

## MISHC TAVR Readmission Prevention Best Practice Protocol

The leading causes for readmission within 30 days of TAVR procedures in the state of Michigan include 1) arrhythmias, 2) heart block, and 3) heart failure (Appendix 1, Michigan Structural Heart Consortium, 2020). Literature review also shows frailty is also associated with heart failure readmissions. (13) This protocol identifies evidence-based indicators that identify patients at increased risk for readmission and actions to consider in managing that risk.

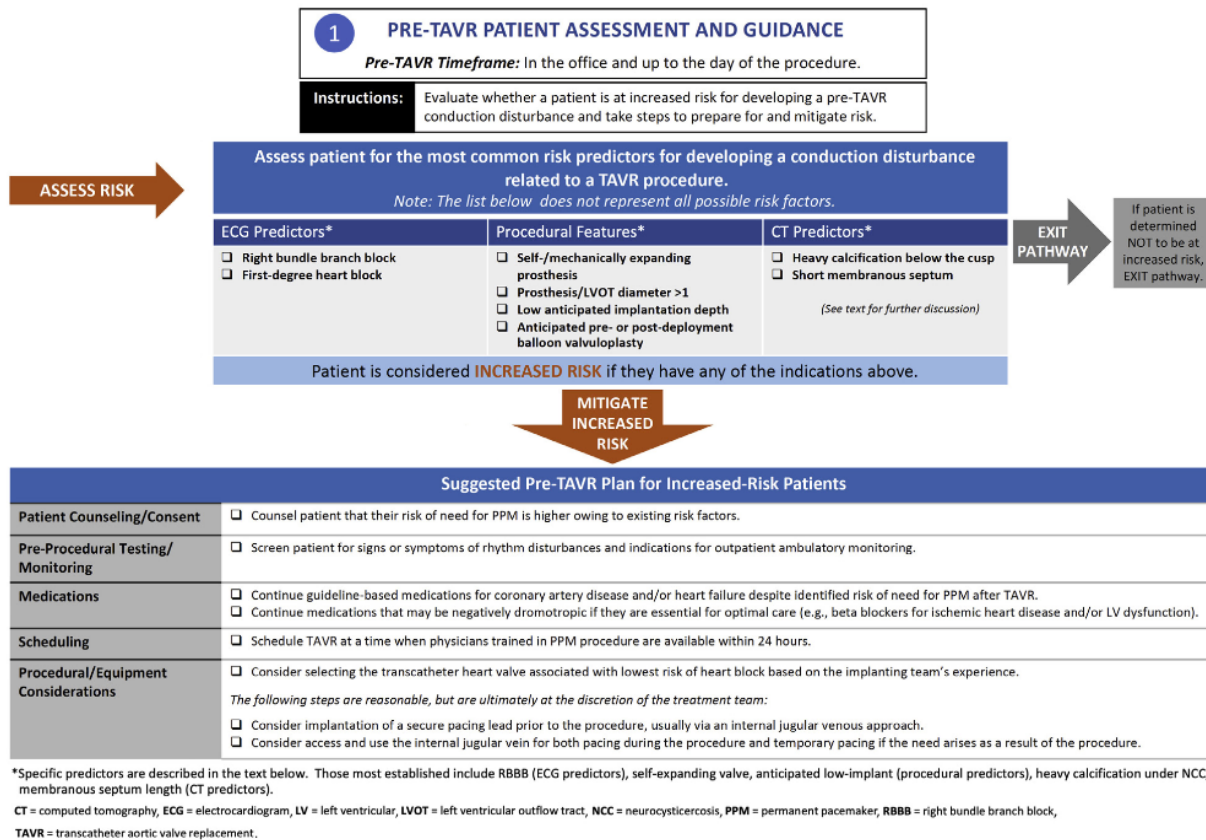
### 1. Cardiac Conduction Disturbances and Arrhythmias

- New onset left bundle branch block (LBBB) and high-degree atrioventricular block (HAVB) are frequent complications associated with TAVR.
- Presence of a right bundle branch block has been noted to increase risk for conduction disturbance (1).
- Pre-existing 1<sup>st</sup> degree atrioventricular block and LBBB or left anterior hemiblock have also been linked to increased risk for further conduction disturbance (1).
- Thorough discussion of increased risk for conduction disturbance should occur in the pre-procedural setting.

#### Pre-procedure Assessment and Actions

- Placement of a permanent pacemaker (PPM) based on pre-procedure EKG and/or Holter monitor findings.
- Guideline-directed treatment of pre-existing dysrhythmias (1). Figure 1.
- Thorough assessment of pre-procedure history of paroxysmal atrial fibrillation. Figure 1.

Figure 1.



Pre-TAVR Patient Assessment and Guidance. Reprinted from “2020 ACC Expert Consensus Decision Pathway on Management of Conduction Disturbances in Patients Undergoing Transcatheter Aortic Valve Replacement: A Report of the American College of Cardiology Solution Set Oversight Committee” by S. Lilly, MD, FACC, 2020, *J Am Coll Cardiol.* 2020 Nov, 76 (20) 2391–2411. (12)

## 2. Heart Failure

Decompensated heart failure is the most common cardiac causes for rehospitalization during the first year following transcatheter aortic valve replacement (TAVR) and is associated with a negative prognosis (3).

### Pre-procedure Assessment and Actions

- Optimization of heart failure regimen with medication management and possible referral to Heart Failure Clinic if appropriate.
- Referral to a Heart Failure Clinic for patients with the following readmission predictors as determined by Chi-square tests of MISHC statewide TVT and STS data from 2018 – 2022 Q1. Figure 6 and Figure 7. These pre-procedure variables were found to predict 30-day readmission for any reason.
  - NT-proBNP > 1000 unless on dialysis statistically significant in our data
  - Creatinine >2.0

- Any history of heart failure
- Moderate to severe pulmonary hypertension defined moderate PAH (50–70 mm Hg), and severe pulmonary hypertension (> 70 mm Hg)
- KCCQ Overall Summary Score completion and evaluation.
  - KCCQ summary scores have been shown to have an independent association with heart failure rehospitalization after transcatheter valve procedures. “When evaluating 2 patients with an otherwise similar estimated risk of clinical events, a patient with a KCCQ score <25 is 3 times as likely to experience death or hospitalization as a patient with similar clinical characteristics whose KCCQ score is >75.” (8).
- A literature search suggests the following pre-procedure variables are also predictors of heart failure readmission.
  - Severe mitral regurgitation
  - Multivalvular disease
- Heart failure diagnosis teaching
  - Signs and symptoms to monitor
  - Appropriate actions to initiate based on provider recommendations
  - Daily weights
  - Dietary recommendations for sodium, fluid, and alcohol consumption
  - Daily exercise regimen

### 3. Frailty Testing

Pre-procedure evaluation of frailty in the heart valve clinic at baseline and follow-up could provide additional support to patients and improve outcomes. Interventions in frail TAVR patients in the preoperative period with an ultimate goal to improve survival and functional status is imperative. (11)

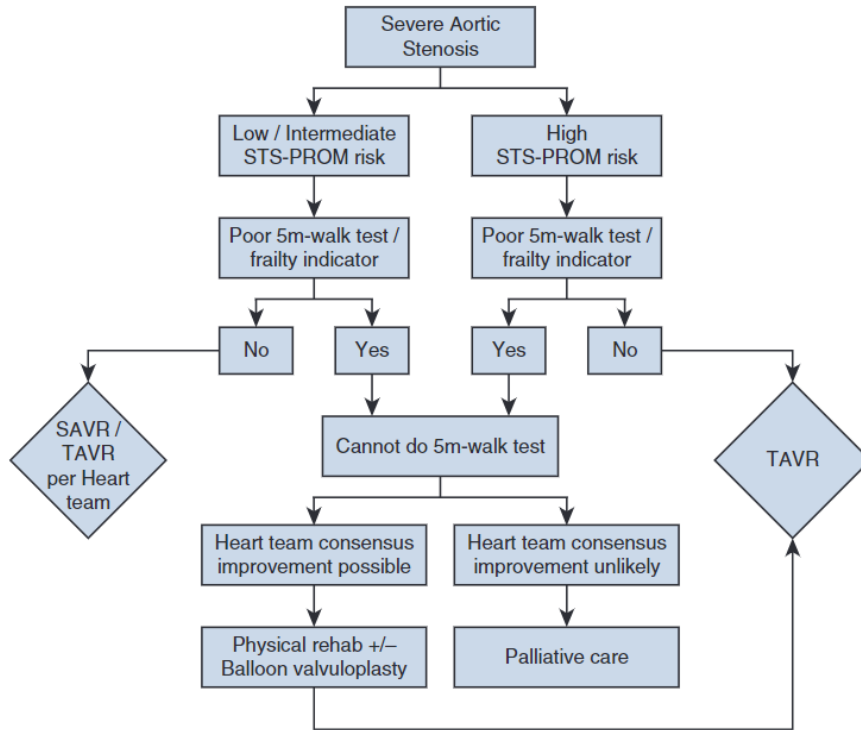
#### Pre-procedure Assessment and Actions

- Frailty Assessment Score
- Focused Physical Therapy pre-assessment for patients felt to be at risk for readmission. Physical Therapy includes strengthening, ROM, education on discharge exercises and expectations of Cardiac Rehabilitation, assessing mobility and if there are care devices that would be beneficial.
- Nutrition Evaluation including A1C and albumin
- Focused Geriatric assessment for ≥ 70 years old – cognitive function, nutritional state, frailty index, mobility impairment, predisposition to delirium, social demographics
- Include Cardiac Rehabilitation expectations in pre-procedure teaching, assess barriers, include family in discussion of expectations (3)
  - Attend 2-3 times a week for a minimum of 8 weeks, preferably the full 12 weeks
  - Endurance and strength exercise depending on ability
  - Nutrition
  - Psychological support
  - Education
- A prehab program prior to surgery involving lifestyle counseling, exercise training, and nutritional counseling can improve postoperative outcomes (9). Implementation of prehabilitation programs decreases length of hospital stay postoperatively, decreases time spent in the intensive care unit, decreases postoperative complications, and improves self-reported quality of life post-surgery. (10)
- Appropriate frailty tests should be administered to accurately assess frailty for calculation of STS risk score and for shared decision making about TAVR procedure. Examples of frailty tests

include the “Sit Test”, the “Squeeze Test”, and the “5-meter walk”. A poor 5 M-Walk test signifying frailty = >7 seconds. Patients that take >7 seconds to walk 5 meters would benefit from referral to pre-procedure rehab to help reverse frailty and optimize patient’s post-procedure experience. (9)

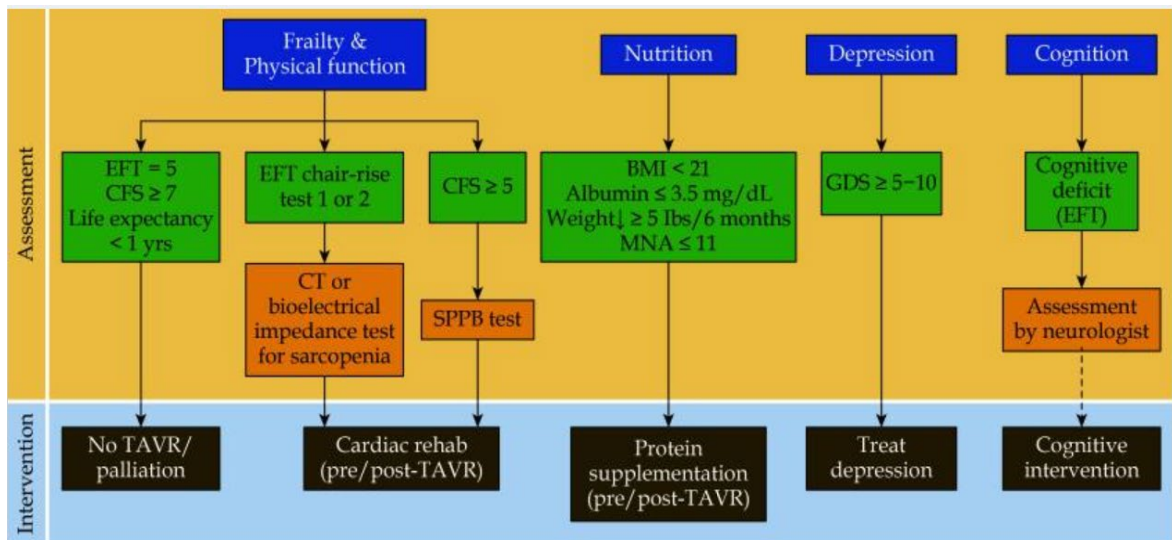
- The algorithms below can be used in the management of severe aortic valve stenosis to help determine the patients that would benefit from pre-procedure optimization.

Figure 2.



Management of severe aortic valve stenosis for transcatheter aortic valve replacement. Reprinted from “Five-meter walk test before transcatheter aortic valve replacement and 1-year noncardiac mortality” by T. Kuzai, MD, PhD, 2022, JTCVS, Open (2022). (9)

Figure 3.



Recommended frailty-based clinical management pathway of elderly TAVR patients. Reprinted from “Frailty in patients undergoing transcatheter aortic valve replacement: from risk scores to frailty-based management” by T. A. Kokkinidis, DG, 2021, J Geriatr Cardiol. 2021 Jun 28;18(6):479-486. (11)

### INTRA-PROCEDURE

Utilize continuous ECG monitoring during the TAVR procedure and have temporary pacing capabilities available. (1)

Depending on any ECG changes or dysrhythmias that may have occurred during the procedure, temporary pacing may be maintained in the post-procedural setting for additional observation, use, or until PPM implant if warranted.

Figure 4.

<div style="text-align: center;"> <span style="border: 1px solid black; border-radius: 50%; padding: 2px 5px;">2</span> <b>INTRAPROCEDURAL TAVR MANAGEMENT</b> </div>		
<b>Intraprocedural TAVR Timeframe:</b> The day of the procedure until completion of procedure.		
<b>Instructions:</b> Prepare and plan ahead for management of conduction disturbances if and when they do occur as part of the procedure.		
IF...	THEN →	Suggested Intraprocedural TAVR Plan
<b>PRIOR TO START OF PROCEDURE</b>	Pre-TAVR assessment indicated that patient is at increased risk for conduction disturbances: → Patient has increased-risk procedural factors (Figure 5):	Continue guideline-based medications for coronary artery disease and/or heart failure despite identified risk of need for PPM after TAVR. Revisit the necessity of a secure pacing lead, internal jugular versus femoral venous access, given increased risk of need for PPM. <ul style="list-style-type: none"> <li>– Consider implantation of secure pacing lead prior to the procedure, usually via an internal jugular vein.</li> <li>– Access and use the internal jugular vein for both pacing during the procedure and temporary pacing if the need arises as a result of the procedure.</li> </ul> Discuss potential for PPM and obtain consent in clinic where feasible.
<b>FOR ALL PATIENTS DURING PROCEDURE</b>		
<i>Irrespective of the type of temporary lead implanted, all patients should be monitored on a telemetry unit with ability to do emergency pacing if required.</i>		
<b>DURING AND UNTIL COMPLETION OF PROCEDURE</b>	No new conduction disturbance	→ Temporary pacemaker and venous sheath can be removed before the patient leaves the procedure room.
	Develops conduction disturbance (e.g., LBBB, PR/QRs duration ≥20 msec) that may require further pacing	→ Internal jugular venous access with a secure pacing lead prior to leaving the procedure room is <b>reasonable</b> for patients with new conduction disturbance but ultimately at the discretion of the implantation team.
	Develops transient complete heart block	→ Internal jugular venous access with a secure pacing lead prior to leaving the procedure room is <b>reasonable</b> for patients with transient heart block but ultimately at the discretion of the implantation team.
	Develops persistent complete heart block	→ Internal jugular venous access with a secure pacing lead prior to leaving the procedure room is <b>indicated</b> for patients with sustained heart block.
	Pre-existing conduction disturbance with indication for PPM	It is preferable to separate the procedures so that informed consent can occur, and the procedures can be performed in their respective spaces with related necessary equipment and staff. → It may be reasonable to perform the PPM procedure on the same day as the TAVR procedure if: <ul style="list-style-type: none"> <li>– PPM is indicated</li> <li>– Informed consent has occurred</li> <li>– Appropriate teams and specialty equipment are available.</li> </ul>
	Pre-existing conduction disturbance and a secure pacing lead in place	→ Monitor on a telemetry unit, with temporary pacemaker attached and programmed to provide back-up pacing if required.
	Multiple factors that additively confer increased risk but individually do not	→ Monitor on a telemetry unit, with temporary pacemaker attached and programmed to provide back-up pacing if required.

LBBB = left bundle branch block, PPM = permanent pacemaker, TAVR = transcatheter aortic valve replacement

Intraprocedural TAVR management. Reprinted from “2020 ACC Expert Consensus Decision Pathway on Management of Conduction Disturbances in Patients Undergoing Transcatheter Aortic Valve Replacement: A Report of the American College of Cardiology Solution Set Oversight Committee” by S. Lilly, MD, FACC, 2020, *J Am Coll Cardiol.* 2020 Nov, 76 (20) 2391–2411. (12)

## POST-PROCEDURE

### Pre-Discharge

- Monitoring for volume overload and striving to achieve euvolemia is essential. Strict monitoring of input and output and diagnostic imaging studies as appropriate.
- Parameters for daily fluid intake should be provided and endorsed to facilitate understanding and compliance after discharge.
- Continued ECG monitoring for conduction disturbance or dysrhythmia.
- Consideration should be given to monitor patients with an escape rhythm for 1-2 days prior to pacemaker placement as the indication may resolve. Outpatient monitoring will be necessary if the escape rhythm resolves, and a pacemaker is not implanted.

### At Discharge

- Schedule follow up appointments (1 week, 30 days, TTE, ECG, labs) prior to discharge and include in discharge instructions
- Initiate Cardiac Rehab (CR)
  - Phase I CR initiated
  - Referral to CR Phase II
  - CR facility chosen

- Schedule first CR appointment if possible
- Patient and family verbalize understanding of post-TAVR discharge instructions including diet and fluid restrictions.
- Document LACE Index Score for risk assessment of hospital readmission, <https://www.mdcalc.com/calc/3805/lace-index-readmission>.
- Provide patient and family with a phone number to call for non-emergent medical issues; encourage patient to call prior to presenting at emergency department.
- Instruct patient how to monitor for irregular heart rate and daily weights.
- Provide medication management and education, if possible have prescriptions filled prior to discharge
- Document weight
- Document NYHA HF class
- Discharge home with Event Monitor for specific time period (e.g.,30 days) for patients with a new rhythm disturbance, patients with a progression of baseline conduction disturbance, or patients for whom the provider believes is warranted.
  - Provide education on the importance of wearing Event Monitor for the recommended time frame and troubleshooting the device

Figure 5.

3 POST-TAVR MANAGEMENT		
<b>Post-TAVR Timeframe:</b> From completion of procedure through 30 days post-discharge.		
<b>Instructions:</b> Manage and monitor patients who do develop a conduction disturbance.		
IF the Patient Aligns with Any of These Scenarios	THEN →	Suggested Post-TAVR Plan
<b>PPM/ EP STUDY</b>	Symptomatic bradycardia or persistent, complete heart block	→ PPM.
	New, progressive, or pre-existing conduction disturbance that changes post-procedure	→ Monitor, consider EP study and PPM.
	Narrow QRS before and after TAVR	→ EP study and PPM are not indicated.
<b>DISCHARGE</b>	All of the following: <input type="checkbox"/> No primary PPM indication <input type="checkbox"/> No new 1 <sup>st</sup> degree or 2 <sup>nd</sup> degree AV block <input type="checkbox"/> No new bundle branch block <input type="checkbox"/> No progression in baseline 1 <sup>st</sup> , 2 <sup>nd</sup> degree AV block or prolongation of the QRS ≥10%	→ Patient can be considered for early discharge.
	If any of the above are present	→ Telemetry until conduction is stable for ≥48 hours; discharge with an outpatient monitor for ≥14 days.
<b>OUTPATIENT MONITORING</b>	New rhythm disturbance (e.g., atrial fibrillation) OR Progression of baseline conduction disturbance OR For whom the provider feels that monitoring is warranted	→ <ul style="list-style-type: none"> <li>▪ Discharge with a monitor for a minimum of 14 days.</li> <li>▪ Care teams should be resourced to manage outpatient monitoring to identify progressive rhythm issues in a timely manner.</li> <li>▪ Use monitoring system that is accurate, enables adherence, notifies care team in a timely manner.*</li> </ul>

\*The monitor should have the capacity to notify care teams quickly in the event of DH-AVB. An AEM or implantable loop recorder would suffice provided it has these attributes.  
 AEM = ambulatory event monitoring, AV = atrioventricular, DH-AVB = delayed high-grade atrioventricular block, ECG = electrocardiogram, EP = electrophysiology, PPM = permanent pacemaker, TAVR = transcatheter aortic valve replacement

Post TAVR management. Reprinted from “2020 ACC Expert Consensus Decision Pathway on Management of Conduction Disturbances in Patients Undergoing Transcatheter Aortic Valve Replacement: A Report of the American College of Cardiology Solution Set Oversight Committee” by S. Lilly, MD, FACC, 2020, *J Am Coll Cardiol*. 2020 Nov, 76 (20) 2391–2411. (12)

### Post-Discharge Follow Up

Early and close follow up telephone calls by structural heart team members may prove to be of significant benefit in identifying patient concerns and potentially prevent unnecessary readmissions. Maintaining

open communication with the patient's other care providers may promote optimal management strategies preventing readmission.

#### 24-72 Hours Post-Discharge

- Valve Coordinator or other clinical staff to contact patient within 48 hours of discharge, preferably within 24 hours, to reiterate medications, weight documentation and CR attendance, further follow up calls may be needed based on findings in initial call, may need to be advanced to other care provider.

#### 1 Week Post-Discharge

- Primary cardiologist or PCP appointment within 1 week to reestablish care
- Clinic visit with Advanced Practice Clinician
  - Ensure patient attending Cardiac Rehab Phase II, reiterate full dose attendance, consideration/discussion of potential delay in Cardiac Rehab if availability is limited
  - Provide a contact number where the patient can reach medical personnel if needed to prevent delay in care and possible readmission

#### 1 Month Post-Discharge

- TTE
- ECG
- KCCQ
- Hgb and creatinine lab draw
- Document NYHA HF class
- Review of Event Monitor report as needed
- Follow up visit scheduled for 1 year post procedure including echo time and date
- If not already attending CR, make sure they are enrolled/attending, look into CR tool kit from CR network to see if there are any guidelines for increasing CR participation early after DC
  - Have provider reiterate importance of CR participation, describe the program and set expectations for full program completion
  - Identify barriers to CR attendance and work to eliminate
  - Set CR appointment while at follow up visit
- Notify Structural Heart team if admitted within 30 days and assess need for HF clinic referral



**Appendix 1. MSTCVS-QC Database, TAVR Reasons for Readmission**

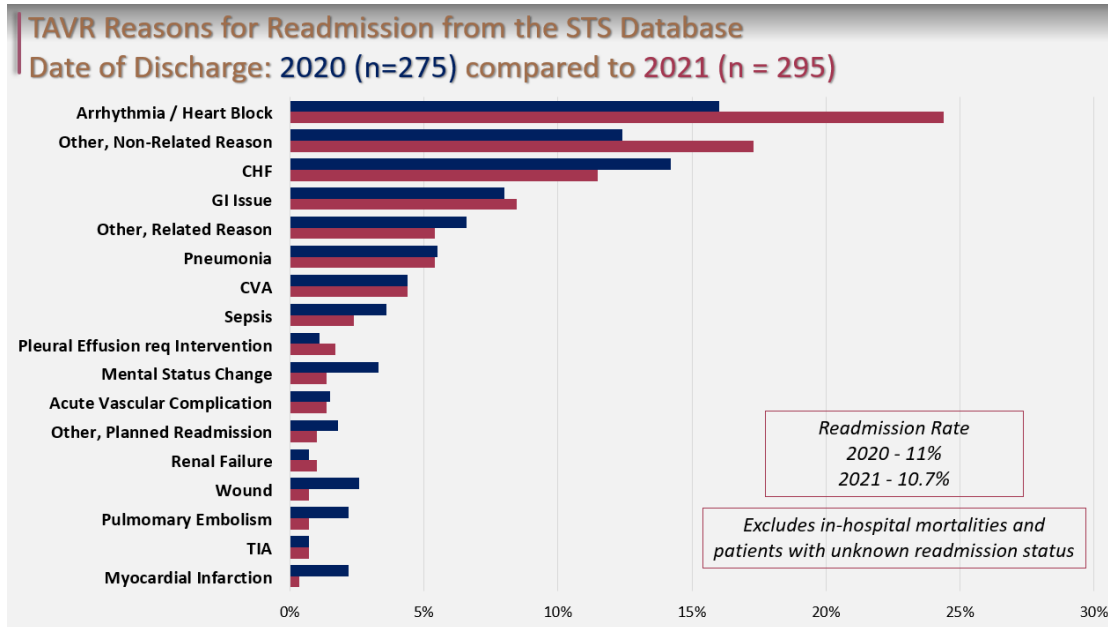


Figure 6. MISHC Data Analysis for Predictors of Readmission at 30 Days Post TAVR

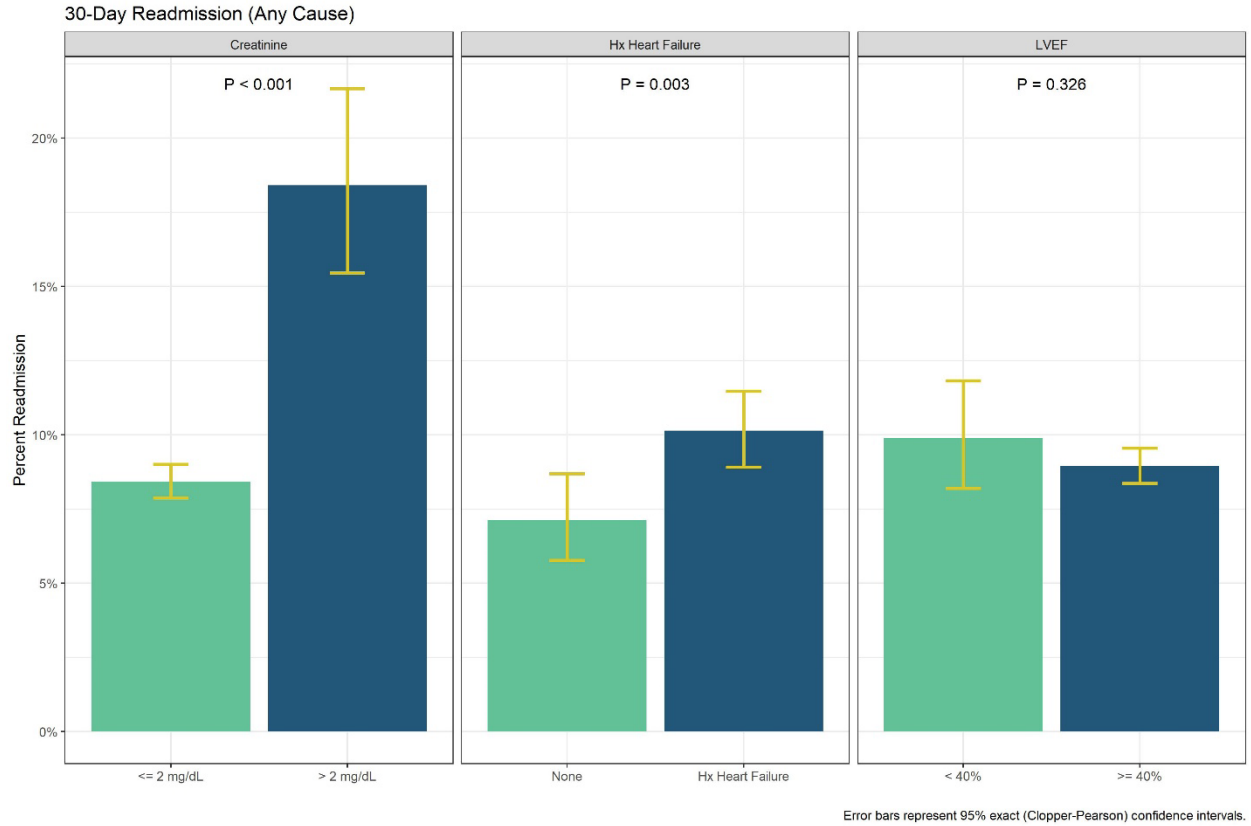
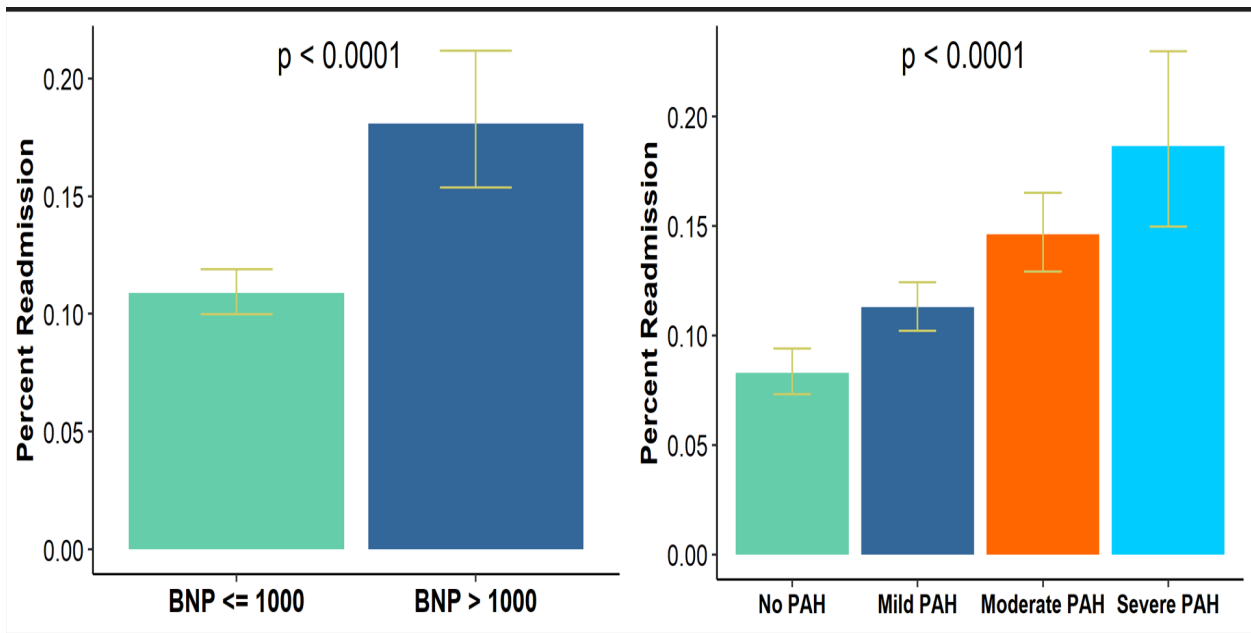


Figure 7. MSTCVS Data Analysis for Predictors of Readmission at 30 Days Post TAVR



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## DISCLAIMER

MISHC Best Practice Protocols are based on consortium-wide consensus at the time of publication. Protocols will be updated regularly, and should not be considered formal guidance, and do not replace the professional opinion of the treating physician.

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