Strategies to Reduce Inpatient TAVR & Improve Patient Outcomes

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Inpatient (Urgent) TAVR: A Common Treatment

~25%

of TAVRs at high-volume referral centers are performed in patients who are already hospitalized

25%

of urgent TAVR patients carried no diagnosis of aortic stenosis in the preceding year

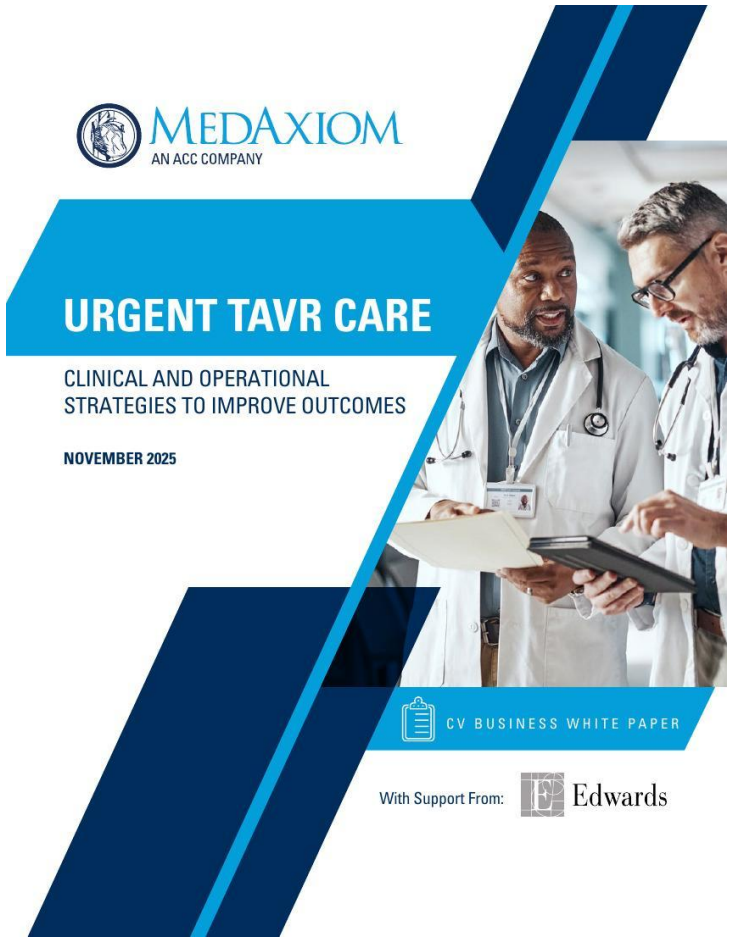
80%

of those undiagnosed patients had a healthcare encounter in the year before urgent admission

Urgent TAVR is often a missed opportunity to treat patients earlier in the disease process.

Bansal A, et al. J Am Heart Assoc. 2021;10(9):e019670. | Ebinger JE, et al. J Am Heart Assoc. 2025;14(11).

MedAxiom White Paper: Urgent TAVR Care



Clinical and Operational Strategies to Improve Outcomes

November 2025 — developed with support from Edwards Lifesciences

Best practices from three programs

Cleveland Clinic
1,290 beds
601 TAVRs (2024)
> 700 TAVRs (2025)

Memorial Healthcare
797 beds
150 TAVRs (2024)

OHSU
576 beds
302 TAVRs (2024)

- Standardized triage and multidisciplinary heart team decision-making
- Medical optimization and BAV as bridging strategies
- Clear escalation pathways and proactive identification of severe AS
- Operational flexibility: reserved slots, expedited imaging, capacity management

Cleveland Clinic, Memorial Healthcare and OHSU program leaders were interviewed for the white paper; the author contributed as one of the interviewed program leaders.

What Drives Urgent Inpatient TAVR?

1	**Referral center realities**	High-acuity transfers concentrate at hub programs; up to ~25% of TAVRs occur in already-hospitalized patients
2	**Late recognition**	Delayed diagnosis and unstructured follow-up; even asymptomatic severe AS deteriorates quickly
3	**Clinical burden**	Rapid mobilization of imaging, anesthesia and procedural teams for sicker patients with longer stays
4	**Operational strain**	Urgent add-ons displace elective cases, disrupt throughput and stress cath lab / hybrid OR schedules
5	**Financial mismatch**	A single DRG (266/267) rarely covers stabilization of decompensated HF or multi-organ dysfunction

Bansal A, et al. J Am Heart Assoc. 2021;10:e019670. | Généreux P, et al. N Engl J Med. 2025;392(3):217-227. | Otto C, et al. J Am Coll Cardiol. 2017;69(10):1313-1346.

Outcomes Track Directly with Procedural Acuity

Table 1: Balloon-Expandable Valve Outcomes Based on Procedure Status

Procedure Status	Elective	Urgent	Emergent	Salvage
30-day outcomes				
All-cause mortality	1.3%	5.2%	17.7%	32.1%
Stroke	1.5%	2.4%	4.5%	11.7%
New requirement for dialysis	0.2%	1.0%	4.5%	14.8%
Major vascular complications	1.2%	1.9%	3.2%	1.8%
Life-threatening bleeding	1.2%	2.7%	7.2%	9.5%

Source: NCDR® STS/ACC TVT Registry™ Rolling 4Q ending Q2 2023.

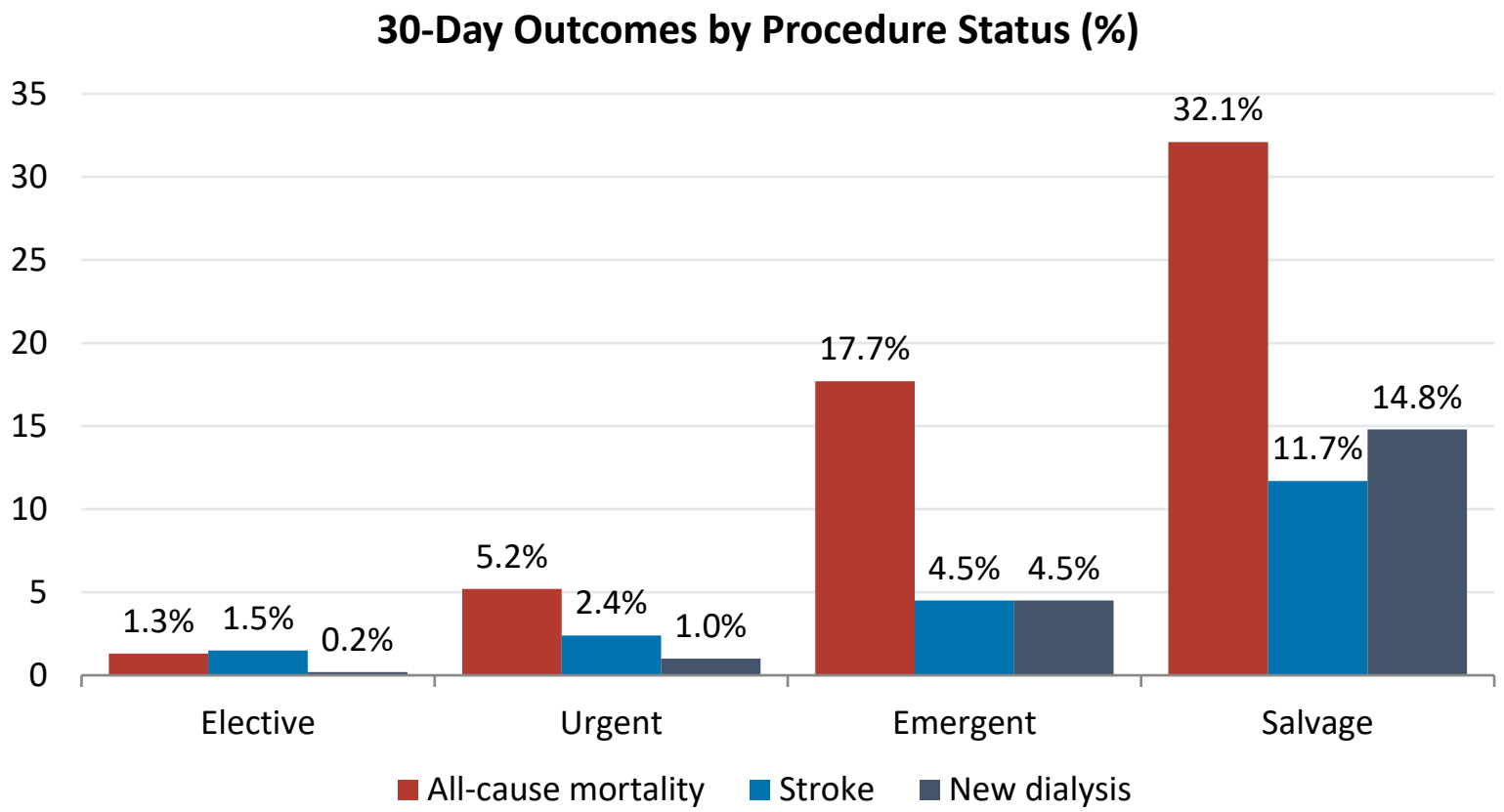
Key points

- 30-day mortality is 4-fold higher for urgent versus elective TAVR (5.2% vs 1.3%)
- Stroke, new dialysis and life-threatening bleeding all rise in parallel
- Urgent TAVR is independently associated with increased in-hospital mortality after adjustment
- Risk is a gradient, not a binary — emergent and salvage status carry a very different prognosis

Inpatient TAVR → Higher Mortality, Stroke, Dialysis, Bleeding and Vascular Complications

NCDR® STS/ACC TVT Registry™ Rolling 4Q ending Q2 2023. | Kolte D, et al. JACC Cardiovasc Interv. 2018;11(12):1175-1185.

The Risk Gradient Across Procedural Status



4×

higher 30-day mortality for urgent versus elective TAVR

- Complications compound cost and length of stay
- Converting even a fraction of urgent cases to elective moves the whole curve

NCDR® STS/ACC TVT Registry™ Rolling 4Q ending Q2 2023. | Zhou JY, et al. JACC Adv. 2025;4(8):102039.

The Extreme Phenotype: Cardiogenic Shock with AS

Why these patients are difficult

- Cardiogenic shock is usually multifactorial
- The contribution of the valve to shock is often ambiguous
- Concomitant issues may contraindicate AVR: active infection, mixed septic and cardiogenic shock, advanced malignancy

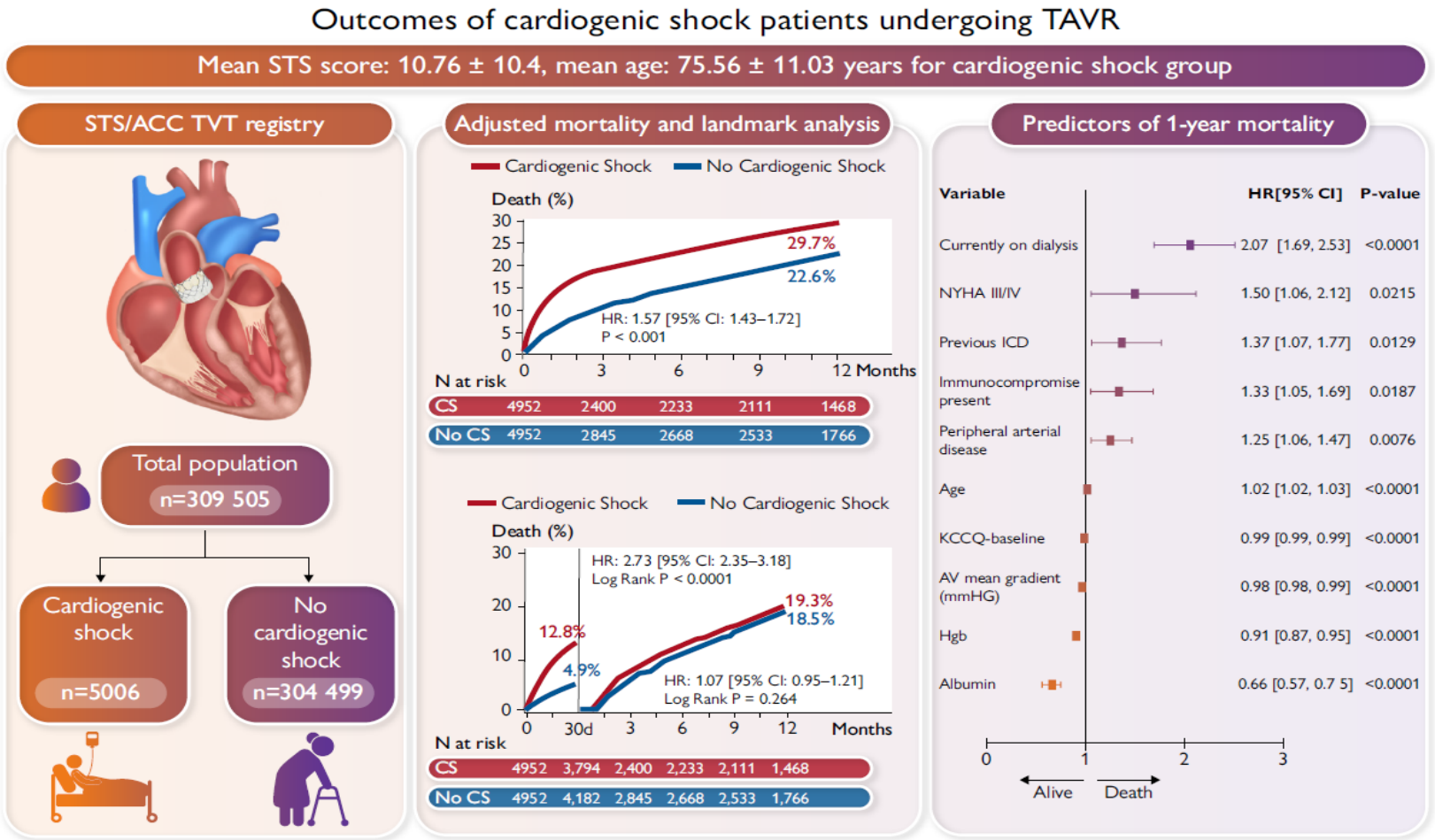
Treatment options

- Medical management
- Balloon aortic valvuloplasty (BAV)
- Transcatheter aortic valve replacement (TAVR)
- Surgical aortic valve replacement (SAVR)

The key question is not “how fast can we treat the valve?”
It is whether the valve is the cause of shock or a bystander.

Nair R, Reed GW, et al. J Am Heart Assoc. 2024;13:e033601.

TAVR in Cardiogenic Shock: STS/ACC TVT Registry

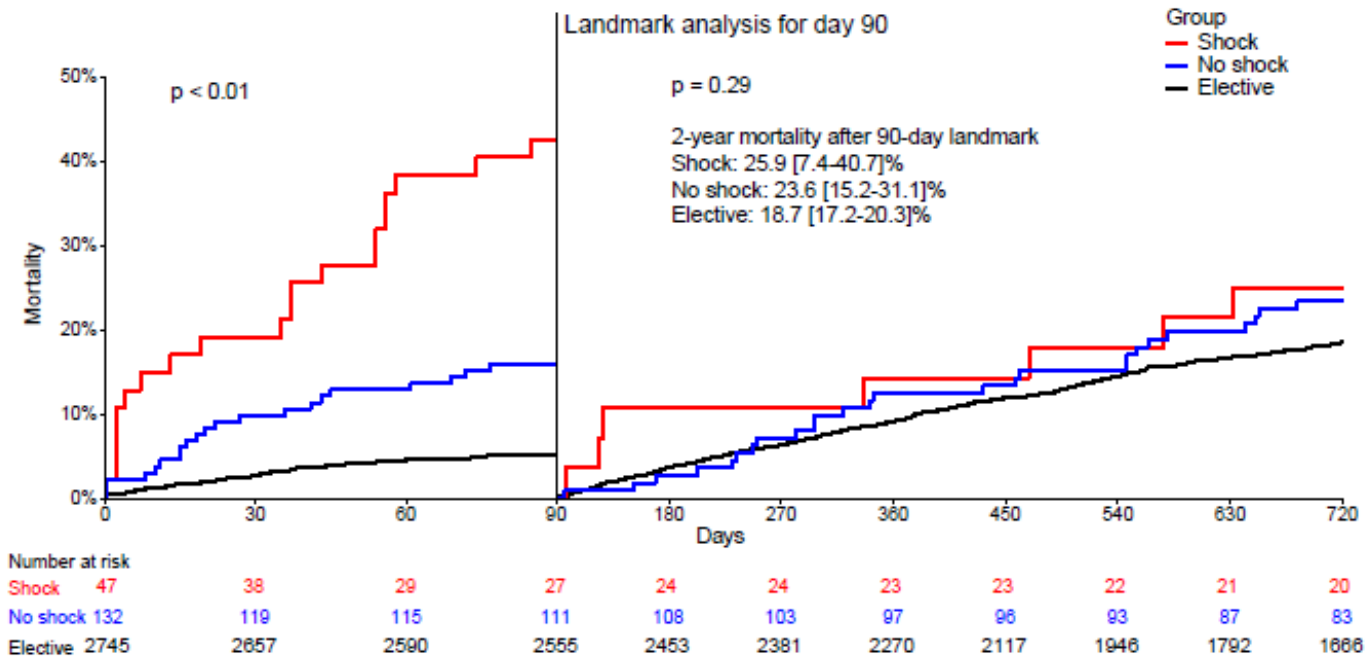


30-day mortality: 12.8% vs 4.9%.

After the 30-day landmark, mortality through 1 year was not significantly different (19.3% vs 18.5%; HR 1.07, P=0.264).

Goel K, et al. Eur Heart J. 2023;44:3181-3195.

Survive the First 90 Days and the Prognosis Converges



If we can carry a patient safely through the early hazard — by stabilizing rather than rushing — the long-term outcome approaches that of an elective patient.

Munich experience

- 2,930 patients undergoing TAVR, 2013–2019
- TAVR in shock is feasible but carries high complication rates; 30-day mortality 17–32%
- Mortality is clearly worse than elective or urgent TAVR without shock
- Landmark analysis at day 90: 2-year mortality 25.9% (shock) vs 23.6% (no shock) vs 18.7% (elective), P = 0.29

Steffen J, et al. Eur Heart J Acute Cardiovasc Care. 2022;11:877-886.

The Economic Signal Points the Same Direction

+$16,109

higher index hospitalization cost per case for urgent/emergent versus elective TAVR

~2 days

added length of stay per case attributable to post-procedural complications

Multivariable-adjusted analysis of more than 15,000 patients; costs reflect complication-related care, longer hospitalization and intensive resource use.

What one program achieved by tightening triage and throughput

≈ 6%

decrease in direct cost per case

≈ 37%

reduction in TAVR length of stay

over a two-year period

Culler S, et al. JACC Adv. 2025;4(9):102107. | Prasad S, et al. J Soc Cardiovasc Angiogr Interv. 2025;4(5):103330. | MedAxiom CV Business White Paper, November 2025.

Why Reimbursement Does Not Absorb the Difference

Fixed DRG payment

TAVR is reimbursed under DRG 266/267 regardless of hospital LOS

Acuity adjustment is incomplete

It does not cover diuresis of decompensated heart failure, multi-organ dysfunction or prolonged ICU care

Displaced elective volume

Every urgent add-on consumes a slot that a predictable, lower-cost elective case would have filled

Competing structural volume

Mitral and tricuspid therapies increasingly compete for the same cath lab and hybrid OR capacity

Minimizing urgent inpatient TAVR improves program sustainability, not just quality metrics.

MedAxiom CV Business White Paper: Urgent TAVR Care. November 2025.

From Reactive to Planned: Five Operational Levers

Common to all three high-performing programs in the white paper

1

Standardized pathways

EHR-triggered consults and structured evaluation windows

2

Heart team & coordinators

Weekly review of every inpatient considered for urgent TAVR

3

Capacity management

Reserved slots, expedited imaging, disciplined turnover

4

Proactive identification

Echo surveillance, AI flagging and referral-pattern feedback

5

Escalation & optimization

BAV, diuresis, GDMT — with leadership review before inpatient TAVR

The unifying principle: the question changes from “can we do this case now?” to “is discharge unsafe?” A “one-size-fits-all” rule is not appropriate — a structured, documented process is.

MedAxiom CV Business White Paper: Urgent TAVR Care. November 2025.

Lever 1: Standardized Care Pathways and Referral Processes

1. **TAVR consult order in the EHR**
   A discrete order triggers the automated workflow and alerts the TAVR coordinators — no case depends on a hallway conversation

2. **Routed to a managed inbox**
   Referrals land in a single coordinator-managed inbox; verbal referrals are always backed by a formal consult order

3. **Structured evaluation window**
   Interventional cardiology and cardiac surgery evaluate same-day or within 48 to 72 hours, for outpatients and inpatients alike

4. **Transfer center coordination**
   External referrals are triaged before arrival so that transfers arrive with a plan rather than an expectation of immediate TAVR

The pathway removes the variability that turns a routine referral into an inpatient emergency.

Lever 2: The Heart Team and the TAVR Coordinator

Weekly multidisciplinary heart team

- 20+ members: interventional cardiology, advanced imaging, advanced heart failure, cardiac surgery, anesthesia, APPs, nursing
- Every hospitalized patient considered for urgent TAVR is presented: history, surgical and procedural risk, frailty, barriers to DC
- Even high-risk patients are not automatically channeled to urgent intervention
- Virtual huddles or structured email review for cases arising between meetings

The coordinator is the operating system

- Guides patients through initial assessment and diagnostic testing
- Organizes communication among heart team members regarding the care plan
- Advocates patient preferences and goals within the multidisciplinary team
- Monitors inpatient progress daily and serves as liaison to referring and procedural teams
- Proactively tracks discharged patients awaiting TAVR and escalates if needed

Lever 3: Capacity Management and Flexible Scheduling

Reserve 1–2 urgent slots per week	Held open for urgent TAVR and backfilled with elective cases if unused — protecting the elective schedule instead of interrupting it
Late-day add-on and overbooking protocols	Absorb genuinely emergent cases without displacing planned cases or generating cancellations
Cross-department imaging priority	Pre-agreed expedited pathways for CT, echocardiography and MRI so workup is not the rate-limiting step
Turnover discipline	One center streamlined hybrid OR turnover to roughly 45 minutes, creating capacity for add-on cases without overtime

Lever 4: Proactive Identification of Severe AS

The gap we are closing

- Most missed cases reflect under-recognition and absent surveillance rather than rapid progression
- Referral delay before and after diagnosis is directly associated with higher post-procedural mortality
- Even asymptomatic severe AS can deteriorate rapidly and unpredictably

What programs are doing

- Systematic review of echocardiographic databases to find untreated severe AS
- Review of referral patterns to identify physicians who tend to delay referral
- Structured outreach and education to referring providers
- Participation in national initiatives such as Target: Aortic Stenosis

Cleveland Clinic: artificial intelligence applied upstream

- AI is used to flag patients with suspected aortic stenosis across the enterprise
- Feedback on flagged patients is returned to referral centers, closing the surveillance loop
- Goal: convert an eventual urgent admission into a scheduled outpatient evaluation

Every urgent case avoided upstream is a case that never competes for a lab slot downstream.

Généreux P, et al. N Engl J Med. 2025;392(3):217-227. | Lindman BR, et al. Circ Cardiovasc Qual Outcomes. 2023;16(6):e009712.

Lever 5: Escalation Frameworks and Medical Optimization

Escalation before inpatient TAVR

- Any case flagged for urgent intervention triggers cross-disciplinary review
- Algorithms — formally documented or culturally ingrained — weigh clinical urgency, comorbid risk and system capacity
- The checkpoint exists to prevent reflexive use of inpatient resources

Optimization is more than BAV

- Aggressive diuresis for volume overload
- Adjustment and optimization of guideline-directed medical therapy
- Correction of anemia
- Stabilization of renal function
- Treatment of infection and resolution of transient contraindications
- Balloon aortic valvuloplasty when a hemodynamic bridge is required

Urgent TAVR should be reserved for patients in whom discharge is clinically unsafe — applied case by case.

Balloon Aortic Valvuloplasty: Safety in the Contemporary Era

Table 1. Complication rates from BAV in pooled analysis of contemporary studies.

	No. of Patients	No. of Studies	Pooled percentage of complications	95% CI
Intraprocedural mortality	7880	16	1.94	1.39-2.59
In-hospital mortality	11,290	15	6.02	4.83-7.32
Stroke	13,751	23	1.27	0.99-1.57
Major vascular events	9297	17	4.77	3.18-6.66
Transfusion/major bleeding events	8523	16	5.79	2.87-9.64
Pacemaker implantation	7808	13	1.89	1.23-2.69
Myocardial infarction	4818	11	0.69	0.24-1.36
Acute aortic regurgitation	5289	13	1.31	0.91-1.78

Use of BAV in unstable patients

- Bridge to recovery from concurrent medical issues
- An option for patients with active infection or transient contraindications to AVR
- Can be performed without rapid pacing
- Typically better tolerated hemodynamically than definitive valve replacement
- Lower procedural risk provides a window for recovery and diagnostic clarity
- Potentially a better utilization of scarce procedural resources

Zhong J, Kamp N, Bansal A, Reed GW, et al. J Soc Cardiovasc Angiogr Interv. 2023;2(4):101002. | Bansal A, et al. Am J Cardiol. 2022;180:91-98.

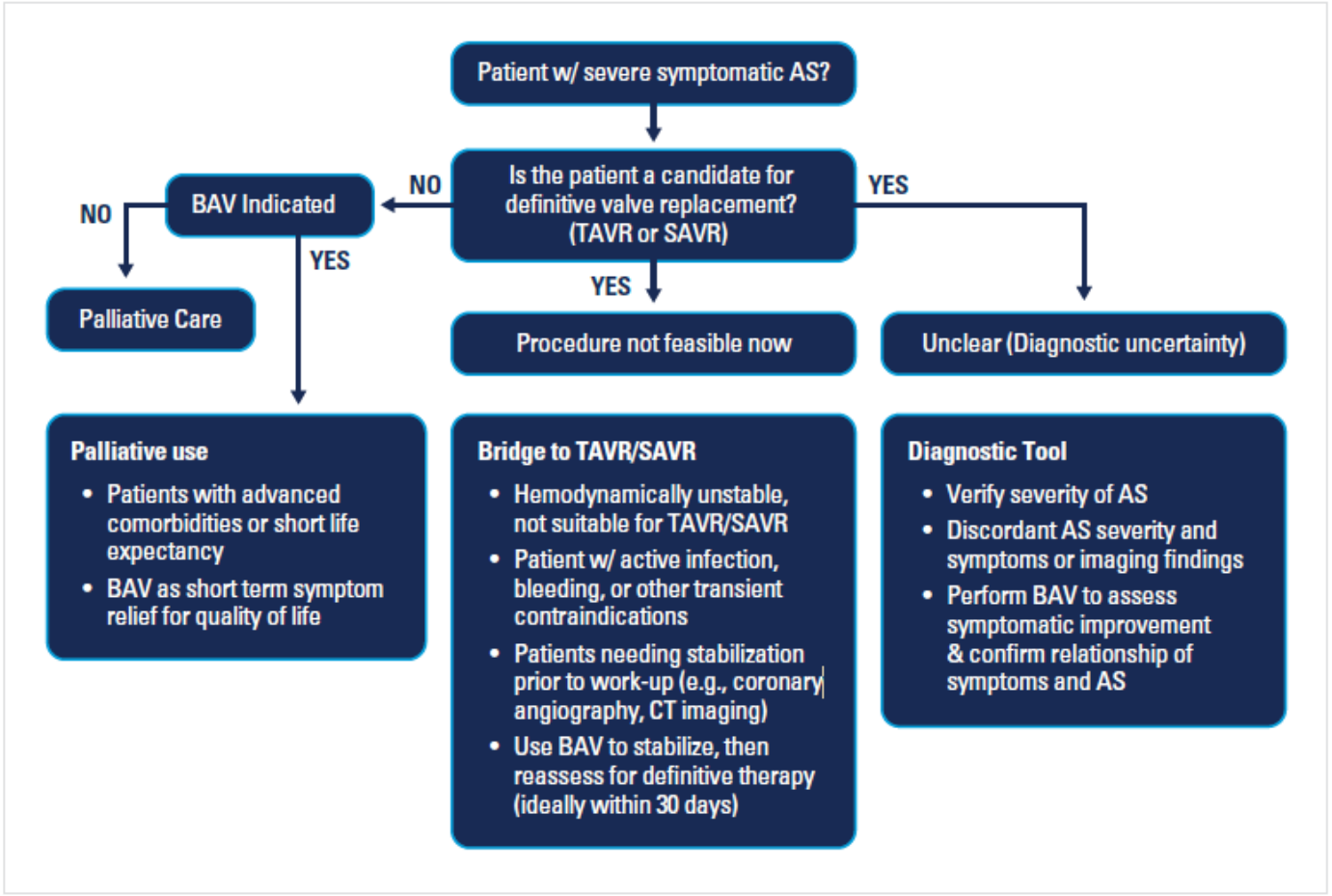
BAV as a Triage Tool: Bridge, Diagnostic Test, or Palliation

Bridge

Stabilize, then reassess for definitive therapy, recognizing that the benefit of BAV may dimmish after 30-90 days.

Diagnostic

Clarify whether AS is driving symptoms when severity and findings are discordant

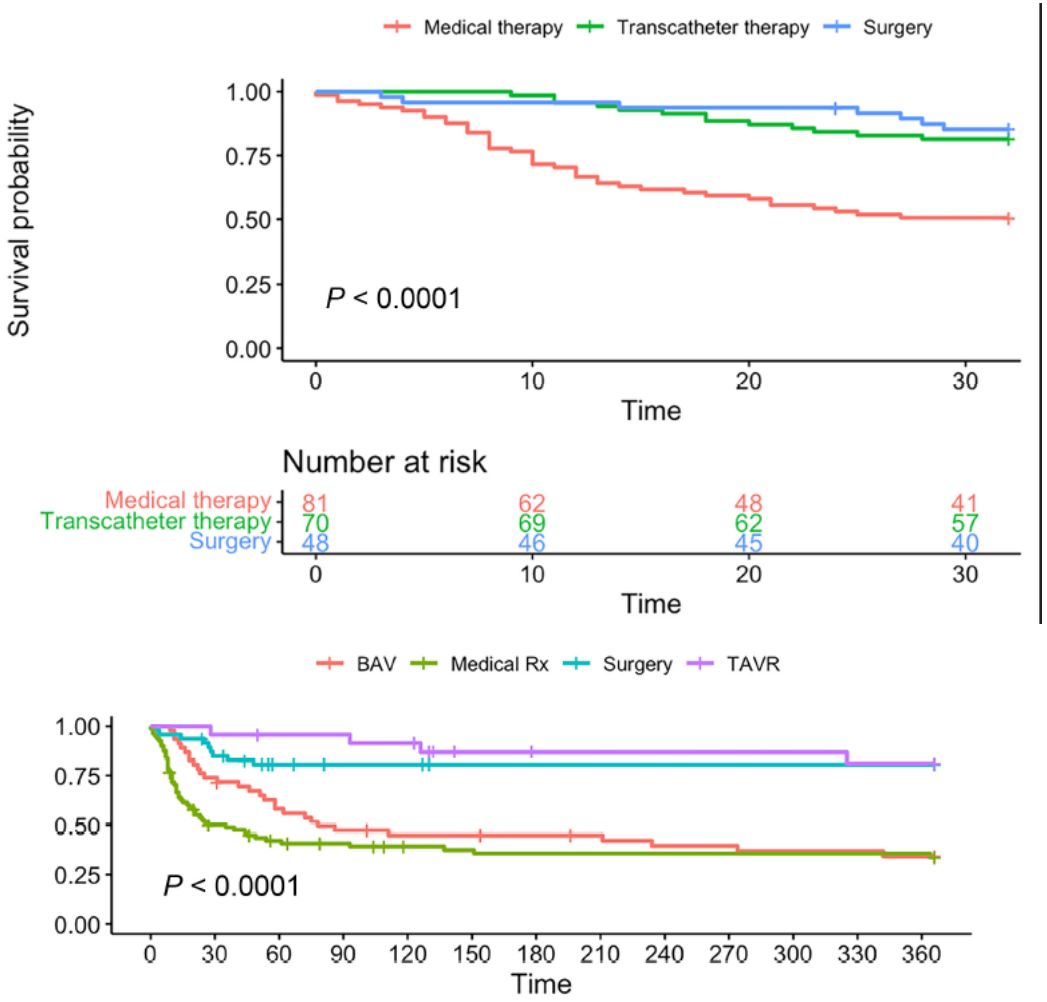


Modified from Zhong J, Kamp N, Bansal A, et al. JSCAI. 2023;2(4):101002.

Palliative

Short-term symptom relief for patients with advanced comorbidity or limited life expectancy

Cleveland Clinic: BAV, TAVR and SAVR in Cardiogenic Shock



What our data showed

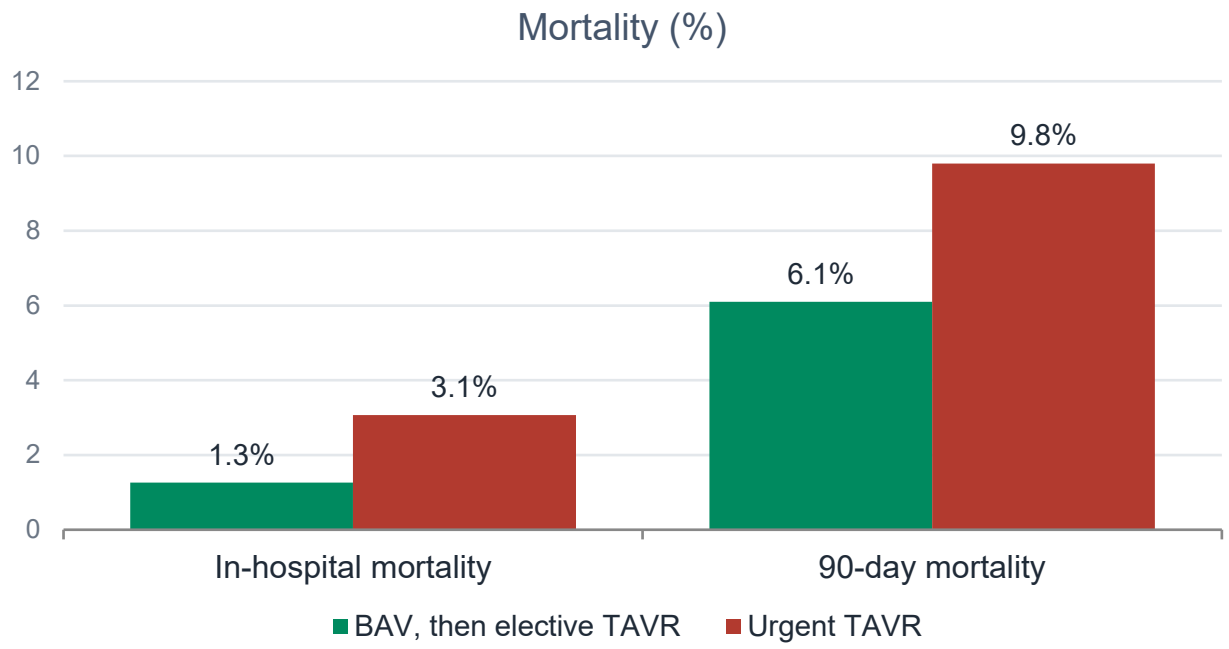
- Mortality with medical management alone is high — conservative therapy is not a safe default
- 30-day survival is similar with transcatheter and surgical therapy
- BAV is associated with survival similar to TAVR and SAVR within the first 2 to 4 weeks
- That survival benefit of BAV disappears between 30 and 90 days

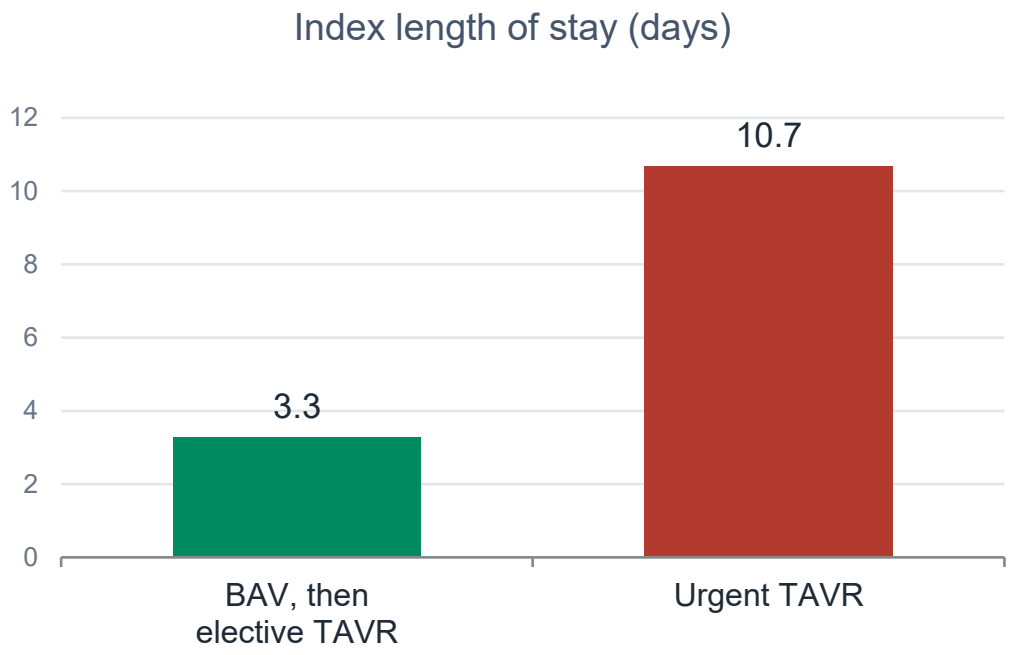
BAV buys a window, not a destination
Definitive therapy should follow within 30 days.

Nair R, Reed GW, et al. J Am Heart Assoc. 2024;13:e033601.

BAV Before Planned, Elective TAVR: Medicare 2019–2023

Patients bridged with BAV and returned electively vs. patients taken directly to urgent TAVR





- Patients bridged with BAV also had fewer ICU admissions and ICU days, less discharge to non-home settings, and lower hospitalization costs
- These data support BAV as a stabilizing strategy that converts urgent cases into elective ones

In-hospital mortality in the BAV-first group is reported as ≤ 1.26%. Observational Medicare claims analysis: patients selected for a BAV-first strategy differ from those taken directly to urgent TAVR, so residual confounding by indication should be assumed.

Dratch A, Murphy S, Kelley M. Reducing urgent TAVR admissions: BAV prior to TAVR. Medicare Fee-For-Service 100% Standard Analytic File, 2019-2023. Edwards Lifesciences; June 23, 2025.

Cleveland Clinic: Reducing Urgent TAVR While Growing Volume

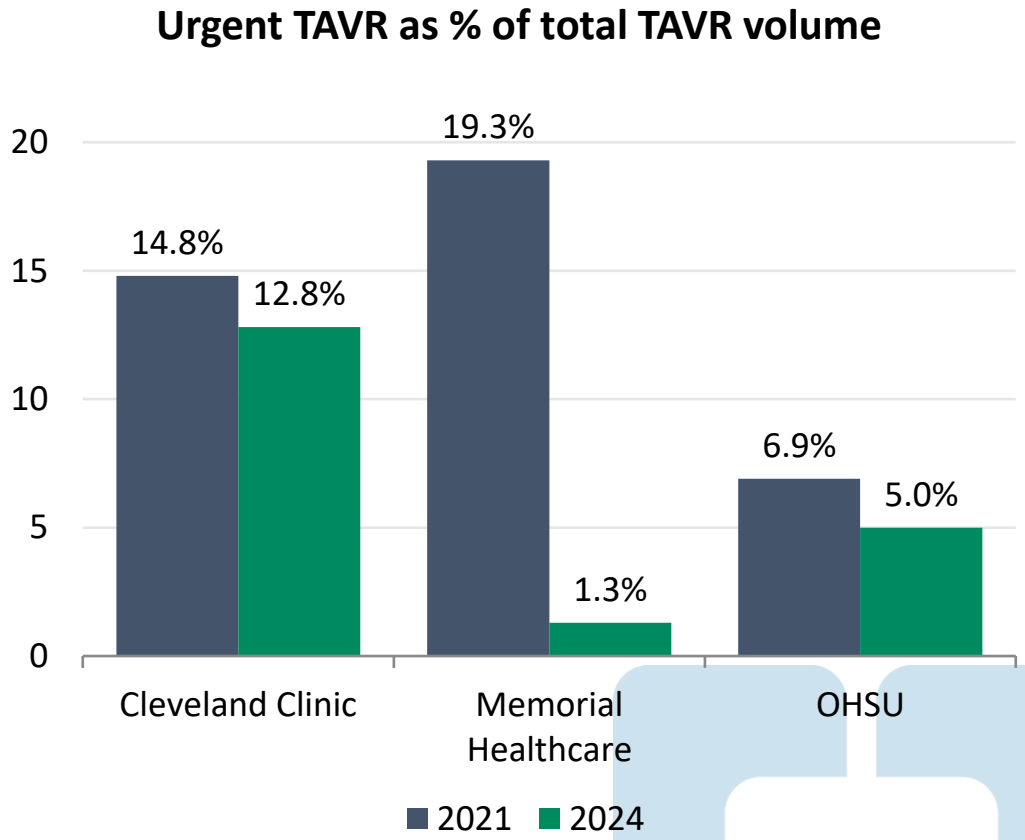
1,290
beds
academic medical
and research center

701
TAVRs in 2025
(NCDR STS/ACC
TVT Registry)

4 + 4
interventional
cardiologists
and cardiac surgeons
focused on TAVR

14.8% → 12.8%

Urgent TAVR: 97/654 in 2021 to 77/601 in 2024
Achieved while serving as a quaternary referral hub for the highest-acuity transfers



MedAxiom CV Business White Paper: Urgent TAVR Care. November 2025; NCDR STS/ACC TVT Registry.

How We Operationalize It at Cleveland Clinic

Selecting BAV deliberately

- BAV offers both diagnostic and therapeutic value in patients whose comorbidities make immediate replacement unsafe
- It clarifies the contribution of AS to symptoms and improves hemodynamics at lower procedural risk than TAVR
- Applied selectively — to the patients most likely to benefit, not as a default

Closing the loop after BAV

- Target definitive TAVR within one month of BAV; the benefit generally lasts only one to three months
- Nurse practitioner clinic visit within the first week after discharge
- Interventional cardiologist review within three to four weeks
- A dedicated 24/7 phone line for patients awaiting definitive therapy

Layered on top: Weekly heart team review of every inpatient considered for urgent TAVR, daily coordinator-led review of the procedural care list, AI-based flagging of suspected severe AS with feedback to referral centers, and reserved procedural capacity so that a genuinely urgent case never has to displace a planned one.

Take-Home Messages

1. **Urgent inpatient TAVR is largely a system outcome**
   A quarter of urgent AVR patients had no prior AS diagnosis despite contact with the healthcare system

2. **Procedural status tracks with outcome and cost**
   4-fold higher 30-day mortality and roughly $16,000 more per case than elective TAVR, without proportional reimbursement

3. **Most of the excess risk is front-loaded**
   Patients who clear the first 90 days approach the outcomes of elective patients — so stabilize first when it is safe to do so

4. **BAV is a bridge with an expiration date**
   Similar early survival to definitive therapy, but the benefit fades by 30 to 90 days

5. **Structure beats heroics**
   Standardized pathways, heart team review, reserved capacity, proactive identification and escalation protocols move programs from reactive to planned care

Thank you | @GrantReedMD