\text{non-inferiority}} < 0.0001$

Non-inferiority criteria met for primary efficacy endpoint

# Aortic Regurgitation

## TRILOGY and ALIGN AR

### Hemodynamic Valve Performance



Baseline (n=180)      30 Days (n=172)

◆ Mean Gradient (mmHg)

CRF  
TCT

\*AVA (cm<sup>2</sup>)

### Paravalvular Regurgitation



30 Days (n=172)

6 Months (n=154)

1 Year (n=141)

□ None/Trace    □ Mild    □ Moderate    □ Severe

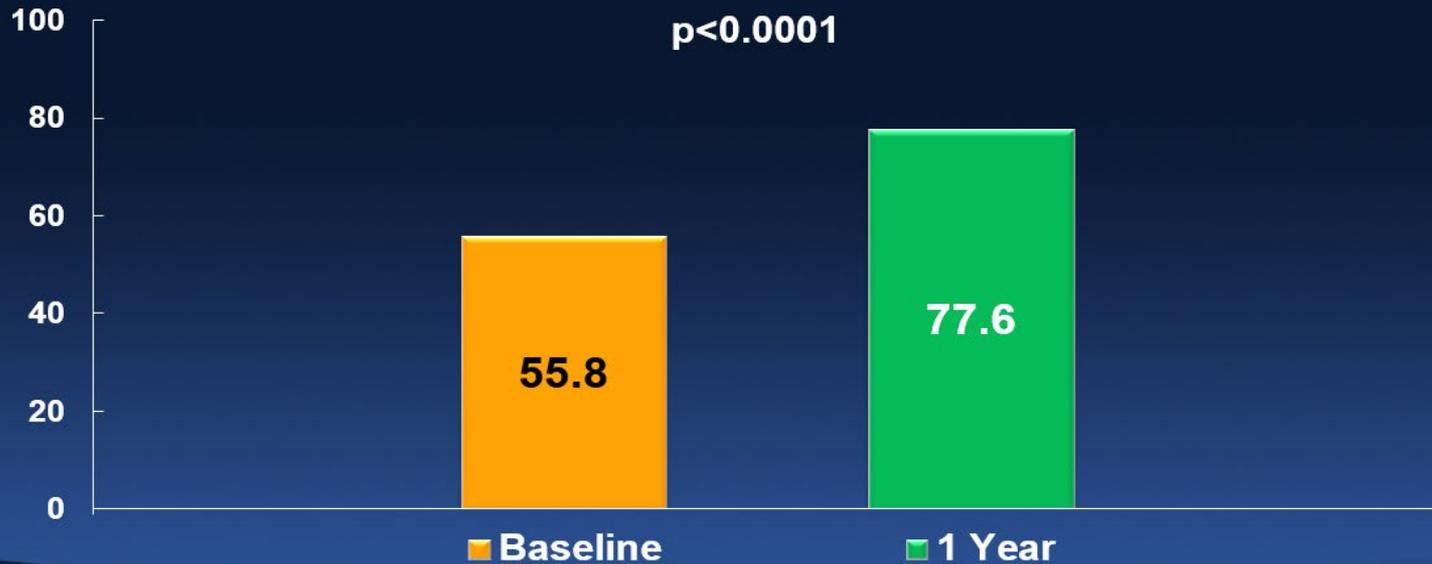
CRF  
TCT

THE  
ALIGN  
AR TRIAL

# Aortic Regurgitation

*TRILOGY and ALIGN AR*

## Quality of Life: KCCQ-OS



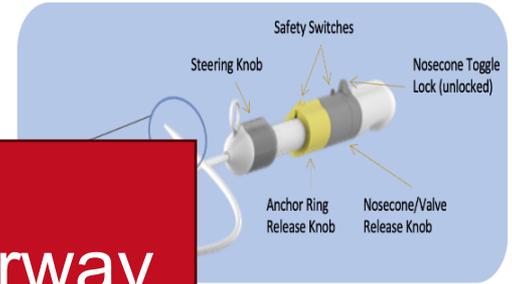
# Aortic Regurgitation J-Valve (from China)

- **Bioprosthesis:** self-expanding nitinol frame, bovine pericardial leaflets
- **Delivery System:** steerable, flexible catheter, femoral access (18, 20, 22 Fr)
- **Locating Feature:** designed to fit the native anatomy
- **Size matrix:** 5 sizes, can treat wide range of anatomies (perimeters 57-104)

J-Valve TF Bioprosthesis

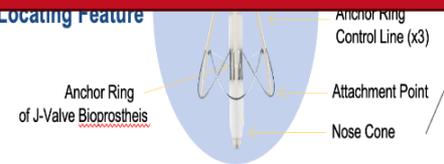


J-Valve TF Delivery Device



JOURNEY Pivotal Trial Underway

J-Valve Locating Feature



J-Valve Anchor Ring conforms to the native sinuses

Valve Size	Annulus Diameter	Annulus Perimeter	Height
22 mm	18-21 mm	57-67 mm	17 mm
25 mm	21-24 mm	65-76 mm	19 mm
28 mm	24-28 mm	73-88 mm	22 mm
31 mm	27-30 mm	85-94 mm	25 mm
34 mm	30-33 mm	94-104 mm	25 mm

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# Leaflet Modification Techniques

## *Mechanical Splitting (SHORTCUT)*



Designed to **enable coronary access & prevent coronary obstruction** during TAVI

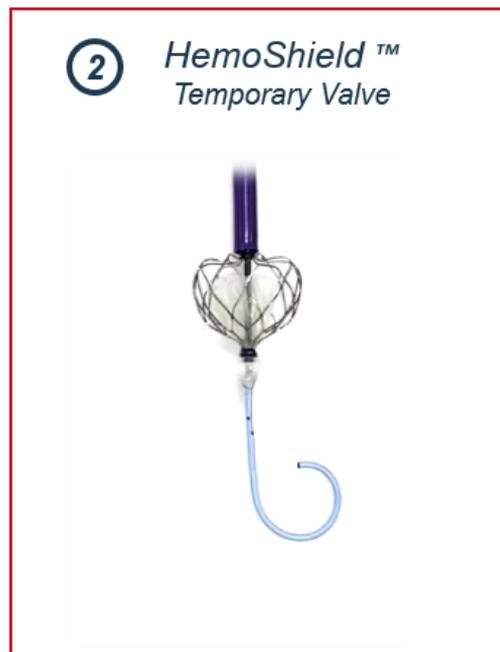


Complete **control over positioning & leaflet splitting location**



Allows for **safe, simple splitting of single or double leaflets** using same device

# CAN WE MAKE LEAFLET MODIFICATION **BETTER**?



**EXCISION Medical**



# ***Excision vs. Laceration – CoreValve in CoreValve***



26mm Evolut Pro in 29 mm Evolut Pro (w/ commissural alignment)

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## 3 **New Valve/Leaflet Designs**

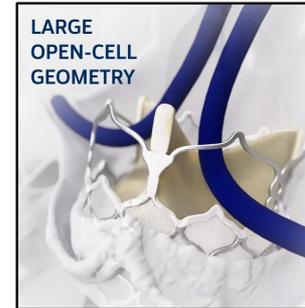
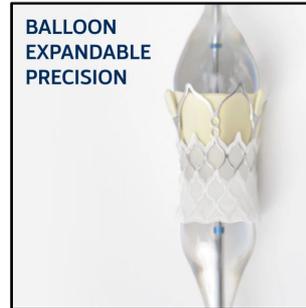
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# New Leaflet Designs

## *DurAVR Concept (Anteris)*

Single-piece, native-shaped  
biomimetic design



# New Leaflet Designs

*DurAVR Concept (Anteris)*

**EFS Valve  
Performance (n=15)**

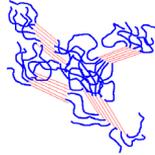
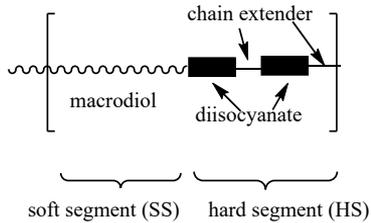
*Mean Annulus  
22.2 mm*

Hemodynamic Parameter	Mean (n=15)
Mean Gradient	
Echo	7.8 mmHg
Invasive	1.8 mmHg
DVI	0.71
EOA	2.4 cm <sup>2</sup>

# New Leaflet Designs

## TRIA Polymer Valve + Robotic Manufacturing (Foldax)

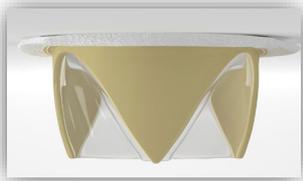
### Polyurethane



### Siloxane polyurethane



*Similar structure used in  
pacing leads for over 15 years*



TRIA™ Mitral Surgical Valve



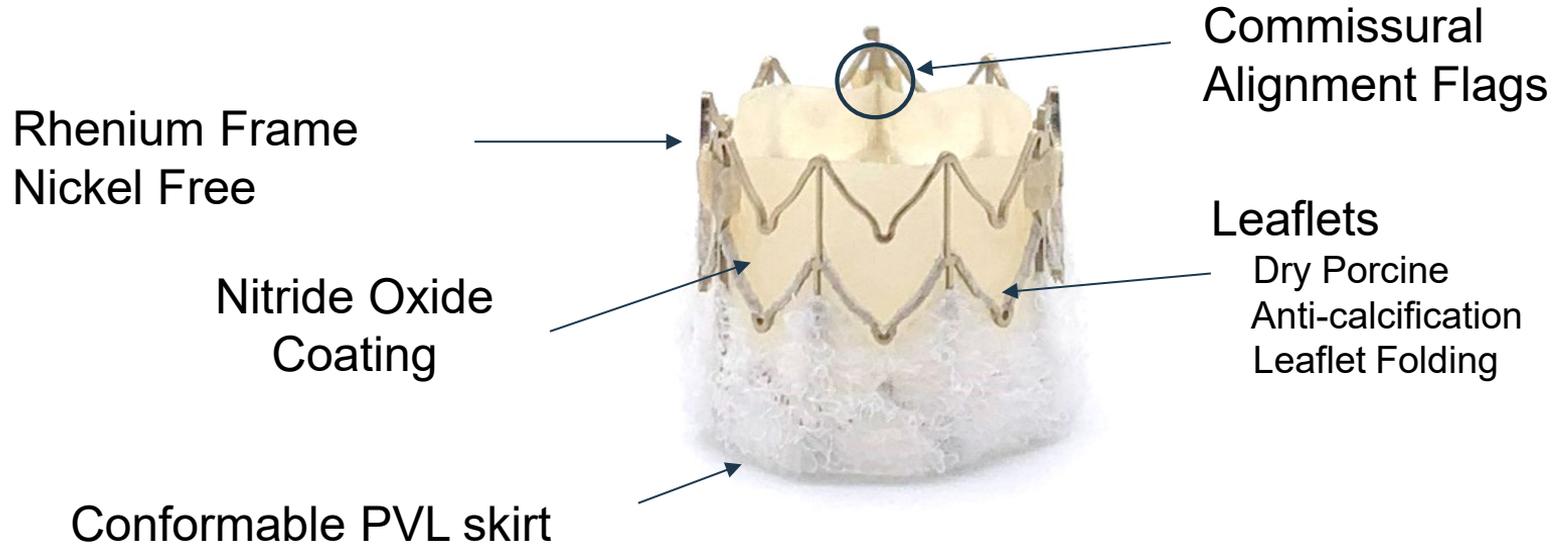
TRIA™ TAVR  
Gen 1 Valve

### Polymeric Valve

- High tensile strength
- Biologically inert
- ? One valve for life?

# New Valve Designs

## *Siegel Valve*



Delivered Crimped On Balloon Through **8 Fr Expandable Sheath**



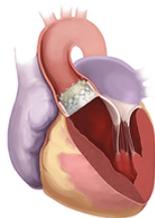
Nickel (Nitinol)  
Aluminum-Vanadium

Poor Mechanical &  
Biological Properties

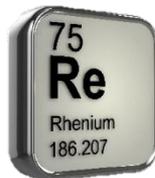


Nickel  
Chromium

Poor Mechanical &  
Biological Properties



# Rhenium Superalloy



- 2-3x Strength
- 2-3x Durability
- <1/3 Recoil
- Superior Biocompatibility
  - Nickel Free
- Improved Radiographic Visibility

## Traditional Materials Closed Cell Design

## Rhenium Frame Open Cell Design

BEV  
Cobalt  
48 Cells

SEV  
Nitinol

Siegel BEV  
Rhenium

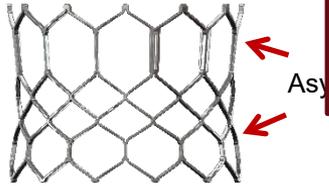
- Reduced Crimp Profile

5 patient FIM study completed  
US EFS expected 2025

Improved Coronary  
Access

Preshortening

- Minimal Recoil →  
Symmetrical Expansion



12 cells per row  
4 rows



15 cells per row  
9 rows



9 cells per row  
2 rows

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# Key Issues for the Next Decade

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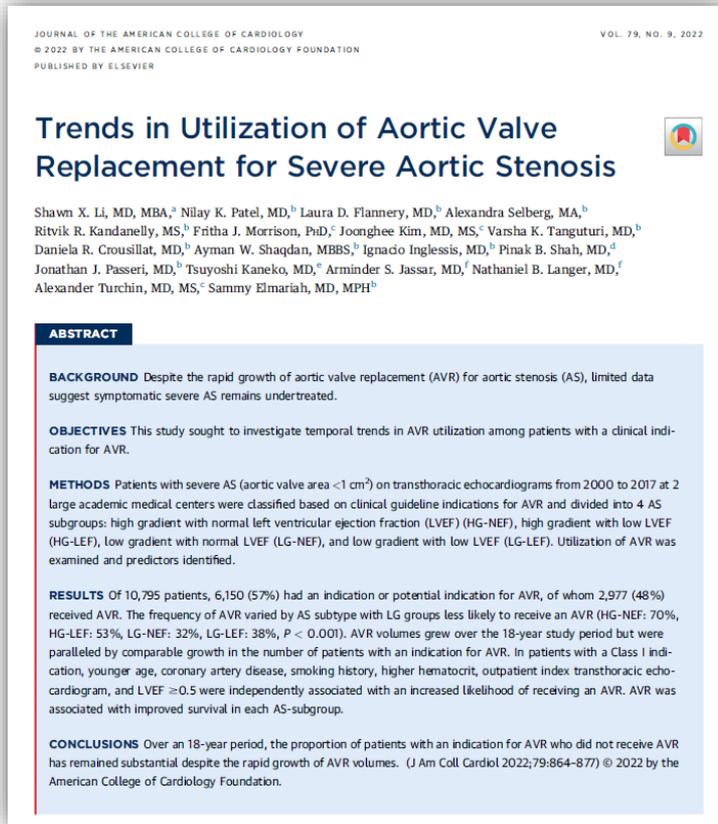
## Issue #1

How are we going to be able to identify and treat all patients who could benefit?

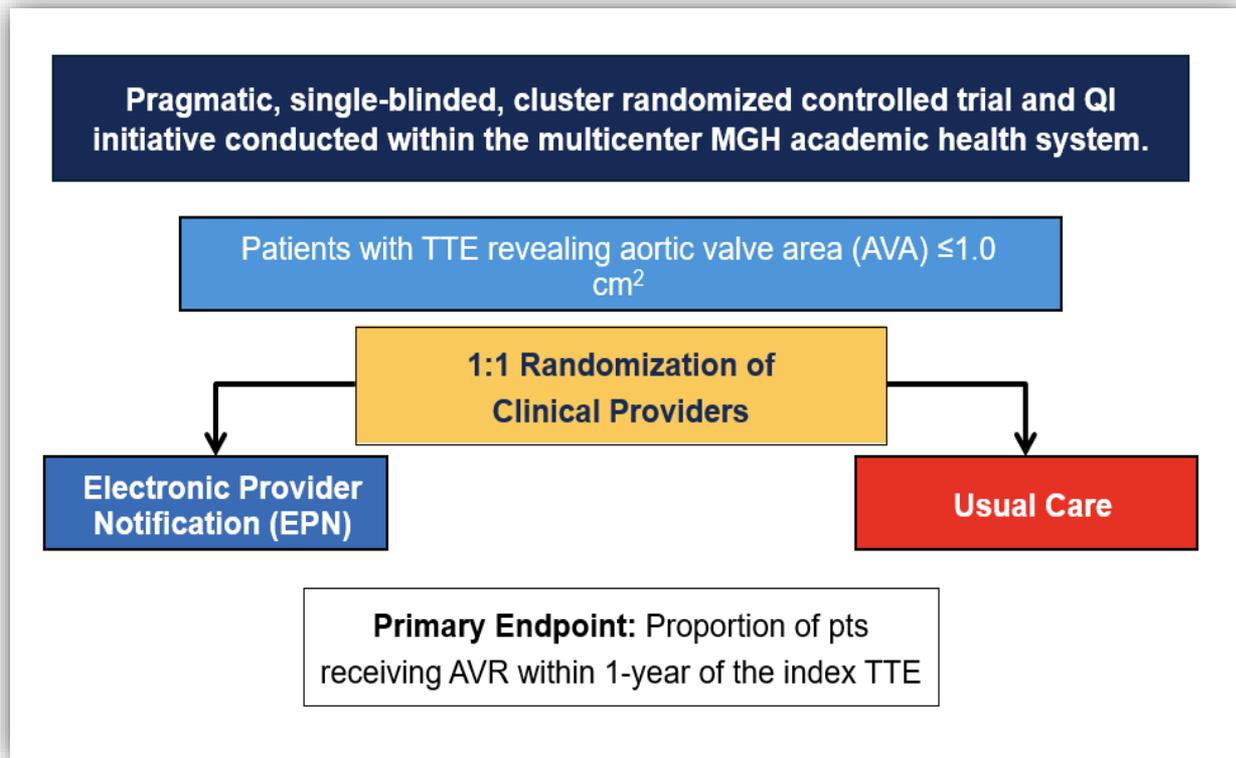
# AS access to care crisis

## MGH-BWH Study

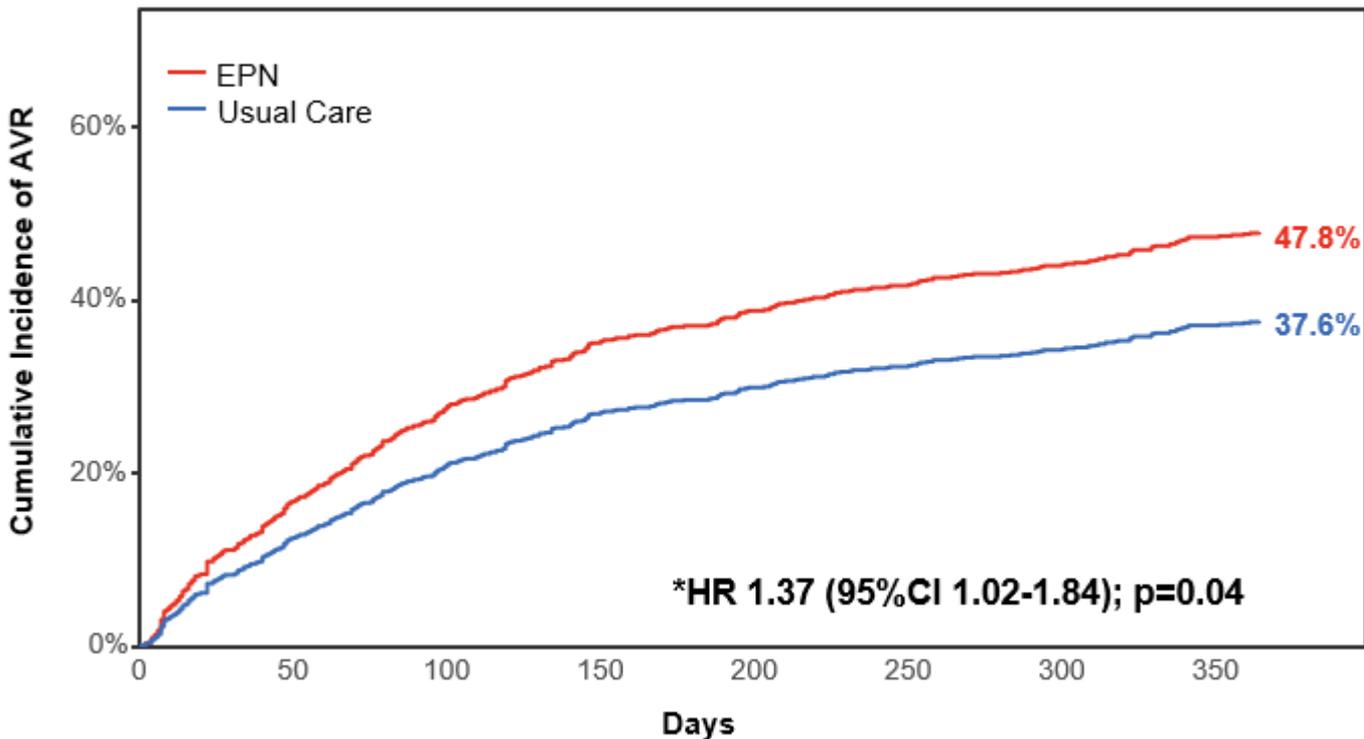
- Identified 6150 pts with Class I indication for AVR between 2000-2017
- Despite increasing number of AVR procedures over time, rate of AVR within 1 year of diagnosis remained ~50%



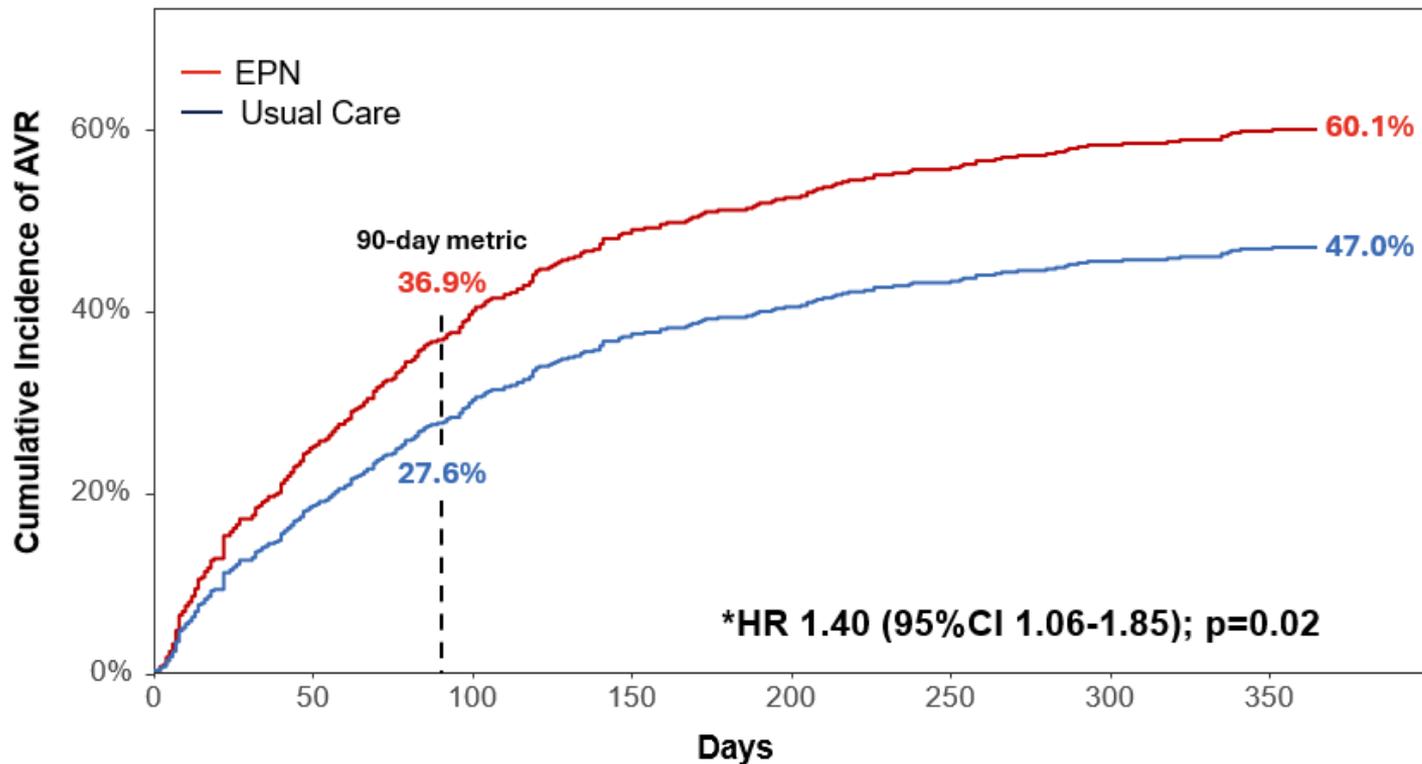
# The good news: we know how to fix this...



# Primary Endpoint: AVR



# Symptomatic Subgroup (n=545)



# Key Issues for the Next Decade

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## Issue #2

Should we be screening for valve disease?

If so, how should we do this?

# How should we screen for valve disease?

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## Study Objectives

- To define the prevalence of acquired VHD (aortic, mitral, and tricuspid) in a representative cohort of the U.S. population, as well as the influence of age, sex, race, and ethnicity on prevalence
- To derive, refine, and validate novel tools to screen for VHD using machine learning algorithms applied to electrocardiographic and blood analytes

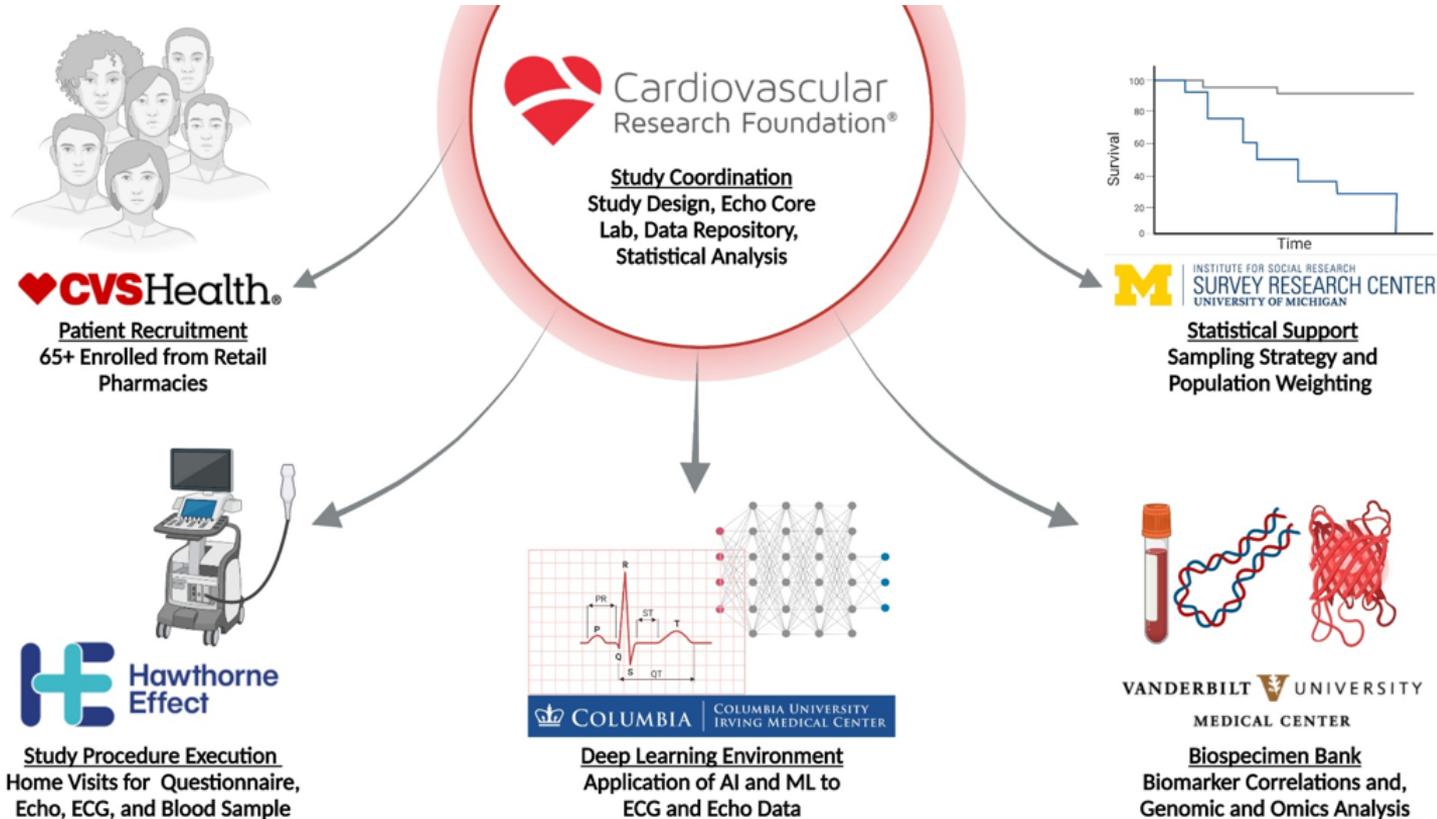
The  
PREVUE-VALVE  
Study

## Digital Approaches to Aortic Valve Disease Screening: The PREVUE-VALVE Study

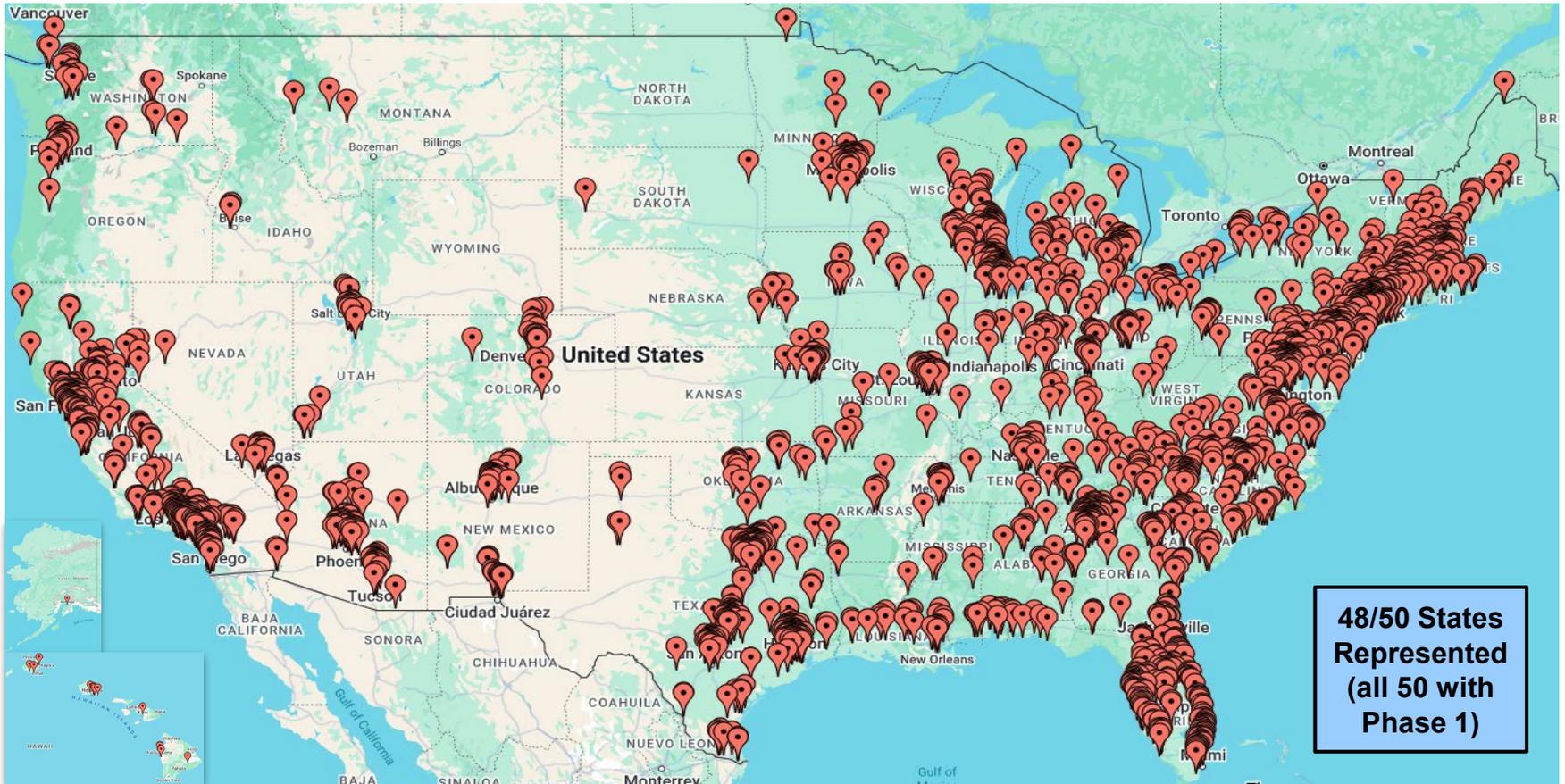
David J. Cohen MD MSc

Cardiovascular Research Foundation, New York NY  
St. Francis Hospital and Heart Center, Roslyn NY

# STUDY PARTNERS AND ORGANIZATION

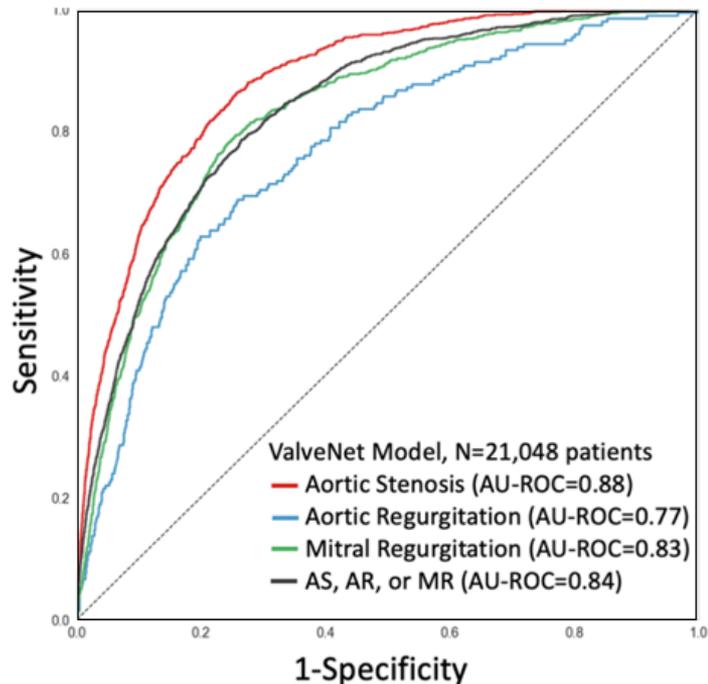


# PREVUE VALVE Study Map (as of 4/30/25)



**48/50 States  
Represented  
(all 50 with  
Phase 1)**

## ValveNet Deep Learning Model



- Deep learning model developed at Columbia → validated both internally and externally
- Using echo as the gold standard, we will test the accuracy of the ValveNet ECG deep learning algorithms to detect clinically relevant VHD
  - *Primary endpoint(s): moderate or severe AS, AR, MR*
  - *Secondary endpoint: composite of moderate-severe VHD, LVEF  $\leq 40\%$ , and moderate-severe LVH*

# Key Issues for the Next Decade

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## Issue #3

Is TAVR for bicuspid AS as good  
as surgery?

# Concerns about TAVR for Bicuspid AS

ESC European Society of Cardiology  
 European Heart Journal (2024) 00, 1–11  
 https://doi.org/10.1093/eurheartj/ehae331

FASTTRACK - CLINICAL RESEARCH  
 Valvular heart disease

## Transcatheter aortic valve implantation in low-risk tricuspid or bicuspid aortic stenosis: the NOTION-2 trial

Troels Hojsgaard Jørgensen<sup>1</sup>, Hans Gustav Horsted Thyregod<sup>1</sup>, Miikka Savontaus<sup>2</sup>, Yannick Willemens<sup>1</sup>, Øyvind Bleie<sup>3</sup>, Mariann Tang<sup>4</sup>, Matti Niemela<sup>5</sup>, Oskar Angerås<sup>6</sup>, Ingibjörg J. Gudmundsdóttir<sup>7</sup>, Ulrik Sartipy<sup>8</sup>, Hanna Dagnegaard<sup>1</sup>, Mika Laine<sup>9</sup>, Andreas Rück<sup>8</sup>, Jarkko Piihola<sup>5</sup>, Petur Petursson<sup>6</sup>, Evald H. Christiansen<sup>4</sup>, Markus Malmberg<sup>2</sup>, Peter Skov Olsen<sup>1</sup>, Rune Haaverstad<sup>10</sup>, Lars Sondergaard<sup>10</sup>, and Ole De Backer<sup>11</sup>, for the NOTION-2 investigators<sup>†</sup>

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Received 14 April 2024, revised 7 May 2024, accepted 14 May 2024

**Abstract**

**Background and Aims** Transcatheter aortic valve implantation (TAVI) has become the first choice to treat older patients with severe symptomatic aortic stenosis (AS). This study aimed to compare TAVI with surgery in low-risk patients  $\leq 73$  years of age, including both tricuspid and bicuspid AS.

**Methods** The Nordic Aortic Valve Intervention (NOTION)-2 trial enrolled 1:1 randomized low-risk patients aged  $\leq 73$  years with severe symptomatic AS to TAVI or surgery. The primary endpoint was a composite of all-cause mortality, stroke, or rehospitalization (related to the procedure, valve, or heart failure) at 12 months.

**Results** A total of 370 patients were enrolled with a mean age of 71.1 years and a median Society of Thoracic Surgeons risk score of 1.1%. A total of 100 patients had bicuspid AS. The 1-year incidence of the primary endpoint was 10.2% in the TAVI group and 7.1% in the surgery group [absolute risk difference 3.1%; 95% confidence interval (CI), -2.7% to 8.8%; hazard ratio (HR) 1.4; 95% CI 0.7–2.9;  $P = .3$ ]. Patients with TAVI, when compared to surgery, had lower risk of major bleeding and new-onset atrial fibrillation and higher risk of non-disabling stroke, permanent pacemaker implantation, and moderate or greater paravalvular regurgitation. The risk of the primary composite endpoint was 8.7% and 8.3% in patients with tricuspid AS (HR 1.0; 95% CI, 0.5–2.3) and 14.3% and 3.9% in patients with bicuspid AS (HR 3.8; 95% CI, 0.8–18.3) treated with TAVI or surgery, respectively ( $P$  for interaction = .1).

**Conclusions** Among low-risk patients aged  $\leq 73$  years with severe symptomatic AS, the rate of the composite of death, stroke, or rehospitalization at 1 year was similar between TAVI and surgery. Transcatheter aortic valve implantation outcomes in young bicuspid AS patients warrant caution and should be further investigated. (NOTION-2, ClinicalTrials.gov, NCT02825134).

**Trial Registration number** ClinicalTrials.gov NCT02825134.

- Patients with bicuspid AS were excluded from all of the pivotal trials of TAVR vs. SAVR
- With FDA approval, TAVR use increasing in younger patients— many of whom have bicuspid AS
- Registry-based studies (which tend to be reassuring) are based on highly selected patients but the selection criteria are unclear
- NOTION 2: Among 100 low-risk pts with bicuspid AS, 1-year death/stroke/rehosp was 4x higher with TAVR than SAVR (14.3% vs. 3.9%)

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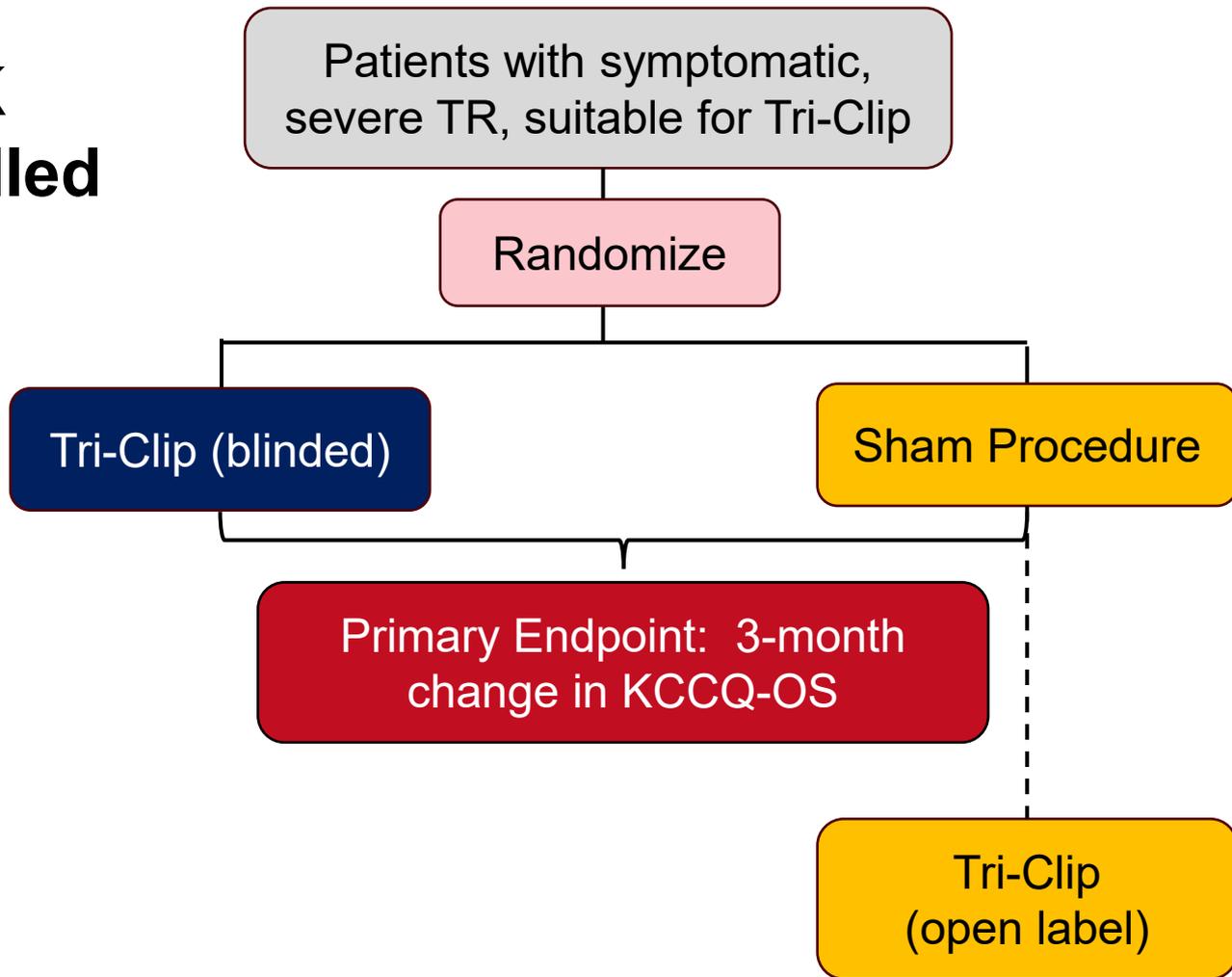
# Key Issues for the Next Decade

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## Issue #4

Is the quality of life benefit of TTVI real, or is it just an expensive placebo?

# Proposed UK Placebo-Controlled Trial



# More Unanswered Questions

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- Will MTEER indications expand to intermediate and low-risk pts?
- Will TMVR become more than a niche?
- Will newer cerebral embolic protection devices reach their potential?
- Should we treat tricuspid valve disease “early”?

# Summary

- Despite more than 15 years of commercial application, innovation in the cath lab remains alive and well
- In TAVR, areas of innovation are focused on unmet needs and include TAVR for AR, novel approaches to leaflet modification, new valve/leaflet technologies, and systems approaches to improving rates of diagnosis and treatment
- Important evidence gaps continue to exist with respect to TV dz (indications, timing, benefit, treatment selection) and aortic valve disease (bicuspid valve disease, outcomes of repeat procedures)→ in many cases the necessary studies are underway or in planning
- Stay tuned... there has never been a better time to be a structural interventionalist!

