

Aortic stenosis is vastly undertreated: Know how to identify and address it

Tools for improving patient identification and referral to treatment

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SNAPSHOT

The burden of aortic stenosis undertreatment

PROBLEM DEFINITION:

Aortic valve replacement (AVR) treatment rates are consistently lower than the growing prevalence of aortic stenosis.

Despite advancements and greater access to transcatheter aortic valve replacement (TAVR) many severe aortic stenosis (sAS) patients still go without treatment.

<50% of people with indication or potential indication for AVR received treatment

PROBLEM IMPACT:

Treatment delays can threaten patient lives.

Aortic stenosis (AS) progression worsens symptoms, lowers life quality, increases mortality risk, and is more costly for the health system.

50% increased mortality risk for sAS patients after two years without AVR

200% increase in cost of treatment associated with delays in care

PROBLEM EXPLANATION:

Under-identification and under-referral contribute to undertreatment.

25% of patients with moderate or severe AS are not clinically recognized

83% of untreated patients were never referred to a heart team for evaluation

SOLUTION:

Prompt referral to a multidisciplinary heart team can mitigate negative outcomes.

A comprehensive patient capture strategy that enables improved patient identification and referral to treatment has been proven to help:

- Increase procedure volumes
- Reduce time to treatment
- Reduce cost of care
- Improve quality and patient outcomes

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Audience: Cardiovascular service line leaders and/or structural heart (SH) program directors and managers.

Goal: Demonstrate how incomplete patient capture contributes to aortic stenosis (AS) undertreatment, explain the burden of undertreatment, and highlight how SH programs can address this gap by leveraging specific opportunities to improve patient identification and management.

How to use this toolkit: SH program leaders should use this toolkit as a guide for how to improve AS patient capture.* Review the following sections to identify your top opportunities for improving AS undertreatment and learn how other leading organizations are tackling this challenge.

* The process by which a patient with indication for AS is successfully referred for evaluation by a multidisciplinary heart team and ultimately receives appropriate AVR treatment.

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- 01 Elevate burning platform**
Understand the current AS patient capture landscape and imperative to address undertreatment
 - 02 Assess opportunities, implement solutions**
Evaluate potential areas of improvement and associated strategies for AS patient capture
 - 03 Review case profiles**
See how five health systems are approaching improvements in AS patient capture

Appendix

Elevate burning platform

Instructions: Use this section to understand and communicate the critical need to address AS underdiagnosis and undertreatment. The following pages will equip SH leaders with the data and insights required to explain the significance of this work to leaders within their organization.

In this section:

- Evidence on the underdiagnosis and undertreatment of AS patients
- Definition of patient capture and its key role in solving the underdiagnosis and undertreatment problem
- Benefits of building a more robust and effective patient capture system to increase access to life-saving treatment

“When you identify people early with valvular disease, then you’re protecting and preserving cardiac tissue ... So, with outreach in the early stages of AS and early identification of patients, hopefully we’ll be **very successful in not only improving our care delivery, but also the experience of our patients across the service line and health system.**”

DEAN FIELD, MD

Divisional VP of Health Informatics & Operations, Virginia Mason Franciscan Health

Despite advancements, sAS undertreatment challenges remain

While breakthroughs in TAVR continue progressing...



Improved valve design and technique

Tissue technology for long-term durability, sealing cuffs/skirts, smaller delivery sheaths, advances in pre-procedural care, etc.



Reduced length of inpatient stay

Patients discharged after TAVR procedure as early as the next day.



Decreased mortality rate

As of 2022 the out-of-hospital 30-day all cause mortality rate was 2.2% and continues to decline.



Expanded access to lower-risk patients

Available to all surgical risk levels, no longer limited to inoperable or high-risk patients.



Updated referral and treatment guidelines

New ACC/AHA¹ guidelines focus on patient-centered approach, early diagnosis, and timely referral to heart valve clinic.

1. American College of Cardiology/American Heart Association.

2. High gradient with normal left ventricular ejection fraction.

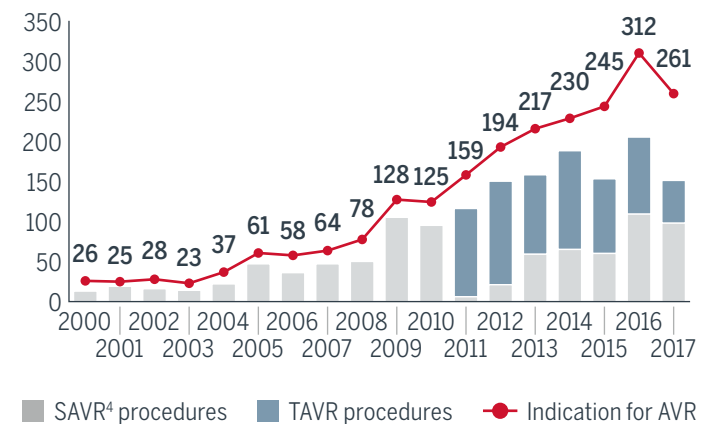
3. Study published in 2022.

4. Surgical aortic valve replacement.

...stagnant treatment rates persist

Class I indication for AVR for HG-NEF² AS patients versus patients who received AVR treatment

n=2,271 patients at Massachusetts General Hospital from a contemporary period defined as 2000 to 2017³

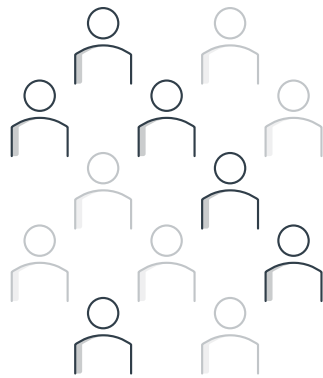


KEY INSIGHT

Even though TAVR and SAVR volumes have increased rapidly, the proportion of patients with an indication for AVR who did not receive treatment remains substantial.

High undertreatment rates, even worse for marginalized populations

Already insufficient treatment rates for the general population are further exacerbated for Black, female, and older AS patients due to disparities in referral and diagnosis.



<50%

of all people with an indication or potential indication for AVR received treatment



Compared to white patients, Black patients...

- Are 23% less likely to receive AVR
- Carry a greater burden of comorbidities
- Are more likely to live in lower-income communities



Compared to male patients, female patients...

- Are 20% less likely to receive AVR
- Have more symptoms, including larger left atrial volumes and higher pulmonary pressures
- Are generally older, with a median age of 81



Compared to younger patients, elderly patients...

- Are less likely to be referred for or to receive AVR
- Only 20.5% of patients 85 years or older underwent AVR compared to 46.0% of patients age <65 years

RELATED RESOURCE:

[Roadmap to advancing equity within your structural heart program](#)

Incomplete patient capture is a significant factor in undertreatment

KEY TERM: Aortic stenosis patient capture

The process by which a patient with indication for AS is successfully identified and referred for evaluation by a multidisciplinary heart team and ultimately receives appropriate AVR treatment.

Shortcomings in the patient identification and referral processes contribute to undertreatment



Poor patient identification

15%

of patients with sAS did not receive a diagnosis of AS up to a year from echo screening

25%

of patients with moderate or severe AS are not clinically recognized



Variation in referral behavior

83%

of untreated patients were never referred to a heart team for evaluation



Factors that further complicate patient capture

Patient education

- Patients pursuing AS care reported having insufficient education about their options
- ≈50% of patients diagnosed with moderate or severe AS do not report their symptoms

Geographical access to care

- Rural residents face longer times to treatment and potentially have access to a narrower range of treatment options
- Rural AS patients on average receive TAVR 2.4 months later than urban AS patients

Neither patients nor health systems can afford to wait

Already insufficient treatment rates for the general population are further exacerbated for Black, female, and older AS patients due to disparities in referral and diagnosis

Treatment delays can cost in terms of...



Increased risk of mortality for patients

Risk of death escalates as the severity of AS increases over time without intervention.



Avoidable spend for the health system

Treatment delays can significantly increase a patient's healthcare costs.

35% of patients waiting for TAVR experience a cardiac event over the course of three months

33%–42% four-year mortality for patients with untreated moderate and severe AS

25% of patients with severe symptomatic aortic stenosis (sSAS) may die within the first five weeks while awaiting treatment

\$10,080 in additional costs for patients who waited 12+ months for TAVR treatment

200% increase in cost of treatment associated with delays in care

\$2,000 in lost revenue per patient for non-elective treatment

A growing emphasis on quality in AS disease management

Historical heavy focus on procedural process and outcomes metrics

TAVR quality measured based on rates of:

- In-hospital or 30-day mortality
- Stroke
- Major bleeding
- Acute kidney injury
- Paravalvular aortic regurgitation

Shifting focus to include metrics on treatment timelines

Recognition that undertreatment is the biggest quality challenge that patients face.

- Higher-quality care means that a larger proportion of patients with AS are diagnosed and treated
- Improved patient identification and care processes are key to expediting time to treatment

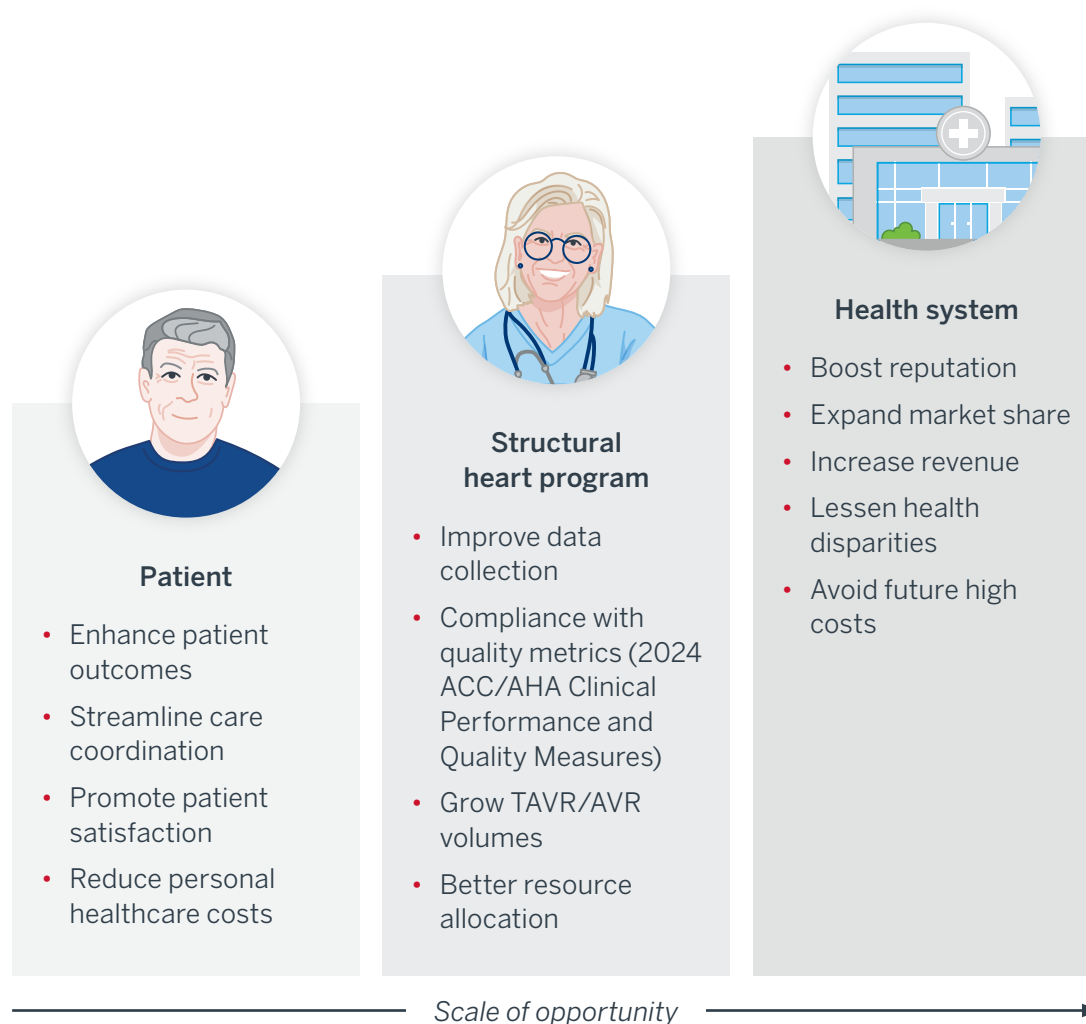
Timeline of evolutions in the TAVR quality landscape

- Jun. 2020** ● [U.S. News TAVR rating published](#)
- Nov. 2020** ● [Target AS launched](#)
 - Deliver treatment within 90 days of a class I indication for AVR
 - Improve data integrity to ensure accurate diagnosis
 - Determine and disseminate quality best practices
- Sept. 2021** ● [TVT-R* Star ratings published](#)
 - Measuring quality of patient safety and real-world outcomes
- Apr. 2024** ● [ACC/AHA Clinical Performance Measures for Valvular Diseases](#)
 - Calls for treatment of patients with sSAS within three months of diagnosis
- Jul. 2024** ● [U.S. News recognizes Target AS Programs](#)

KEY INSIGHT: The shifting payment landscape has a growing emphasis on quality. Leaders should prioritize new quality metrics to be prepared for future regulatory updates.

* Transcatheter Valve Therapy Registry.

Timely AS patient capture has scaled positive impacts for patients and health systems



KEY INSIGHT

Optimizing the patient capture process strengthens the structural heart program and creates a cascade of opportunities for patients and the health system.

Investing in this area also paves the way for future program evolution in technology platforms, data collection and analytics, and even payment transformation.

SOCIETAL IMPACT

The value of health and survival resulting from TAVR generates a net benefit of \$43.4 billion to society for all patients with sSAS, or \$212,199 per patient.

Causes for AS undertreatment span the entire care journey

Effectively addressing AS undertreatment means solving for various challenges across the care journey. We outlined three key areas for improvement based on common factors that contribute to undertreatment. The next section offers solutions for addressing undertreatment, with specific upstream focus on patient identification and referral.



Identifying patients and referring to heart team

- **Low awareness/misinterpretation of symptoms as signs of aging** — failure to recognize heart murmurs, chest pains, shortness of breath, fatigue, etc. as signs of AS.
- **Complex nature of diagnosis** — failure to integrate multiple points of disparate data, including high-quality imaging, echocardiogram (echo) report, caregiver feedback, complete patient record, patient-reported outcomes, etc.
- **Early discharge** — premature end of care encounter without referral for multidisciplinary heart team evaluation.
- **Lack of upstream patient capture-related quality metrics** — historical lack of provider quality and clinical accountability standards targeting patient capture.
- **Outdated and/or inconsistent referral guidance** — perceived excessive surgical risk because of advanced age, comorbidities, patient demographic inequities, etc.



Tracking patients through the system

- **Care fragmentation** — lack of coordination between care teams involved in pre-procedure care and patient follow-up.
- **Delayed retesting** — absence of proper disease progression monitoring for early stage AS patients.
- **Bottlenecks** — process barriers lead to poor patient flow, extended treatment wait times, increased costs, compromised care quality, etc.



Improving patient and health system outcomes

- **Access concerns** — inability to accommodate patient influx from improved patient capture due to lack of staff, screening/consult capacity, and physical space for care delivery.
- **Systemic and physical barriers to care** — mistrust of healthcare system, cost, lack of regional access to procedure, comorbidities, etc.

Factors contributing to undertreatment

Assess opportunities, implement solutions

Instructions: Using the tools and industry best practices outlined in this section, evaluate opportunities to improve patient capture and treatment for AS. Then, determine which strategies are the best fit for your organization based on existing capabilities and how much additional time and resources you're able to invest.

In this section:

- Tools to help you assess your program's opportunities for impact and readiness to invest
- Compare the benefits, cautions, and levels of investment associated with different strategies
- Guidance on designing your own patient capture solution

“We approached this project twofold: as a **growth strategy** for the service line and as a **quality improvement strategy** to identify undertreated valvular heart disease patients within our organization.”

KARRIE DAVIS, MSN, FNP-BC
Center Director, Wellstar Center for
Cardiovascular Care

Assess your organization's potential to increase patient capture

Use this step-by-step process to determine the number of patients within your system with sAS diagnoses that do not receive treatment. This will help quantify your opportunity to improve patient capture.

#1

Determine the number of patients with indication for sAS

Extract filtered data from PACS¹ to determine number of echos indicating sAS for a select time frame.

#2

Determine the number of AVR procedures performed

Extract data from EHR² to determine number of AVR procedures performed for the same timeframe.

#3

Calculate the difference between potential patients and actual treatment

Subtract the number of AVR procedures from the filtered number of echos.

The difference is your opportunity for patient capture.

Common filters: Measurements (Vmax,³ AVA,⁴ MPG,⁵ % area reduction, % diameter reduction), finding codes, text code contains "severe."

Advanced: Consider opportunities for patient capture not reflected in echo data by including EHR data (ICD-10 codes, patient encounter data, etc.).

Alternative calculation using unfiltered echo data:
Multiply total echos x 0.034 (pooled prevalence of sAS) to determine estimate number of echos that indicate sAS.

Quality check: For AVR procedures performed, calculate the average number of days from diagnosis to treatment, compared to the quality goal of 90 days.

DATA SPOTLIGHT

3.4%

Pooled prevalence of sAS in 9,723 adults older than 75⁶

200%

Projected increase in AS prevalence by 2040 and a 300% projected increase by 2060

1. Picture archiving and communication systems.
2. Electronic health record.
3. Peak aortic jet velocity.
4. Aortic valve area.

5. Mean transaortic pressure gradient.
6. Various studies have determined the prevalence of sAS to be between 2% and 5%, with prevalence exponentially increasing with age.

Compare your TAVR usage to industry benchmarks

Estimating average TAVR volumes is challenging because the number of procedures performed per site varies based on factors such as SH program maturity, provider count, and patient demographics. Review the data in this table to get a sense of how your organization compares to industry benchmarks. Access the Advisory Board tools listed on the right to help with custom data pulls.

Current and projected annual use rate of TAVR for patients age 65+, based on population size ¹

Size of patient population served	100K–400K	400K–700K	700K–1M
2023 use rate ²	160–640	640–1,120	1,120–1,600
2028 projected use rate ³	225–900	900–1,575	1,575–2,250
2033 projected use rate ⁴	264–1,056	1,056–1,848	1,848–2,640

Inpatient discharge volumes for TAVR, based on hospital bed size⁵

Representative of only Medicare fee-for-service claims data

Bed size	50th percentile	90th percentile
201–300	32	102
301–400	39	136
401–500	55	162
500+	81	245

1. Advisory Board's Market Scenario Planner Tool uses national demand models constructed from several data sources, including Medicare data from CMS, national sample data from AHRQ, and other proprietary commercial claim sets.

2. 2023 use rate for patients 65+: 1.6 per 1,000 patients, meaning ≈16 of every 10,000 patients receive TAVR.

3. 2028 projected use rate for patients 65+: 2.25 for every 1,000 patients, meaning ≈22.5 of every 10,000 patients receive TAVR.

4. 2033 projected use rate for patients 65+: 2.64 for every 1,000 patients, meaning ≈26.4 of every 10,000 patients receive TAVR.

5. Volume of inpatient discharges as reported in CMS' Inpatient Standard Analytical File (SAF); reflects Medicare fee-for-service discharges in 2023 Q1–2023 Q4. Claims involving outlier payments or non-Medicare primary payer codes have been excluded. This metric is not risk-adjusted.

DATA TOOLS SPOTLIGHT

- **Market Scenario Planner:** Get volume growth forecasts for AVR procedures, customized to your market to inform service and site investment decisions.
- **The Hospital Benchmark Generator:** See how your organization stacks up against others in your market on finance, quality, and utilization performance metrics.
- **Market Opportunity Calculator:** Estimate your five-year growth opportunity and predict how much volume and revenue your SH program could capture, based on ability to activate latent demand and compete for patients.

RELATED RESOURCE:
[Infographic: How healthy is your structural heart program](#)

Evaluate your readiness to implement new solutions for enhanced AS patient capture

Use this checklist to determine where additional investments may be needed before implementing a patient capture solution. Check the criteria that your organization already satisfies. Use the example considerations on the right to guide the assessment of your organization's readiness.

Leadership and organization	<ul style="list-style-type: none"> Baseline data to demonstrate opportunity and gain leadership support Funding to support necessary time and resource investments Physician buy-in Designated solution champion
Staffing	<ul style="list-style-type: none"> Value clinic coordinator or other project lead Information technology and analytics staff support Clinical staff to support projected volume growth (echo techs, cath lab staff, nurses, surgeons, anesthesiologists, etc.)
Infrastructure and facilities	<ul style="list-style-type: none"> PACS data reporting EHR structured reporting Multi-system interoperability
Workflow and processes	<ul style="list-style-type: none"> Provider outreach communication protocol (phone call, text, EHR notification) Patient triage and care process protocol (process for patient tracking, documenting next steps, follow-up reminders) Testing and procedure schedules to accommodate projected growth (CT* scan availability, operating room/cath lab space, etc.)
Data capture and reporting	<ul style="list-style-type: none"> Patient outcomes reports/dashboards Designated performance metrics

* Computed tomography.

EXAMPLE CONSIDERATIONS

- Do you have the leadership buy-in to support a new patient capture strategy?
- Which staffing roles still need to be recruited to support increased capacity?
- What existing technologies and infrastructure do we have in place to support a patient capture strategy?
- Are there any current workflow bottlenecks or inefficiencies that could hinder new patient capture strategies?
- How will we measure the impact/effectiveness of a new patient capture strategy?

RELATED RESOURCE:

[Toolkit: Build the case for structural heart program investments](#)

Three approaches for improving patient identification and referral



Identifying patients and referring to heart team

Factors inhibiting patient identification and referral

- Low awareness of symptoms/ misinterpretation of symptoms
- Complex nature of diagnosis
- Premature discharge
- Lack of upstream patient capture-related quality metrics
- Outdated and/or inconsistent referral guidance

Enhancing AS patient identification relies on targeted echo surveillance and shaping provider referral behavior.

Solutions apply echo data to direct provider outreach or influence referral behaviors. They tackle AS undertreatment by using a data-driven strategy for pinpointing patients and refining referrals.

Here are methods from top programs that boost patient identification and referrals:

1. Manual echo surveillance + provider outreach

Accessible solution that leverages existing infrastructure and echo data to identify potential patients

2. Automated large data surveillance + provider outreach

High-investment solution capable of improving efficiency and expanding the opportunity for patient identification

3. Point-of-care advisories

Upstream intervention that relies on in-person, immediate referral behavior rather than retroactive recommendations

Manual echo surveillance and provider outreach

Manual patient identification solutions rely on surveying echo data from PACS reports. Valve clinic staff can design reports to be regularly extracted from PACS by filtering for designated measurements, findings codes,* and text codes (moderate, severe). These reports create a target-patient list, organized by disease classification and referral status.

Valve clinic staff review target-patient lists to ensure that those with severe AS indication are seen by a cardiologist and referred for evaluation by the multidisciplinary heart team.

If an AVR treatment referral has not already been made, valve clinic staff will initiate outreach to ordering providers. Outreach is often best received from clinician to clinician (specialist, advanced practice provider, nurse practitioners to referring physician).

* Findings code example: Decrease in the maximal aortic cusp separation (<8mm in adults).

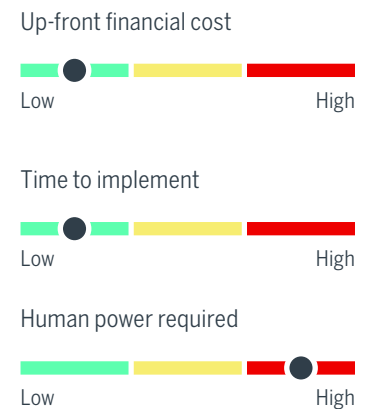
Benefits

- Easy implementation using existing infrastructure
- Person-to-person communication boosts physician engagement and buy-in
- Low cost to implement and maintain
- Minimal data validation and review after initial PACS search filters are set

Cautions

- Time-consuming process to maintain
- Subject to human error and/or biases
- Patient identification potential limited to those who have received an echo

Investment required



KEY INSIGHT

Manual surveillance and outreach is an accessible solution that leverages existing data and infrastructure. While the point of capture for this solution is limited to after a patient has already received an echo, targeted provider outreach can inspire future behavior change that favors earlier referrals from the initial point of care.

Automated large data model surveillance and provider outreach

High-tech platforms automate the echo surveillance process and expand capacity to survey larger quantities and diverse sources of data. These platforms aggregate data across disparate systems, namely PACS and the EHR, to produce one large dataset.

To review data, platforms often leverage artificial intelligence (AI) via natural language processing (NLP) to identify patients with select criteria.

These high-tech platforms can efficiently build and organize target-patient lists used to direct provider outreach. Valve clinic staff can manually manage outreach or automate it using tech-enabled communication, such as robotic process automations (RPAs). Automated outreach encourages the target patient's provider to submit a referral based on data-surveillance criteria.

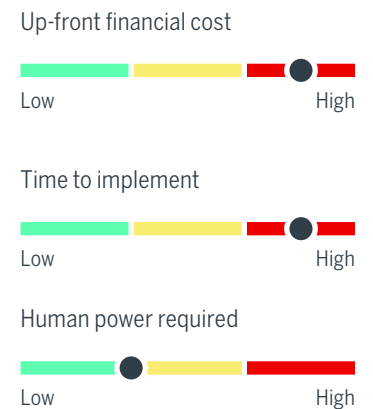
Benefits

- Increased potential for upstream patient identification
- Can accommodate large quantities of patient data, real-time and retroactively
- Automation reduces potential human biases that impact patient screening, improving equitable identification
- Does not create additional long-term workforce burden

Cautions

- Costly in terms of both time and money required to implement
- Can produce a backlog of previously unreviewed patients
- High degree of data validation required to ensure high-tech platforms are programmed to appropriately identify patients

Investment required



KEY INSIGHT

Automated large data surveillance requires time and financial investment into high-tech platforms. Large data surveillance increases the potential for patient capture by processing more inclusion criteria and identifying patients at an earlier point of care.

Point-of-care advisories

Rather than identifying potential patients through retroactive data surveillance, this solution takes an upstream approach by intervening at the point of care. Valve clinic staff can design and implement tech-enabled advisories in different care settings.

Some use EHR-embedded best practice advisories (BPAs) that are triggered when specified criteria indicating a potential AS diagnosis are met. BPAs alert the provider in the EHR when a referral might be necessary.

Alternatively, advisories can be used during echo screening. Advisories can be programmed to notify echo techs of potential AS-related findings, prompting contact to the valve clinic team for further evaluation.

Benefits

- The most upstream form of patient identification
- Helps to establish long-term behavioral change for referring providers
- Automatic process that occurs without regular intervention from valve clinic staff

Cautions

- Advisories may frustrate providers
- Advisories can be easily ignored
- Thorough up-front data validation is necessary to ensure BPAs are accurately flagging the appropriate patients

Investment required

Up-front financial cost



Time to implement



Human power required



KEY INSIGHT

Compared to other solutions, point-of-care advisories intervene at the earliest capture point by preventing missed opportunities for referral during an upstream care interaction. Point-of-care advisories remove the need for initial outreach from valve clinic staff but require data monitoring, follow-up, and modification when advisories are declined.

Improve tracking to prevent patient falloff

Assess opportunities,
implement solutions



Tracking patients through the system

Factors inhibiting efficient patient tracking

- Bottlenecks and process barriers that delay care
- Delayed retesting
- Care fragmentation

“Despite patients having a referral, there was still the potential for them to get lost through the process.”

STRUCTURAL HEART PROGRAM MANAGER

Community heart and vascular hospital

Addressing AS undertreatment goes beyond improving patient identification. Without proper patient tracking, referred patients might miss critical procedures or face delays in care.

There are three key elements of high-quality patient tracking:

1. Referral documentation

- After patient identification, clear documentation of referral creates a trackable starting point of care.
- Programs can gain insights from referral data, which tracks patient capture sources and reveals trends in referral amounts and provider patterns.

2. Patient triage list

- After referral, patients are organized based on disease severity to help with prioritization and determine the appropriate next steps:
 - Moderate classification: Placed on a reminder list for regular disease progression monitoring.
 - Severe classification: Next care steps and timeline clearly documented.

3. Phase-of-care charting

- If a procedure is the most appropriate step, each phase of care leading up to and following the procedure should be documented. This includes all office visits, consults, and tests ordered.
- Detailed documentation facilitates prompt care and reveals any delays or obstacles.

RELATED RESOURCE:

[Case study: How structural heart programs can reduce time to treatment](#)

Assess solution performance by measuring various outcomes



Improving patient and health system outcomes

Factors that inhibit improved outcomes

- Systemic and physical barriers to care
- Capacity concerns

There are various ways to design and implement a patient capture solution, but the goal of each approach is the same — improve the treatment rate of AS. Progress is typically gauged by increases in procedural volumes and cost savings. However, a broad range of metrics is essential for a true assessment of a patient capture solution's effectiveness.

Leading programs monitor these additional metrics to determine their impact:

Quality outcomes

- ▲ Patient experience
- ▲ Equitable access to care
- ▼ 30-day readmission
- ▼ 30-day stroke
- ▼ 30-day mortality

Timeline efficiency

- ▼ Days from initial diagnosis to treatment
- ▼ Days from referral to procedure
- ▼ Days from referral to CT
- ▼ Days from CT to treatment

Volume growth

- ▲ Clinic volume
- ▲ Procedure volume
- ▲ Number of referrals
- ▲ Capacity for growth

Workforce improvements

- ▲ Physician satisfaction
- ▲ Physician referral behavior
- ▼ Workforce turnover

Lessons learned across solutions for addressing undertreatment

Review these key learnings from peer organizations that are innovating their processes to improve patient capture. Rollover each key learning to see additional recommendations.

Consider which strategies to include as part of your solution to improve patient capture

Review these sample strategies for addressing the under-identification and undertreatment of patients with AS. Check which strategies are the best fit for your organization to improve AS patient identification. Use the guiding questions to consider the feasibility, impact, and investment needed for each strategy.



Guiding questions

How much are you prepared to financially invest up-front?

What is your anticipated timeline for strategy implementation?

What level of human power can you commit to a strategy?

	Homegrown	High-tech
Patient identification	Echo surveillance via review of PACS reports Target-patient list created by manual review of echo data	Tech-enabled processing of echo reports and EHR data Target-patient list created using NLP-enabled review of large data model
Provider outreach	Manual provider outreach facilitated by multidisciplinary heart team (e.g., alerts from echo tech) Provider education initiatives	Automated, tech-enabled provider outreach messages (e.g., RPAs) BPAs programmed within EHR
Patient tracking	Text or phone call-based referrals Patient triage and reminders manually updated in spreadsheets	Electronic referrals made within the EHR AS-specific phase-of-care dashboards and checklists within the EHR
Measuring outcomes	Tracking procedure volumes using EHR or claims data Cross-referencing number of documented AS cases with number of patients who received treatment	Data visualization software, interactive dashboards Real-time monitoring of metrics and trends (referral trends, time to treatment, etc.)

Review case profiles

Review case profiles

Instructions: Review approaches to improvements to AS patient capture at five health systems. During your review, identify and assess strategies and components that may be effective within your organization.

In this section:

- Insights from health system leaders on how their patient capture strategies met the needs of their patient population and addressed unique hurdles
- Comprehensive operationalization of each strategy's tackled problem, strategy approach, outcome measurement, and future directions

“The technology is the easy part. Getting it right and making sure what you built is producing the results that you want, that falls on the people. Technology isn't the solution; **it's just a facilitator.**”

DEAN FIELD, MD

Divisional VP of Health Informatics & Operations, Virginia Mason Franciscan Health

“Our strategy is all about finding the AS patients who would have otherwise fallen through the cracks and getting patients to treatment a little bit quicker.”

MANAGER

Structural Heart Program,
Community Heart and Vascular Hospital

Case profiles

Community Heart and Vascular Hospital

Annual volume: 228 TAVRs*

System size and location:
56-bed specialty heart hospital, part of Community Health Network in central Indiana

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When implementing a new strategy, begin with a manual process to avoid high-cost, time-consuming barriers to entry. Focus on establishing necessary workflow updates and securing buy-in before shifting to a more automated process that helps improve efficiency.

- By leveraging existing tools, Community lowered the potential cost and operational hurdles associated with implementing an AS patient capture strategy.
- After 11 years of success with their home-grown strategy, Community made the compelling case for further investment in more efficient technology that eliminates manual data transfers and reentry between disparate systems.



Problem

Community experienced inefficiencies in the patient tracking process due to dependency on multiple spreadsheets, leading to inconsistent monitoring and potential oversight of patient referrals and care steps.



Approach

- The valve clinic team manually runs weekly echo surveillance reports in the PACS system to identify patients with moderate and severe symptomatic AS to inform provider outreach.
- On average, they identify two to three patients a week for referral. The demonstrated success of this process strengthens the case for Community to invest in further streamlining their patient capture process.
- Both moderate and severe patients are manually added to respective patient reminder lists within the EHR where valve clinic staff can keep track of each patient's referral status and care next steps.



Outcomes

- 9** decrease in median days from referral to TAVR in one year
- 5%** decrease in 30-day readmission rates for TAVR from 2022 to 2023
- 382** SH referrals thus far in 2024



Future directions

- Community is implementing structured reporting to integrate patient identification and tracking processes into their EHR. This enables echo reports to operate directly within the EHR and links flagged patients to a structural heart dashboard.
- This will also enhance the functionality of their existing "Episode of Care" model that organizes pre- and post-procedure care in EHR-based checklists for all referred patients. Data from all patient episodes are organized in a dashboard that facilitates care monitoring for up to a year post-procedure.

* Annual TAVR volumes for Community Heart and Vascular Hospital structural heart program.

Morristown Medical Center

Annual volume: 800 TAVRs¹

System size and location:
735-bed research and academic hospital, part of Atlantic Health System in Northern New Jersey

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Leverage NLP techniques to filter through extensive patient datasets, identify specific clinical markers that reveal key patient groups and early intervention opportunities.

- Morristown initially focused on identifying high-priority³ patients, but this approach proved ineffective in identifying the most suitable patients for intervention due to common disqualifying factors such as frailty or comorbidities.
- Morristown also identifies moderate patients for monitoring and clinical trials. They found that moderate patients often progress to severe by the time of evaluation, making them eligible for commercial intervention. By identifying these patients early on, Morristown can provide treatment at the earliest opportunity and prevent further disease progression.



Problem

Morristown needed to implement a patient capture approach to accommodate the expected increase in new AS cases due to expanding indications for treatment and new FDA-approved TAVR treatment devices.



Approach

- An AI-based digital health platform both proactively and retrospectively analyzes echo data, pinpointing AS patients previously overlooked for treatment and potential candidates for clinical trials and early commercial treatment.
- Using data visualization software, Morristown created a referral dashboard to analyze referral patterns and monitor physician referral behaviors to identify opportunities to increase referrals.
- Morristown uses educational dinners and information sessions for physicians with low referral rates to boost AS awareness and encourage referrals. Engaging providers when their patients qualified for clinical trials, created a “halo effect” of earlier referral for all patients.



Outcomes

- 17%** Increase in SH referrals from 2023 to 2024
- 18%** Increase in SH procedures from 2023 to 2024
- 22%** Increase in SH clinic visits from 2023 to 2024



Future directions

- Morristown will implement predictive analytics to anticipate when moderate AS might progress to severe AS.
- Morristown will include metrics assessing health equity and implement strategies to ensure AS treatment for underrepresented populations.
- In their patient education initiative, Morristown will send letters to qualifying patients describing their AS condition and prompting them to discuss the condition with their provider.
- Morristown will use this patient identification process for other therapies, like tricuspid and left atrial appendage closure devices.

1. Annual TAVR volumes for all TAVR-performing hospitals in the health system; Morristown is a hub-and-spoke program and takes echo referrals from several sister hospitals that do not perform TAVR.
2. As indicated by being symptomatic, severe, and in the system for 90+ days without a specialist visit.

Wellstar Center for Cardiovascular Care

Annual volume: 200–250 TAVRs¹

System size and location:

Seven cardiovascular care-accredited hospitals, 26 ambulatory CV clinics, eight cardiac rehabilitation centers, five multispecialty health parks, and six accredited emergency cardiac care centers, part of Wellstar Health System in Central Georgia.²

Automated EHR alerts create a standardized process to ensure providers refer patients at the point of care and collect data to refine patient capture processes over time.

- Wellstar implement BPAs³ prior to discharge with a dual goal in mind: to ensure that all patients, even those admitted for non-cardiac conditions, receive SH referrals; and to continuously improve patient capture over time.
- A dashboard tracks BPA “declines” and rationale, providing insights into provider behavior and enabling close collaboration with physicians to ensure that BPAs are relevant and impactful.



Problem

Wellstar providers were frustrated with late referrals for AS patients, often leading to patient ineligibility for interventions like TAVR.



Outcomes

17% Growth in SH procedures within six months of launch, exceeding typical growth expectations

15% Increase in SH clinic volumes in FY 2024 compared to FY 2023



Approach

- Physician champions at Wellstar developed an EHR-based registry with robust inclusion and exclusion criteria, leveraging echo measurements and comorbidity data to identify AS patients earlier in their disease.
- When a patient meets criteria, the EHR generates BPAs to prompt physicians to refer severe AS patients to the SH program, minimizing referral leakage and preventing patients from getting lost in the system.
- Wellstar uses a patient workflow tool to track referrals to the SH program, oversee treatments and follow-ups, and differentiate between patients needing immediate intervention and those under surveillance.



Future directions

- Wellstar will increase the number of procedure case days and physicians in the SH clinic to accommodate higher patient volumes and address ongoing patient access challenges.
- In the next phase of this work, Wellstar is planning to refine screening criteria based on trends in provider responses to the BPA alerts.

1. Annual TAVR volumes for all TAVR-performing hospitals in the health system.
2. System size based on the number of hospitals performing TAVR in the system.
3. Best practice alert: Appears on screen once a patient is flagged as meeting criteria for AS and providers must either “accept” or “decline” the alert to refer the patient to the SH clinic.

Preston Medical Center¹

Annual volume: 75–80 TAVRs²

System size and location:

Two cardiology groups, part of Preston Medical Group¹ on the Pacific Coast

.....

Facilitating cardiologist appointments and valve clinic referrals for eligible AS patients before they leave the hospital improves the AS detection rate and increases the likelihood of receiving follow-up care.

- Preston patients meeting the AS criteria receive a cardiology evaluation and SH referral prior to discharge.
- Preston secured assurance from hospitalists that they would not prematurely discharge flagged patients without a cardiology evaluation to prevent missed opportunities for early intervention and improved patient care.



Problem

Indication for AS can often be overlooked in echo results, leading to missed critical diagnoses and patients being discharged without a clear understanding of their condition or next steps.



Approach

- When echo technicians detect abnormal measurements indicative of AS, they send text alerts to both the SH coordinator and on-call cardiologist.
- The SH coordinator arranges for an immediate evaluation by the cardiologist, enabling referral at the point of care.
- The SH coordinator conducts a monthly audit by cross-referencing documented AS cases in the echo charting system against the alerts sent and patients who received treatment. Any patients not accounted for are identified and referred for follow-up.
- Preston sends letters to community-based PCPs detailing their patients' treatments for sAS and pre- and post-TAVR echo results, improving education and physician engagement.



Outcomes

15 days Average time from patient referral to TAVR

“Our alert system has proven time after time to be the driver of the sAS patients who are in the hospital, with echos, and cared for in a timely manner. Whether it be TAVR, SAVR, or medical management.”

SH COORDINATOR

PRESTON MEDICAL CENTER



Future directions

- Preston is focused on preserving a 95%–100% match rate between the number of documented AS cases in the echo charting system, the alerts sent, and the patients receiving treatment.
- By maintaining a high match rate, Preston ensures consistent standards of care and reduced variability in patient outcomes.

1. Pseudonym.
2. Annual TAVR volumes for all TAVR-performing hospitals within Preston Medical Group.

Virginia Mason Franciscan Health

Annual volume: 500 TAVRs¹

System size and location:

10 hospitals, 1,500-bed health system in Western Washington, part of CommonSpirit Health.

.....

Emerging AI and tech solutions can be strategically deployed to streamline patient identification in a resource-limited environment by enhancing capture rates, increasing volumes, reducing screening biases, and mitigating provider burnout.

- Virginia Mason Franciscan Health (VMFH) providers and coordinators were experiencing burnout from their current responsibilities, so they prioritized a strategy for capturing AS patients that wouldn't add to their staff's workload.
- Leveraging AI to navigate complex patient data reduced the cognitive burden on providers by streamlining the decision-making process, improving operations, and ultimately enabling better patient care.



Problem

VMFH noticed that many patients were being diagnosed with AS at advanced stages of the disease, adversely impacting their long-term health outcomes and opportunities for treatment.



Approach

- VMFH creates a comprehensive dataset by integrating patient data from the EHR and PACS systems. They then utilize AI to analyze patient records and identify indications of AS that may have been otherwise overlooked.
- RPAs² are designed to independently screen the dataset and automatically generate EHR alerts, nudging providers to refer potential AS patients. This enhances efficiency and prevents additional tasks for SH staff.
- Once identified and referred to the SH clinic, the SH team tracks the patient's journey in the EHR to ensure they receive the necessary follow-up care and appointments.



Outcomes

3-4x Increase in number of referrals after just one month of using RPAs

25% Additional expected potential growth of TAVR volumes

"One coordinator didn't have the bandwidth for all the outreach, but the RPA makes it sustainable."

STACIE WAGES, RN

STRUCTURAL HEART PROGRAM DIRECTOR



Future directions

- VMFH strives to mitigate biases and disparities in healthcare delivery by automating the identification process.
- VMFH is maximizing their resources and infrastructure to provide timely care and accommodate increased referral rate and procedure volumes.

1. Annual TAVR volumes for all TAVR-performing hospitals in the health system.
2. Robotic process automations.

Appendix

Appendix

Instructions: Review supplemental materials further detailing components of AS patient capture strategies from the five organizations featured in the previous case studies.

In this section:

Additional information from interviews with structural heart leaders on their patient capture solutions

Morristown Medical Center

The screenshot below displays Morristown Medical Center's SH Patient Lists dashboard within the Egnite CardioCare platform. The dashboard focuses on AS and six other cardiovascular conditions. This dashboard links to AI-generated patient candidate lists, allowing the SH team to effectively manage three broad patient categories:

- High-priority patients: Includes lists to identify symptomatic patients who have not yet been evaluated by the SH team and were diagnosed over 90 days ago.
- Candidates for intervention: Includes lists to handle engagement and follow-ups for treatment candidates and potential clinical trial participants.
- Disease management: Includes lists to continue to monitor status of patients that have been identified.

Patient Lists All Unreviewed Reviewed

Cardiovascular Disease

Aortic Stenosis	Aortic Regurgitation	Mitral Stenosis	Mitral Regurgitation	Tricuspid Regurgitation	Heart Failure	AFib
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High Priority Patients

159 Active, not evaluated, symptomatic or EF < 50, 90+ days since diagnosis	16 Active, not evaluated, symptomatic or EF < 55, 90+ days since diagnosis	18 Active, not evaluated, symptomatic or EF < 50, 180+ days since diagnosis	106 Active, not evaluated, symptomatic or EF < 60, 180+ days since diagnosis	91 Active, not evaluated, symptomatic or EF < 50, 180+ days since diagnosis, one or more VHD M, M-S, S	29 Active, 2 or more HF admissions in the past 90 days, not evaluated by HF specialist, prescribed less than 3 GDMT medications with a HF/EF diagnosis or other heart failure diagnosis and an LVEF of ≤ 40%	24 Active, CHA2DS2-VASc ≥ 2 (men) or ≥ 3 (women), not prescribed anticoagulation, no history of bleeding, ≥ 2 admissions in the past 90 days, not evaluated by a specialist
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Candidates For Intervention

AS AVR (358) AS Outreach (977)	AR AVR (39)	MS MVR (35)	MR MVR (163) TEER (80)	TR TVR (340)	ICD (1425) CRTD (675) PA Sensor (1184) HOCA (407)	LAAC (4110) AF Ablation (19896)
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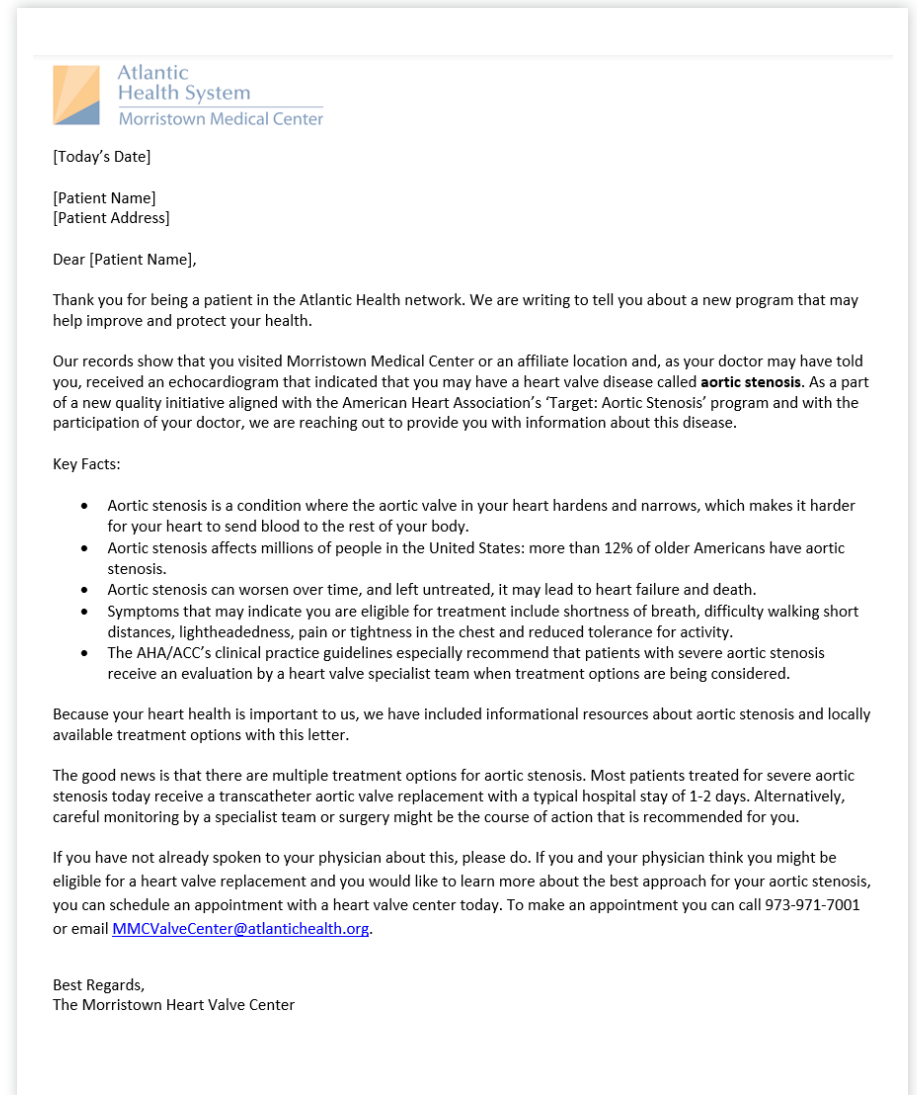
Disease Management


Severe AS (544) Moderate To Severe AS (511) Diagnostic Precision (333) Disease Progression (289)	Severe AR (49) Moderate To Severe AR (122)	Severe MS (48) Moderate To Severe MS (41)	Severe MR (286) Moderate To Severe MR (561)	Severe TR (480) Moderate To Severe TR (669)	HF/EF (17096) HFpEF (17702)	AF GDMT Eligible (47456)
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Intended Use

Morristown Medical Center

The screenshot depicts an example of the letter that the Morristown Medical Center sends to patients, notifying them of an echo that indicates AS. As part of the hospital's education initiative, this letter informs the patient of the echo findings, disease education, locally available treatment options, and follow-up recommendations. The goal of these letters is to help improve patient education and prompt patients to discuss their AS condition with their provider.



 Atlantic Health System
Morristown Medical Center

[Today's Date]

[Patient Name]
[Patient Address]

Dear [Patient Name],

Thank you for being a patient in the Atlantic Health network. We are writing to tell you about a new program that may help improve and protect your health.

Our records show that you visited Morristown Medical Center or an affiliate location and, as your doctor may have told you, received an echocardiogram that indicated that you may have a heart valve disease called **aortic stenosis**. As a part of a new quality initiative aligned with the American Heart Association's 'Target: Aortic Stenosis' program and with the participation of your doctor, we are reaching out to provide you with information about this disease.

Key Facts:

- Aortic stenosis is a condition where the aortic valve in your heart hardens and narrows, which makes it harder for your heart to send blood to the rest of your body.
- Aortic stenosis affects millions of people in the United States: more than 12% of older Americans have aortic stenosis.
- Aortic stenosis can worsen over time, and left untreated, it may lead to heart failure and death.
- Symptoms that may indicate you are eligible for treatment include shortness of breath, difficulty walking short distances, lightheadedness, pain or tightness in the chest and reduced tolerance for activity.
- The AHA/ACC's clinical practice guidelines especially recommend that patients with severe aortic stenosis receive an evaluation by a heart valve specialist team when treatment options are being considered.

Because your heart health is important to us, we have included informational resources about aortic stenosis and locally available treatment options with this letter.

The good news is that there are multiple treatment options for aortic stenosis. Most patients treated for severe aortic stenosis today receive a transcatheter aortic valve replacement with a typical hospital stay of 1-2 days. Alternatively, careful monitoring by a specialist team or surgery might be the course of action that is recommended for you.

If you have not already spoken to your physician about this, please do. If you and your physician think you might be eligible for a heart valve replacement and you would like to learn more about the best approach for your aortic stenosis, you can schedule an appointment with a heart valve center today. To make an appointment you can call 973-971-7001 or email MMCVValveCenter@atlanticealth.org.

Best Regards,
The Morristown Heart Valve Center

Wellstar Center for Cardiovascular Care

The yellow box at the bottom-right of the screenshot below depicts an example of Wellstar's TAVR best practice advisory (BPA) in Epic for a fictitious patient. Once a patient is flagged, the BPA appears on the EHR screen and requires the provider to interact with the BPA by ordering the referral or by providing a reason for declining to order the referral. For structural heart, BPAs appear in the following care settings:

- Inpatient: BPA fires when the provider launches the Discharge Order Set.
- Outpatient, for PCPs and cardiologists: BPA fires when the provider opens the patient's chart.
- Emergency department: BPA fires only when the patient does not have a Wellstar cardiologist. The referral goes straight to general cardiology for the patient to be evaluated before referral to the structural heart team.

The screenshot displays the Epic EHR interface in the 'Plan' tab. The 'BestPractice Advisories' section is expanded, showing a yellow alert for 'Referral to Structural Heart recommended'. The alert text states: 'This patient is a potential candidate for the following Structural Heart procedure: • TAVR'. Below the text are three buttons: 'Order', 'Do Not Order', and 'Ambulatory Referral to Structural Heart Clinic'. An 'Acknowledge Reason' section includes radio buttons for 'Not clinically appropriate', 'Patient declines', and 'Other (see comments)'. A yellow callout box at the bottom right of the alert contains the text 'Accept (1)'. Two blue callout boxes are overlaid on the image: one pointing to the alert with the text 'Would only be preset if patient meets clinical criteria' and another pointing to the 'Plan' tab with the text 'Available in Plan tab (OP) section; requires action if present'.

* Disclaimer: The patients and information presented here are fictitious and for demonstration purposes only.

Wellstar Center for Cardiovascular Care

The screenshot below depicts the clinical registry criteria for Wellstar's AS BPA in Epic. This AS-specific BPA is programmed to screen patient EHRs using these criteria and notify providers in the EHR when a patient is flagged and needs a TAVR referral.

Aortic Stenosis: TAVR

Age 18+ years

AND Documented Moderate, or Moderate to Severe, or Severe Aortic Stenosis

AND *One of the following:*

Moderate (and above) AR

OR Aortic Valve Area $\leq 1.2 \text{ cm}^2$

OR Peak Velocity $> 300 \text{ cm/s}$ (prior to 1/24/23 or after 4/27/23) or 3 m/s (between 1/24/23 and 4/27/23)

OR Dimensionless index $< .30$

OR Mean gradient $\geq 30 \text{ mm Hg}$

OR Mean Gradient ≥ 20 AND < 30 AND LVEF < 50

OR Bioprosthetic valve (ICD 10 Z95.2)

Candidate Exclusion *Patients with existing LVAD, DNR, Vent Dependence*

Workflow Exclusion *Patients who had OP visit with a Structural Heart or Cardiac Surgery clinician within the past 1 year or have an upcoming clinic appt (no time frame)*

* Disclaimer: The patients and information presented here are fictitious and for demonstration purposes only.

Preston Medical Center¹

Below is an example of Preston Medical Center's monthly audit report.² The SH coordinator cross-references the number of sAS patients flagged by the echo techs, the number of text alerts sent to the coordinator and on-call cardiologist, and the number of cardiologist consults. The purpose of this audit report is to ensure that the echo alerts are achieving the intended impact, indicated by the same number of alerts sent as cardio consults conducted. The audit also indicates how many patients went to TAVR workup and how many patients went to open heart surgery (OHS).

SEVERE AORTIC STENOSIS AUDIT BY ISCV 2024							
Month	# Severe Alerts	# alerts (phone)	# cardio Consults	# CVS Consults	#pts sent to TAVR workup	# patients to OHS	NOTES
January	14	13/14 92%	13/14 92%	5	6	2	
			The one that was not sent did not get a cards consult		1-DNR; 2 to scripps; 2 out of area		█ did not send 1 alerts █ (1.5.24) (she also missed two in December)
February	10	9/10 90%	7/10 70%	4	4	1	
			1 alert did not get sent and the other pt was not seen by cardio 1DNR				█ (if find him and get him into cards). He was a fall most likely from the AS).
March	13	10/10 100%	11/13 85%	6	3	3	
			1=hospice; 1 just not seen (by cards)				
April	8	10/10 100%	9/10 90%	3	1	1	
			1= GB. Received alert - no consult				The missed consult will see GB cardio as out pt
May	12	12/12 - 100%	11/12 - 92%	3	2	1	
			1 - no alert = no consult		1 - Out of network		

1. Pseudonym.

2. The numbers in the graphic above are illustrative.

Preston Medical Center

This screenshot depicts an example of the letter that the Preston Medical Center Valve team sends to notify community-based PCPs that one of their patient's received treatment for sAS.* This letter informs the PCP of their patient's pre- and post-TAVR echo findings, education regarding measurements, procedure details and benefits, and follow-up recommendations. The goal of these letters is to help improve PCP education on the benefits of TAVR and influence future referral behavior when a patient has an abnormal echo or other signs or symptoms of sAS.

6.18.2024

██████████

Your patient, **MARK SMITH (BD: 01.01.2001)**, was seen and treated at ██████████ for the diagnosis of severe aortic stenosis. On **6.17.2024** an Edwards SAPIEN3, **size 26mm transcatheter** heart valve was implanted via the **transfemoral** approach.

Transcatheter aortic valve replacement (TAVR) with the SAPIEN 3 valve allows patients who are a surgical risk to avoid an open-heart procedure. Benefits of TAVR include: relief of symptoms, improved heart function and shorter recovery time to resume everyday activities. TAVR has also shown substantial improvement in a patient's health as early as 30 days after their procedure.

ECHO Findings	Pre-TAVR	Post-TAVR	Severe AS defined as:
AV Area	0.6 cm ²	2.7 cm ²	≤ 1.0
Peak Velocity	4.1 cm/sec	1.8 m/sec	≥ 4.0
Mean Gradient	45 mmHg	8 mmHg	≥ 40

Needs 2/3 (AVA, Velocity MG) to meet criteria

██████████ TAVR/Structural Heart belongs to the TAVR registry, so follow-ups within the timeframe is important. Follow-up for this patient will include a 30 day and a **1 year** follow-up. Records of these follow ups can be faxed to the Cardiology Department at ██████████

These follow-ups may occur at the patients Cardiologists office.

30 Day (21-75 days post procedure): __ (HGB, Creatinine, EKG, Echo and EKG)

1 Year (+/- 60 days): __ (HGB, Creatinine, EKG, Echo and EKG)

Please feel free to contact us with any questions. We appreciate your continued confidence and trust in our Heart Team as we strive to improve patient outcomes.

* The names and numbers in the letter above are illustrative.

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