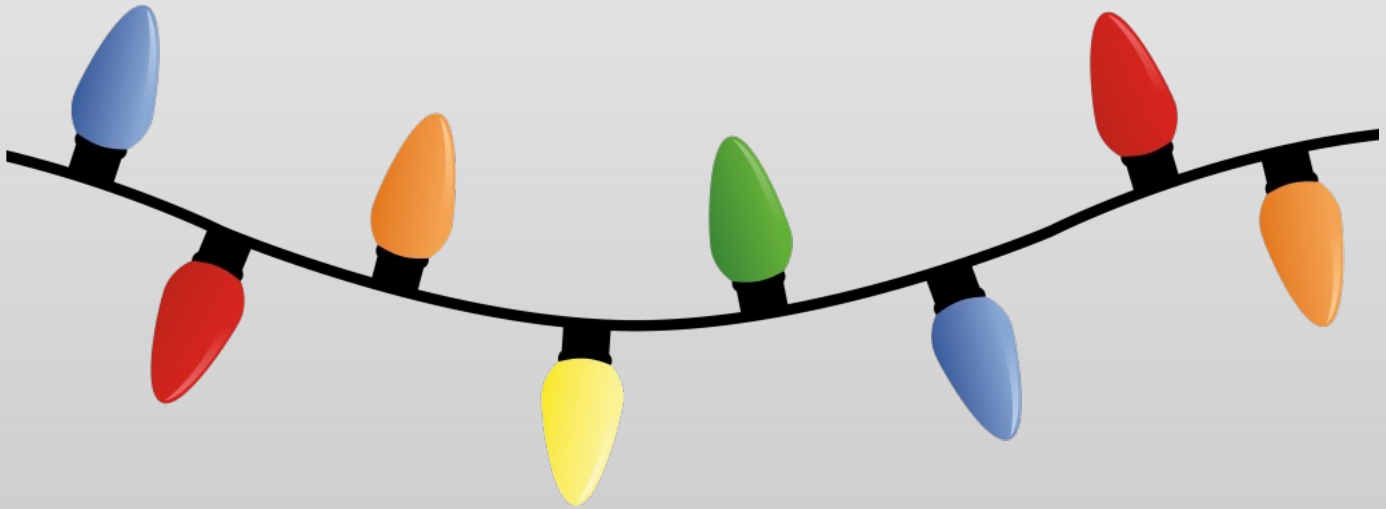
Virginia Cardiac Services Quality Initiative

Winter 2023 Virtual Quarterly Meeting

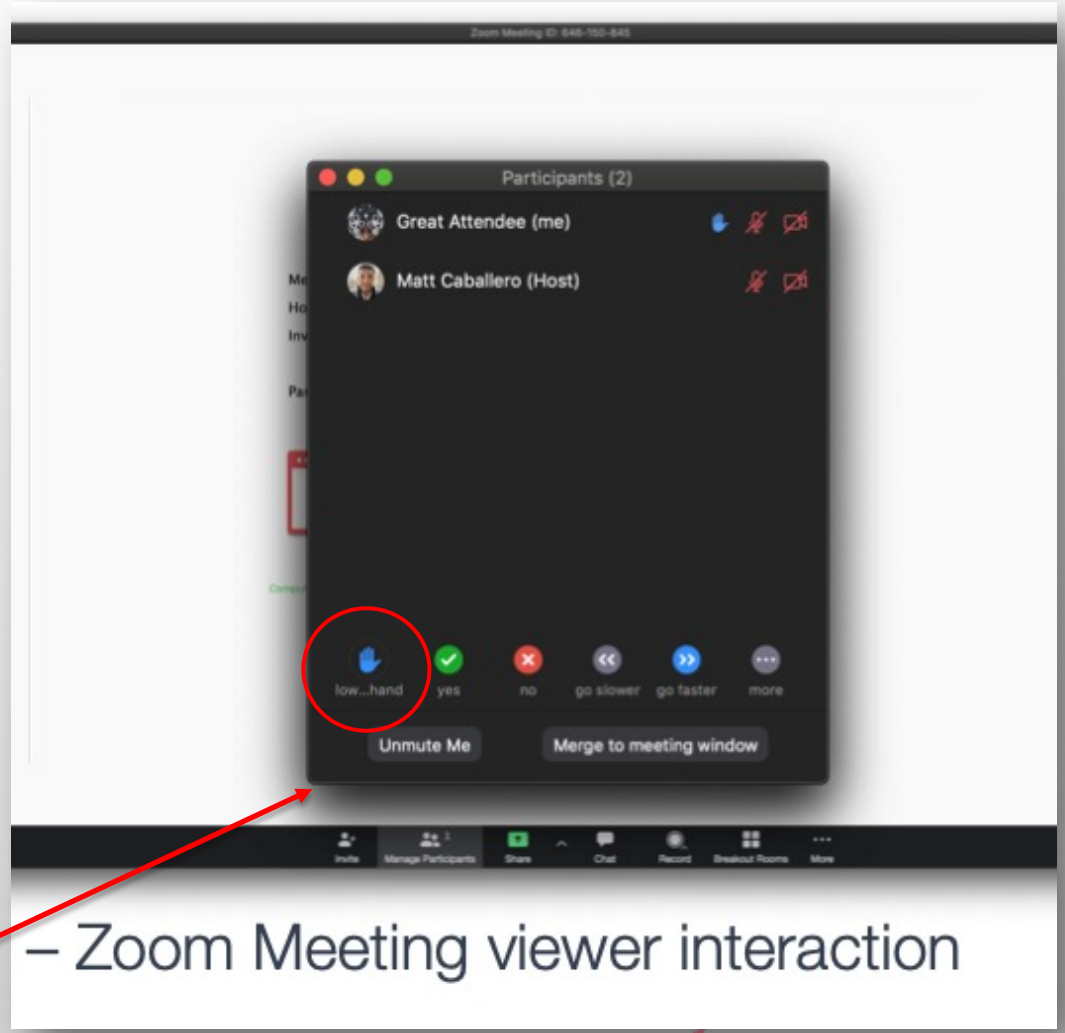


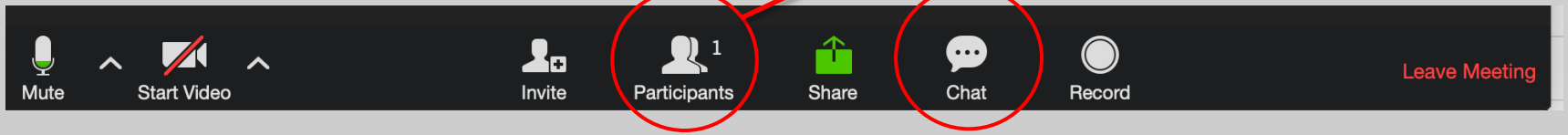
Transforming Cardiovascular Care to Improve Patient Experience and Value

VCSQI

To ensure a smooth meeting...

- Please mute your lines (phone or audio), until called upon
  - Interactive features available under **'participants'** window
- Hold questions until end of presentation
- Use "Raise Hand" feature for questions or comments
- The Chat Room can also be used to ask questions
- **Call/text Sherri (216) 513-3141** if you need assistance





CME Credits

VCU Health
Continuing Education

- Please enter your name and organization in the chat so we can record your attendance.
- After the meeting, instructions will be provided explaining how to claim your CME credits.
- You must evaluate the activity and claim credit. This can be done on a computer or via the CloudCME App.
- vcu.cloud-cme.com

VCSQI

Tonight's Agenda

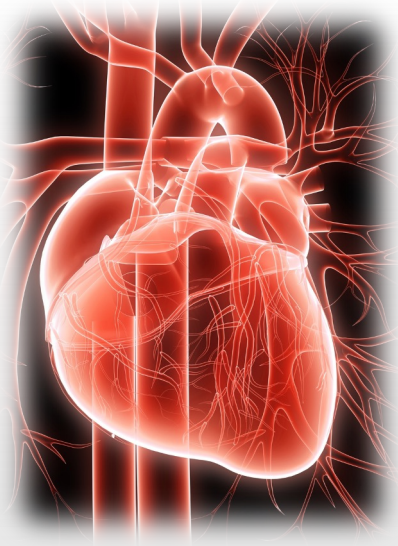
5:30 – 5:35 p.m.	**Welcome and Updates from the Board** *Mohammed Quader, MD; Virginia Commonwealth University*
5:35 – 5:50 p.m.	VCSQI Data Review *Eddie Fonner, VCSQI Executive Director*
5:50 – 7:00 p.m.	VCSQI Workgroups, Committees, VHAC Updates & More! *VHAC – Peter O'Brien, MD, FACC; Centra Lynchburg* *Perfect Care Network – Kevin Lobdell, MD; Atrium Health* *Research & Writing Committee – Nicholas Teman, MD; UVA* *Perfusion Group – Eve Dallas, CCP; UVA*
VCSQI Quality Initiatives: **Successful integration and implementation of quality improvement strategies improve outcomes and quality measures.**	
7:00 – 7:25 p.m.	Making Strides in Readmission *Brody Wehman, MD; Bon Secours MRMC* *Meredith Newton, NP; Bon Secours MRMC*
7:25 – 8:00 p.m.	Successful Integration of AKI Strategies to Improve Outcomes *Mike Brown, CCP; Mary Washington Hospital*

VCSQI

Welcome and Highlights from the Board

Mohammed Quader, MD
Virginia Commonwealth University
VCSQI Chairman

VCSQI Strategic Plan



Mission

Transform Cardiovascular Care to Improve Patient Experience and Value

Vision

Optimize Heart Care Outcomes Through National Collaboration, Innovation and Research

Core Values

- **V** alue-Based Best Practices
- **C** ollabration & Transparency
- **S** tewardship of Healthcare & Costs
- **Q** uality and Patient Centered
- **I** nnovation; Data and Analytic-Driven

Board Updates: Winter 2023

- Succession Planning:
  - Formalization of Vice Chair Position and Timeline
- 2024 Board of Directors' Terms
- Upcoming Change in Investment Account Provider
  - Transition from Merrill Lynch to UBS
- 2023 VCSQI Contributor of the Year
  - Winner will be announced in January!

Congratulations to our new Vice Chair!

Nick Teman, MD

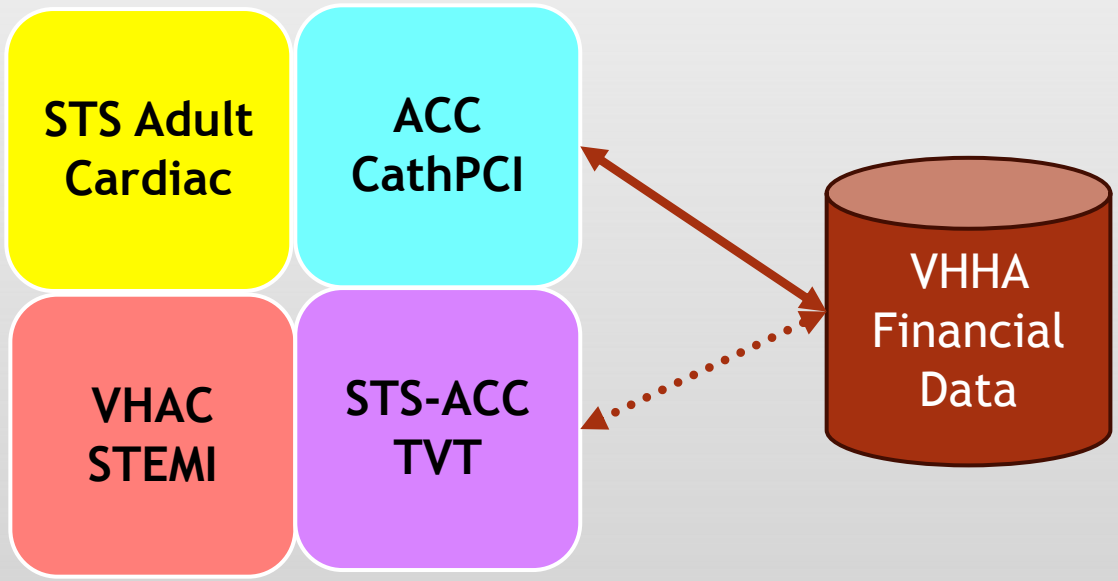
University of Virginia

Cost and Quality Data Review

Eddie Fonner
Executive Director, VCSQI

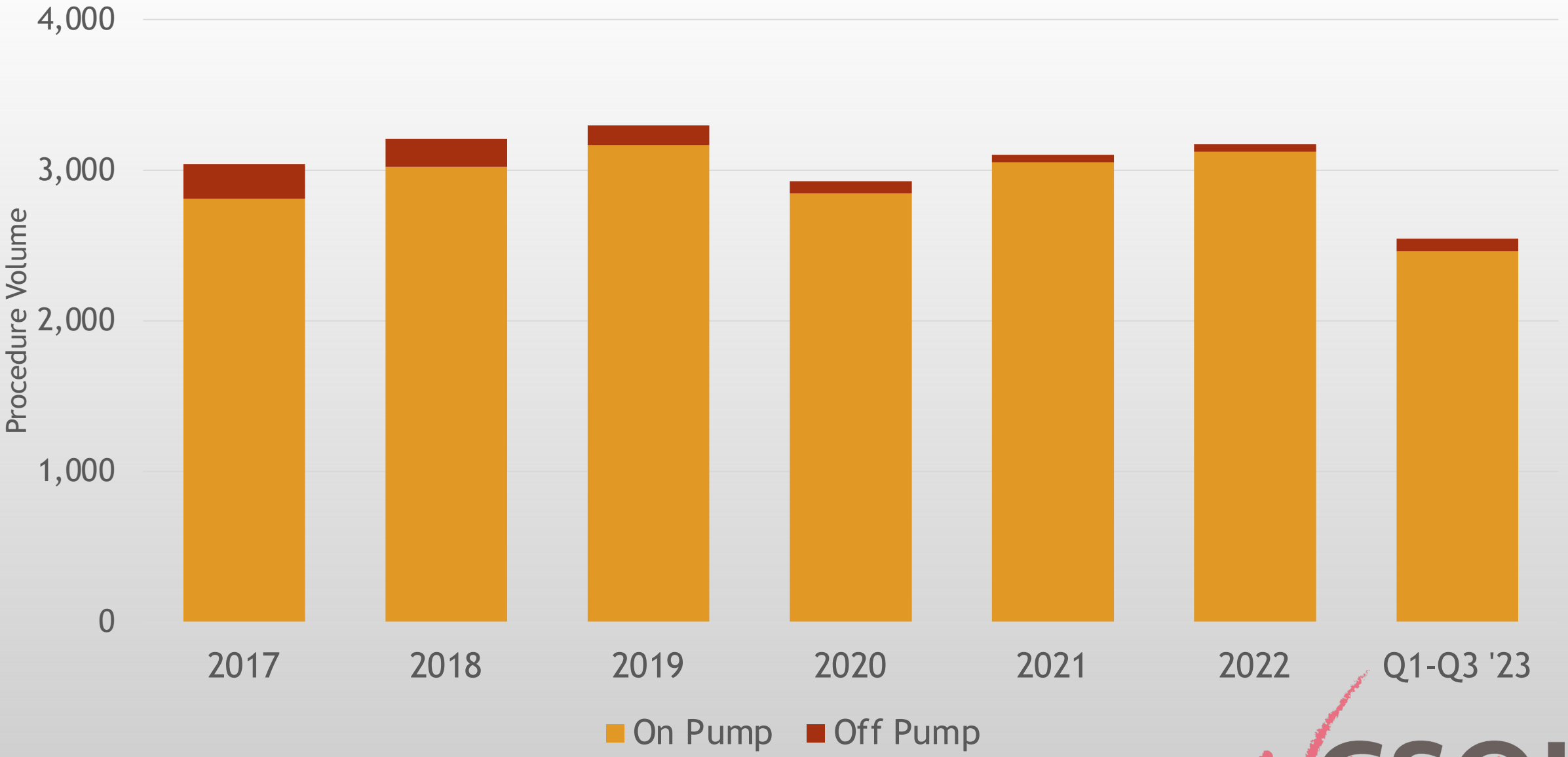
VCSQI Database Summary

- **Extensive Database**
  - 144,000+ STS Adult patients from 2001-2023
  - 64,000+ ACC CathPCI patients
  - 32,000+ ACC CP-MI episodes
  - 4,000+ TVT operations
- **Quarterly and Ad Hoc Reports**
- **Scientific Publishing**
  - 80+ manuscripts & presentations



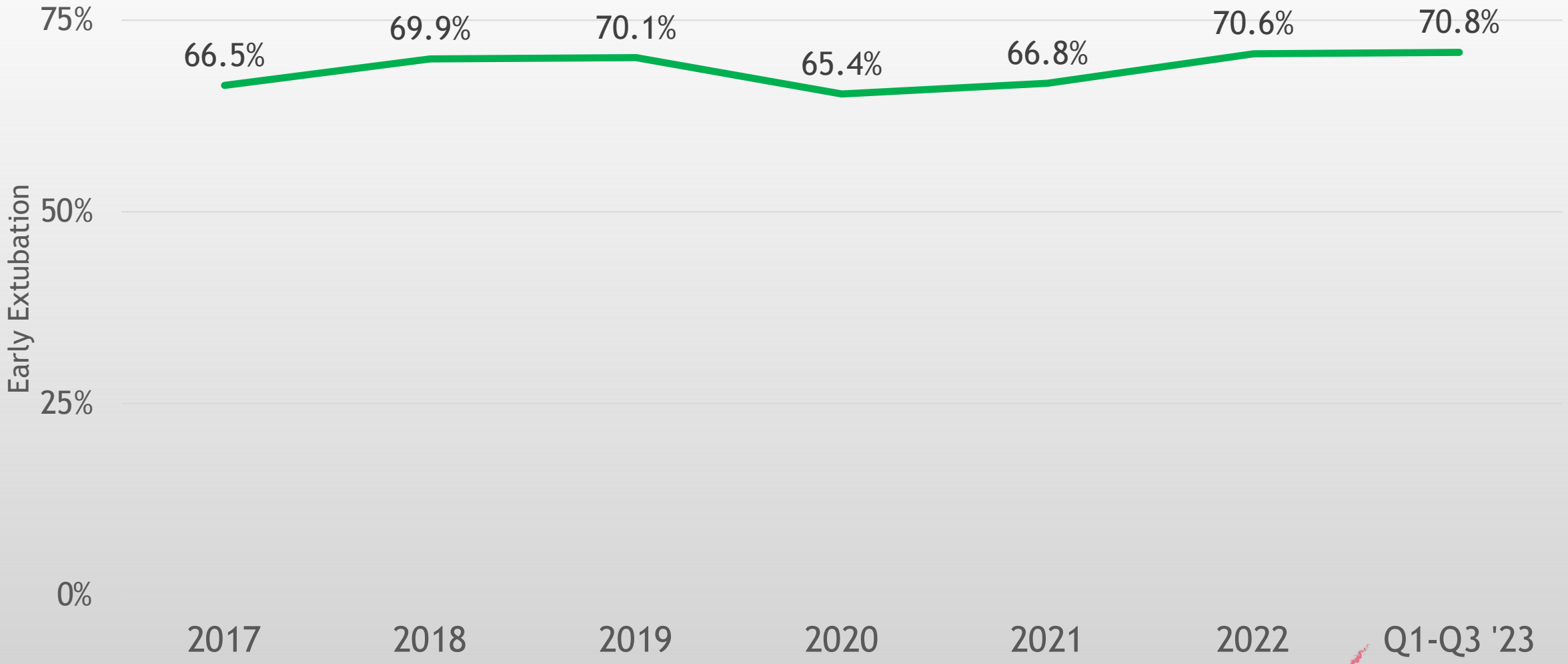
STS Adult Cardiac

Procedure Volume by CPB Usage: Isolated CAB, CY 2017—Q3 2023

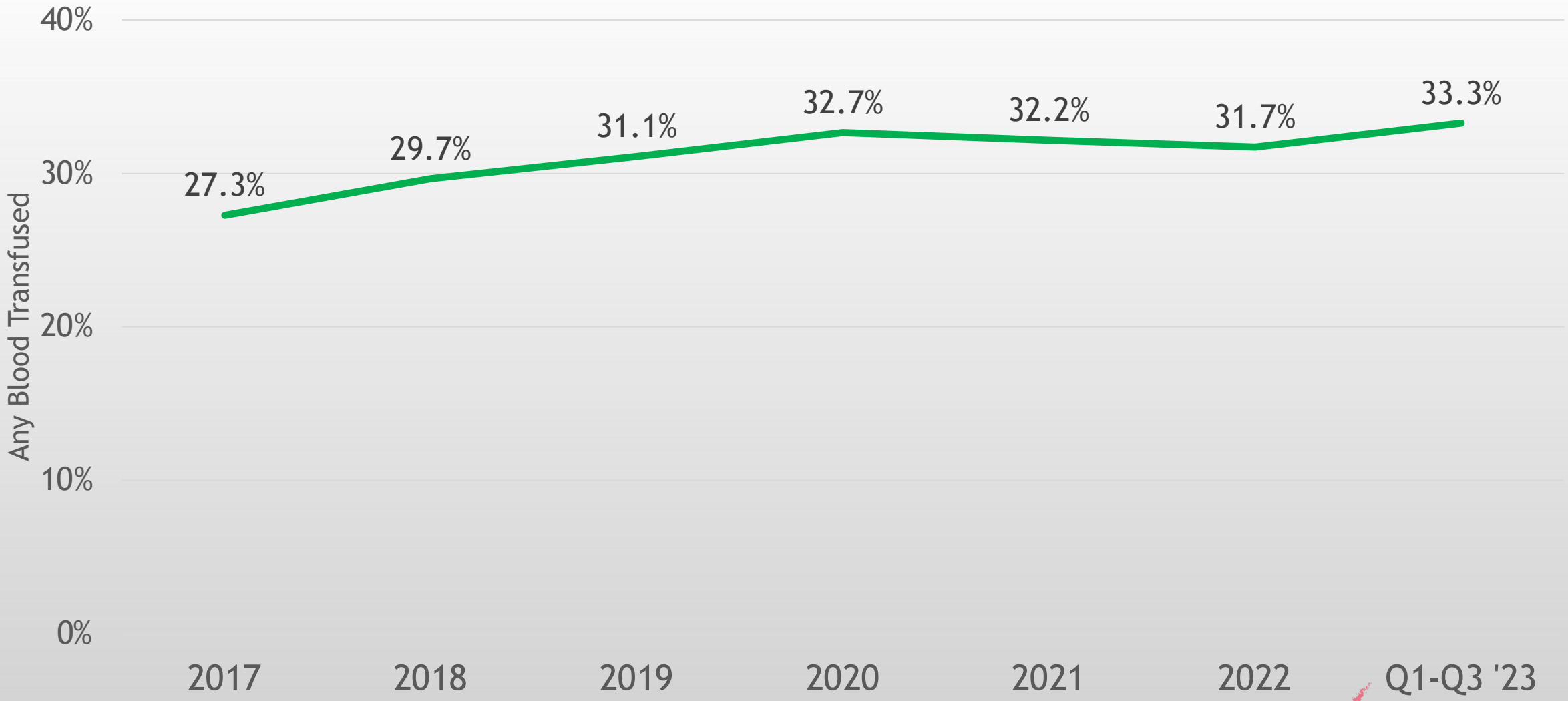


Decline in Off-Pump Cases from 7.6% in 2017 to 1.5% in 2022

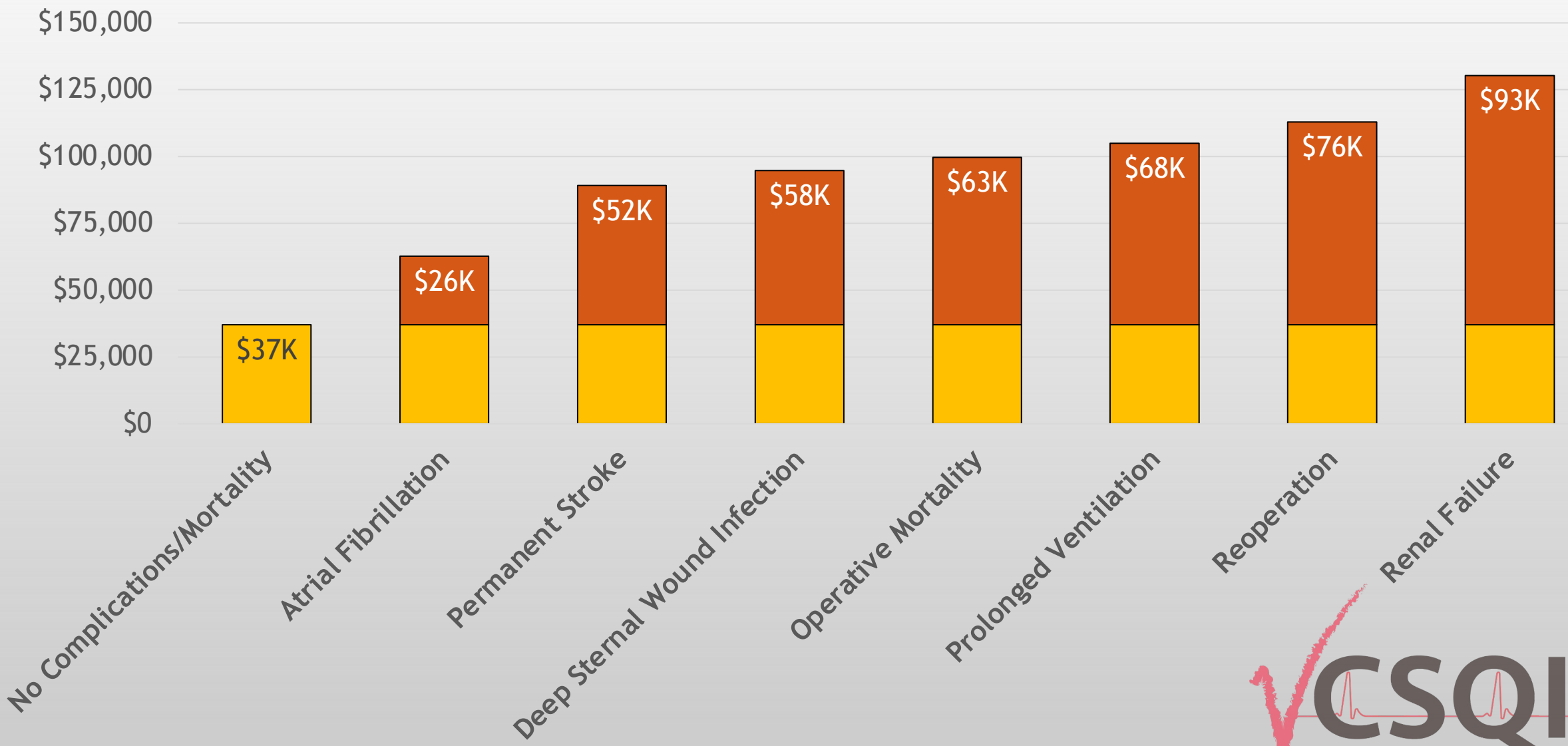
Early Extubation: Isolated CAB, CY 2017—Q3 2023



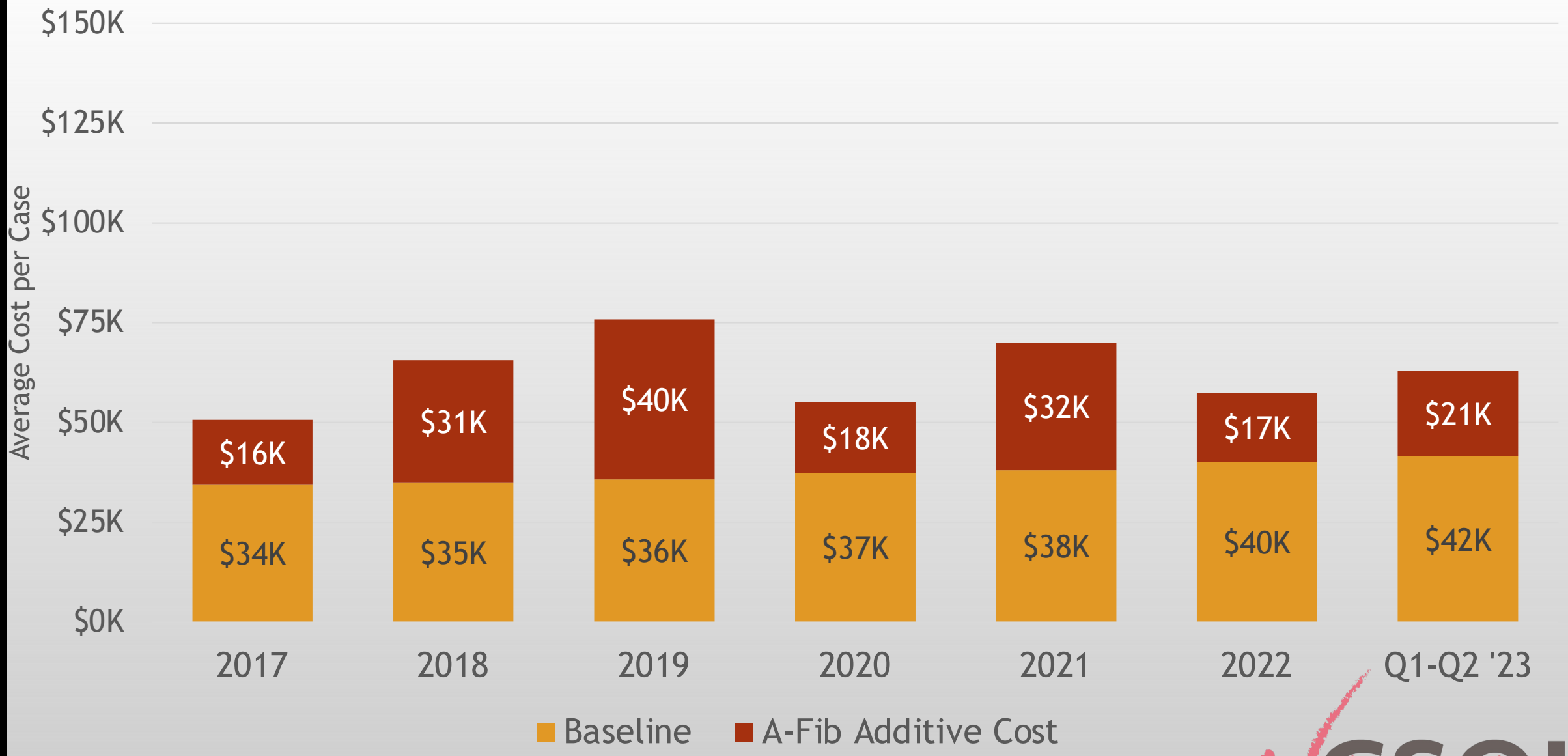
Any Blood Transfusion (Intra- or Post-op): Isolated CAB, CY 2017—Q3 2023



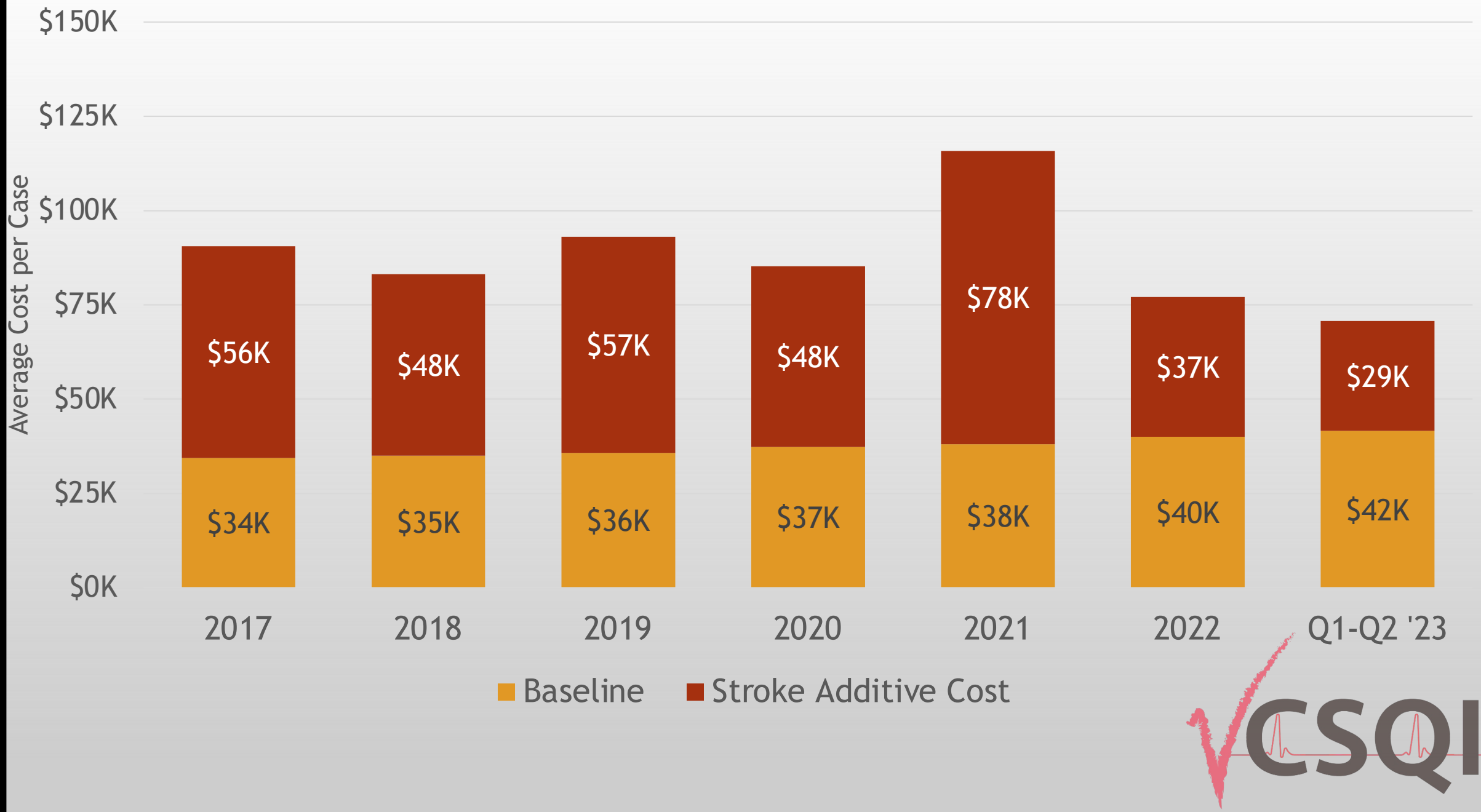
STS Additive Costs: Isolated CAB, Q1 2017 – Q2 2023



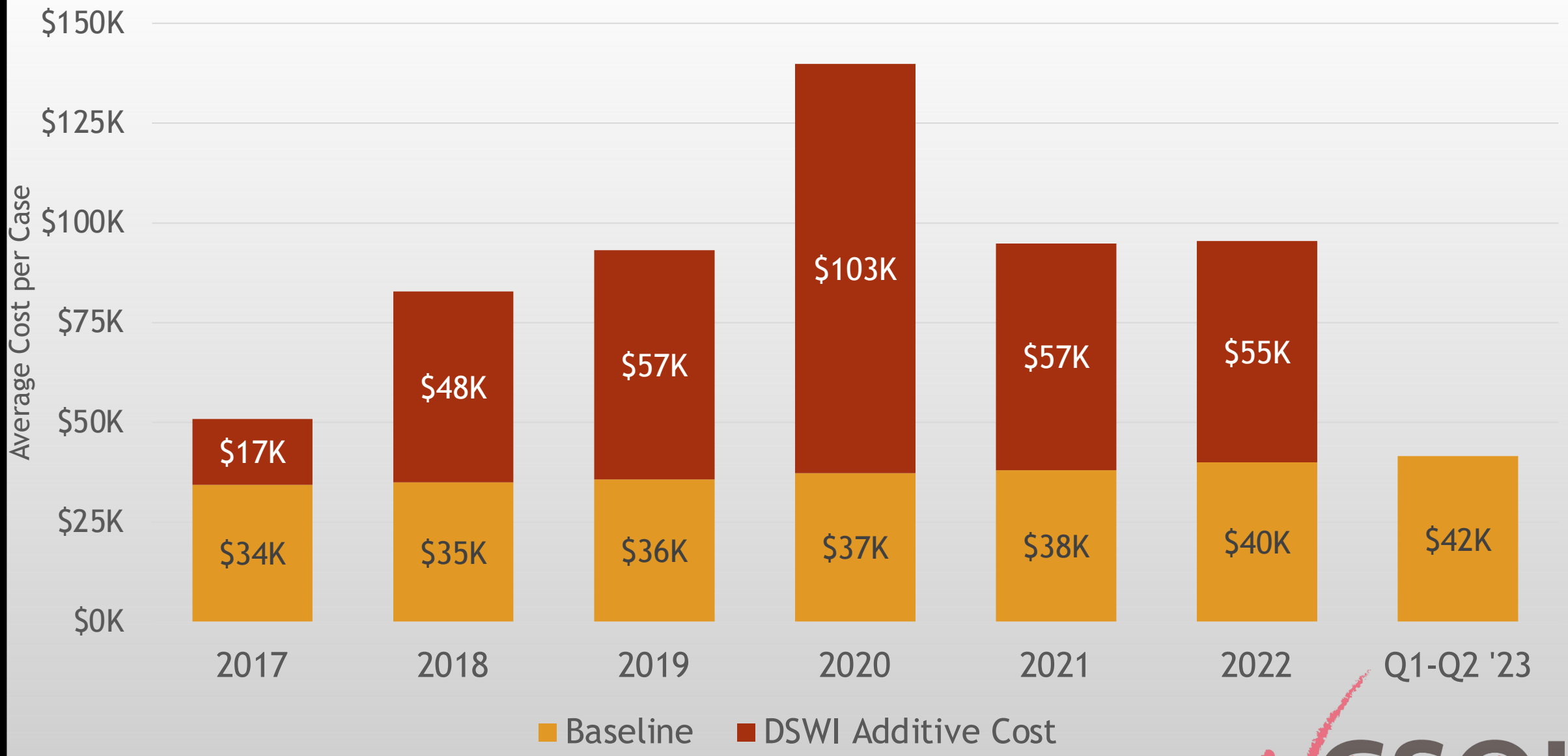
Post-op A-Fib Additive Costs: Isolated CAB Procedures, CY 2017—Q2 2023



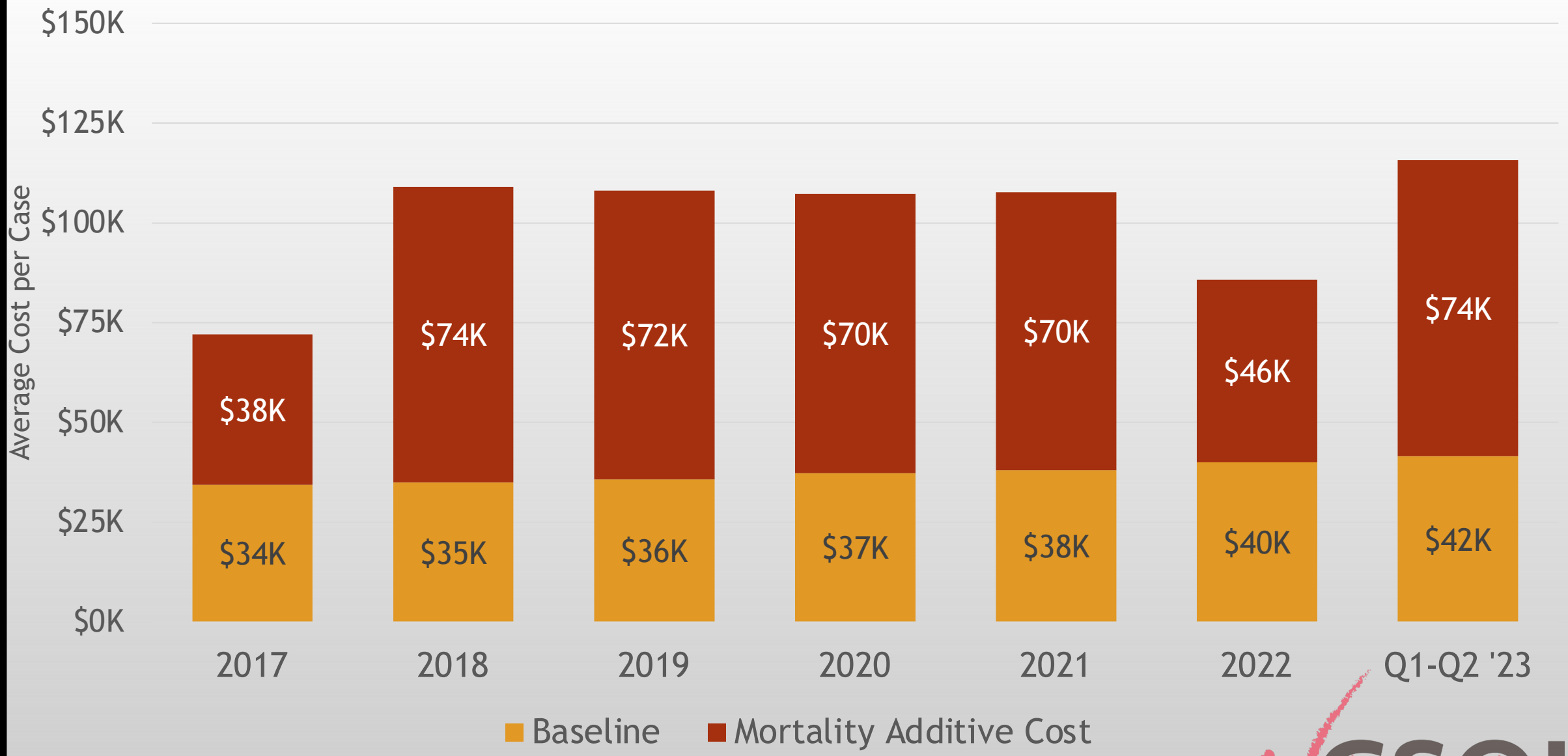
Permanent Stroke Additive Costs: Isolated CAB Procedures, CY 2017—Q2 2023



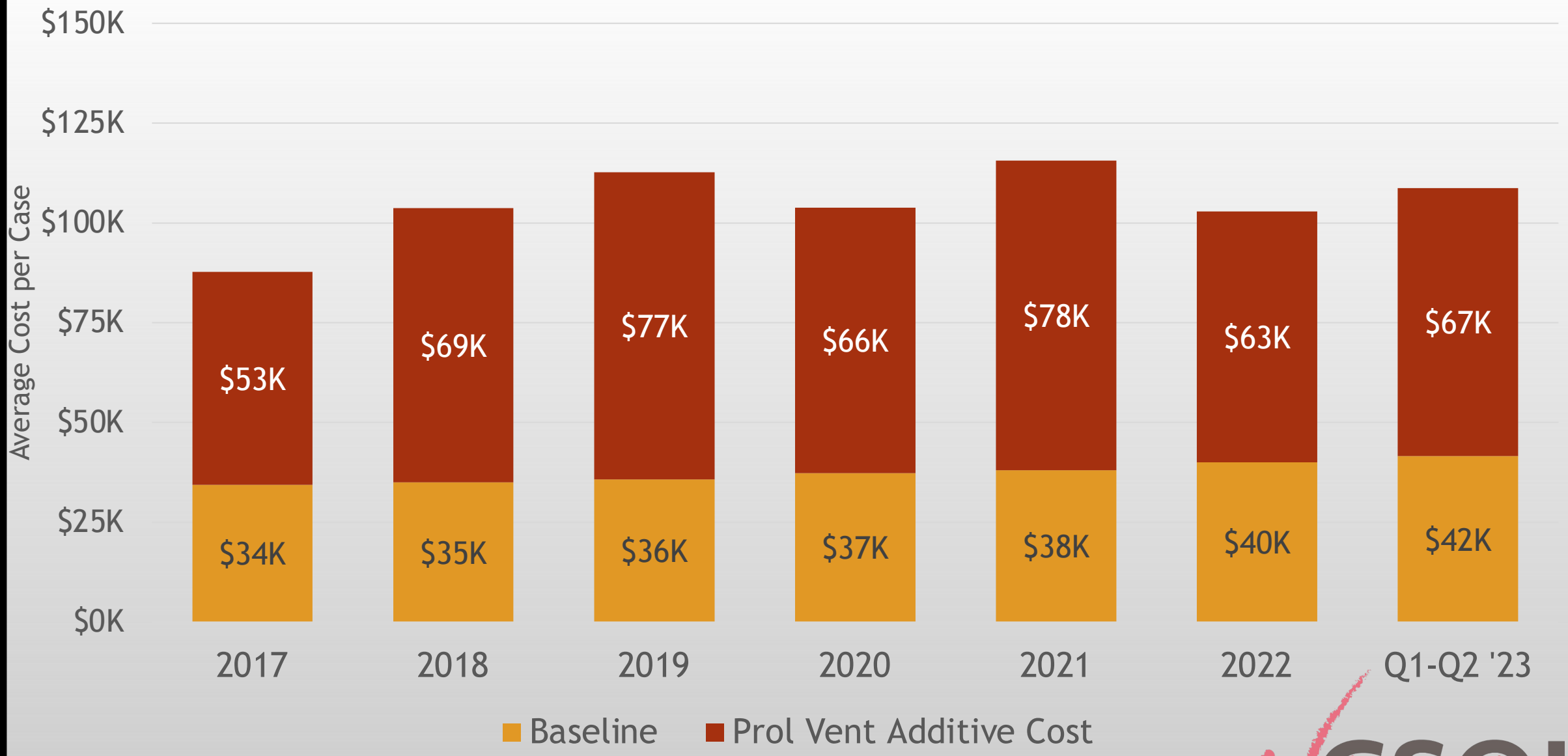
Deep Sternal Wound Infection Additive Costs: Isolated CAB Procedures, CY 2017—Q2 2023



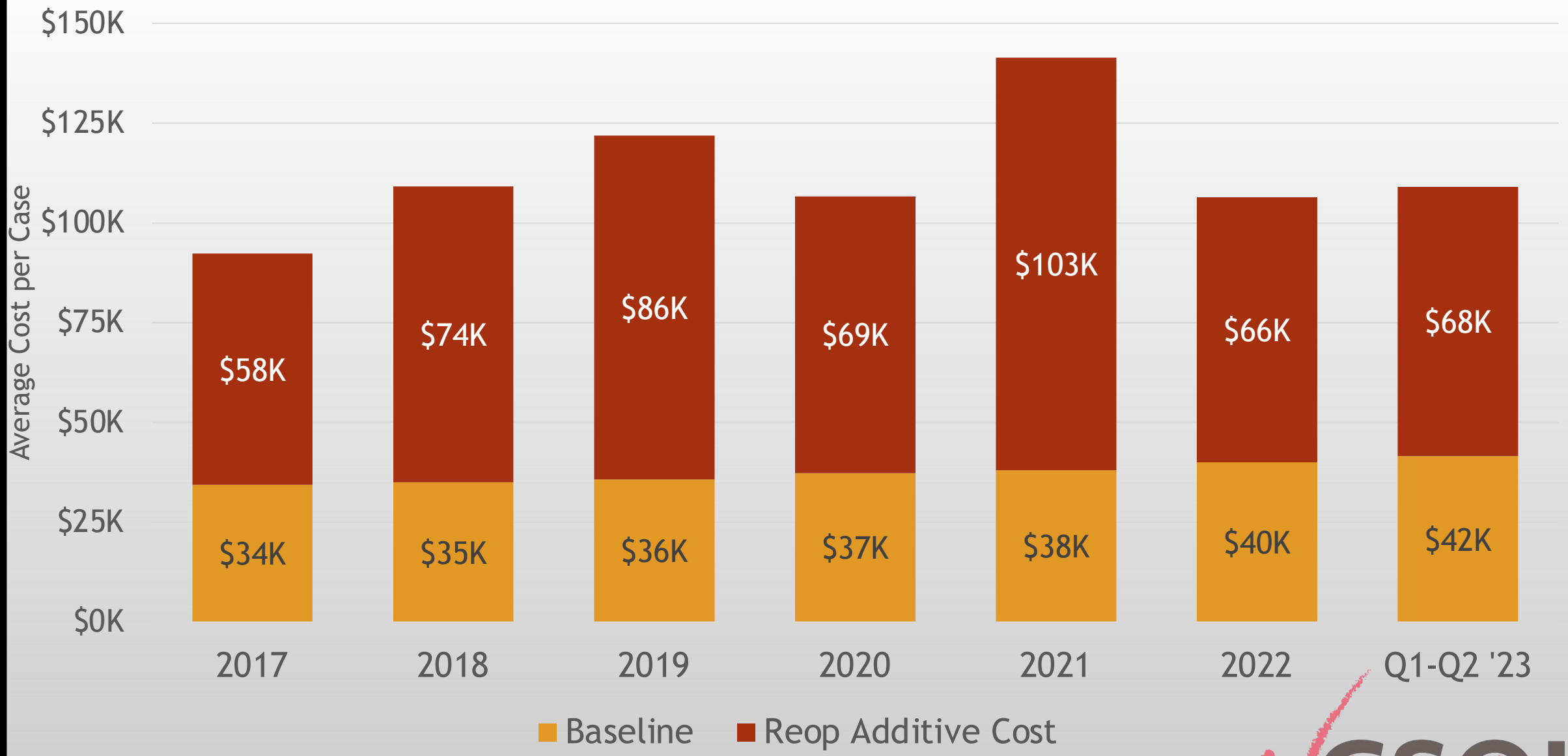
Operative Mortality Additive Costs: Isolated CAB Procedures, CY 2017—Q2 2023



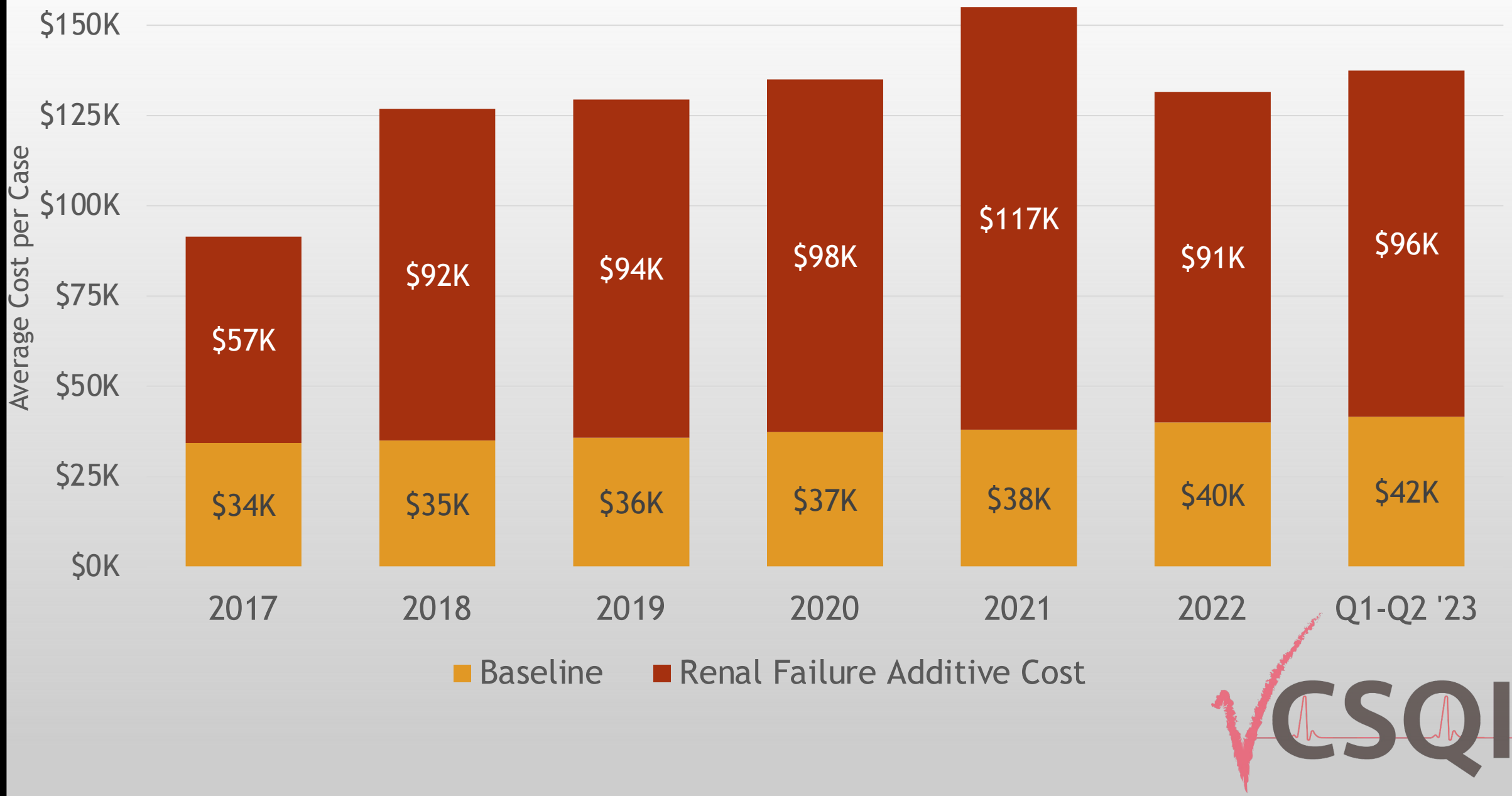
Prolonged Ventilation Additive Costs: Isolated CAB Procedures, CY 2017—Q2 2023



Reoperation Additive Costs: Isolated CAB Procedures, CY 2017—Q2 2023

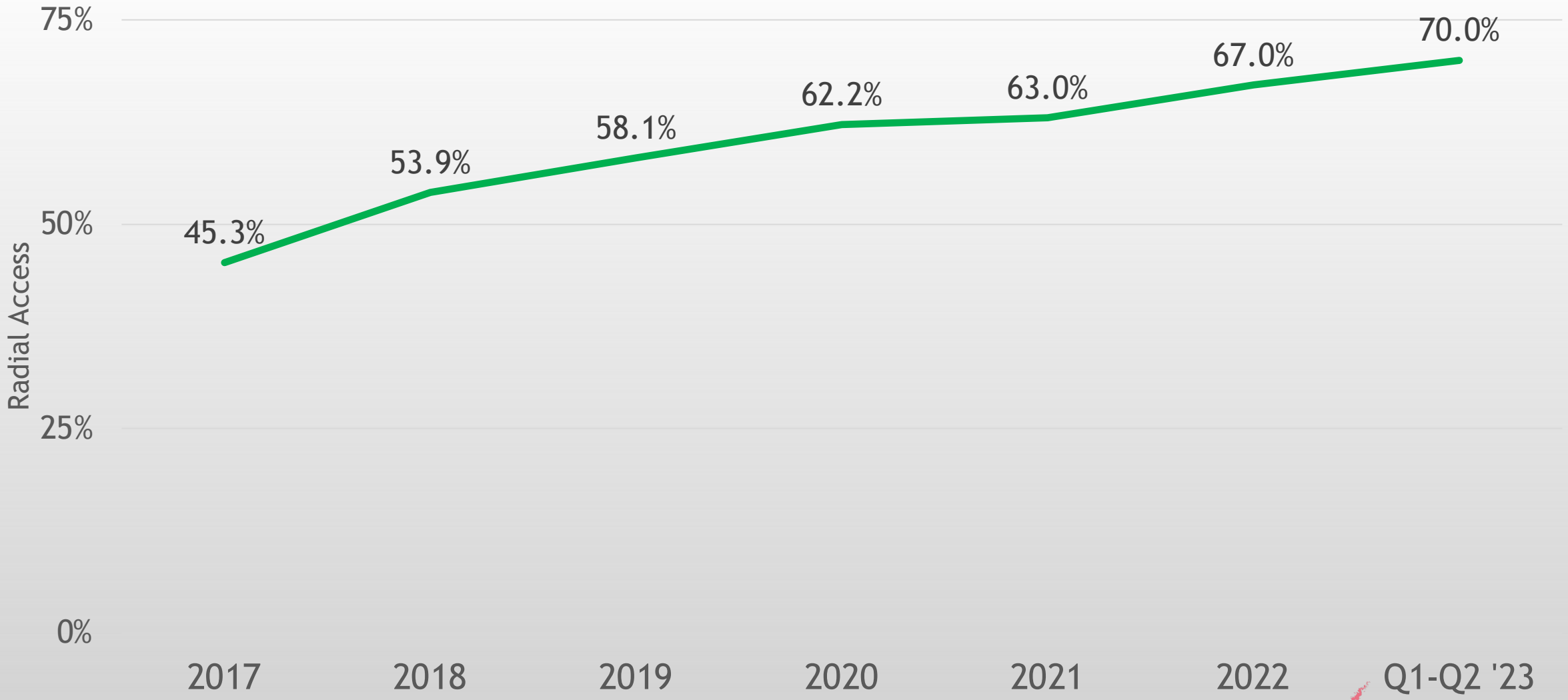


Renal Failure Additive Costs: Isolated CAB Procedures, CY 2017—Q2 2023

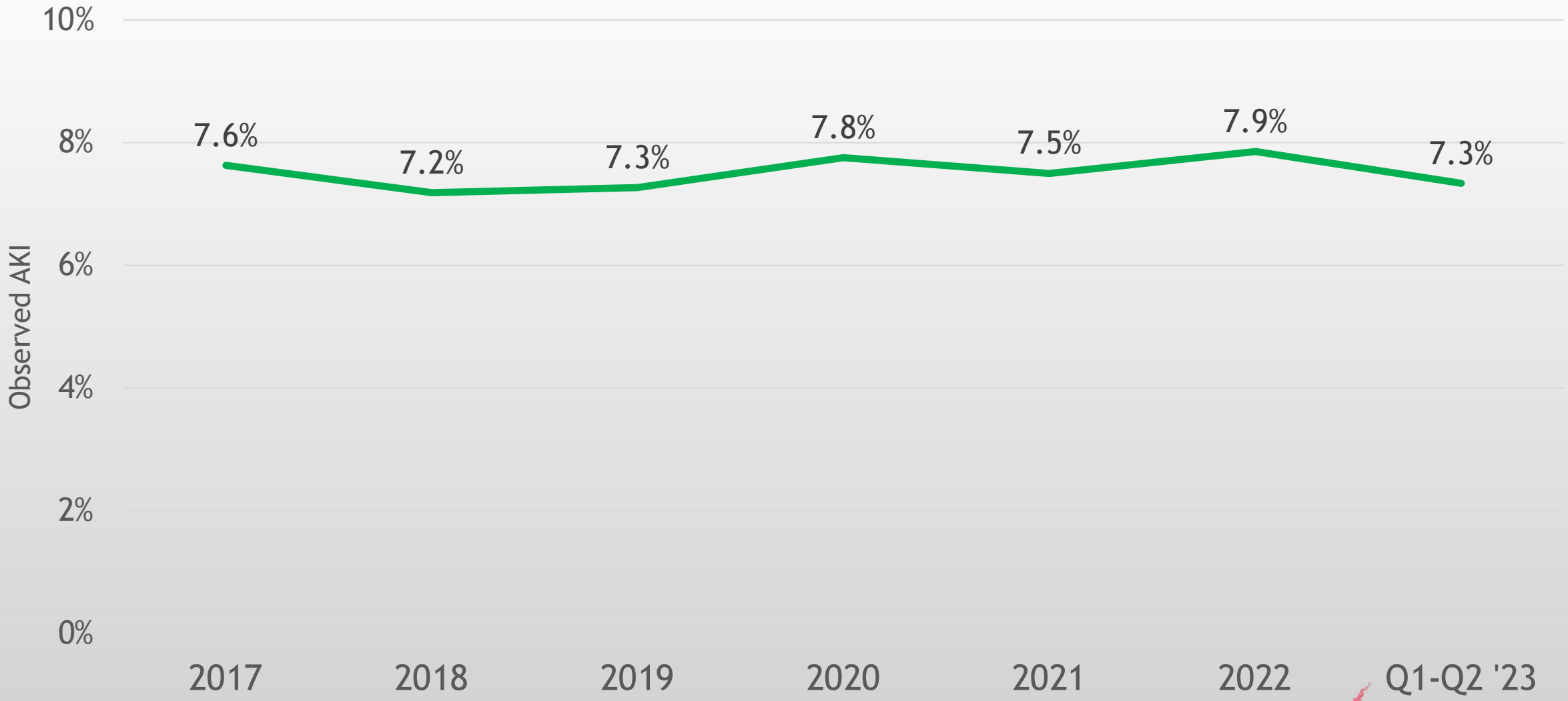


ACC CathPCI

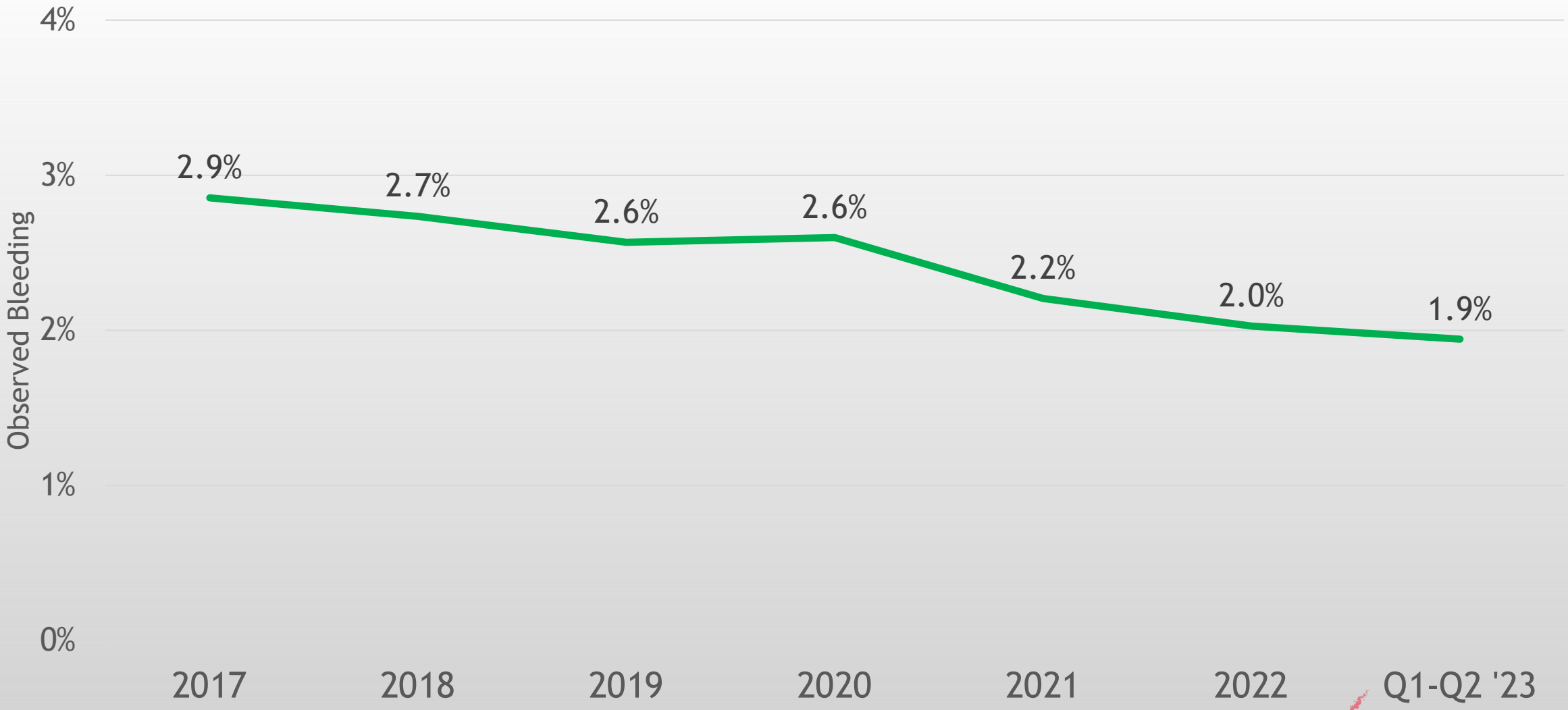
Radial Access Site: All PCI Procedures, CY 2017—Q2 2023



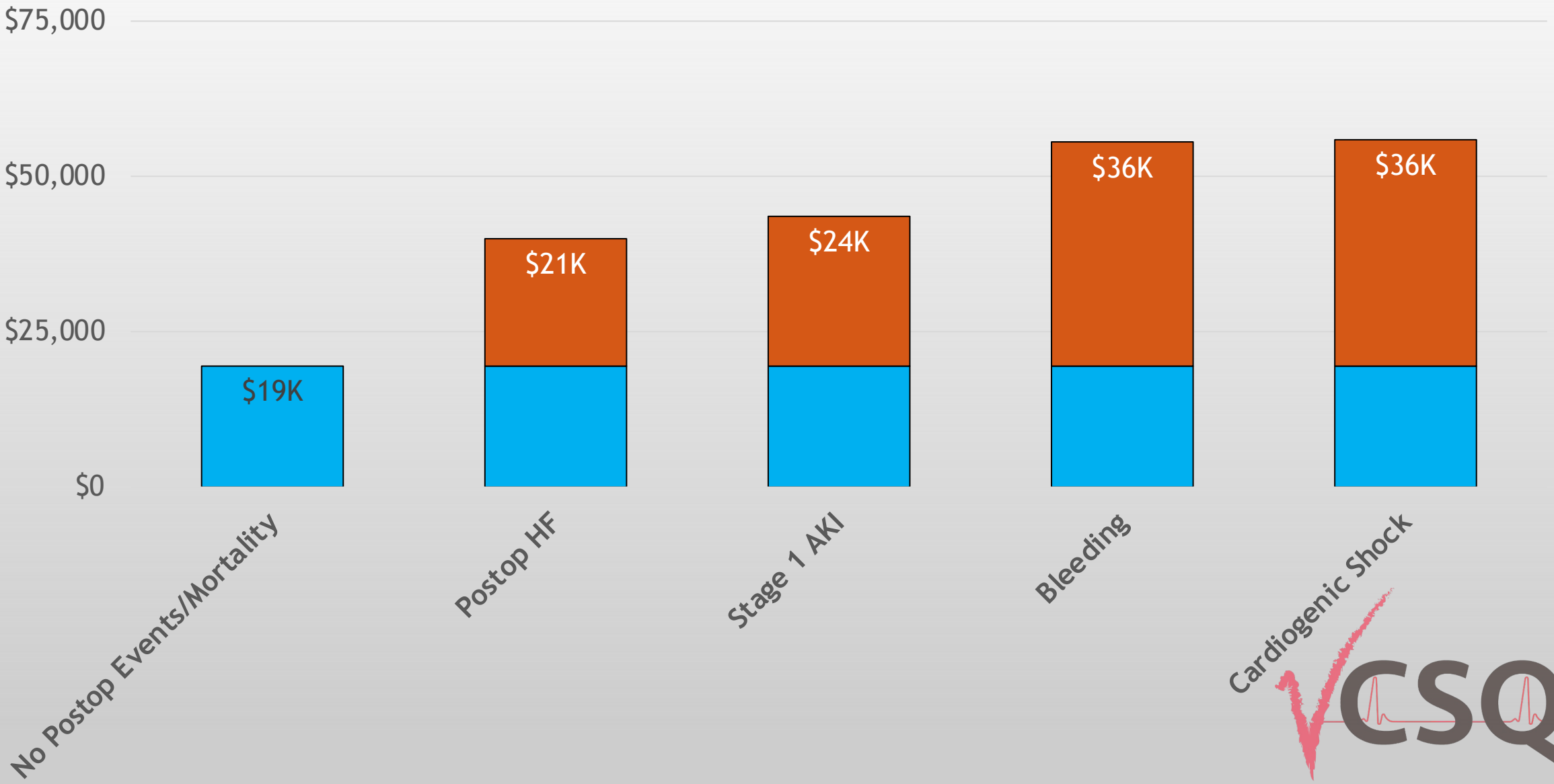
Observed Acute Kidney Injury: All PCI Procedures, CY 2017—Q2 2023



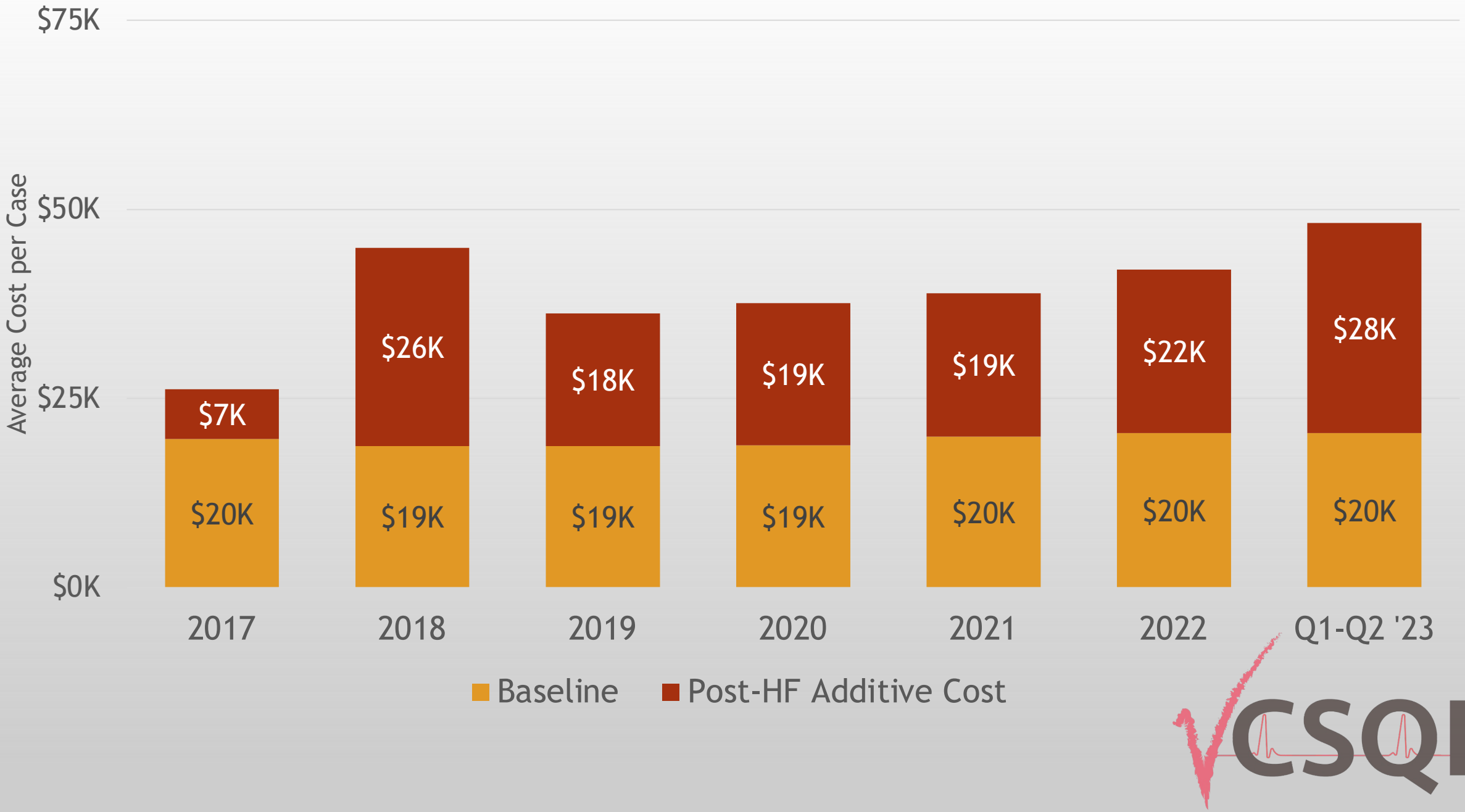
Observed Bleeding Events: All PCI Procedures, CY 2017—Q2 2023



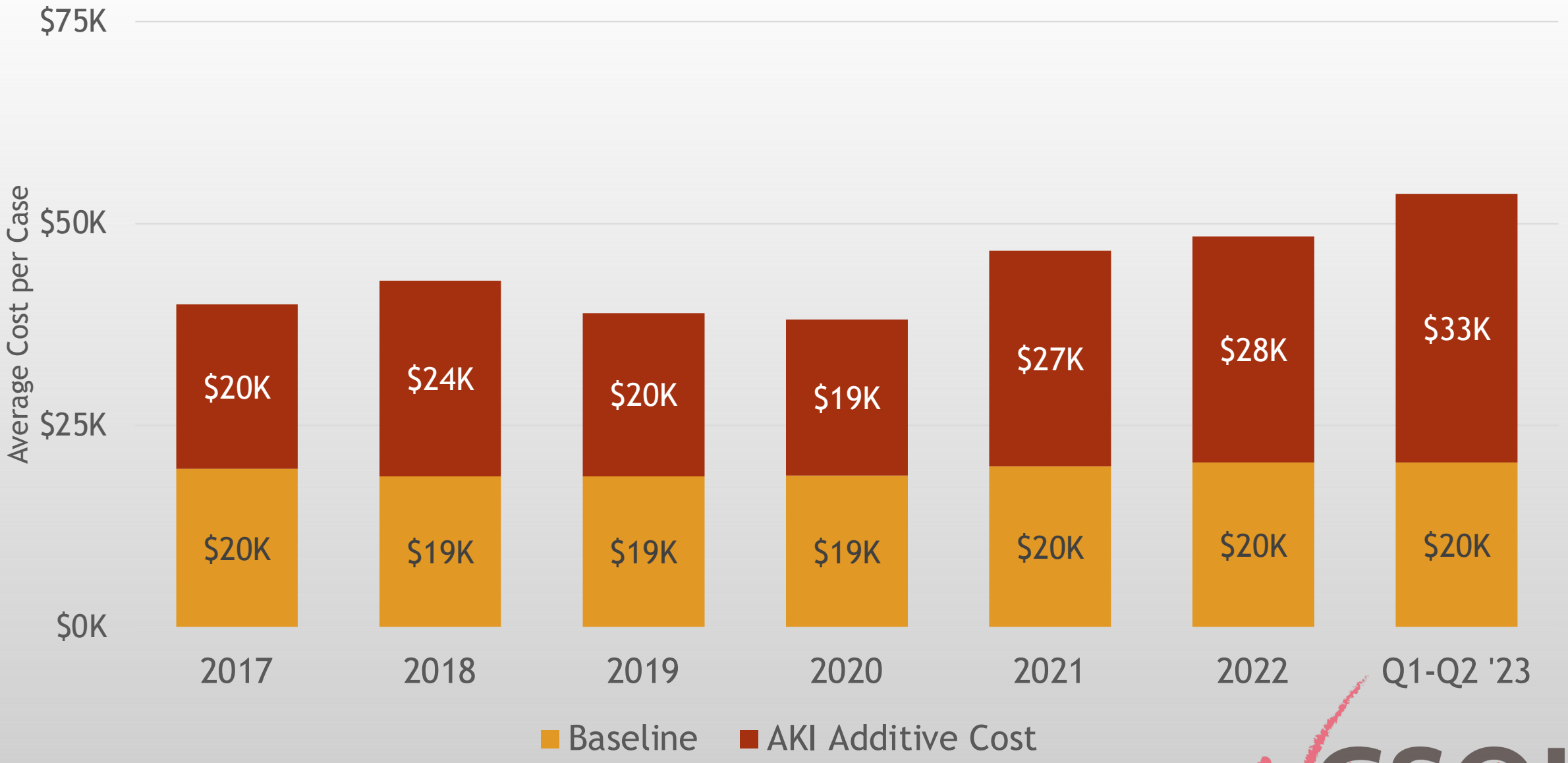
CathPCI Additive Costs: Q1 2017 – Q2 2023



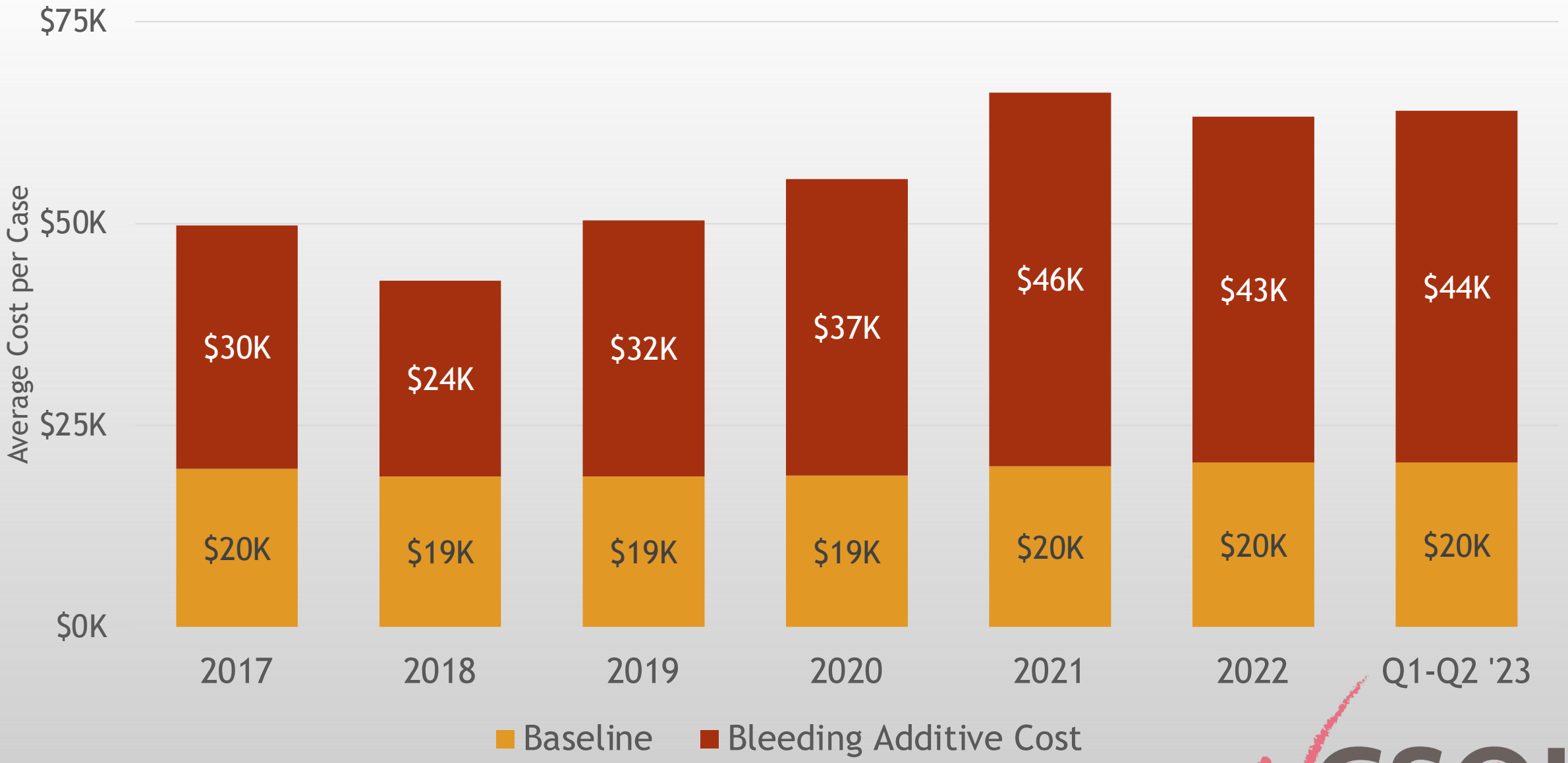
Post-PCI Heart Failure Additive Costs: All PCI Procedures, CY 2017—Q2 2023



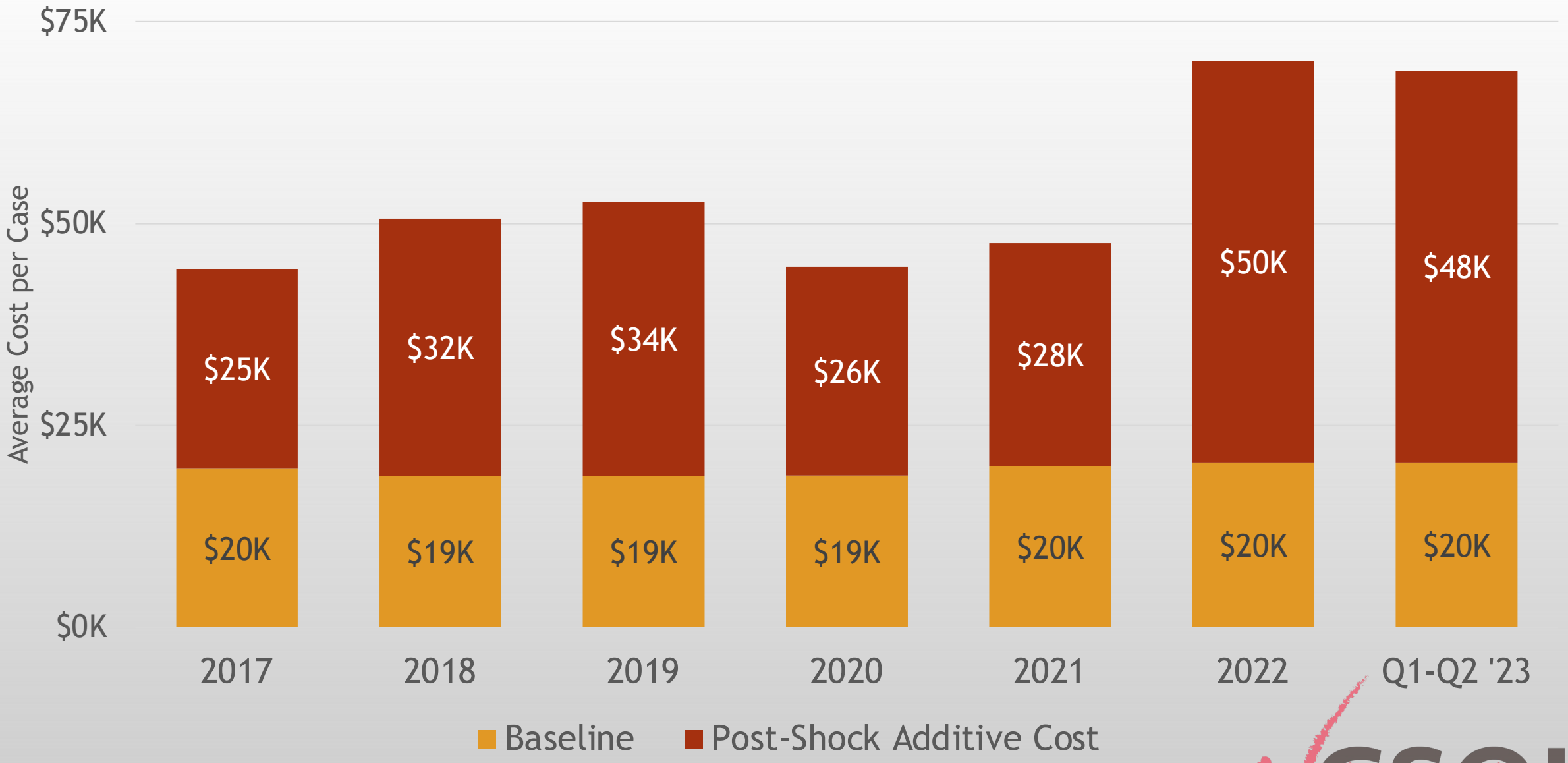
Post-PCI AKI Additive Costs: All PCI Procedures, CY 2017—Q2 2023



Post-PCI Bleeding Additive Costs: All PCI Procedures, CY 2017—Q2 2023



Post-PCI Shock Additive Costs: All PCI Procedures, CY 2017—Q2 2023



Summary of Cost Trends

- Isolated CAB procedures remain more expensive than PCI, and baseline costs of CAB have increased more than PCI
- Renal Failure and Reoperation had the largest year-over-year increases in STS
- All post-procedure events that we measured increased year-over-year in CathPCI
- Shock had the biggest impact and and largest increase in additive costs

- Quarterly Reports Available at:
  - https://www.vcsqi.org/members
- In the Pipeline:
  - Hospital-Specific Cost Reports
  - STEMI and TVT Cost Data
  - DEI and Z-Codes

Thank You!

Questions / Suggestions?

VCSQI Workgroups, Committees, VHAC Updates & More!

Virginia Heart Attack Coalition (VHAC)

Peter O'Brien, MD, FACC

Centra Lynchburg

VHAC Co-Founder

Transforming Cardiovascular Care to Improve Patient Experience and Value

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VHAC Strategic Plan…The Three Pillars

- Sustainable Regional Activity
- EMS education, training and equipment
- State Data Collection and Reporting

In our 15th Year, How do We Get Better?

…Strategic Planning Initiative

Goal Setting

CSQI

Transforming Cardiovascular Care to Improve Patient Experience and Value

SWOT ANALYSIS – SNAPSHOT

	Helpful To achieving the objective	Harmful To achieving the objective
Internal Attributes of the organization	**STRENGTHS** • Successful & Important Systems of Care Framework for Acute Cardiovascular Care • Active Multidisciplinary Acute CV Care Healthcare Network of Providers • Relationship with VCSQI • Meaningful Data/Information • Leadership, Vision, and Drive • Stakeholder Communication • Resilience, Longevity, Purpose, Efficiency • Volunteer Effort and Decentralized Leadership • Data-driven approach • Positive and enthusiastic environment • Multidisciplinary collaboration • Unbiased input • Elimination of silos • Empowerment of members • Networking opportunities • Learning from other centers	**WEAKNESSES** • Understanding of Stakeholder Needs • Meeting/Maintaining Relevance • Greater Engagement of Members • Succession Planning • Leadership Opportunities and Interest • Database Merger Issues; Control of Data Communication • Accountability of Regional Leads to Drive Change • Competition among hospital systems with resultant less collaboration • Shock - High Opportunity with Low Resolve • Overreliance on a Few Individuals and Non-Physician Volunteers • Lack of Permanent Regional Coordinators and Formal Plans • Limited Publication and Research • Operational and Geographic Challenges • Rural Challenges • Need for More EMS Engagement • Constant Process Relearning
External Attributes of the environment	**OPPORTUNTIES** • Grow Initiatives • Include Cost Data and Complications • Greater Stakeholder Engagement • Pipeline of Leaders • Capitalize on Relationship with VCSQI • Consistent Engagement and Accountability from Regional Leaders • Becoming a 501(c)(3) and Hiring Regional Coordinators • Pursue Research Publications (via collaboration with VCSQI) • Leverage Partnerships with Public Health and Other Organizations • Identify Competing Demands on Volunteer Time • Further Data Utilization • Expansion to Other Disease States • Engaging New Members • Regional Cooperation • Enhanced Outreach • Collaboration with EMS • Standardization of Guidelines • Establishing standards for cardiac patient care • Sharing process improvement strategies • Increased collaboration with hospital EMS agencies • Expanding parameters and generating new initiatives • Engaging new members effectively	**THREATS** • Apathy and Lack of Engagement • Healthcare Provider Burnout • Competing Healthcare Initiatives and Priorities • Inability to Create a Leadership Pipeline • Cost Considerations • Failure to Launch Initiatives • Loss of Leaders and Difficulty in Ensuring Steady Engagement • Need for Full Participation in VCSQI STEMI Registry • Inability to Identify Stakeholder Needs and Maintain Value • Inability to Adapt Quickly Enough • External Healthcare Regulations • Funding Constraints • Competition from Other Healthcare Organizations • Maintaining Engagement • Standardization Challenges • Disparities in Access

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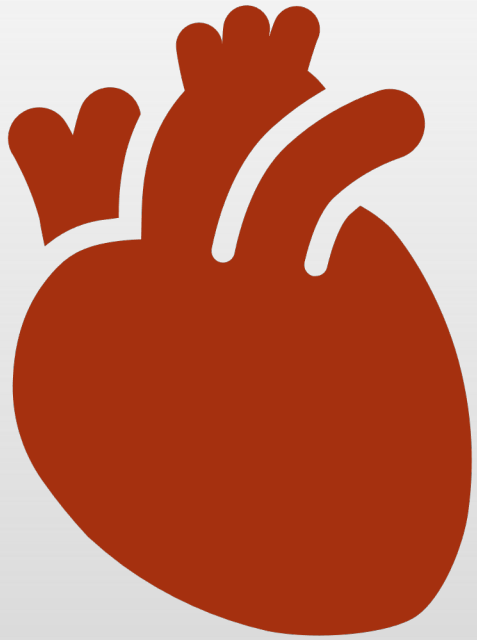
Strategic Goals and Objectives *revised*:

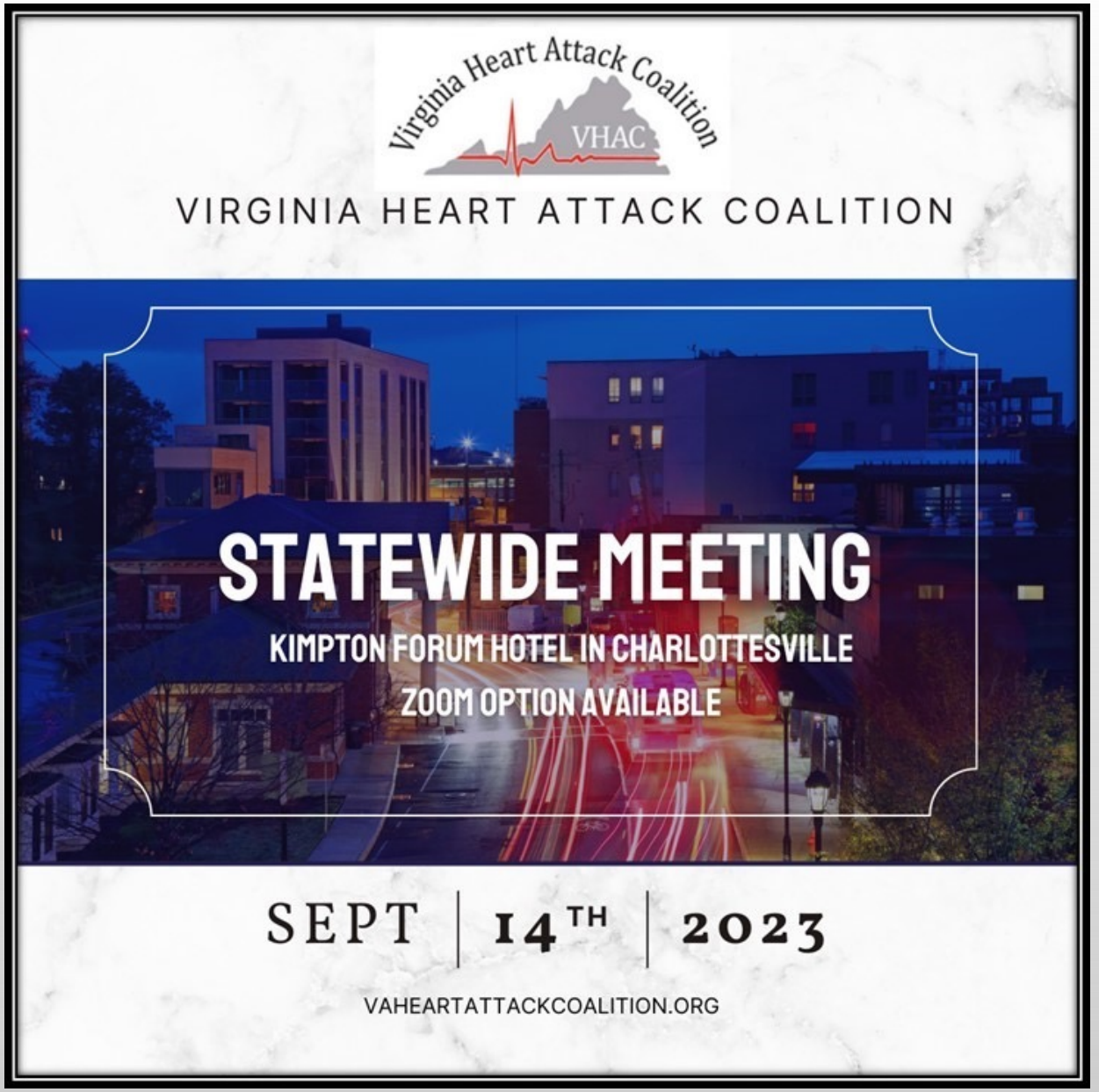
1. Synergizing Success: Enhanced Engagement, Leadership, and Partnerships
2. Data-Driven Excellence
3. Enhance External Collaborations
4. Heart of Excellence: Data-Informed and Community-Engaged Cardiac Care
5. Leadership and Community Harmony



Strategic Planning 2023—How Do We Get Better?

VHAC in its 15th year—with successes but persistent gaps, barriers and opportunities.

- Initiating a comprehensive assessment…starting with leadership but ultimately engaging all members:
  - 1. SWOT Analysis (Successes, Weaknesses, Opportunities, Threats)--Core leader focused discussion
  - 2. Revised Mission and Vision Statements
  - 3. Survey of our members
  - 4. Strategic Planning Workshop

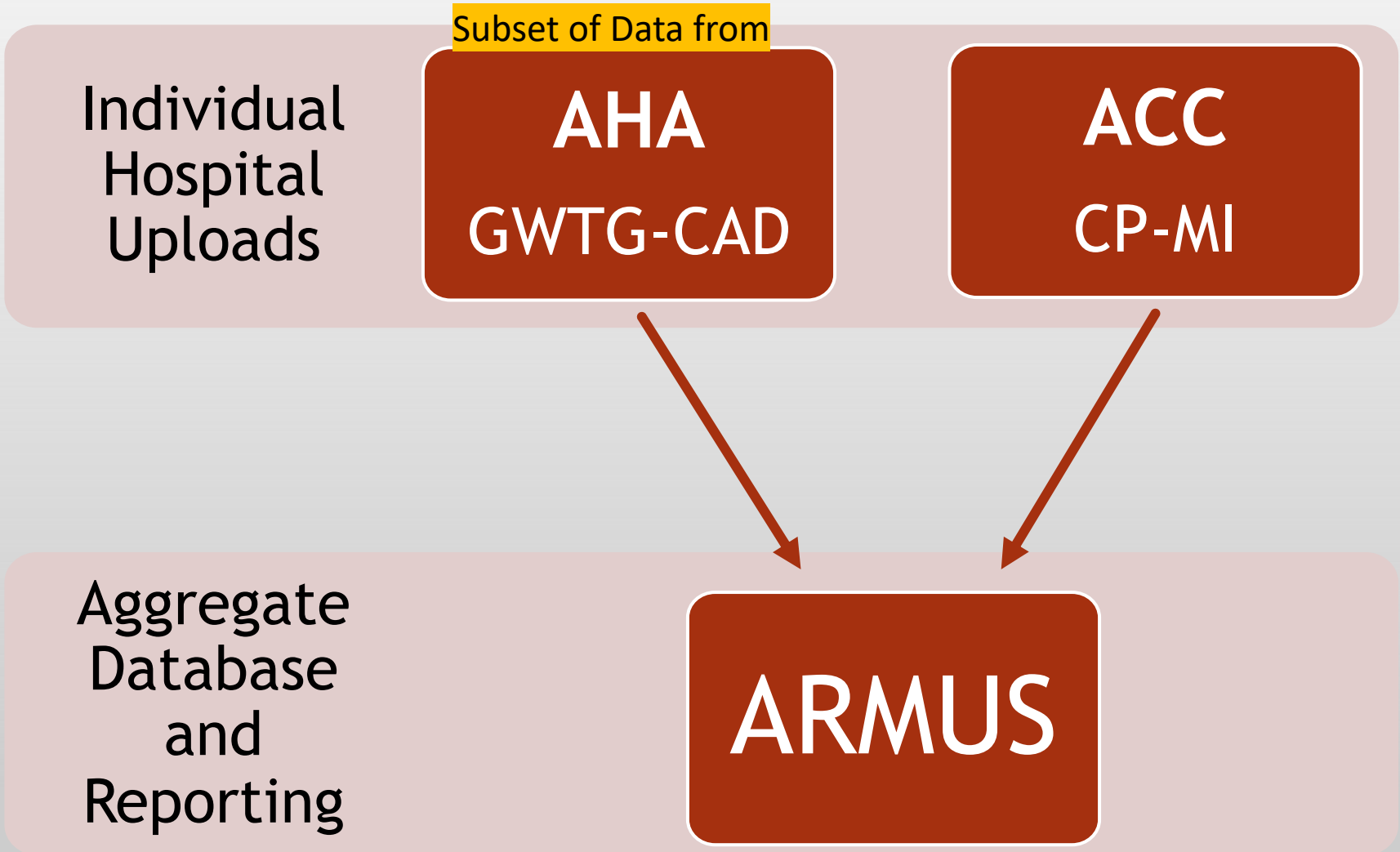

Virginia Heart Attack Coalition
VHAC
VIRGINIA HEART ATTACK COALITION
STATEWIDE MEETING
KIMPTON FORUM HOTEL IN CHARLOTTESVILLE
ZOOM OPTION AVAILABLE
SEPT | 14TH | 2023
VAHEARTATTACKCOALITION.ORG

VHAC-VCSQI Statewide STEMI Database

Q2 2023 Summary Reports

Transforming Cardiovascular Care to Improve Patient Experience and Value

Data Aggregation Model



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STEMI Database Participation

- 20 VCSQI Programs included in the database
  - 5 New members pending uploads
- 18 Programs currently sharing CP-MI data quarterly
- 2 Programs from GWTG-Only
  - Sharing a subset / data export from GWTG-CAD

STEMI Reports by Region: Q3 2022 – Q2 2023

Population: All STEMI Patients, Q3 2022 – Q2 2023 (N=1,554)	VCSQI	East	North	Northwest	South	West
Median Door In - Door Out (Minutes): Transfer Patients	**59.0**	63.0	55.0	65.0	49.5	67.0
Median Transfer Time between Hospitals	**30.0**	30.0	25.0	31.0	39.0	34.0
FMC to Primary PCI <= 90 Minutes: Non-Transfer Patients	**91.0%**	89.6%	90.6%	98.3%	90.7%	81.2%
Median FMC to Primary PCI: Non-Transfer Patients	**72.0**	74.0	75.0	67.0	66.0	77.0

= Exceeds VCSQI Average

= Equal to VCSQI Average

= Lower than VCSQI Average

Virginia Heart Attack Coalition VHAC

VCSQI

STEMI Reports by Hospital: Q3 2022 – Q2 2023

Population: All STEMI Patients, Q3 2022 – Q2 2023 (N=1,554)	VCSQI	2OZJ3	3E3HC	5BKOW	5ZUU4	GYV6A	H5QSA	HVZZJ	J5DO3	KHOVI	PUEGF	R2ENC	T4DUC	U6FDP	UHYL6	UWG46
Median Door In - Door Out (Minutes): Transfer Patients	**59.0**	61.0	53.0	72.0	57.0		67.0	54.0	55.0	64.5	71.0	39.0	50.0	49.5	26.0	116.0
Median Transfer Time between Hospitals	**30.0**	26.5	19.0	33.0	28.0		34.0	29.0	21.0	27.0	68.5	15.5	21.5	39.0	28.0	28.0
FMC to Primary PCI <= 90 Minutes: Non-Transfer Patients	**91.0%**	97.1%	94.3%	100.0%	91.2%	100.0%	81.2%	88.0%	91.8%	75.6%	93.2%	94.9%	80.8%	90.7%	98.0%	87.8%
Median FMC to Primary PCI: Non-Transfer Patients	**72.0**	76.0	72.0	65.0	74.0	69.0	77.0	75.5	76.0	79.0	70.5	71.0	83.5	66.0	65.0	76.0

= Exceeds VCSQI Average

= Equal to VCSQI Average

= Lower than VCSQI Average

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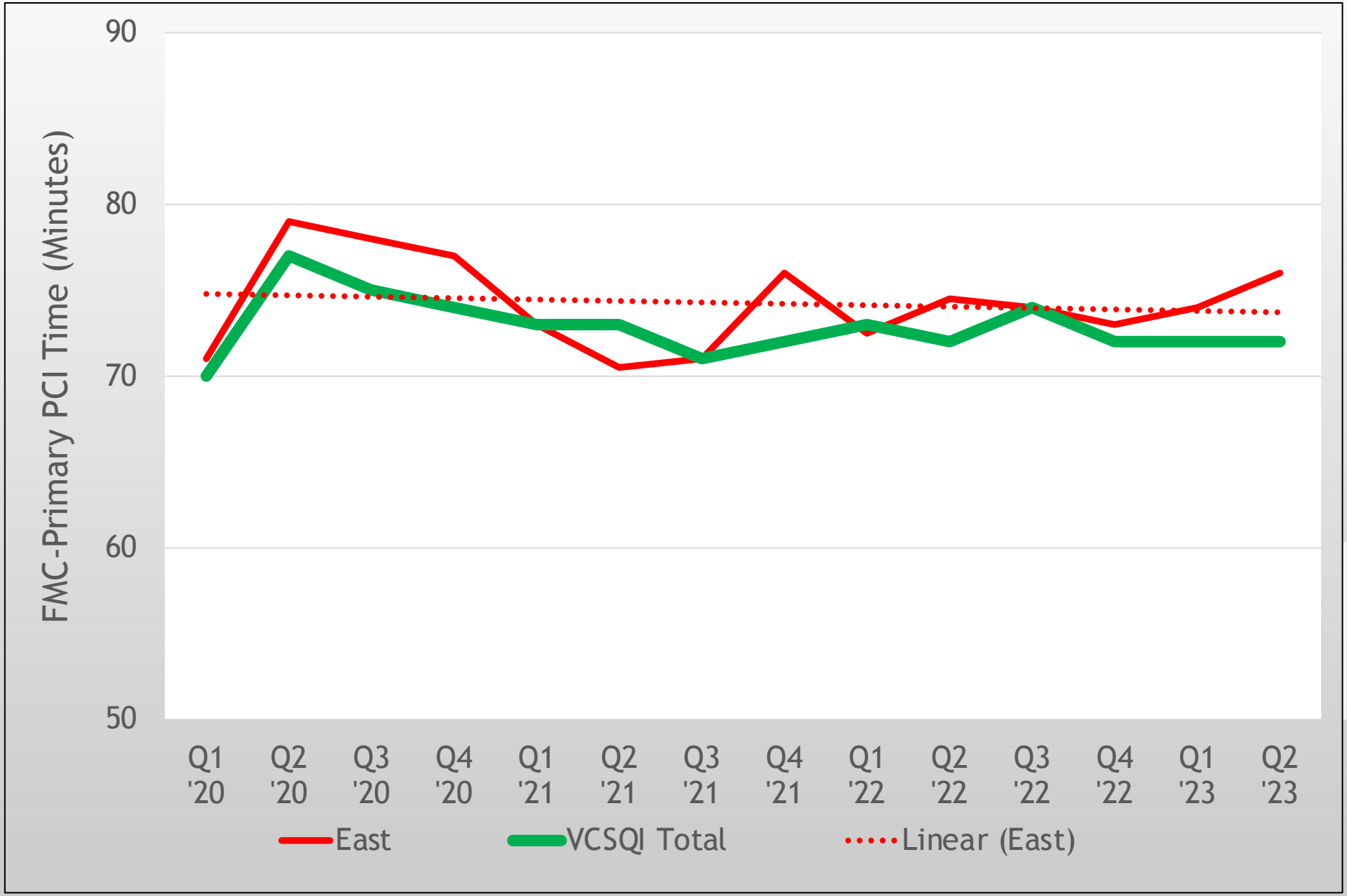
Median FMC-Primary PCI (Non-Transfer) by Quarter: Eastern



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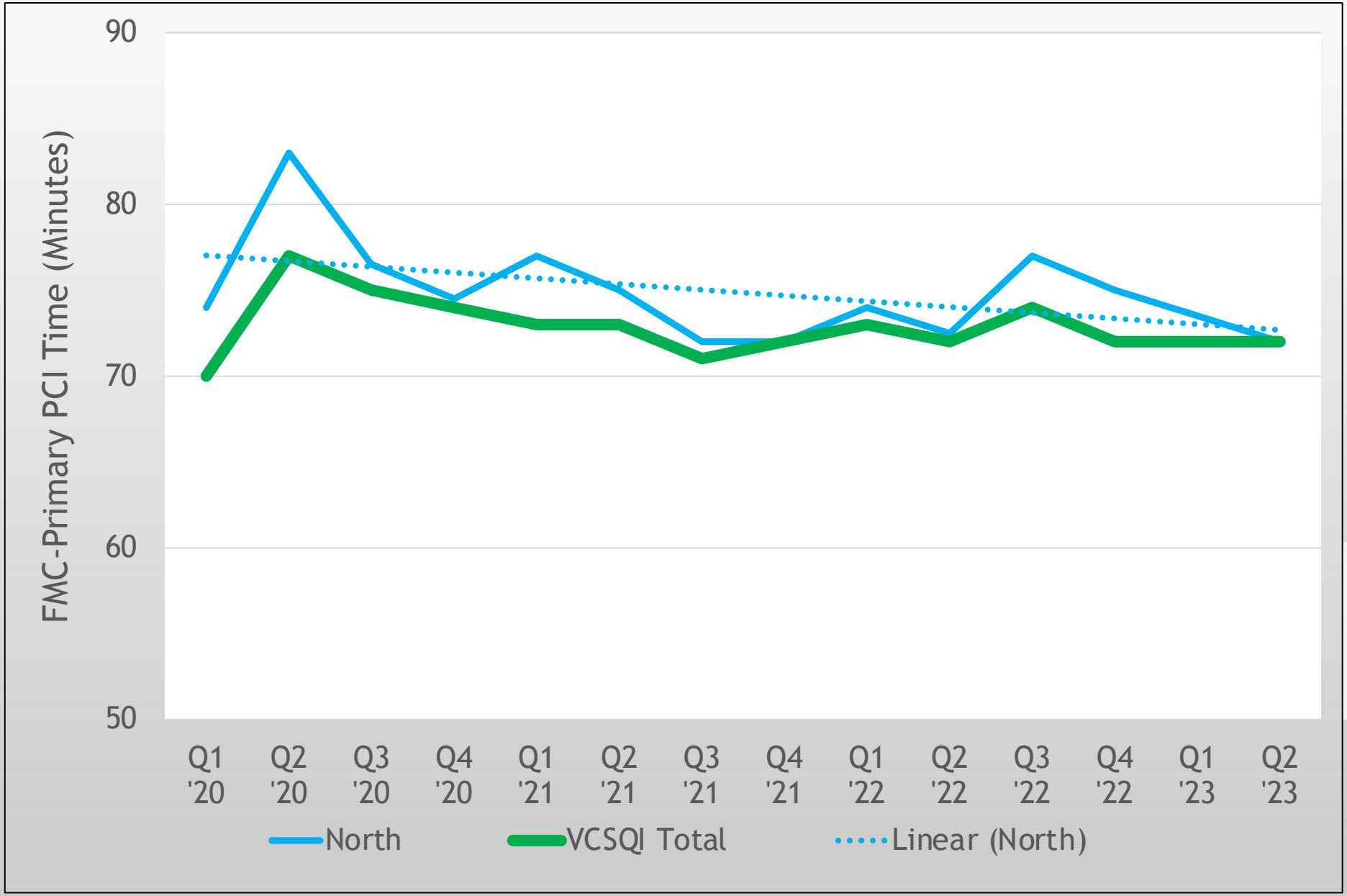
Median FMC-Primary PCI (Non-Transfer) by Quarter: Northern



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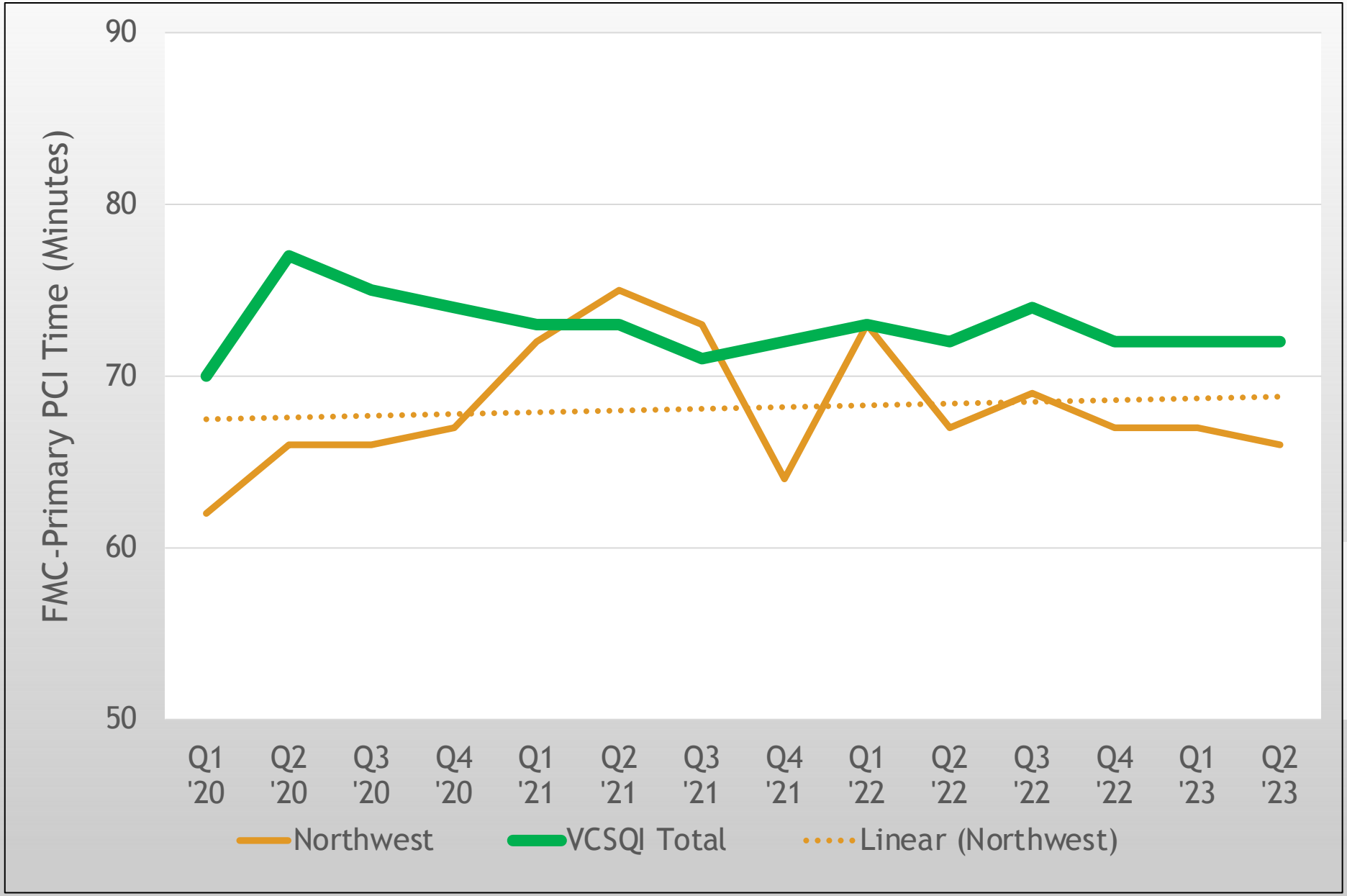
Median FMC-Primary PCI (Non-Transfer) by Quarter: Northwest



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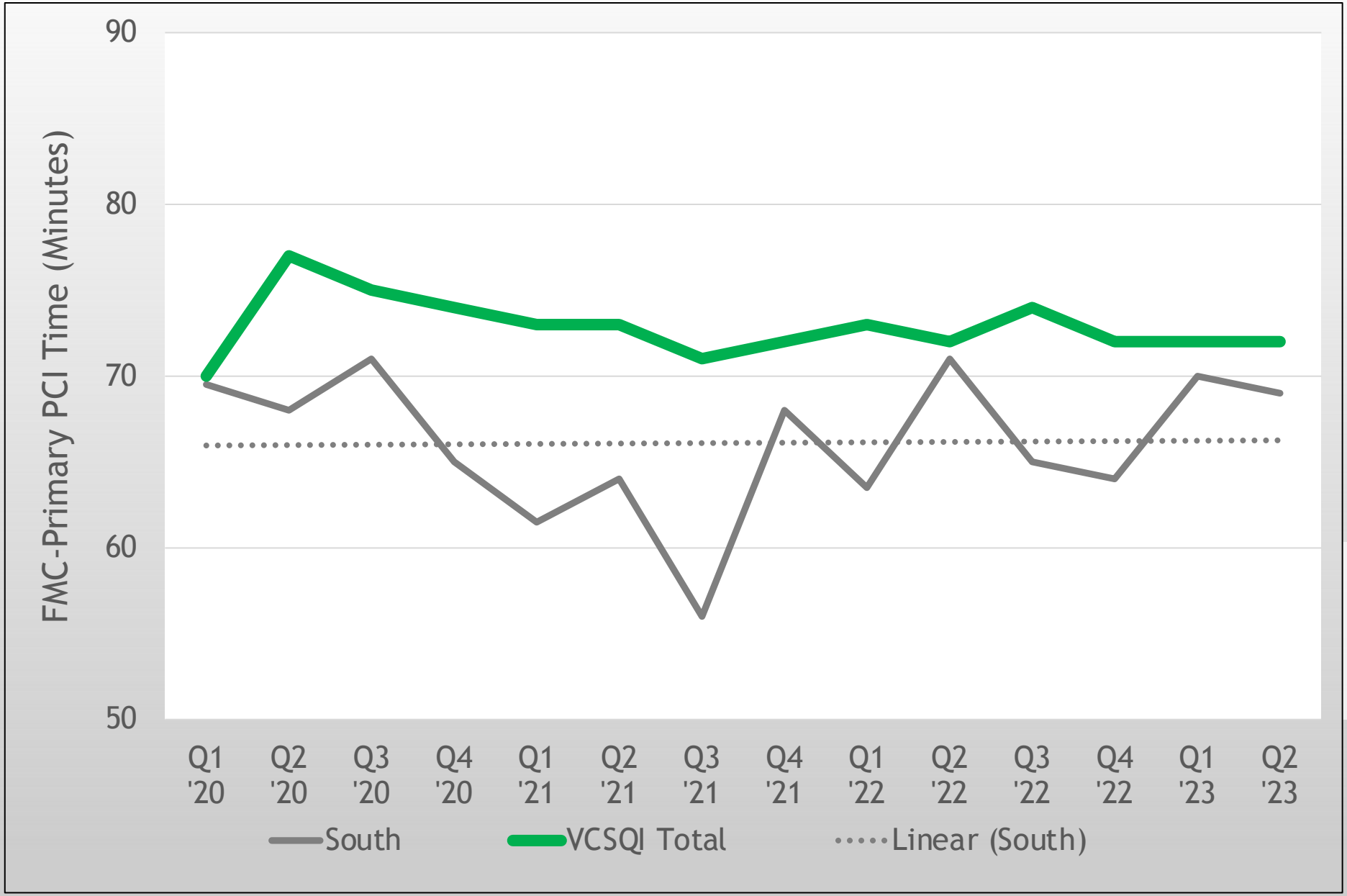
Median FMC-Primary PCI (Non-Transfer) by Quarter: Southern



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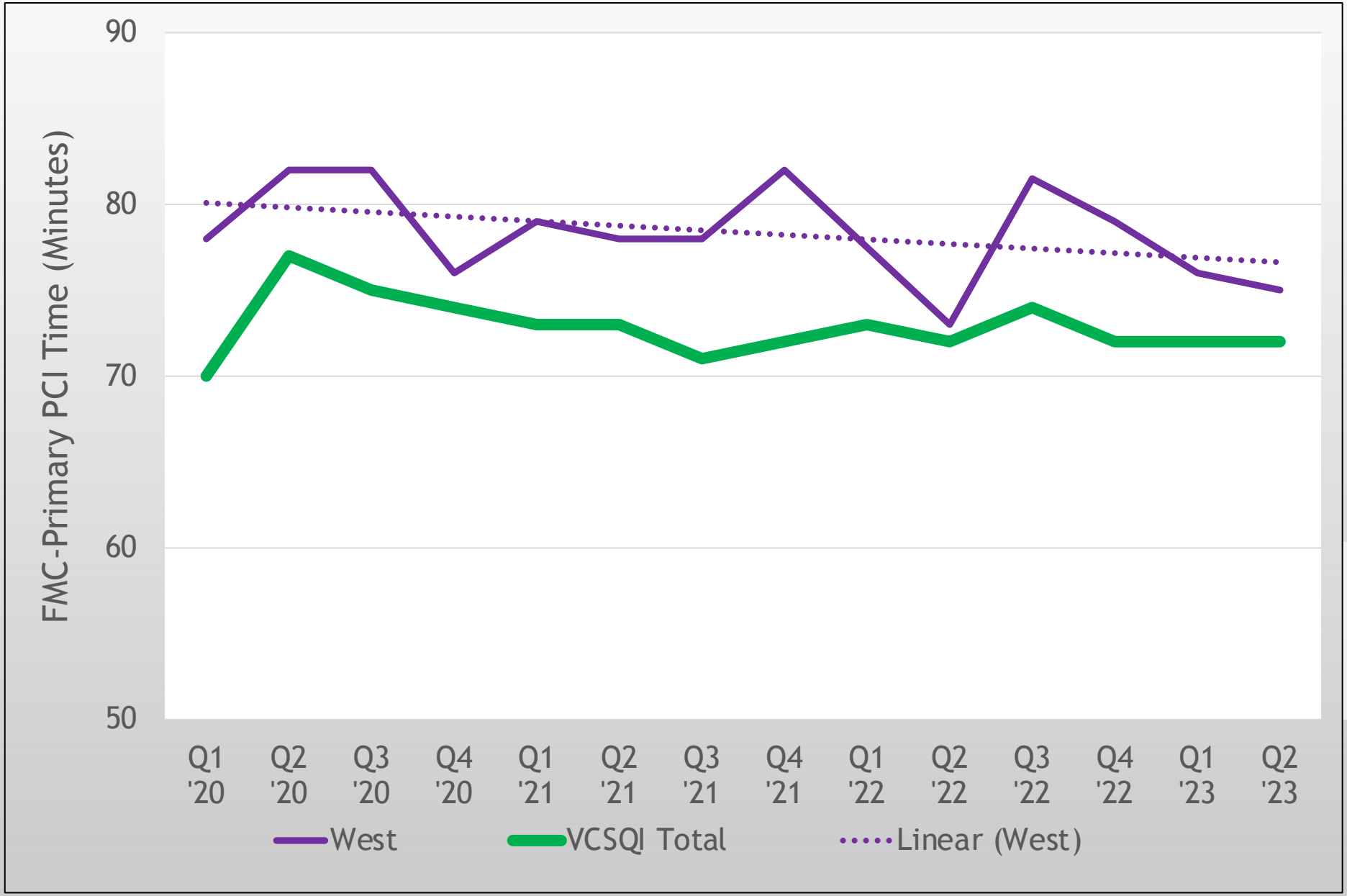
Median FMC-Primary PCI (Non-Transfer) by Quarter: Western



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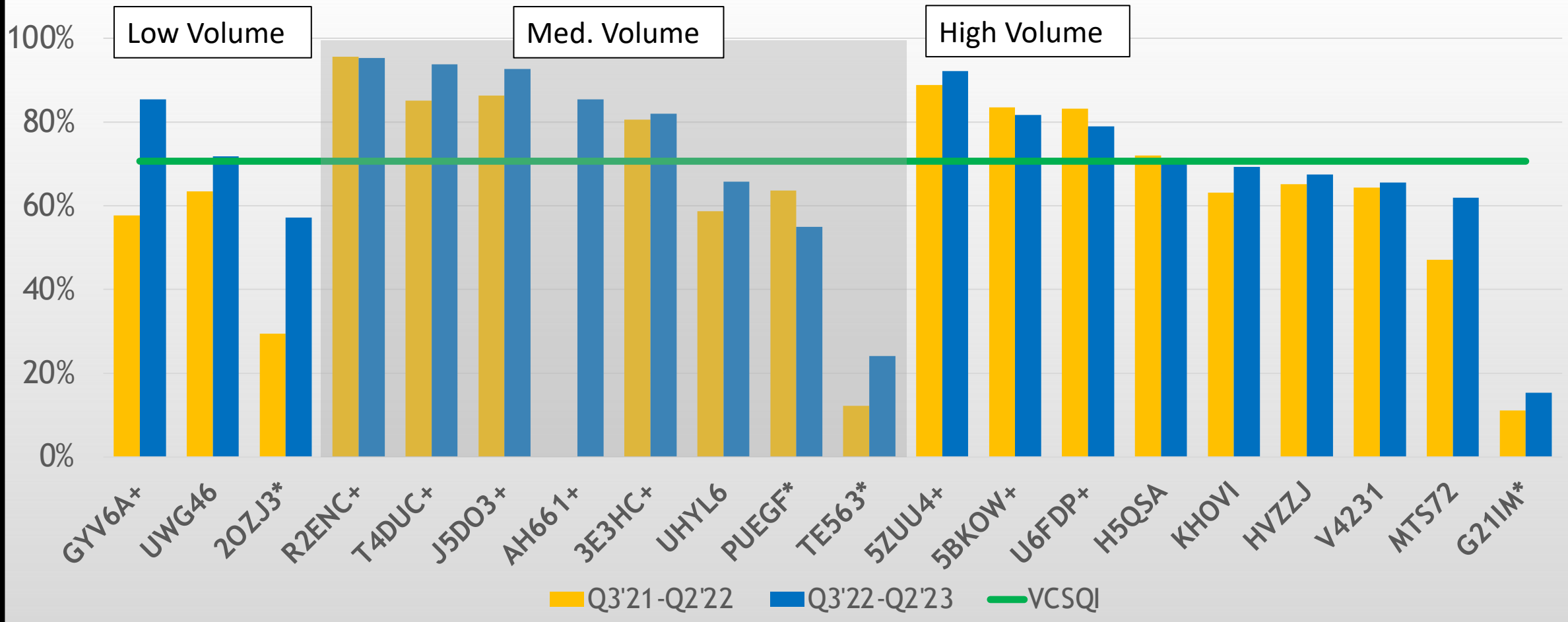
Radial Access Site by Hospital: Immediate PCI for STEMI Procedures, Q3 2021 – Q2 2023 (N=4,263)



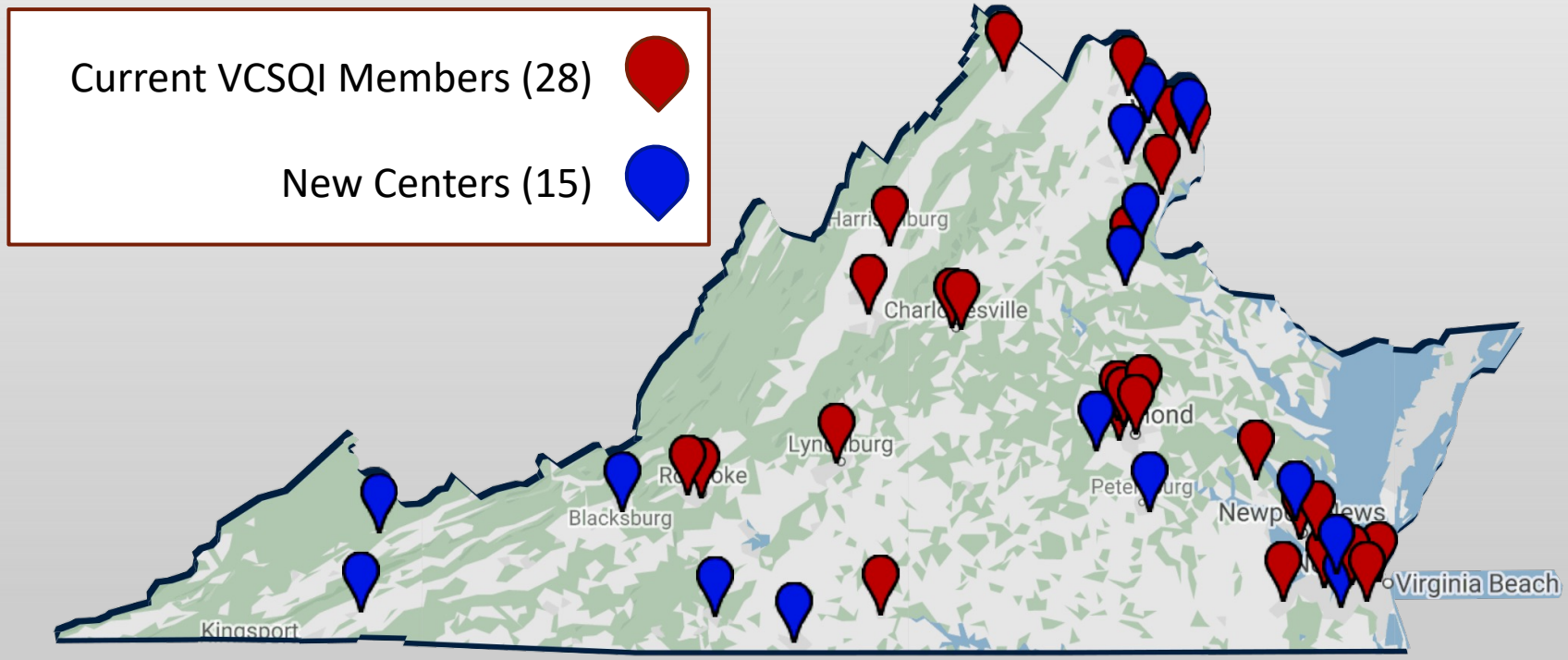
VCSQI: Femoral – 29.2% **Radial – 70.6%**

For the latest 4 quarter period:
A plus (+) following the hospital code indicates the hospital is statistically better than the rest of VCSQI
An asterisk (*) following the hospital code indicates the hospital is statistically poorer than the rest of VCSQI

VCSQI

We Need Your Help! Logistics and Next Steps

- Data Use Agreements will be automatically incorporated into current VCSQI members' database contracts
- New members gain access to all VCSQI resources: quarterly reports, angiogram reviews, collaborative workgroups (Shock + AKI), and more!



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VHAC
VCSQI

The work continues…

- Recruiting Regional leaders and stakeholders
- Get involved with your own STEMI/Shock Committees
- Clinical Workgroups: PE, ED Bypass, Thrombolytics, Shock, etc.
- Third Thursday Calls, 6:30-7:30. All are welcome!!!
- State Meeting 9/14/23—Success!!!
- Data Manager Work Group calls, 3rd Wednesday--Q&A, discussion, moral support

Join Us and Be That Person…Your STEMI Patients are Counting on You!

- *Patient centered, Guideline Driven Care (Prehospital 12 leads and immediate activation are Class I Indications!)*
- *Goal Setting*
- *Hardwiring*
- *Ownership*
- *Accountability*

VCSQI

Perfect Care Network

Kevin Lobdell MD, LTC, MC, USAR

Atrium Health

Perfect Care Impact

K Lobdell, S Crotwell, G Rose, L Watts, B LeNoir, T Maxey, & J Frederick

Sanger Heart & Vascular Institute

Advocate Health

PERFECTCARE

Now part of ADVOCATEHEALTH

Standard Practice Routines

	T&P	6/20/2019
Standard Practice Routines	Intraop	Discuss In Working group: Ready for approval
	Standard setup (Anesthesia)	4/11/2019
	Glycemic control	4/11/2019
	Perfusion Bundle	4/25/2019
	Intraoperative Temperature	4/25/2019
	Sedation and Analgesia	5/9/2019
	Holding Area	5/9/2019
	TEG / Coag	5/9/2019
	TEE	5/9/2019
	Operative Plan	6/20/2019
Standard	ICU	Discuss In Working group: Ready for approval
	Handoff: OR to ICU	4/9/2019
	Glycemic control	4/9/2019

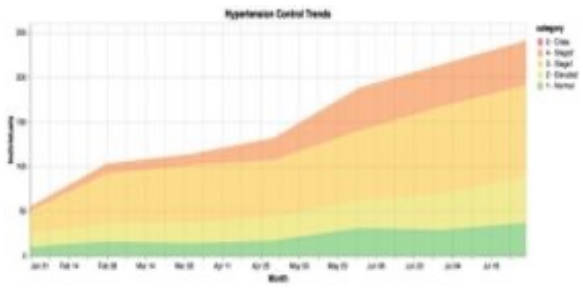
The “Perfect Care” (PC) initiative enrolls adult cardiac surgery patients into a comprehensive program that eliminates barriers to access care via remote perioperative monitoring.

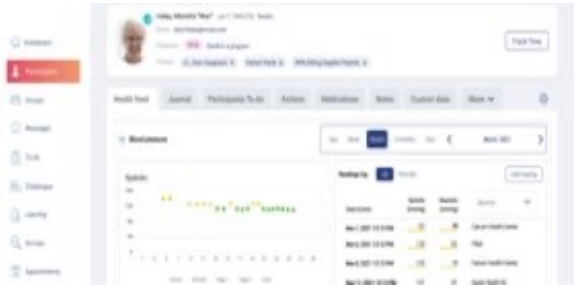
PC includes a digital health kit + application for appointment scheduling, tracking biometric data, patient reported outcomes, audiovisual visits, & messaging.

PC’s transformation of perioperative cardiac care aimed to reduce postoperative length of stay (PLOS) & improve 30-day readmission + mortality.

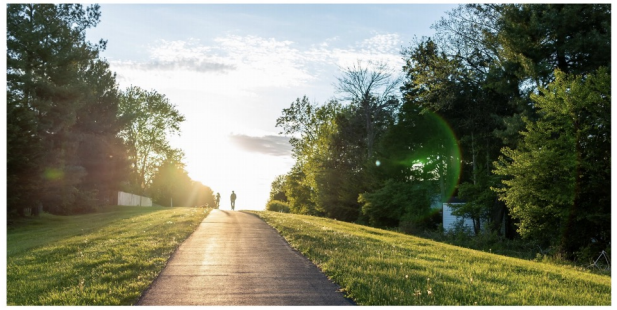
Perfect Care

Pathway + Novel Biometrics + PROs





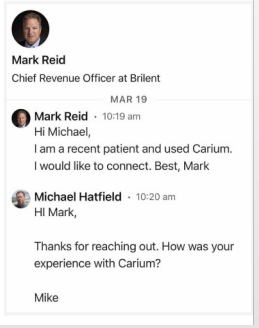
Patient Advocacy: Mark's Story of Empowerment During Surgery Recovery



Many of us often receive LinkedIn connection requests, messages, and solicitations, and they bring about various emotions - from interest, to excitement, and sometimes even annoyance. A couple of weeks ago, Carium's Chairman and Co-Founder, Mike Hatfield, received a LinkedIn message that truly sparked joy. The message was from Mark Reid, Chief Revenue Officer at Brilent, and it said, "Hi Michael, I'm a recent patient and used Carium. I would like to connect..."

Mike is incredibly humble, but has a variety of professional accomplishments in his executive career. Mike and Mark chatted on the phone and we invited Mark to participate in our Patient Advocacy program. Upon talking to Mark, Mike said, "Having this type of impact on a person, is one of my greatest professional accomplishments."

Carium established its program to regularly bring in people that have been patients, to first-hand share their unfiltered experience. Their stories inspire our team to continue to improve, innovate, and develop with the patient at the center. Here is Mark's story about being an active participant in his recovery, empowered by data, technology and the connection to his care team.



Mark Reid
Chief Revenue Officer at Brilent

MAR 19

Mark Reid · 10:19 am
Hi Michael,
I am a recent patient and used Carium.
I would like to connect. Best, Mark

Michael Hatfield · 10:20 am
HI Mark,

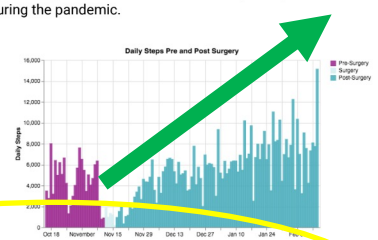
Thanks for reaching out. How was your experience with Carium?

Mike

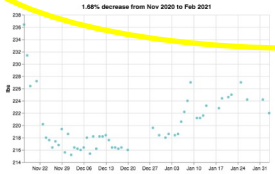
Once discharged from the hospital, Mark followed the instructions provided to him by the Perfect Care team - via the mobile app. He took his blood pressure readings and stepped on his digital scale daily at home. His steps, sleep, and resting heart rate were automatically shared with his Clinical Nurse Navigator, Shannon Crotwell, RN BSN CCRN. He also sent her images of his wound from the incision, asked questions, read learning content about the recovery process, and weekly they also connected via video. All of this was done from a single telehealth platform.

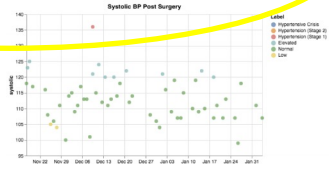
Mark was also provided a home care nurse, but after the first visit, he let the care team know he preferred the convenience of connecting virtually with Shannon on Carium, especially with the risks of having someone in his home during the pandemic.

In the first week post heart surgery, a person's weight is an important metric to monitor because a sudden increase is often a sign of fluid retention. As time goes on, the activity metrics are a good indicator of a successful recovery.



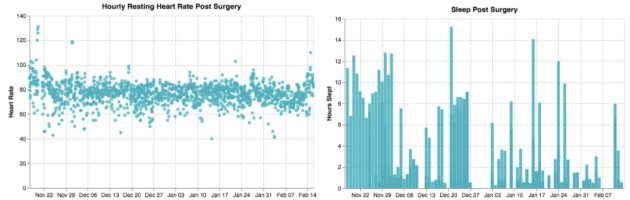
The ability to see his data, coupled by the consistent virtual management from the Perfect Care team made a big difference for Mark. "Having the data in front of me helped me know I was okay," he remarked. "It also gave my wife peace-of-mind knowing I was being monitored and cared for virtually by my care team. It was like having the 'What to Expect, When Your Expecting Guide', but catered to post heart surgery."

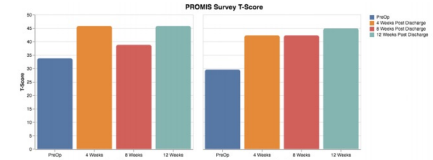


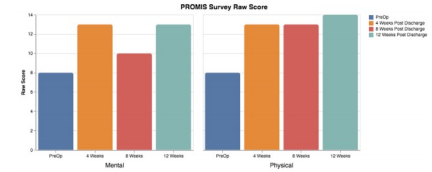


Now, four months later, Mark just walked 2.31 miles — and that hill is no longer dubbed Mount Kilimanjaro.

Stories like Mark's inspire and motivate our team to continue on our mission to digitally transform healthcare.







Technologic Transformation of Perioperative Cardiac Care and Outcomes

Kevin W. Lobdell, MD,[1] Shannon Crotwell, BS, CCRN,[1] John Frederick, MD,[1] Larry T. Watts, MD,[1] Bradley LeNoir, MD,[1] Eric R. Skipper, MD,[1] Thomas Maxey, MD,[1] Gregory B. Russell, MS,[2] Robert Habib, PhD,[3] and Geoffrey A. Rose, MD[1]

ABSTRACT

BACKGROUND The "Perfect Care" initiative engages, educates, and enrolls adult cardiac surgery patients into a comprehensive program that incorporates remote perioperative monitoring (RPM). This study investigated the impact of RPM on postoperative length of stay, 30-day readmission and mortality, and other outcomes.

METHODS This quality improvement project compared outcomes in 354 consecutive patients who underwent isolated coronary artery bypass and who were enrolled in RPM between July 2019 and March 2022 at 2 centers against outcomes in propensity-matched control patients from a pool of 1301 patients who underwent isolated coronary artery bypass from April 2018 to March 2022 without RPM. Data were extracted from The Society of Thoracic Surgeons Adult Cardiac Surgery Database, and outcomes were analyzed according to its definitions. RPM used perioperative standard practice routines, a digital health kit for remote monitoring, a smartphone application and platform, and nurse navigators. Propensity scores were generated with RPM as the outcome measure, and a 2:1 match was generated using a nearest-neighbor matching algorithm.

RESULTS Patients who underwent isolated coronary artery bypass and who were participating in RPM showed a statistically significant, 15.4% (1 day) reduction in postoperative length of stay ($P < .0001$) and a 44% reduction in 30-day readmission and mortality ($P < .039$) compared with matched control patients. Significantly more RPM participants were discharged directly home instead of to a facility (99.4% vs 92.0%; $P < .0001$).

CONCLUSIONS The RPM platform and associated efforts to engage and monitor adult cardiac surgery patients remotely is feasible, is embraced by patients and clinicians, and transforms perioperative cardiac care by significantly improving outcomes and reducing variation.

(Ann Thorac Surg 2023;116:413-20)

Heart disease is the most common cause of death in the United States and results in nearly 700,000 deaths annually.[1] The Society of Thoracic Surgeons (STS) Adult Cardiac Surgery Database records approximately 295,000 cardiac surgical procedures each year, and these procedures are associated with a mortality rate ranging from 1% to 10% and an incidence of complications ranging from 33% to 54%. Complications diminish quality of life and life expectancy, prolong hospital length of stay, and increase readmissions while simultaneously increasing health care costs.[1-4]

As a result of the impact of complications and myriad operational variables, traditional cardiac surgery quality improvement efforts have successfully focused on structure, process, and actions—such as early extubation, goal-directed therapy, glycemic control, blood management, and communication—to mitigate the risk of death and complications.[5-7] More recently, interest

The Supplemental Tables can be viewed in the online version of this article [https://doi.org/10.1016/j.athoracsur.2023.03.024] on http://www.annalsthoracicsurgery.org.

How Can Technology Transform Perioperative Cardiac Care and Outcomes?

STUDY POPULATION

354 consecutive, isolated coronary artery bypass patients

708 propensity-matched controls

INTERVENTION

Remote perioperative monitoring

OUTCOMES

↓**15.4%** 1-day reduction in postoperative length of stay (p<0.0001)

↓**44%** Reduction in 30-day readmissions + mortality (p<0.039)

Remote perioperative monitoring of cardiac surgery patients is associated with shorter postoperative length of stay and fewer 30-day readmissions + mortality

THE ANNALS OF THORACIC SURGERY

Official Journal of The Society of Thoracic Surgeons and the Southern Thoracic Surgical Association

Lobdell et al, 2023

@annalsthorsurg #TSSMN

#VisualAbstract

#AnnalsImages

Remote monitoring following adult cardiac surgery: A paradigm shift?

Kevin W. Lobdell, MD,[a] Shannon Crotwell, BS, CCRN,[a] Larry T. Watts, MD,[a] Bradley LeNoir, MD,[a] John Frederick, MD,[a] Eric R. Skipper, MD,[a] Gregory B. Russell, MS,[b] Robert Habib, PhD,[c] Thomas Maxey, MD,[a] and Geoffrey A. Rose, MD[a]

ABSTRACT

Background: The Perfect Care (PC) initiative engages, educates, and enrolls adult cardiac surgery patients into a transformational program that includes an app for appointment scheduling, tracking biometric data and patient-reported outcomes, audiovisual visits, and messaging, paired with a digital health kit (consisting of a fitness tracker, scale, and sphygmomanometer). PC aims to reduce postoperative length of stay (LOS) as well as 30-day readmission and mortality.

Methods: This was a retrospective review of patients who underwent coronary artery bypass (CAB), valve, or combined CAB and valve procedures at either of the 2 participating hospitals between April 2018 and March 2022. Patients who participated in the PC quality improvement initiative were compared to propensity-matched controls (1:1 matching). The evaluation focused on postoperative LOS and a novel composite measure comprising 30-day readmission and mortality.

Results: Remote monitoring (PC) was associated with a shorter postoperative LOS, lower combined rate of 30-day readmission and mortality, and less variation compared to matched non-PC controls.

Conclusions: Integrated improvements in postoperative remote monitoring of adult cardiac surgery patients may reduce time in the hospital and post-acute care facilities. Future prioritized efforts include the development of additional, personalized biometric monitoring devices, use of biometric data to augment risk assessment, and investigation of the value of remote monitoring on various patient risk profiles to address potential disparities in care. (JTCVS Open 2023;■:1-11)

Perfect Care includes an app and digital health kit for remote patient monitoring.

CENTRAL MESSAGE

The Perfect Care platform proposes a potentially transformational approach to engaging, remotely monitoring, and managing adult cardiac surgery patients after discharge to improve outcomes.

PERSPECTIVE

Cardiac surgery is common, costly, and risky. Despite continuous improvement efforts, considerable opportunities remain to reduce the time that patients are hospitalized and visit clinics and emergency departments, as well as to mitigate the risk of readmission and early mortality. Digital health technologies and novel care routines promise a paradigm shift in the delivery of high-quality cardiac care.

See Commentary on page XXX.
See Discussion on page XXX.

JTCVS OPEN @AATSJournals

Remote Monitoring Following Adult Cardiac Surgery: A Paradigm Shift?

STUDY POPULATION		INTERVENTION
649 CAB, valve, and CAB + valve patients	**649** Propensity-matched controls	Remote perioperative monitoring

OUTCOMES

19.4% PLOS ↓	**37% Readmissions + Mortality** ↓	**No disparities in outcomes associated with remote perioperative monitoring**
Mean 1.2-day reduction in postoperative length of stay *P* < .001	**Mean reduction in 30-day readmissions + mortality OR: 0.60; 95% CI (0.37, 0.95)**	

Remotely monitored patients experienced a shorter PLOS and lower composite rate of 30-day readmissions + mortality, without racial disparity

CAB, coronary artery bypass; CI, confidence interval; OR, odds ratio; PLOS, postoperative length of stay

IMPACT

1000 Consecutive Remotely Monitored Patients

Table 2: Outcomes after cardiac surgical procedures (STS Definitions)

Outcome	Non-PC (n=1000)	PC (n=1000)	p-value
Complications			
Stroke	12 (1.2%)	6 (0.6%)	0.17
Reoperation	33 (3.3%)	26 (2.6%)	0.36
DSWI	0	0	>0.99
ARF	13 (1.3%)	10 (1.0%)	0.53
Prolonged Ventilation	52 (5.2%)	36 (3.6%)	0.14
Total LOS, d			
Mean ± SD	9.7 ± 8.9	8.4 ± 5.9	<0.0001
Median (IQR)	8 (5, 11)	7 (5, 10)	<0.0001
Postoperative LOS, d			
Mean ± SD	7.4 ± 7.9	6.3 ± 4.8	0.0002
Median (IQR)	6 (5, 7)	5 (4, 7)	<0.0001
Readmission Rate (%), Mean ± SD	7.0 ± 0.8	4.7 ± 0.7	0.027
Mortality Rate (%), Mean ± SD	1.4 ± 0.4	0	0.0001
30-day Readmission + Mortality (%), Mean ± SD	8.1 ± 0.9	4.7 ± 0.7	0.0020

Abbreviations: ARF, acute renal failure; DSWI, deep sternal wound infection; LOS, length of stay; PC, Perfect Care; STS, Society of Thoracic Surgery

Table 3: Discharge destination after mixed cardiac procedures

Discharge location, %	Non-PC (n=989)[a]	PC (n=1000)	p-value
Home	92.2	97.8	<0.0001
Extended care-transitional care unit	6.4	1.9	<0.0001
Other acute care hospital	0.4	0	0.061
Nursing home	0.6	0.3	0.33
Left against medical advice	0.4	0	0.061

[a]11 patients died prior to discharge and were not included in this analysis

Impact Analysis

Atrium Health

DISCLAIMER: The intended use of the Dashboard information is for internal use ONLY. It is not to be distributed or published external to the participating organization. This confidential document contains competitive healthcare information pursuant to N.C. Gen Stat. 131-97.3 and is not a public record.

Date of Surgery

7/1/2019 — 7/31/2023

PC_Label

- Select all
- Non-PC
- PC

Status	# Encounters
Urgent	1773
Emergent Salvage	33
Emergent	306
Elective	2358
	3
Total	**4473**

Hospital Name	# Encounters
Carolinas Medical Center - Pineville	1002
Carolinas Medical Center - Northeast	1197
Carolinas Medical Center	2274
Total	**4473**

Procedure Type	# Encounters
AV Replacement	309
AV Replacement + CAB	154
AV Replacement + MV Replacement	39
CAB Only	2104
MV Repair	133
MV Repair + CAB	14
MV Replacement + CAB	70
MV Replacement Only	271
Other	1379
Total	**4473**

Predicted Morbidity or Mortality RANGE	MEAN pt age	# Encounters	MEAN LOS- Admit:OR	MEAN LOS- OR:DC	MEAN LOS- Admit:DC	% Readmit
<15% (Low)	**63.56**	**2352**	**2.00**	**6.31**	**8.30**	**5.23%**
Non-PC	64.17	1331	2.07	6.63	8.69	6.09%
PC	62.77	1021	1.91	5.88	7.79	4.11%
15%-30% (Mod)	**66.60**	**508**	**3.66**	**10.24**	**13.90**	**10.83%**
Non-PC	67.28	349	3.83	11.24	15.07	10.89%
PC	65.11	159	3.30	8.03	11.33	10.69%
> 30 % (High)	**64.03**	**195**	**6.56**	**18.04**	**24.59**	**15.38%**
Non-PC	64.29	152	7.06	20.47	27.53	19.08%
PC	63.12	43	4.79	9.44	14.23	2.33%
No Risk Score	**58.27**	**1418**	**4.38**	**12.65**	**16.99**	**11.57%**
Non-PC	58.31	1193	4.97	13.61	18.54	11.74%
PC	58.08	225	1.24	7.58	8.82	10.67%
Total	**62.25**	**4473**	**3.14**	**9.27**	**12.40**	**8.32%**

5964

Avoided Days (...

(Estimated 2d LOS on...

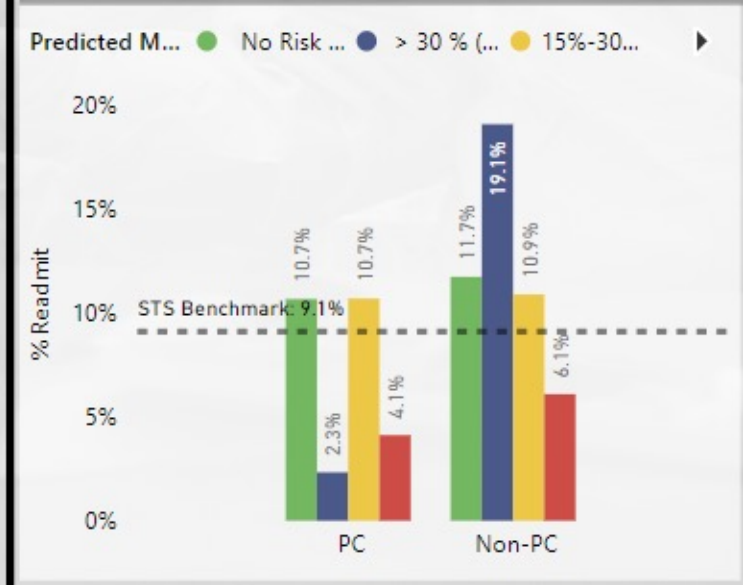
$6,3...

$Saved (Avoide...

Predicted Morbidity or M...

- Select all
- <15% (Low)
- 15%-30% (Mod)
- > 30 % (High)
- No Risk Score

Analysis Below limited to 7/2/2019 to most current



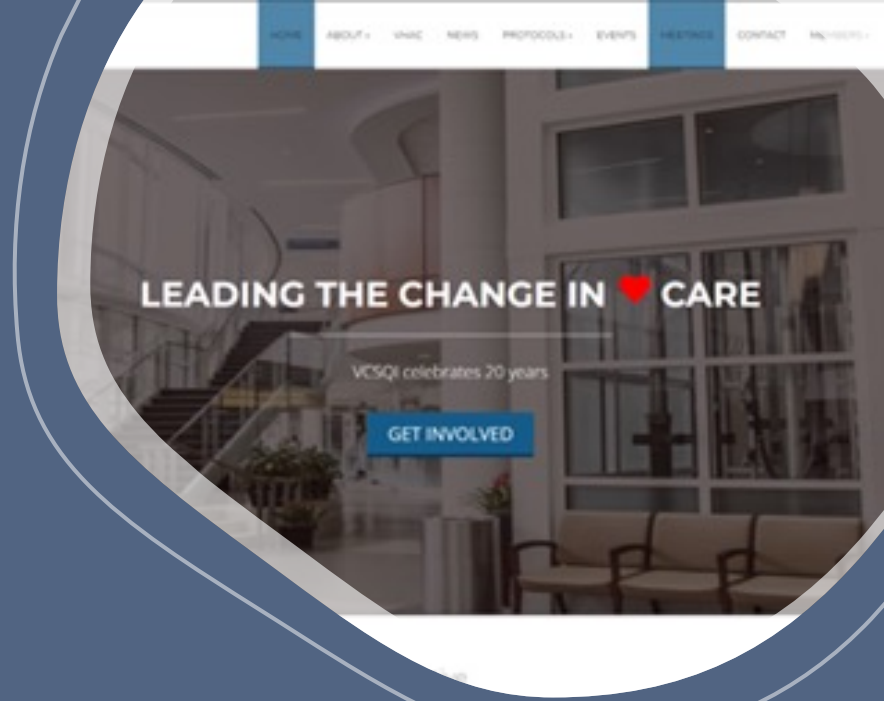
204

Avoided Readmissions

(Estimated 2d LOS on Readmit)

$3,157,3...

$Avoided Readmissions



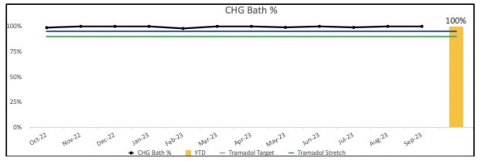
Perfect Care Impact Network

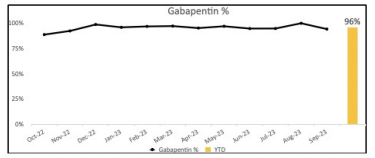
PSO protected collaboration: Advocate (5/15), VCSQI (17) & MCSQI (11)

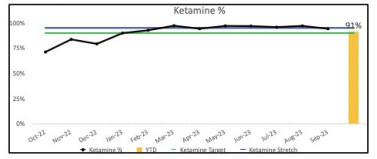
Workgroups

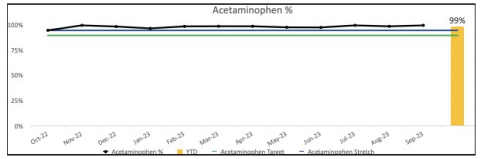
1. Informatics
2. GDP & GDT
3. Readmissions

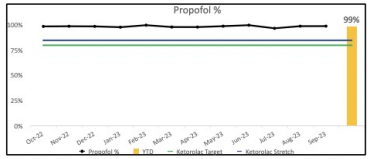
	2023 Target	2023 Stretch	YTD	Oct-22	Nov-22	Dec-22	Jan-23	Feb-23	Mar-23	Apr-23	May-23	Jun-23	Jul-23	Aug-23	Sep-23	YTD	
Total Patients				80	92	82	99	96	108	105	101	95	96	101	104	1159	
CHG Bath %	90%	95%	100%	98.75%	100.00%	100.00%	100.00%	97.92%	100.00%	100.00%	99.01%	100.00%	98.96%	100.00%	100.00%	99.57%	
Gabapentin %	watch	watch	96%	88.75%	92.39%	98.78%	95.96%	96.88%	97.22%	95.24%	97.03%	94.74%	94.79%	100.00%	94.23%	95.60%	
Ketamine %	90%	95%	91%	71.25%	83.70%	79.27%	89.90%	92.71%	97.22%	94.29%	97.03%	96.84%	95.83%	97.03%	94.23%	91.37%	
Acetaminophen %	90%	95%	99%	95.00%	100.00%	98.78%	96.97%	98.96%	99.07%	99.05%	98.02%	97.89%	100.00%	99.01%	100.00%	98.62%	
Propofol %	80%	85%	99%	98.75%	98.91%	98.78%	97.98%	100.00%	98.15%	98.10%	99.01%	100.00%	96.88%	99.01%	99.04%	98.71%	
Ondansetron %	95%		70%	75.00%	81.52%	69.51%	55.56%	72.92%	64.81%	63.81%	80.20%	69.47%	61.46%	66.34%	75.96%	69.54%	
Mobility POD 1 Compliance	90%	95%	73%	68.75%	73.33%	66.67%	69.07%	72.92%	65.42%	69.90%	82.47%	78.72%	72.63%	78.00%	78.85%	73.16%	Up to, Ambulate, Stand X1, chair
Mobility POD 2 Compliance	90%	95%	83%	76.92%	90.22%	71.95%	80.61%	81.91%	81.48%	81.90%	90.00%	83.16%	82.11%	91.09%	82.69%	83.07%	
Mobility POD 3 Compliance	90%	95%	77%	61.54%	81.52%	65.85%	75.51%	73.40%	79.61%	72.12%	78.00%	83.16%	78.95%	90.00%	79.81%	77.03%	Up to, Ambulate, Stand X2, chair
Blood Glucose <200 am POD0 %				95.00%	93.48%	87.80%	87.88%	92.71%	90.74%	90.48%	82.18%	91.58%	86.46%	88.12%	92.31%	89.82%	
Blood Glucose <200 am POD1 %				100.00%	95.65%	97.56%	96.97%	100.00%	100.00%	97.14%	98.02%	98.95%	98.96%	99.01%	97.12%	98.27%	
CI >= 2.2 %				77.94%	90.12%	90.54%	88.75%	78.21%	85.71%	87.50%	86.81%	88.10%	87.50%	83.84%	88.76%	86.26%	
Temp >= 36 %				73.97%	81.18%	78.75%	74.44%	86.21%	78.64%	67.35%	72.04%	78.16%	77.27%	73.00%	72.22%	75.98%	

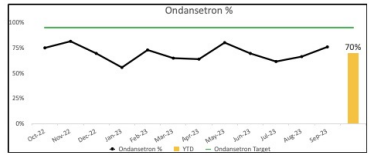


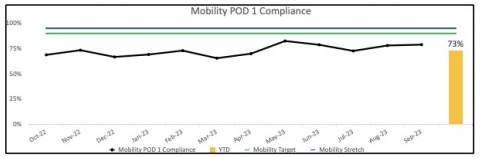


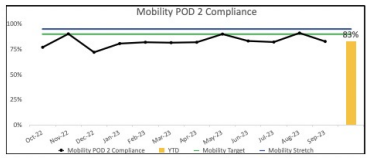


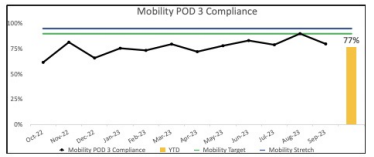


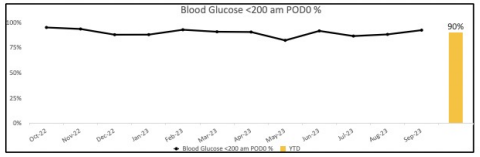


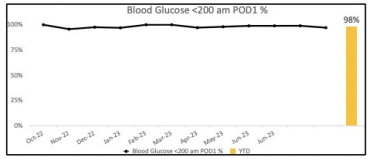


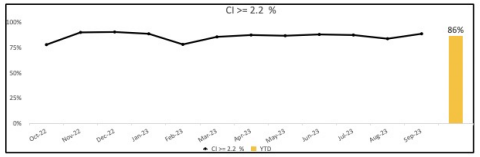


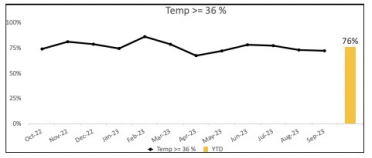












Drainology Survey

Review Article

Innovations
2023, Vol. 00(0) 1–8
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SAGE

Chest Tube Management: Past, Present, and Future Directions for Developing Evidence-Based Best Practices

Kevin W. Lobdell[1], MD and Daniel T. Engelman[2], MD

Abstract

In the field of modern cardiothoracic surgery, chest drainage has become ubiquitous and yet characterized by a wide variation in practice. Meanwhile, the evolution of chest drain technology has created gaps in knowledge that represent opportunities for new research to support the development of best practices in chest drain management. The chest drain is an indispensable tool in the recovery of the cardiac surgery patient. However, decisions about chest drain management—including those about type, material, number, maintenance of patency, and the timing of removal—are largely driven by tradition due to a scarcity of quality evidence. This narrative review surveys the available evidence regarding chest-drain management practices with the objective of highlighting scientific gaps, unmet needs, and opportunities for further research.

Central Message
This review article examines chest tube management over the last 20 years to encourage clinicians to evaluate how they manage chest drains.

Keywords

chest tube drain, cardiothoracic surgery, retained blood syndrome

Introduction

Chest drains have been used for centuries to treat infection, pneumothorax, effusions, and military and civilian thoracic trauma,[1–3] and in the era of modern cardiothoracic surgery, they are a ubiquitous tool for managing shed mediastinal blood, non-bloody effusions, air leaks, and drainage of infected spaces. However, despite their long history of use, chest drains remain "neglected" in a scientific sense. Their use varies widely between and within institutions,[4] governed chiefly by traditions passed down from mentor to trainee or through institutional standards of care. Many of these traditions have not been vetted through the process of evidence generation, systematic review, and creation of evidence-to-decision frameworks.[5–9] Consequently, chest drains are a necessary tool being used within an unnecessarily complicated system rife with variability and unpredictability—a state that is antithetical to delivery of safe, high-quality, value-driven health care.[10,11]

For the cardiac surgeon, the meticulous monitoring and management of chest tube drainage and residual fluid collection is of critical importance to surgical outcomes. While a small volume of residual blood is to be expected within the mediastinum after cardiac surgical procedures, there is growing evidence that some of the complications that arise after cardiac surgery, such as pericardial and pleural effusions, tamponade, and postoperative atrial fibrillation (POAF), correlate with pooling of shed mediastinal blood and persistent exposure to mediators of inflammation.[12–17]

Given the adverse effects associated with retained blood, other fluids, or air in thoracic spaces[12–18] and a lack of high-quality evidence for mitigating these complications, there exists a tremendous opportunity to improve the science and, with it, the consistency, safety, and quality of care and, ultimately, postoperative outcomes. The purpose of this narrative review is to examine the state of the field over approximately the past 20 years and inspire clinicians to think about how they manage chest drains: why they do it the way they do, whether or not there is current evidence to support their practices, and what kinds of data they might contribute to the field that could improve clinical consistency and patient outcomes. We review the key variables and other considerations for the design of robust quality improvement or investigator-initiated studies of

[1]Sanger Heart & Vascular Institute, Atrium Health, Charlotte, NC, USA
[2]Heart & Vascular Program, Baystate Health, University of Massachusetts Medical School – Baystate, Springfield, MA, USA

Corresponding Author:
Kevin W. Lobdell, MD, Sanger Heart & Vascular Institute, Atrium Health, 1237 Harding Place 5th Floor, Innovation Center, Charlotte, NC 28204 USA.
Email: kevin.lobdell@atriumhealth.org

Table 1. Matrix of Research Questions to Establish Best Practices in Chest Tube Management After Cardiac Surgery.

How do these variables:	Affect these outcomes:	When adjusted for these factors?
Drain material	Drainage volume	Patient factors
Drain size	Chest tube occlusion	Functional capacity at presentation
Drain style	Reexploration	Body habitus
Drain number	Pericardial effusion	Underlying disease and comorbidities
Anatomical placement	Pleural effusion	Medication history
Manual manipulation	Tamponade	Other medical risk factors
Active clearance	Postoperative atrial fibrillation	Health literacy
Digital drain systems	Prolonged ventilation	Values and attitudes
Negative pressure	Acute kidney injury	Procedural factors
Chest radiography	Mortality	Surgery type
Chest tube duration	Effluent hematocrit	Urgency
Shared decision making	Inflammatory mediators	Surgical approach
	Surveillance radiography	Concomitant procedures
	Chest tube duration	Pericardial closure
	Pneumothorax	Aortic cross-clamp time
	Intensive care unit length of stay	Cardiopulmonary bypass time
	Hospital length of stay	Transfusions
	Discharge setting	Coagulation status
	Readmissions	Perioperative complications
	Patient reported:	Fluid status
	Pain	Early or late onset of complications
	Sleep	Discharge setting
	Comfort	Length of stay
	Mobility	
	Quality of life	

Table 2. Specific or Surrogate Measures to Consider for Selected Outcomes.

Outcome	Measures
Drainage volume	Total, daily, longitudinal
Retained blood syndrome	Measure individual outcomes for reexploration and interventions for hemorrhage, effusions, and tamponade.
Hemorrhage	Incidence of reexploration for bleeding
Pericardial effusion	Pericardiocentesis
Pleural effusion	Thoracentesis
Tamponade	Pericardial window, pericardiocentesis
Readmissions	30-day and 90-day
Pain	Visual analog scale, numeric analog scale, acute and longitudinal
Comfort	Composite of sleep, mobility/functional status, quality of life
Mobility/functional status	In-hospital ambulation time, discharge destination
Quality of life	Validated instruments for patient-reported outcomes

Research and Writing Committee: Year in Review

Nick Teman, MD

University of Virginia

Committee Chair

Southern Thoracic Surgical Association 2023

MEETING DATES
Nov. 2–5, 2023

EXHIBIT DATES
Nov. 3–4, 2023

70TH STSA ANNUAL MEETING

22. Mechanical Circulatory Support Devices for Post-Cardiotomy Shock – Prevalence and Outcomes From a Decade of Statewide Registry Data

Rahul Rajeev[1], Andrew Phillips[2], Raymond Strobel[3], Alex Wisniewski[3], Andrew Young[3], Clifford Fonner, Alan Speir[4], Nicholas Teman[3], Michael Mazzeffi[5], Mark Joseph[6], Ramesh Singh[4], Daniel Tang[7], Michael Kontos[1], Vigneshwar Kasirajan[1], Mohammed Quader[1]

[1]Virginia Commonwealth University, Richmond, VA; [2]VCU School of Medicine, Richmond, VA; [3]University of Virginia, Charlottesville, VA; [4]Inova Heart and Vascular Institute, Falls Church, VA; [5]University of Virginia Health Systems, Charlottesville, VA; [6]Carilion Clinic, Roanoke, VA; [7]Inova Health System, Fairfax, VA

55. Traveling Long Distances Does Not Impact Operative Mortality in Acute Type A Aortic Dissection

Anthony Norman[1], Raymond Strobel[2], Andrew Young[2], Alex Wisniewski[2], Raza Ahmad[2], Michael Mazzeffi[1], Alan Speir[3], Mohammed Quader[4], Jared Beller[2], Leora Yarboro[2], John Kern[1], Kenan Yount[2], Nicholas Teman[2]

[1]University of Virginia Health System, Charlottesville, VA; [2]University of Virginia, Charlottesville, VA; [3]Inova Heart and Vascular Institute, Falls Church, VA; [4]Virginia Commonwealth University, Richmond, VA

STS Coronary Conference 2023

12:10 p.m.	**Prevalence of Subocclusive Coronary Lesions and the Impact on Radial Artery Utilization** Andrew Young, MD *(Charlottesville, VA, USA)*

Mitral Conclave 2023

AATS MITRAL CONCLAVE
May 4 - 5, 2023 at the New York Hilton Midtown, New York, NY, USA

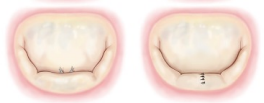
Mitral Valve Repair in a Regional Collaborative: Respect or Resect?

Alex M. Wisniewski, MD[1], Raymond Strobel, MD[1], Anthony Norman, MD[1], Andrew Young, MD[1], Mohammed Quader, MD[2], Kenan Yount, MD[1], Nicholas Teman, MD[1]
[1]Department of Surgery, University of Virginia, Charlottesville, VA, [2]Virginia Commonwealth University, Department of Surgery, Richmond, VA

Objectives

Mitral valve repair is the gold standard for the treatment of degenerative mitral valve disease although multiple repair techniques exist in practice. These may be broadly categorized into leaflet resection (resect) or leaflet sparing (respect) techniques. Proponents of a leaflet sparing approach suggest a decrease in valve stress which may allow for longer-term durability.

Hypothesis:
Over the past decade, leaflet-sparing approaches have become the main repair technique with similar short-term outcomes.



Neochordae

Triangular Resection

Figure adapted from Padala et al. (1)

Methods

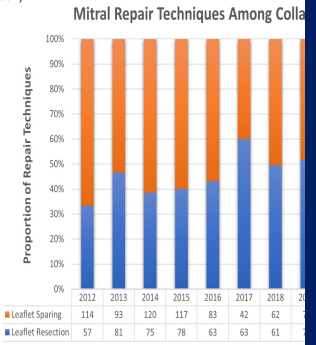
Utilizing the Virginia Cardiac Services Quality Initiative (VCSQI) database which comprises 18 centers performing cardiac surgery across the state of Virginia, we all patients undergoing mitral valve repair identified from January 2012 until December 2002 .

Exclusions: Transcatheter or percutaneous approaches, tumor resection, endocarditis, emergent operation, major concomitant procedures including atrial fibrillation ablation and tricuspid valve intervention.

Statistical Analysis: Continuous variables were analyzed via two-way t-tests, categorical variables via chi-square and Fisher exact testing. Linear regression was used to determine presence of timewise trend in proportion of repair technique. Logistic regression was utilized to determine independent predictors of leaflet-sparing techniques compared to leaflet resection.

Results

- 1658 patients were identified that underwent isolated mitral valve repair from 2010-2022
- 57.2% (948) underwent leaflet sparing technique
- No significant trend over time in proportion of one technique t
  = 0.004)



Results

Baseline Characteristics

- Leaflet sparing approach more often in females (44.0% vs. 34.
  7.3%), more often redo operations (6.4% vs. 2.1%) with higher
  morbidity or mortality (PROMM 8.5% vs. 7.8%) (all p < 0.05)
- Leaflet sparing associated with longer CPB (138 minutes vs. 1
  (96 minutes vs. 90), anterior leaflet prolapse (8.2% vs. 1.2%),
  (75.1% vs. 68.7%) (all p < 0.05)

References

1. Padala, M., et al. (2009). "Mitral valve hemodynamics after repair of acute posterior leaflet prolapse: quadrangular resection
Journal of thoracic and cardiovascular surgery 138 2: 309-315.
2. Sá, M.P., et al., Respect versus resect approaches for mitral valve repair: A study-level meta-analysis. Trends Cardiovasc Me

Funding: T32HL007849 training grant.

Results

Postoperative Outcomes

Disclosures: None

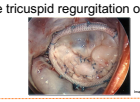
Is Tricuspid Annuloplasty Falling Out of Favor During Mitral Surgery?

Alex M. Wisniewski, MD[1], Raymond Strobel, MD[1], Anthony Norman, MD[1], Andrew Young, MD[1], Mohammed Quader, MD[2], Nicholas Teman, MD[1], Kenan Yount, MD[1]
[1]Department of Surgery, University of Virginia, Charlottesville, VA, [2]Virginia Commonwealth University, Department of Surgery, Richmond, VA

Introduction

Concomitant repair of the tricuspid valve during mitral surgery for degenerative mitral regurgitation remains contentious especially in the case of moderate tricuspid regurgitation or excessive annular dilation. A recent CTSNet trial did not demonstrate a mortality benefit or quality of life improvement to concomitant TA but did demonstrate a significantly higher rate of permanent pacemaker. We sought to identify all patients from a regional collaborative meeting criteria for concomitant tricuspid valve repair during mitral surgery and determine the rate of actual intervention upon the tricuspid valve in those patients given the recent trial results.

Hypothesis:
Following trial publication, we hypothesized that the rate of concomitant tricuspid annuloplasty for the indications of moderate tricuspid regurgitation or annular dilation greater than 40mm would decrease.



Methods

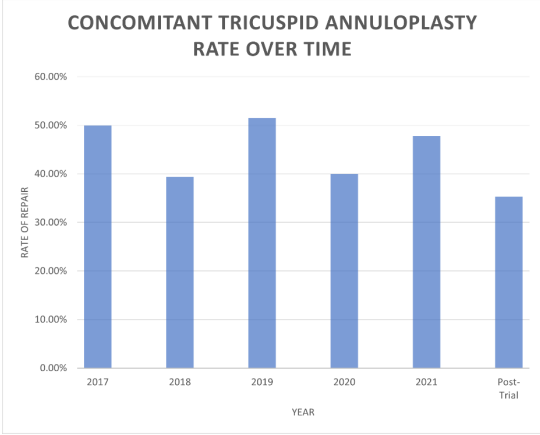
Utilizing the Virginia Cardiac Services Quality Initiative (VCSQI) database which comprises 18 centers performing cardiac surgery across the state of Virginia, all patients undergoing mitral valve repair with concomitant tricuspid annuloplasty from 2017 until present were identified. Our time event was February 22, 2022 when the trial results were published with a 1-month washout period before and after time of publication to account for surgeon practice change.

Exclusions: Those with endocarditis, primary tricuspid regurgitation, severe tricuspid regurgitation, or undocumented degree of tricuspid disease were excluded.

Statistical Analysis: Continuous variables were analyzed via two-way t-tests, categorical variables via chi-square and Fisher exact testing. Linear regression was used to determine presence of timewise trend in rate of tricuspid repair.

Results

- 164 patients met inclusion criteria with 17 (10.4%) patients undergoing surgery in the post-trial period
- Baseline characteristics were similar between both groups with similar age (66 years post-trial vs. 67 years, p=0.97) and no difference in baseline comorbidities or mean predicted risk of mortality (median 0.70% post-trial vs. 0.99%, p=0.51)
- The rate of intervention for tricuspid disease did not differ between the post and pre-trial groups on univariate analysis (35.3% vs. 45.6%, p=0.42)



References

1. Gammie, J.S., et al., *Concomitant Tricuspid Repair in Patients with Degenerative Mitral Regurgitation.* N Engl J Med, 2022. **386**(4): p. 327-339.
2. Pick, Adam. "Tricuspid Valve Repair Surgery." *Heart Valve Surgery*, https://www.heart-valve-surgery.com/tricuspid-valve-repair.php.

Funding: T32HL007849 training grant.

Results

Postoperative Outcomes

- Patients in the post-trial group had similar outcomes of major morbidity including stroke (0.0% post-trial vs. 0.0%, p=1.0), prolonged ventilation (5.9%% post-trial vs. 8.8%%, p=0.68), reoperation for any reason (11.8% post-trial vs. 5.4%, p=0.30), renal failure (0.0% post-trial vs. 3.4%, p=0.44), and similar operative mortality (0.0% vs. 4.8%, p=0.36)
- The rate of permanent pacemaker trended toward a decrease in the post-trial group but did not reach statistical significance (0.0% vs. 6.8%, p=0.27)

Postoperative Outcomes	Pre-trial (n=147)	Post-trial (n=17)	P Value
Mitral Valve Repair	143 (97.28%)	16 (94.12%)	0.473
Atrial Fibrillation Ablation	67 (45.58%)	11 (64.71%)	0.135
Full Sternotomy	104 (70.75%)	11 (64.71%)	0.606
Redo	3 (2.04%)	1 (5.88%)	0.331
Cardiopulmonary Bypass Time (minutes)	160 ± 58	167 ± 60	0.749
Reintubation	8 (5.44%)	1 (5.88%)	0.940
Total Ventilator Hours	59 [35, 118]	90 [28, 123]	0.386
Prolonged Ventilation	13 (8.84%)	1 (5.88%)	0.679
ICU Readmission	2 (1.36%)	1 (5.88%)	0.188
Total ICU Hours	59 [35, 118]	89 [28, 123]	0.356
Postoperative Pacemaker	10 (6.80%)	0 (0.00%)	0.267
Postoperative Stroke	0 (0.00%)	0 (0.00%)	1.000
Postoperative Pneumonia	3 (2.04%)	0 (0.00%)	0.552
Reoperation for Any Reason	8 (5.44%)	2 (11.76%)	0.302
Reoperation for Bleeding	7 (4.76%)	1 (5.88%)	0.839
Reoperation for Valve Dysfunction	0 (0.00%)	1 (5.88%)	**0.003**
Length of Stay (days)	6 [5, 8]	7 [6, 8]	0.385
Postoperative Renal Failure	5 (3.40%)	0 (0.00%)	0.440
Postoperative Dialysis	5 (3.40%)	0 (0.00%)	0.440
Dialysis After Discharge	1 (0.68%)	0 (0.00%)	0.733
Readmission	12 (8.16%)	3 (17.65%)	0.199
Operative Mortality	7 (4.76%)	0 (0.00%)	0.358

Conclusions

- Despite similar degrees of indication for tricuspid intervention in the pre- and post-trial period, there appears to be a slow, non-significant downtrend in the rate of concomitant TA during mitral surgery
- Longer-term data with a larger study power is necessary to elucidate this trend
- Short-term outcomes for concomitant tricuspid annuloplasty during mitral surgery remain reassuring with low morbidity and mortality

Disclosures: None

AATS 2023

L3. ELSO Center of Excellence Award Associated with Lower Failure to Rescue after Cardiac Arrest

May 6, 2023

Presented by:
J. W. Hayanga , Invited Discussant , *West Virginia University*
Raymond Strobel , Abstract Presenter , *University of Virginia*

Source:
103rd Annual Meeting, the Los Angeles Convention Center, Los Angeles, CA, USA
Los Angeles Convention Center, 502B

244. Prevalence and Predictors of Venous Thromboembolism Following Coronary Bypass Surgery

May 8, 2023

Presented by:
Richard J. Shemin , Invited Discussant , *Ronald Reagan UCLA Medical Center*
Alex Wisniewski , Abstract Presenter

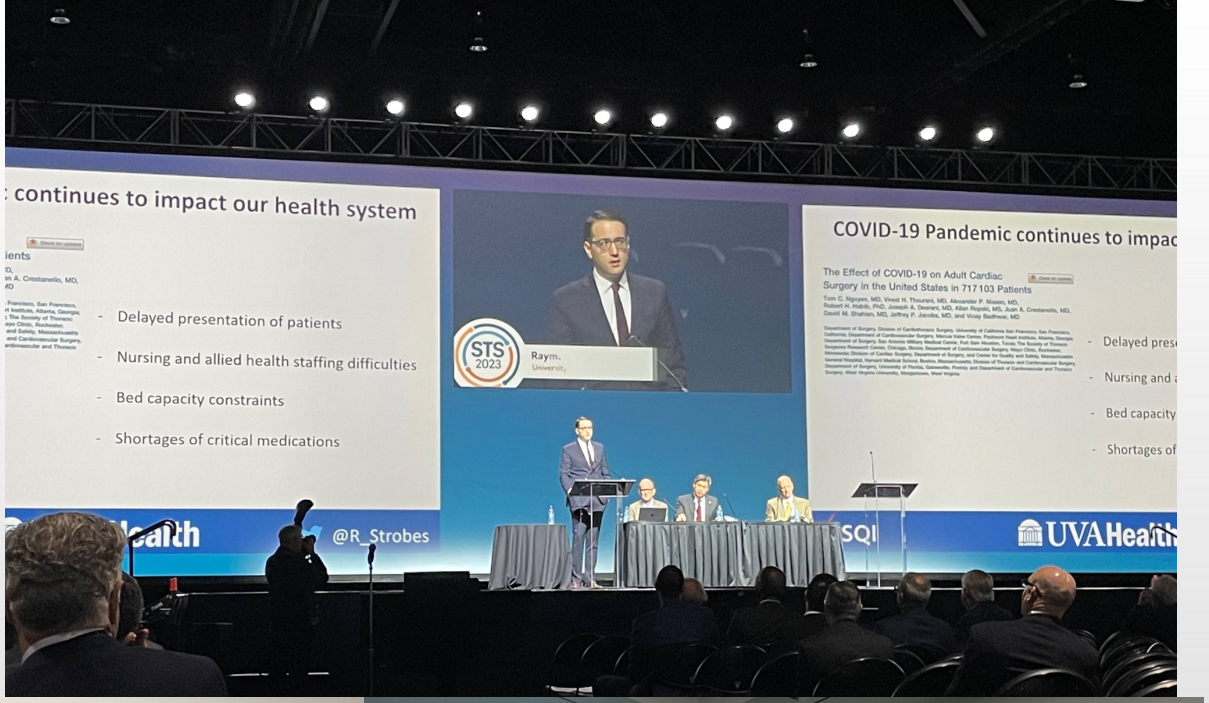
Source:
103rd Annual Meeting, the Los Angeles Convention Center, Los Angeles, CA, USA
Los Angeles Convention Center, 409AB

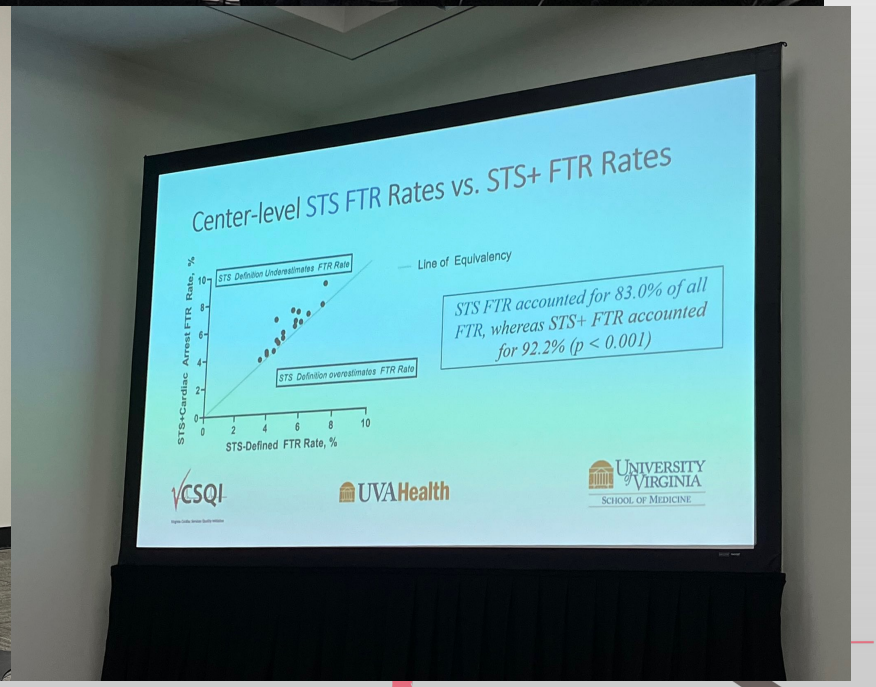
STS 2023

Strobel/Kaplan Covid-19 Outcomes based on socioeconomic status

Strobel STS FTR should include cardiac arrest

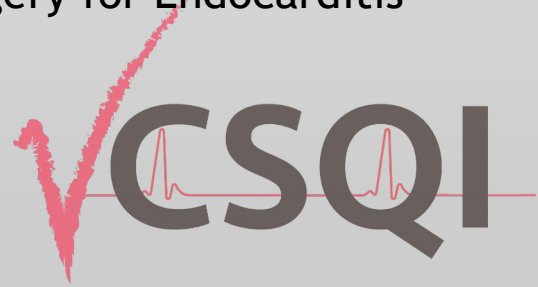
Strobel Center case volume associated with STS FTR





Publications

1. JTCVS 2023 - Postoperative Catheterization Following CABG
2. JTCVS 2023 - Center Case Volume and Failure to Rescue
3. JTCVS 2023 - ELSO Center of Excellence and Failure to Rescue
4. JTCVS Open 2023 - Heart Transplant Allocation Changes
5. Journal of Interventional Cardiology 2023 - Radial Access and AKI
6. Annals of Thoracic Surgery 2023 - COVID-19 and Socioeconomic Status
7. Annals of Thoracic Surgery 2023- Socioeconomic Distress and PCI vs CABG
8. Annals of Thoracic Surgery 2023 – CABG Practice Based on Race
9. Annals of Thoracic Surgery 2023 – STS Definition of Failure to Rescue Should Include Cardiac Arrest
10. Journal of Surgical Research 2023 – Pulmonary Hypertension in Mitral and Coronary Surgery
11. Journal of Surgical Research 2023 – Temporal Analysis of Deep Sternal Wound Infection
12. Seminars in Thoracic and Cardiovascular Surgery 2023 – Socioeconomic Distress and Surgery for Endocarditis



Upcoming Work

- Poster: Does Timing of Intensive Care Unit Arrival Matter in Elective Cardiac Surgery?
  - Wisniewski et al
- Poster: Multi-Institutional Multivariable Model to Predict Intensive Care Unit Length of Stay after Cardiac Surgery
  - Wisniewski et al
- Poster: Impact of Cooling Strategies on Transfusion Requirements in Aortic Hemiarch Surgery
  - Norman et al

Upcoming Work

- 9 Abstracts submitted

Upcoming Work

- MET/RRT Survey
  - Determine association with morbidity, mortality, and failure to rescue

- Call for proposals
  - Deadline January 15th, 2024

Research and Writing Committee

- Monthly meeting 1st Tuesday 5pm
- Research proposal discussion
- Abstract and Manuscript Review
- All are welcome

Perfusion Updates

Eve Dallas, CCP
University of Virginia
Workgroup Champion

New and Ongoing Initiatives

1. Bolstering ECMO data collection:

Currently collected in STS:

ECMO: ☐ Yes ☐ No (If Yes ↓) MCADECMO (3766)	
	ECMO Mode: ☐ Veno-venous ☐ Veno-arterial ☐ Veno-Arterial Venous (VAV) ☐ Veno-venous arterial (VVA) ECMO (3776) ECMO Initiated: ** ☐ Preop ☐ Intraop ☐ Postop ☐ Non-operative ECMOWhen (3780)

2. Perfect Care Network: Goal-Directed Perfusion

3. VCSQI + TVT Data = Patient Risk Model?

4. + !! Q2 2023 Perfusion Metrics

VCSQI Perfusion Group

VCSQI TVT Data: All Cases, 1/1/2021-4/15/2023 (N=2,970)

	All Patients	DC Status: Alive	DC Status: Deceased	p value
N	**2,970**	**2,917**	**53**	
		98.2%	1.8%	
Prior PCI	25.3%	25.4%	18.9%	0.28
Prior CABG	13.5%	13.5%	11.3%	0.64
Prior Other Cardiac Surgery	23.9%	23.6%	45.3%	< 0.001
Carotid Stenosis:				
None	92.9%	92.9%	88.7%	0.23
Right	2.2%	2.2%	1.9%	0.88
Left	2.2%	2.2%	1.9%	0.91
Both	2.7%	2.6%	7.5%	0.03
Peripheral Arterial Disease	20.5%	20.4%	30.2%	0.08
Dialysis	3.6%	3.6%	5.7%	0.42
Chronic Lung Disease:				
None	76.6%	76.7%	69.8%	0.24
Mild	11.5%	11.4%	15.1%	0.41
Moderate	7.7%	7.7%	7.5%	0.97
Severe	4.3%	4.2%	7.5%	0.23
Predicted FEV1 >=65%	41.8%	41.9%	37.9%	0.67
NHYA Class IV	4.5%	4.4%	15.1%	< 0.001
Cardiogenic Shock within Previous 24 Hours	1.3%	1.2%	7.5%	< 0.001
Cardiac Arrest within Previous 24 Hours	0.1%	0.1%	0.0%	0.85
Porcelain Aorta	0.3%	0.2%	3.8%	< 0.001
Inotropes	7.5%	7.3%	17.0%	0.008
Left Main Stenosis >=50%	6.4%	6.4%	6.5%	0.98
Annular Calcification - CTA Findings	33.8%	33.9%	25.0%	0.36
Moderate/Severe Annular Calcification - ECHO Findings	79.7%	79.8%	77.8%	0.83
Moderate/Severe Mitral Regurgitation	0.5%	0.4%	3.8%	< 0.001
Procedural Acuity:				
Elective	81.9%	82.4%	54.7%	< 0.001
Urgent	17.6%	17.3%	35.8%	< 0.001
Emergent	0.3%	0.2%	5.7%	< 0.001
Salvage	0.1%	0.0%	3.8%	< 0.001
Frailty Test Score <50 (More Frail)	47.7%	47.4%	71.4%	0.005
History of A-Fib	41.2%	40.7%	69.8%	< 0.001
Valve in Valve Procedure	7.3%	7.3%	8.3%	0.84
Female Gender	45.2%	44.8%	67.9%	< 0.001
Age ≥ 65	87.6%	87.6%	90.6%	0.51
Diabetes	38.2%	38.4%	28.3%	0.14

VCSQI Perfusion Group

New and Ongoing Initiatives

1. Bolstering ECMO data collection:

Currently collected in STS:

ECMO: ☐ Yes ☐ No (If Yes ↓) MCADECMO (3766)	
	ECMO Mode: ☐ Veno-venous ☐ Veno-arterial ☐ Veno-Arterial Venous (VAV) ☐ Veno-venous arterial (VVA) ECMO (3776) ECMO Initiated: ** ☐ Preop ☐ Intraop ☐ Postop ☐ Non-operative ECMOWhen (3780)

2. Perfect Care Network: Goal-Directed Perfusion

3. VCSQI + TVT Data = Patient Risk Model?

4. + !! Q2 2023 Perfusion Metrics

VCSQI Perfusion Group

Patient Demographics & Characteristics

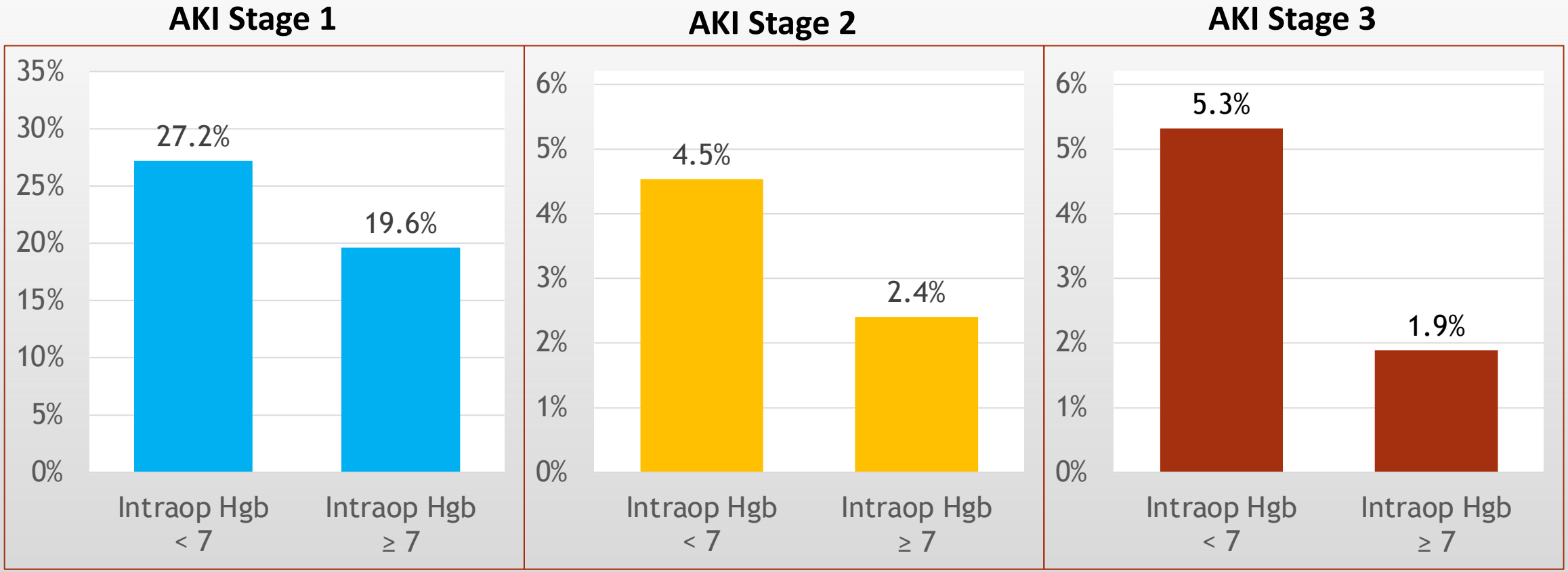
Population: Q3 2020 – Q2 2023	CAB	AVR	AVR + CAB	MVR	MVR + CAB	MVr	MVr + CAB	AVR + MVR	Other	Total
Number of Cases	9,544	770	680	672	189	660	227	137	4,909	**17,788**
Percent of Cases	53.7%	4.3%	3.8%	3.8%	1.1%	3.7%	1.3%	0.8%	27.6%	**100%**
Age (Years, mean)	65.6	59.3	69.3	61.6	67.7	62.0	67.3	60.4	61.5	**64.1**
Female	22.9%	32.1%	19.3%	54.6%	37.6%	41.1%	22.0%	49.6%	36.2%	**29.1%**
Mean BMI (kg/m2, mean)	30.00	30.35	29.71	28.61	27.89	27.02	28.44	29.05	29.68	**29.70**
Diabetes	50.2%	24.3%	51.3%	20.5%	36.0%	8.9%	41.0%	21.9%	24.8%	**39.0%**
Ejection Fraction < 40%	13.7%	7.3%	12.7%	5.4%	19.4%	1.5%	26.1%	6.6%	18.8%	**14.1%**
Bypass Time (Minutes, mean)	96.8	115.8	167.6	142.8	187.9	145.0	178.5	206.6	168.0	**124.1**
Cross Clamp Time (Minutes, mean)	72.8	84.8	133.4	101.2	148.3	102.4	138.5	158.8	121.3	**91.4**
Elective	39.1%	78.4%	63.2%	69.2%	57.7%	88.2%	59.5%	59.1%	53.7%	**49.3%**
Urgent	58.5%	20.1%	36.2%	26.9%	37.0%	11.4%	39.6%	36.5%	30.3%	**44.6%**
Emergent/Salvage	2.5%	1.4%	0.6%	3.9%	5.3%	0.5%	0.9%	4.4%	16.0%	**6.1%**

Legend – Patient Status:

Elective: planned surgery, usually comes from home the day of surgery
Urgent: inpatient who could not wait safely at home for their surgery
Emergent: cannot wait, needs to go to OR now
Salvage: CPR in progress, on induction or ECMO preop

VCSQI Perfusion Group

AKI vs. Intraop Hgb < 7: VCSQI Total, CAB Only, Q3 2021 – Q2 2023 (N = 6,209)



p < 0.001

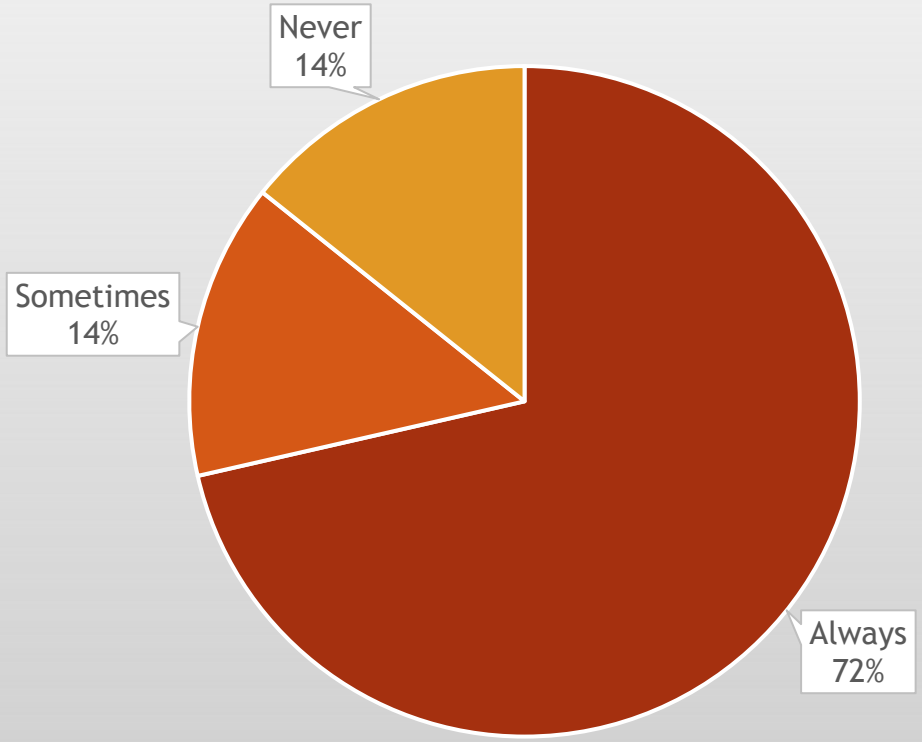
p < 0.001

p < 0.001

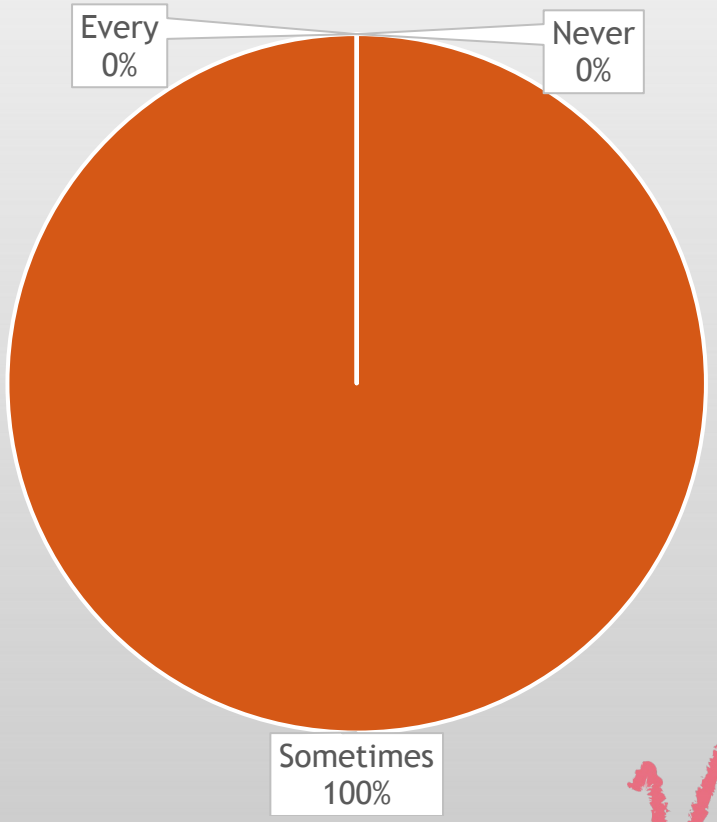
VCSQI Perfusion Group

VCSQI PG – Questions of the Week

Do you use DO2 as a measure of perfusion adequacy on pump (adults)?

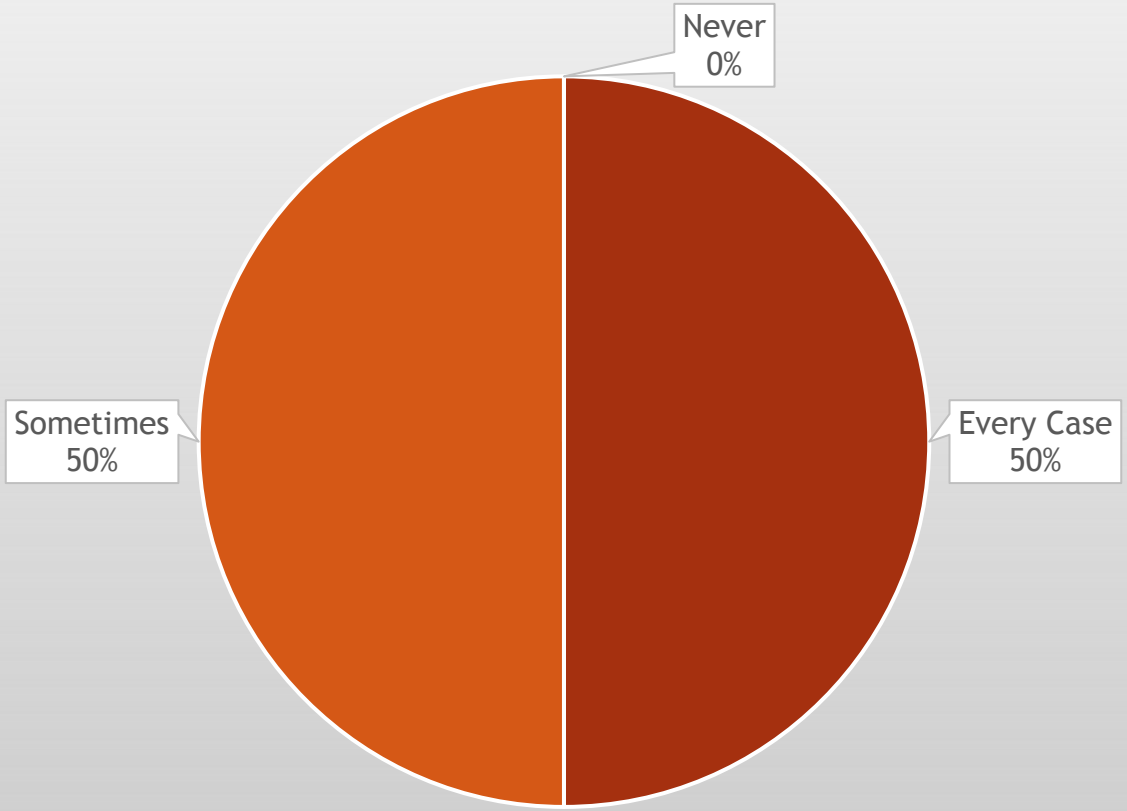


Do you practice ANH (adults)?



This week's question:

Do you measure cerebral oximetry intraoperatively?



VCSQI Quality Initiatives:

Successful integration and implementation of quality improvement strategies improves outcomes and quality measures

Making Strides in Readmission

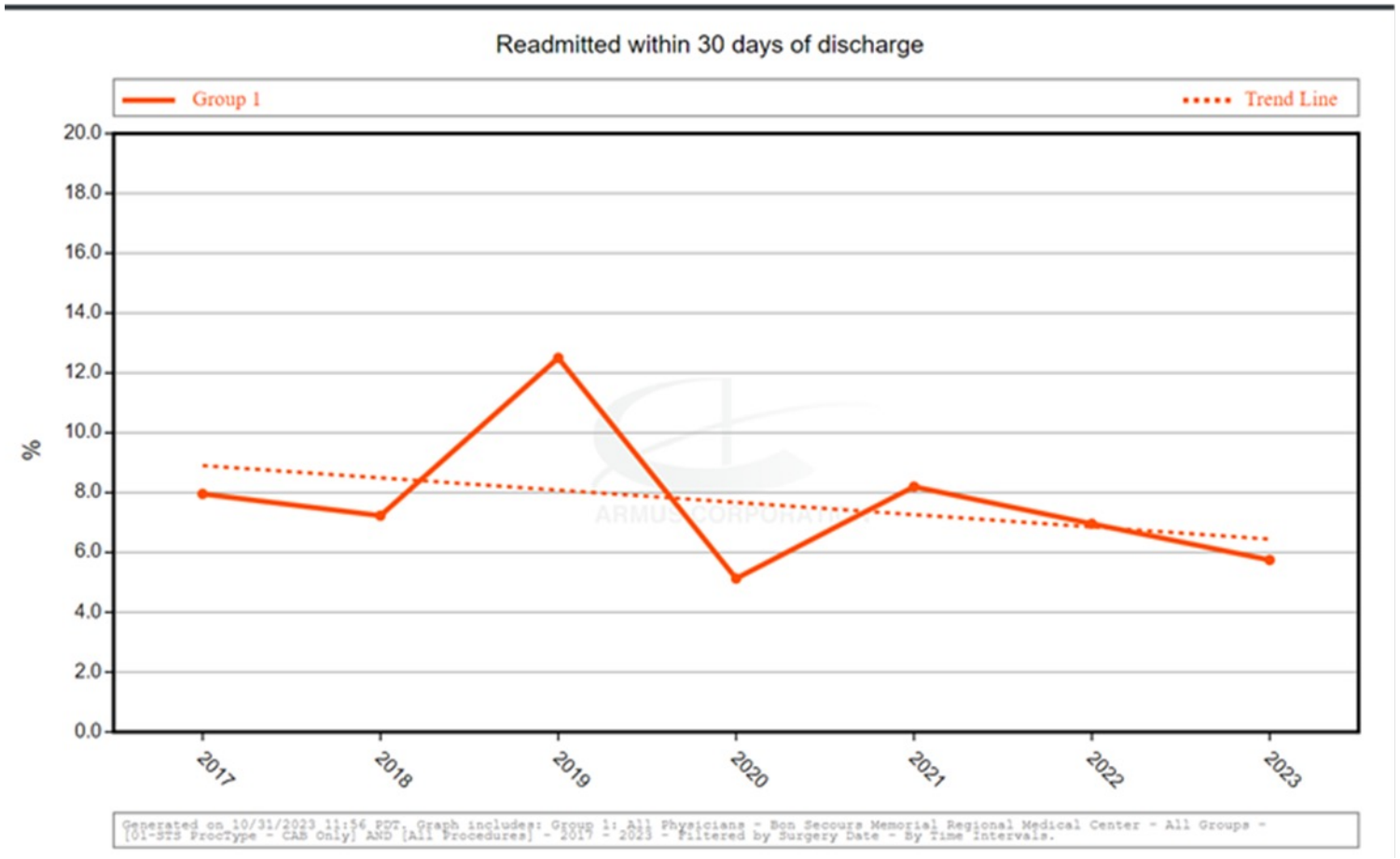
Brody Wehman, MD; Bon Secours MRMC

Meredith Newton, NP; Bon Secours MRMC

Reducing CABG Readmissions at Memorial Regional Medical Center

Brody Wehman, MD

Meredith Newton, NP


Readmitted within 30 days of discharge
Group 1
Trend Line
20.0
18.0
16.0
14.0
12.0
10.0
8.0
6.0
4.0
2.0
0.0
%
2017
2018
2019
2020
2021
2022
2023
Generated on 10/31/2023 11:56 PDT. Graph includes: Group 1: All Physicians - Bon Secours Memorial Regional Medical Center - All Groups - [01-STS ProcType - CAB Only] AND [All Procedures] - 2017 - 2023 - Filtered by Surgery Date - By Time Intervals.

Bon Secours

Timeline of staffing changes

- July 2018 Dr. Wehman comes to MRMC as the full time surgeon
- January 2019 Cardiac Surgery Nurse Navigator added to staff
- November 2019 a NP is added to MRMC cardiac surgery staff
- June 2021 a second NP is added to the cardiac surgery staff at MRMC

Cardiac surgery nurse navigator

- Meets the patient prior to surgery, gives instructions and answers questions
- Goes through discharge instructions and medications with the patient and family just prior to discharge
- Calls the patient the day after discharge

Sternal wound care

- The patient is given written and verbal instructions as well as being sent home with dial soap and CHG
- Prineo dressing is applied to the sternal incision in the OR and removed at the 1 week follow up appointment

Cardiac operations meeting

- All stakeholders attend a monthly meeting to look at the current data on outcomes, complications and discuss any problems/barriers to better care

When patients come to the ER

- Interface with ED and hospitalists to co-manage patient
  - Direct phone number to the ER physician
- Use of observation status when appropriate

Potential barriers

- Budget constraints for new positions
- Engaged team members who want to continuously improve and feel ownership in the program and outcomes
- Administration buy in and support at cardiac ops meetings

Summary

- Dedicated surgeon
- Dedicated APC team
- Nurse navigator
- Engaged cardiac ops team
- Open communication with hospitalists and ER

Bon Secours

Thank you

Successful Integration of AKI Strategies to Improve Outcomes

Mike Brown, CCP

Mary Washington

Successful Integration of AKI Strategies Focusing on VCSQI AKI Recommendation Guidelines to Improve Outcomes

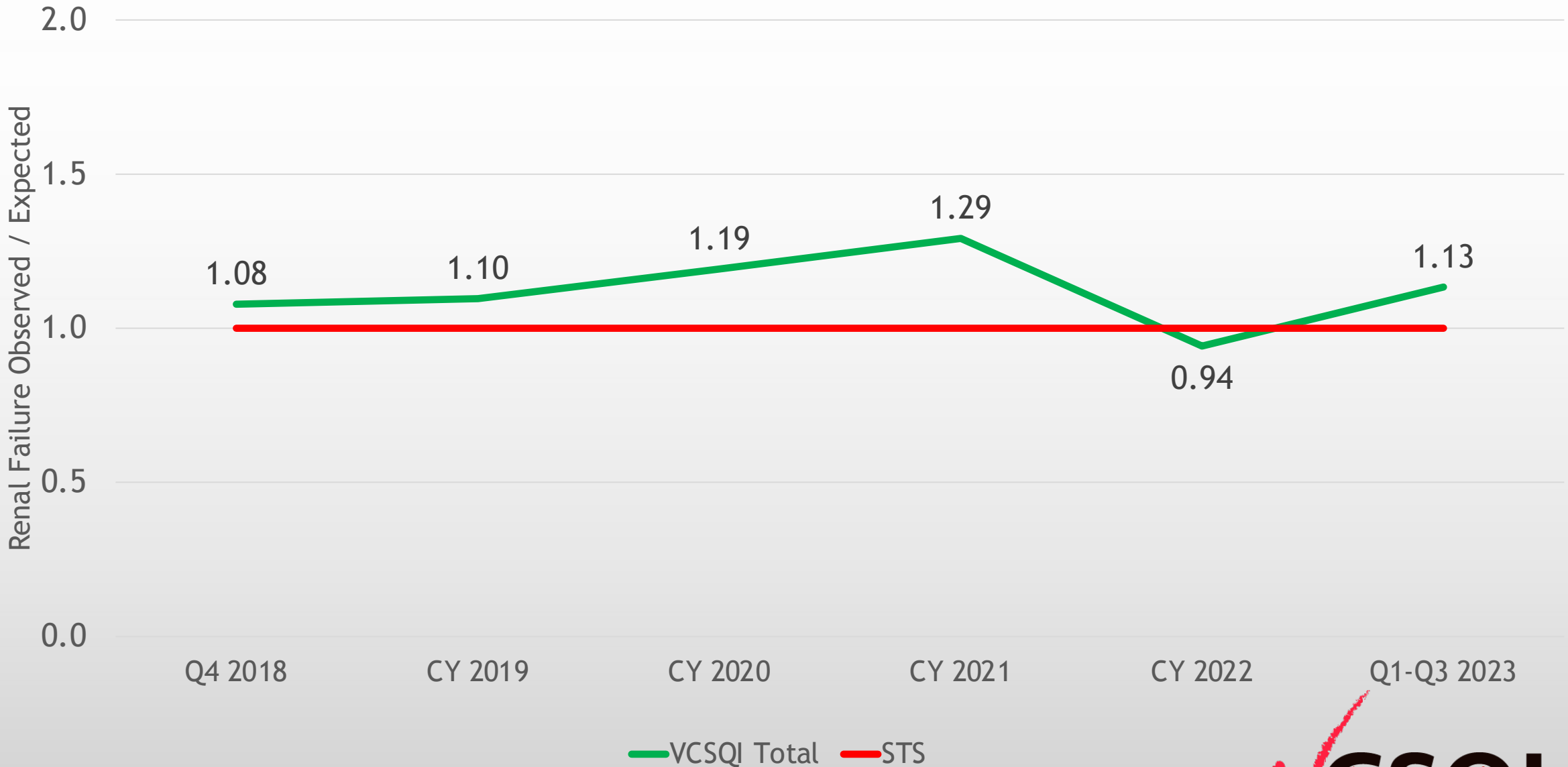
Mike Brown

Mary Washington Healthcare

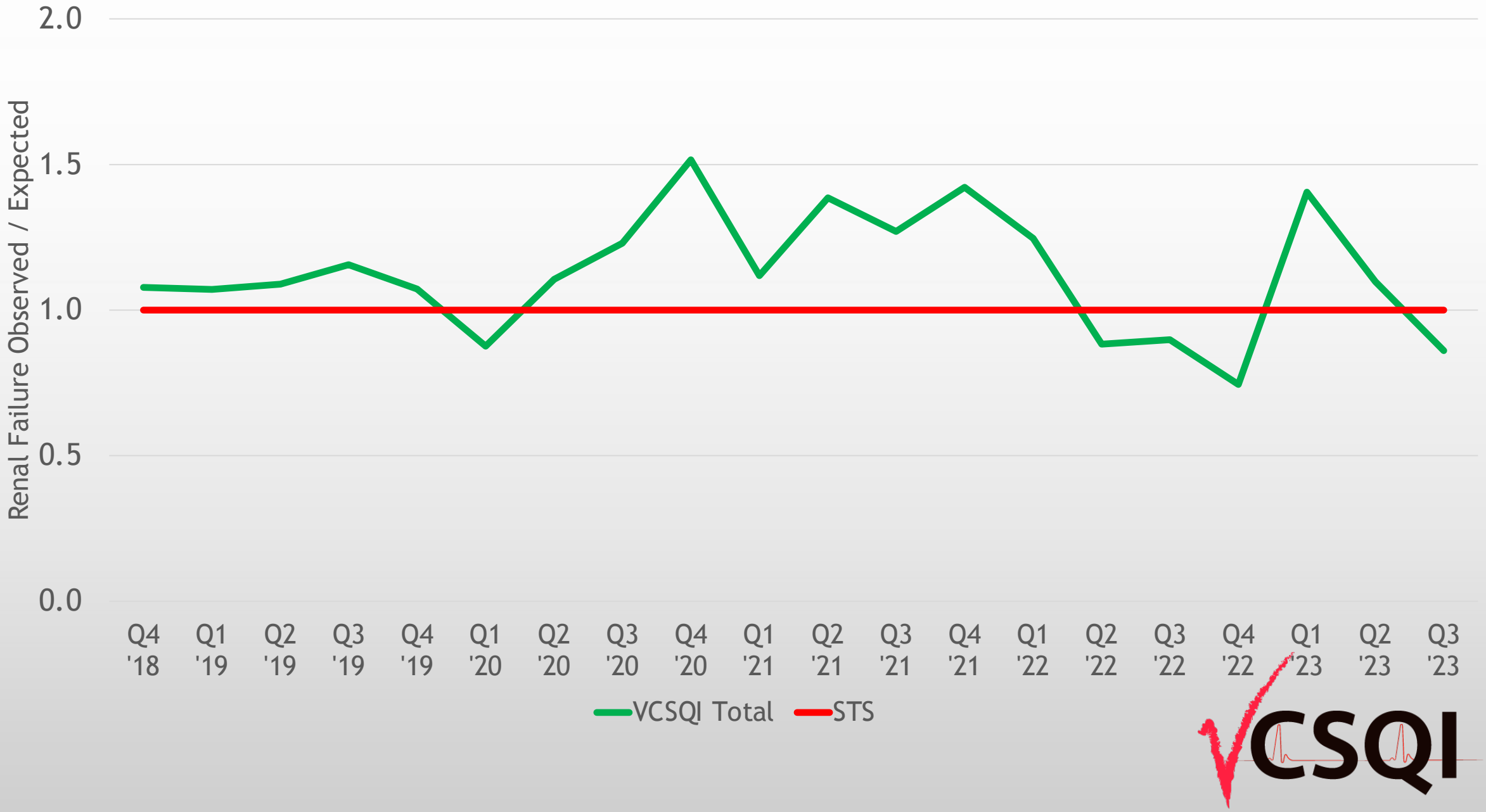
Program Director, Cardiac Surgery/Structural Heart

Chief, Perfusion Services

Renal Failure O/E (Recalibrated) by Year: Isolated CAB, Q4 2018—Q3 2023 (N=15,852)



Renal Failure O/E (Recalibrated) by Quarter: Isolated CAB, Q4 2018—Q3 2023 (N=15,852)



AKI WORKGROUP

AKI Reduction Recommendations and Suggestions for Care

OVERVIEW

The following recommendations were developed within the VCSQI AKI Workgroup.
Champion(s): Michael Brown, CCP (Mary Washington), Chris Sytsma, RN, MSN (Winchester), Nicholas Teman, MD (UVA), Kerry Prewitt, MD (Sentara).

Project Members: Denise Cox (Sentara), Bridget Keeley, CCP (Winchester), Jeff Rich, MD (VCSQI), Judy Smith (UVA), Kevin Lobdell, MD (Perfect Care), Shelley Cahalan (Sentara), LouAnn Janney (Carilion), Emaad Abdel-Rahman, MD (UVA), Christine Kim, MD (VCU), Evelyn Dallas, CCP (UVA)

Recognition and a special thanks to Dr. Matthew Cauchi and members of the Carilion Clinic for laying the foundation in developing AKI recommendations for Cardiology. Additional recognition is due to the members of the Sentara Health System for carrying the torch to enhance Cardiology recommendations.

We are also honored to recognize the input of the VCSQI Perfusion Group for providing guidance in this regard.

The following are the definitions of AKI as presented during the 2021 Winter Quarterly Meeting by Dr. Gregory Dehmer (Carilion) Click here to watch the full presentation.

	NCDR	STS
Source	Derives from the consensus statements formulated by the: • Acute Dialysis Quality Initiative (ADQI) group • American Society of Nephrology (ASN) • ARF Advisory group • International Society of Nephrology (ISN), • National Kidney Foundation (NKF) • Kidney Disease: Improving Global Outcomes group (KDIGO)	Derived from the RIFLE criteria **R**isk, **I**njury, **F**ailure, **L**oss of kidney function, **E**nd-stage renal disease
Definition	An abrupt (within 48 hours) reduction in kidney function currently defined as an absolute increase in serum creatinine of ≥ 0.3 mg/dl (≥ 26.4 µmol/l), a percentage increase in serum creatinine of ≥ 50% (1.5-fold from baseline), or a reduction in urine output (documented oliguria of less than 0.5 ml/kg per hour for > six hours).	Renal failure is defined as sCr levels 4 mg/dL or greater (176.8 mmol/L), a 3x or greater increase in sCr levels over the baseline preoperative value, or a new requirement for dialysis
Reference(s)	• Mehta RL, Kellum JA, Shah SV, et al. Crit Care 2007;11:R31 • Kellum JA, Mehta RL, Angus DC, et al. Kidney Int 2002;62:1855-63	Bellomo R, Ronco C, Kellum JA, Mehta RL, Palevsky P and the Acute Dialysis Quality Initiative (ADQI) workgroup. Crit Care. 2004 Aug; 8(4):R204-12

Where do we start? Ask the difficult questions…

- **What are we currently doing right and wrong?**
  - What does our performance in key contributing indicators look like?
- **Are we doing the small things?**
  - First focus → low hanging fruit
- **Blood conservation: Did we go too far?**
  - Perfusion strategies
  - Intra-Op Fluid Resuscitation Strategy/Guidelines
  - Transfusion Trigger: do we reconsider the high-risk patient population?
- **How do we integrate new strategies post Covid-19?**
  - Changes in staff/travelers → time for restructuring orientation and re-education process

How does hyperglycemia (and hypoglycemia) impact kidney function?

Hyperglycemia and Acute Kidney Injury During the Perioperative Period

Carlos E. Mendez[1] · Paul J. Der Mesropian[1] · Roy O. Mathew[1] · Barbara Slawski[2]

Abstract Hyperglycemia and acute kidney injury (AKI) are frequently observed during the perioperative period. Substantial evidence indicates that hyperglycemia increases the prevalence of AKI as a surgical complication. Patients who develop hyperglycemia and AKI during the perioperative period are at significantly elevated risk for poor outcomes such as major adverse cardiac events and all-cause mortality. Early observational and interventional trials demonstrated that the use of intensive insulin therapy to achieve strict glycemic control resulted in remarkable reductions of AKI in surgical populations. However, more recent interventional trials and meta-analyses have produced contradictory evidence questioning the renal benefits of strict glycemic control. Although the exact mechanisms through which hyperglycemia increases the risk of AKI have not been elucidated, multiple pathophysiologic pathways have been proposed. Hypoglycemia and glycemic variability may also play a significant role in the development of AKI. In this literature review, the complex relationship between hyperglycemia and AKI as well as its impact on clinical outcomes during the perioperative period is explored.

Keywords Hyperglycemia · Perioperative · Postoperative · Acute kidney injury · Inpatient glycemic control · Hypoglycemia · Glycemic variability

This article is part of the Topical Collection on *Hospital Management of Diabetes*

✉ Carlos E. Mendez
carlos.mendez2@va.gov

Paul J. Der Mesropian
Paul.DerMesropian2@va.gov

Roy O. Mathew
Roy.Mathew@va.gov

Barbara Slawski
bslawski@mcw.edu

[1] Albany Stratton VA Medical Center, Albany Medical College, 113 Holland Avenue, Albany, NY 12208, USA

[2] Department of Medicine, Froedtert and Medical College of Wisconsin, 9200 W Wisconsin Ave, Milwaukee, WI 53226, USA

Published online: 20 January 2016

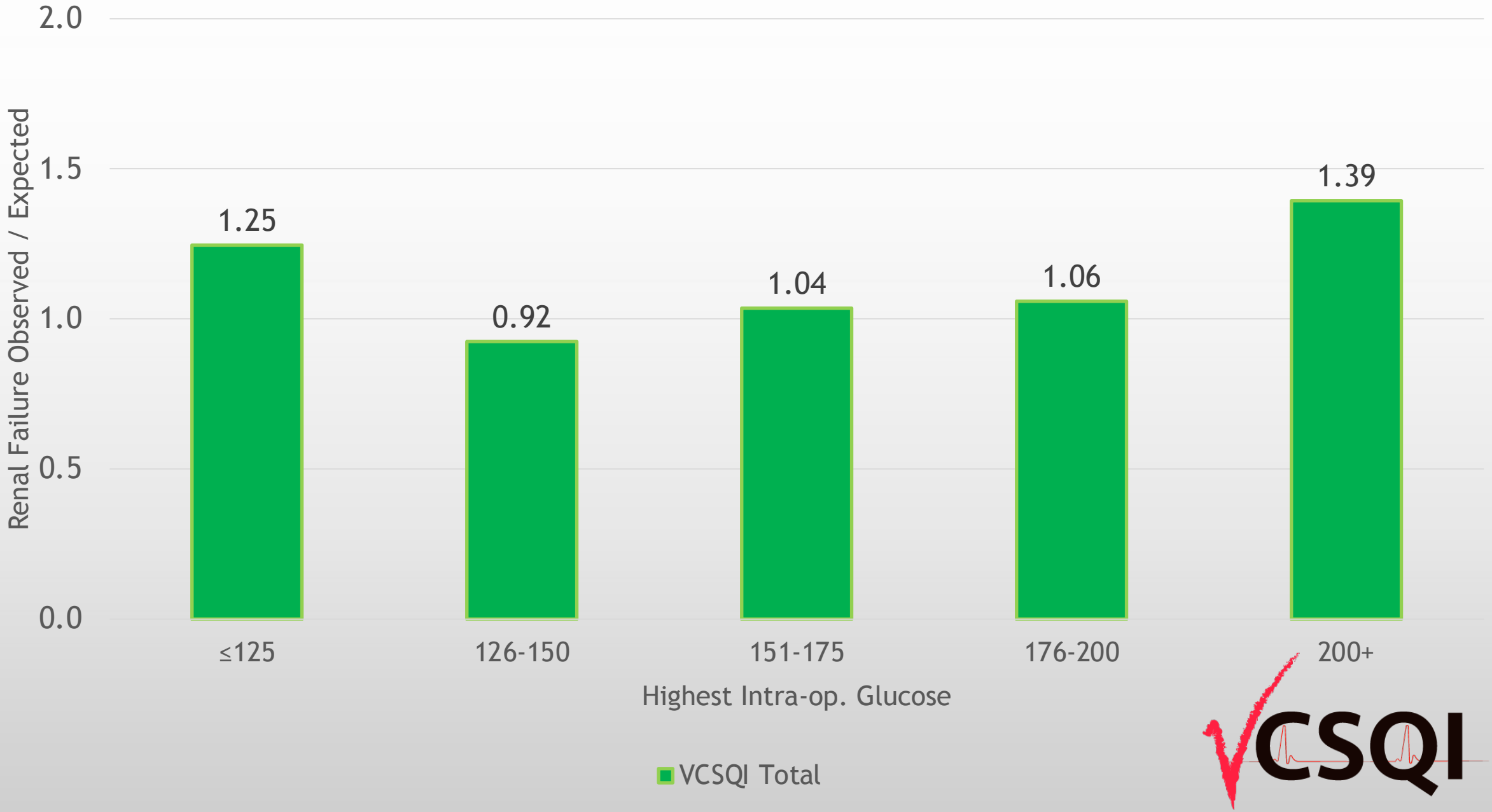
Introduction

Hyperglycemia is frequently seen in the perioperative setting. Whereas it is estimated to be present in 32 to 38 % of overall hospitalized patients [1, 2], in surgical patients, it is found in as many as 40 % of non-cardiac surgeries and 80 % of cardiac surgeries [3, 4••]. Hyperglycemia is directly associated with overall increased morbidity and mortality in hospitalized patients [5], and it has been especially recognized as an important risk factor for postoperative complications in patients with and without a previous history of diabetes [6–9].

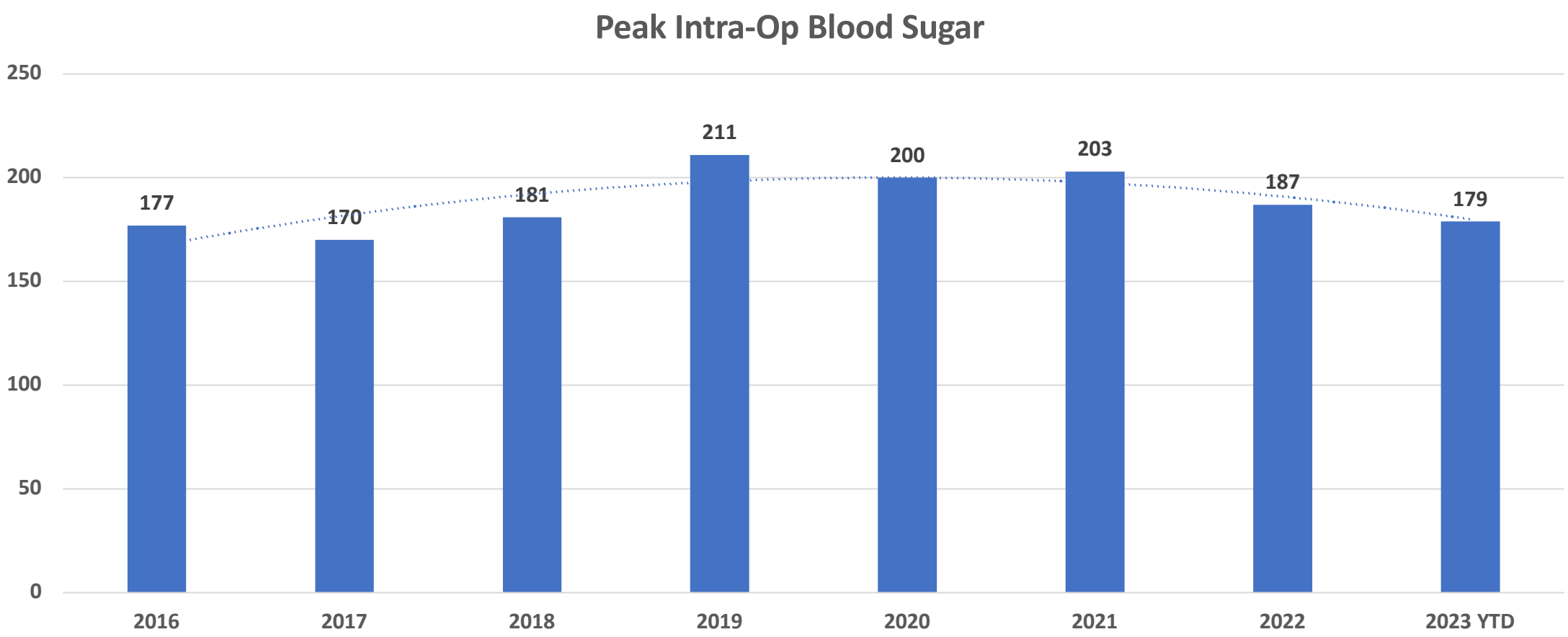
The majority of the clinical evidence on the negative effects of perioperative hyperglycemia comes from studies on cardiac surgical patients. In this setting, perioperative hyperglycemia has been primarily associated with an increased rate of deep sternal wound infections and mortality [10–12]. In addition, perioperative hyperglycemia has also been shown to increase the risks of stroke and systemic blood infections [13], lengths of ventilation and intensive care unit (ICU) stay [14], and acute kidney injury (AKI) during the postoperative period [15]. In non-cardiac surgery patients, studies suggest similar negative effects. Postoperative hyperglycemia has been proposed as the single most important factor associated with increased rate of surgical site infections in general surgical patients [16•]. Additionally, perioperative hyperglycemia has

- Increases activation and production of inflammatory cytokines causing vascular permeability
- Increases production of reactive oxygen species in the mitochondria
- Increases oxidative stress
- Anesthesia → stimulates hyperglycemia, RAS activation, and intrarenal inflammation

Renal Failure O/E vs. Highest Intra-op. Glucose: Isolated CAB, Q4 2018—Q3 2023



Low hanging fruit…



What were the barriers, and did we need to fix?
Keep it simple

Cardiac Surgery Intraop Blood Sugar Algorithm

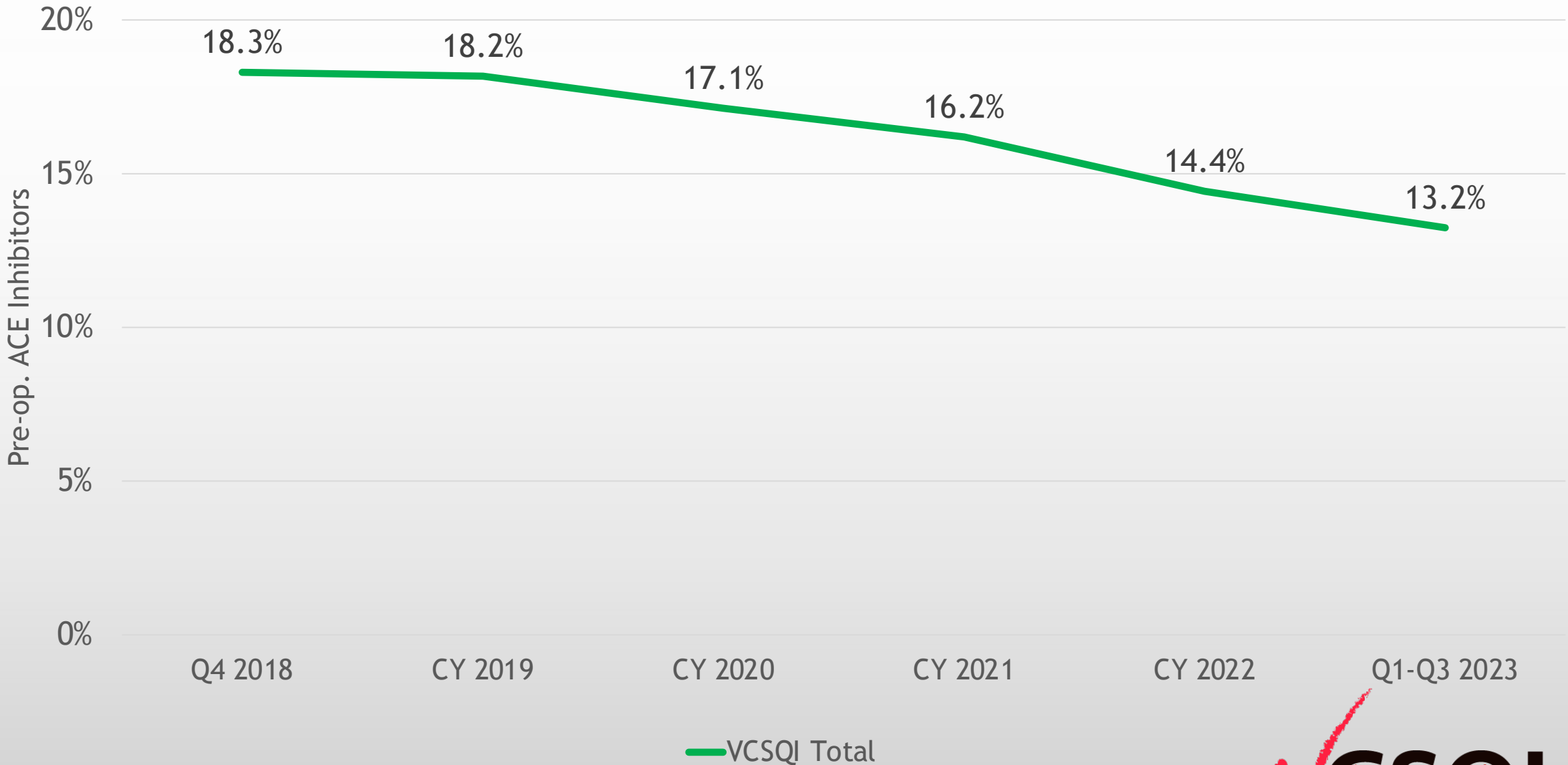
Trigger: Start Insulin infusion when blood glucose ≥ 110mg/dl

BG mg/dl	Bolus	Infusion
110-130	_____	2 unit/hr.
131-150	1 unit	2 unit/hr.
151-180	2 units	3 unit/hr.
181-200	3 units	4 unit/hr.
200-250	4 units	5 units/hr.

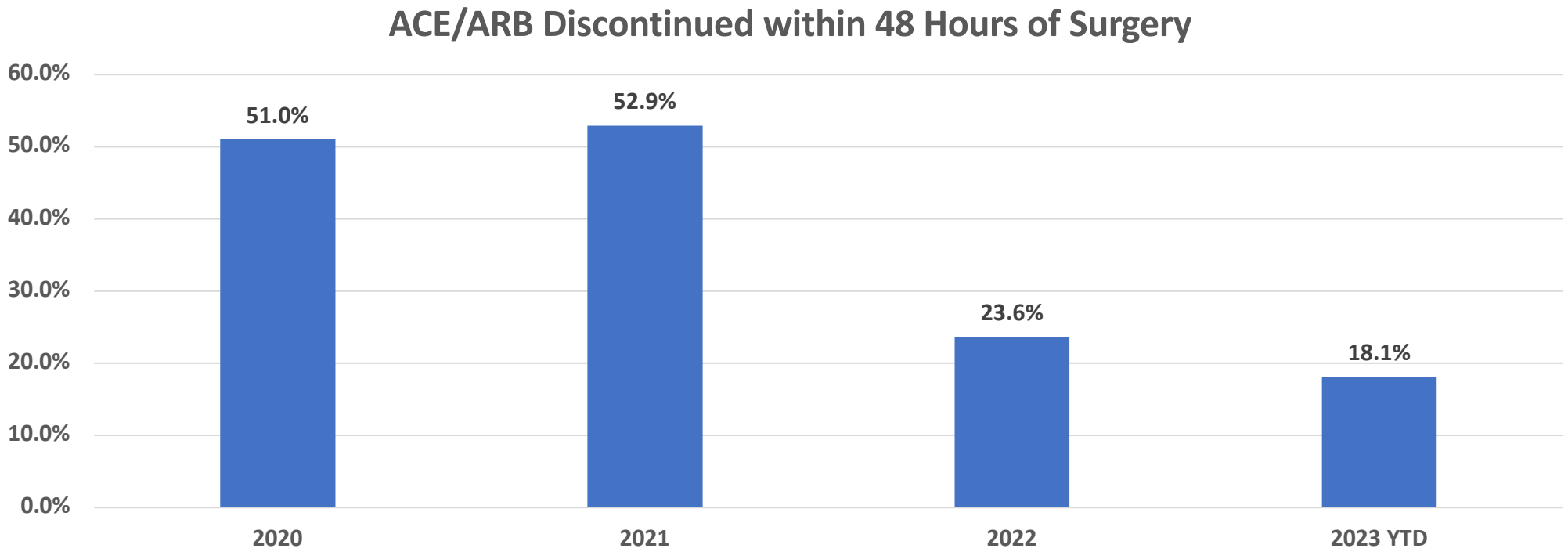
- ✓ Protocol changes
  - ✓ Start insulin sooner
  - ✓ Recheck more often
- ✓ New CRNAs/re-education

✓ **Q30 minute blood glucose or < when indicated**

Pre-op. ACE Inhibitors by Year: Isolated CAB, Q4 2018—Q3 2023



More low hanging fruit…



What were the barriers?

- Covid-19- transient staff
- New APPs
- Poor partnership and compliance with collaborating physicians

Intraoperative fluid balance and cardiac surgery-associated acute kidney injury: a multicenter prospective study

Henrique Palomba [a], Ricardo E. Treml [b], Tulio Caldonazo [c], Henrique T. Katayama [d], Brenno C. Gomes [e], Luiz M.S. Malbouisson [d], João Manoel Silva Junior [d,*]

[a] Hospital Alemão Oswaldo Cruz, Departamento de Medicina Intensiva, São Paulo, SP, Brazil
[b] Friedrich-Schiller-University, Department of Anaesthesiology and Intensive Care Medicine, Jena, Germany
[c] Friedrich-Schiller-University, Department of Cardiothoracic Surgery, Jena, Germany
[d] Universidade de São Paulo, Departamento de Anestesiologia, São Paulo, SP, Brazil
[e] Universidade Federal do Paraná, Departamento de Medicina Integrada, Setor de Ciências da Saúde, Curitiba, PR, Brazil

Received 18 February 2022; accepted 24 July 2022
Available online 30 July 2022

KEYWORDS
Acute kidney injury;
Coronary artery bypass;
Cardiac surgery;
Fluid therapy;
Cardiovascular disease;
Cardiopulmonary bypass

Abstract
Background: Recent data suggest the regime of fluid therapy intraoperatively in patients undergoing major surgeries may interfere in patient outcomes. The development of postoperative Acute Kidney Injury (AKI) has been associated with both Restrictive Fluid Balance (RFB) and Liberal Fluid Balance (LFB) during non-cardiac surgery. In patients undergoing cardiac surgery, this influence remains unclear. The study objective was to evaluate the relationship between intraoperative RFB vs. LFB and the incidence of Cardiac-Surgery-Associated AKI (CSA-AKI) and major postoperative outcomes in patients undergoing on-pump Coronary Artery Bypass Grafting (CABG).
Methods: This prospective, multicenter, observational cohort study was set at two high-complexity university hospitals in Brazil. Adult patients who required postoperative intensive care after undergoing elective on-pump CABG were allocated to two groups according to their intraoperative fluid strategy (RFB or LFB) with no intervention.
Results: The primary endpoint was CSA-AKI. The secondary outcomes were in-hospital mortality, cardiovascular complications, ICU Length of Stay (ICU-LOS), and Hospital LOS (H-LOS). After propensity score matching, 180 patients remained in each group. There was no difference in risk of CSA-AKI between the two groups (RR = 1.15; 95% CI, 0.85-1.56,

Brazilian Journal of Anesthesiology Volume 72, Issue 6, Nove-Dec 2022, Pages 688-694

Compared Restrictive Versus Liberal Fluid Balance (≤ 2000 ml versus ≥ 2000 ml)

Excluded insensible fluid loss

Primary Endpoint: CSA-AKI

Defined as increase in Creatinine ≥ 0.3 within 48 hrs or ≥ 1.5-1.9 x baseline OR urine output < 0.5ml.kg.h in 6-12 hours.

Secondary Endpoints:

In-Hospital Mortality

Cardiovascular complications

ICU-LOS

Findings:

No difference in risk of CSA-AKI between groups

Liberal Fluid Balance showed:

Greater in-hospital mortality

Greater cardiovascular complications

Did we go too far with blood conservation?

- ✓ Acute Normovolemic Hemodilution
- ✓ Retrograde Autologous Prime
- ✓ Selective Ultrafiltration
- ✓ Intra-Op Transfusion Trigger: Historical intra-op RBC transfusion for Iso Cabg→ **5.2%** ***Is this a good thing?***

PLUS

- ✓ 1,500-2000 ml Anesthesia intra-op fluid resuscitation guide

What did we observe?

Intra-Op fluid management: ***Significant*** Variation among clinicians…

Are we too dry?

- ***Opportunity:*** *Re-educate CRNA staff*

Transfusion triggers: Is there a best time to transfuse?

RESEARCH ARTICLE

Perioperative hemoglobin area under the curve is an independent predictor of renal failure after cardiac surgery. Results from a Spanish multicenter retrospective cohort study

Paula Duque-Sosa[1]*, Diego Martínez-Urbistondo[2☯], Gemma Echarri[1☯], Raquel Callejas[1☯], María Josefa Iribarren[1‡], Gregorio Rábago[3‡], Pablo Monedero[1☯], Spanish group of renal dysfunction in cardiac surgery (GEDRCC-2)[¶]

1 Department of Anesthesia and Critical Care, Clínica Universidad de Navarra, Pamplona, Navarra, Spain, **2** Department of Internal Medicine, Division of Intermediate Care and Hospitalists Unit, Clínica Universidad de Navarra, Pamplona, Navarra Spain, **3** Department of Cardiovascular Surgery, Clínica Universidad de Navarra, Pamplona, Navarra, Spain

☯ These authors contributed equally to this work.
‡These authors also contributed equally to this work.
¶Membership of the Spanish group of renal dysfunction in cardiac surgery (GEDRCC-2) is provided in the Acknowledgments.
* pduque@unav.es

Preoperative anemia in patients undergoing coronary artery bypass grafting predicts acute kidney injury

Luca De Santo, MD,[a] Gianpaolo Romano, MD,[b] Alessandro Della Corte, MD, PhD,[c] Vincenzo de Simone, MD,[c] Francesco Grimaldi, MD,[c] Maurizio Cotrufo, MD,[c] and Marisa de Feo, PhD[c]

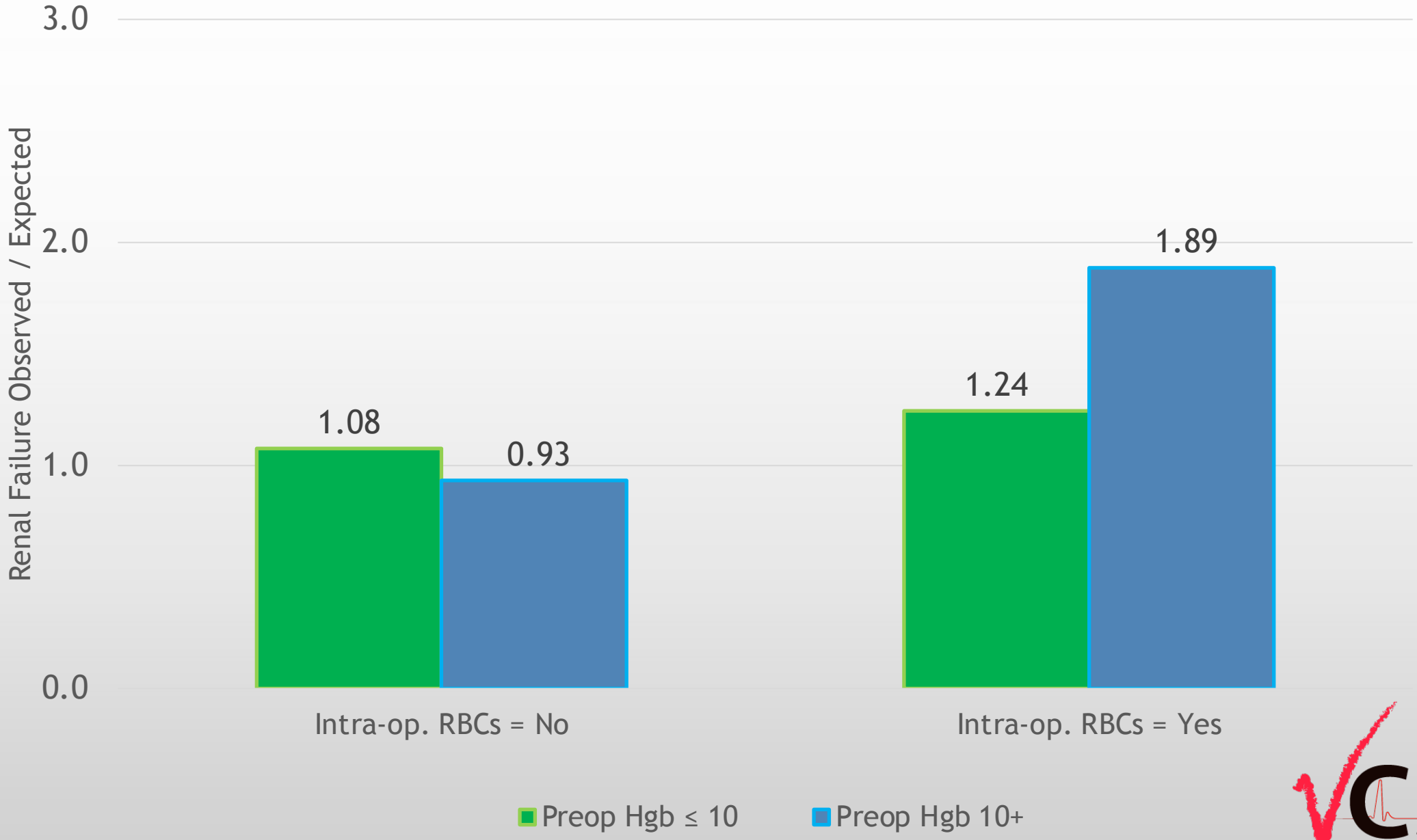
Objectives: Recent authoritative studies suggested that low preoperative hemoglobin concentration may affect cardiac surgery outcomes. This study aimed, primarily, to investigate whether preoperative anemia is an independent determinant of adverse events after coronary artery bypass grafting and, secondarily, to evaluate the potential dose responsiveness between anemia severity and primary end points.

Methods: This single-center prospective study investigated 1214 consecutive patients undergoing coronary artery bypass grafting between January 2004 and June 2007, collecting 100 variables per patient. In 1047 patients (median age 64 years, 18.8% female, 38.9% diabetic, 31.9% urgent/emergency, 15.3% with low preoperative left ventricular ejection fraction) who underwent on-pump procedures and received no preoperative transfusion, the prevalence of preoperative anemia (according to World Health Organization definition) and its unadjusted and adjusted relationships with in-hospital death, cardiac morbidity, and acute kidney injury (AKI–RIFLE [Risk, Injury, Failure, Loss, End-stage kidney disease] criteria) were obtained.

Results: The prevalence of preoperative anemia was 28%. In-hospital death averaged 3.9%, cardiac morbidity 7.3%, and acute kidney injury 4%. Unadjusted odds ratios (Ors) for in-hospital death, cardiac morbidity, and acute kidney injury were 3.8 (95% confidence interval [CI] 2.0–7.3), 1.7 (95% CI 1.1–2.8), and 4.0 (95% CI 2.1–7.6), respectively. Adjusting for anemia in confounders proved an independent predictor of acute kidney injury (OR 2.06; 95% CI 1.14–3.70), whereas the cardiac morbidity and in-hospital mortality were independently predicted by kidney function. No dose–response relationship emerged between anemia severity and acute kidney injury.

Conclusions: Preoperative anemia is independently associated with acute kidney injury after coronary artery bypass grafting. Further studies are warranted to determine whether preoperative low hemoglobin concentration is a marker of severity of illness or a modifiable risk factor.

Renal Failure O/E vs. Preop Hgb and Intra-op. RBCs: Isolated CAB, Q4 2018—Q3 2023



Goal-Directed Oxygen Delivery

Hemoglobin 7.0-8.0 gm

@ 2.4 L/min Cardiac Index

DO2i= 222-252 ml O^2/min/m^2

Hemoglobin 10.0 gm

@ 2.4 L/min Cardiac Index

DO2i= 314.4 ml O^2/min/m^2

J Extra Corpor Technol. 2021;53:97–124
The Journal of ExtraCorporeal Technology

Original Articles

STS/SCA/AmSECT/SABM Update to the Clinical Practice Guidelines on Patient Blood Management

Pierre Tibi, MD;[a] R. Scott McClure, MD, FRCSC;[b] Jiapeng Huang, MD;[c] Robert A. Baker, PhD, CCP;[d] David Fitzgerald, DHA, CCP;[e] C. David Mazer, MD;[f] Marc Stone, MD;[g] Danny Chu, MD;[h] Alfred H. Stammers, MSA, CCP Emeritus;[i] Tim Dickinson, CCP;[j] Linda Shore-Lesserson, MD;[k] Victor Ferraris, MD;[l] Scott Firestone, MS;[m] Kalie Kissoon;[m] Susan Moffatt-Bruce, MD, FRCSC[n]

[a]Department of Cardiovascular Surgery, Yavapai Regional Medical Center, Prescott, Arizona; [b]Division of Cardiac Surgery, Libin Cardiovascular Institute, Foothills Medical Center, University of Calgary, Calgar, Canada; [c]Department of Anesthesiology & Perioperative Medicine, University of Louisville, Louisville, Kentucky; [d]Cardiac Surgery Research and Perfusion, Flinders University and Flinders Medical Centre, Adelaide, Australia; [e]Division of Cardiovascular Perfusion, Medical University of South Carolina, Charleston, South Carolina; [f]Department of Anesthesia, St. Michael's Hospital, University of Toronto, Toronto, Canada; [g]Department of Anesthesia, Mount Sinai Medical Center, New York, New York; [h]Department of Cardiothoracic Surgery, University of Pittsburgh School of Medicine, Pittsburgh, Pennsylvania; [i]Specialty Care, Nashville, Tennessee; [j]Department of Cardiovascular Surgery, Mayo Clinic, Rochester, Minnesota; [k]Department of Anesthesiology, Zucker School of Medicine at Hofstra/Northwell Northshore University Hospital, Manhasset, New York; [l]Division of Cardiovascular and Thoracic Surgery, University of Kentucky, Lexington, Kentucky; [m]The Society of Thoracic Surgeons, Chicago, Illinois; and [n]Division of Thoracic Surgery, Department of Surgery, University of Ottawa, Ottawa, Canada

POSTOPERATIVE MANAGEMENT

Transfusion Triggers

- In patients undergoing cardiac surgery, a restrictive perioperative allogeneic RBC transfusion strategy is recommended in preference to a liberal transfusion strategy for perioperative blood conservation, as it reduces both transfusion rate and units of allogeneic RBCs without increased risk of mortality or morbidity (Class I, Level A).
- Allogeneic RBC transfusion is unlikely to improve oxygen transport when the hemoglobin concentration is greater than 10 g/dL and is not recommended (Class III: No benefit; Level B–R).

Transfusion and anemia trends among our ARF patients

Q4 2018-Q1 2022 Iso Cabg ARF

- 33% Pre-op Hgb ≤ 10gm
- 60% Normal pre-op creatinine
- 7.1 gm Average low intra-op Hgb
- **Only** 30% Transfused RBCs Intra-Op

Changes in practice/trends:

Intra-op RBC transfusion rate ↑ from 5.2% historical to 8.5%

50% of patients with intra-op Hgb < 8gm transfused based on DO2i ≤ 270 ml O2/min/m2

New observations: **0 ARF in the anemia transfused population**

Perfusion Management: Past and present

Historical: Conventional perfusion management

- Cardiac Index 2.4 L/minute
- SVO^2- based cardiopulmonary bypass
- MAP $\geq$ 60 mmHg

Current Strategy: Goal-Directed Perfusion Management

✓ Goal-Directed Oxygen Delivery

✓ Arterial Perfusion Blood Temp $\leq$ 36.9^{o}C

✓ Mean Arterial Pressure $\geq$ 65 mmHg (MWH)

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Goal Directed Perfusion Is Not Associated with a Decrease in Acute Kidney Injury in Patients Predicted to Be at High Risk for Acute Renal Failure after Cardiac Surgery

Mark Broadwin, MD;* Monica Palmeri, MS;† Tyler Kelting, MS, CCP;† Robert Groom, MS, CCP;‡ Michael Robich, MD;§ F. Lee Lucas, RN, PhD;‖ Robert Kramer, MD†

*Lehigh Valley Health Network, Department of Surgery, Allentown, Pennsylvania; †Maine Medical Center, Division of Cardiovascular Surgery, Portland, Maine; ‡Tenwek Hospital, Bomet, Kenya; §Tufts University Medical Center, Department of Cardiac Surgery, Boston, Massachusetts; and ‖Center for OUtcomes Research and Evaluation, Maine Medical Center, Portland, Maine

Abstract: Small increases in serum creatinine postoperatively reflect an acute kidney injury (AKI) that likely occurred during cardiopulmonary bypass (CPB). Maintaining adequate oxygen delivery (DO_2) during CPB, known as GDP (goal-directed perfusion), improves outcomes. Whether GDP improves outcomes of patients at high risk for acute renal failure (ARF) is unknown. Forty-seven adult patients undergoing cardiac surgery with CPB utilizing GDP with Cleveland Clinic Acute Renal Failure Score of 3 or greater were compared with a matched cohort of patients operated upon using a flow-directed strategy. CPB flow in the GDP cohort was based on a DO_2 goal of 260 mL/min/m^2. Serum creatinine values were used to determine whether postoperative AKI occurred according to AKIN (Acute Kidney Injury Network) guidelines. We examined the distribution of all variables using proportions for categorical variables and means (standard deviations) for continuous variables and compared treatment groups using *t* tests for categorical variables and tests for differences in distributions for continuous and count variables. We used inverse probability of treatment weighting to adjust for treatment selection bias. In adjusted models, GDP was not associated with a decrease in AKI (odds ratio [OR]: .97; confidence interval [CI]: .62, 1.52), but was associated with higher odds of ARF (OR: 3.13; CI: 1.26, 7.79), mortality (OR: 3.35; CI: 1.14, 9.89), intensive care unit readmission (OR: 2.59; CI: 1.31, 5.15), need for intraoperative red blood cell transfusion (OR: 2.02; CI: 1.26, 3.25), and postoperative platelet transfusion (OR: 1.78; CI: 1.05, 3.01) when compared with the historic cohort. In patients who are at high risk for postoperative renal failure, GDP was not associated with a decrease in AKI when compared to the historical cohort managed traditionally by determining CPB flows based on body surface area. Surprisingly, the GDP cohort performed significantly worse than the retrospective control group in terms of ARF, mortality, intensive care unit readmission, and RBC and platelet transfusions. **Keywords:** CPB, physiology, pathophysiology, kidney, perioperative care. *J Extra Corpor Technol. 2022;54:128–34*

Acute kidney injury (AKI) after cardiac surgery is associated with poor short- and long-term outcomes and is a signal for adverse outcomes (1–6). Small increases (.3 mg/dL) in serum creatinine (SCr) postoperatively reflect a kidney injury that most likely occurred in the operating room during cardiopulmonary bypass (CPB). This delayed signal provides an opportunity to scrutinize intraoperative processes of care and determine strategies to decrease its incidence. One of the possible sources of the renal injury is poor oxygen delivery during CPB. The renal medulla is a reliable hypoxemic signal for this research purpose and is vulnerable to small shifts of oxygen delivery (DO_2) that can result in organ dysfunction and cell death. Small changes in SCr can provide a surrogate marker for hypoxemia and inadequate organ perfusion.

Maintaining DO_2 levels above a recommended level during CPB improves physiological and clinical outcomes (7–9). This strategy is described as goal-directed perfusion (GDP) (10). DO_2 is measured in real time

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Address correspondence to: Robert Kramer, MD, Division of Cardiovascular Surgery, Maine Medical Center, 22 Bramhall St., Portland, ME 04102. E-mail: kramer@mmc.org
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Summary:

- Patients with high-risk for AKI treated with a goal-directed oxygen delivery strategy did **not** reduce incidence of post-op AKI when compared to conventional perfusion.

- GDP performed worse than conventional perfusion in mortality, ARF, ICU readmission and RBC transfusion

Goal-directed perfusion to reduce acute kidney injury: A randomized trial

Marco Ranucci, MD, FESC,[a] Ian Johnson, CCP,[b,c] Timothy Willcox, CCP,[d,e] Robert A. Baker, PhD, CCP,[f] Christa Boer, MD, PhD,[g,h] Andreas Baumann, MD,[i,j] George A. Justison, CCP,[k,l] Filip de Somer, CCP,[m] Paul Exton, BSc (Hon) ACP,[n] Seema Agarwal, FRCA,[b,c] Rachael Parke, PhD,[d,e] Richard F. Newland, CCP,[f] Renard G. Haumann, CCP,[g,h] Dirk Buchwald, PhD, CCP,[i,j] Nathaen Weitzel, MD,[k,l] Rajamiyer Venkateswaran, MD FRCS(Cth),[n] Federico Ambrogi, PhD,[o] and Valeria Pistuddi[a]

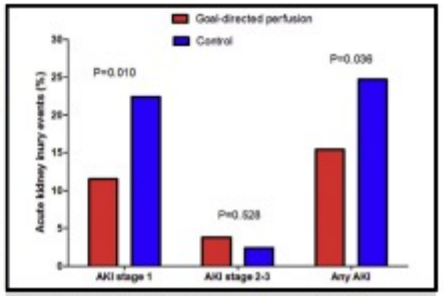
ABSTRACT

Objective: To determine whether a goal-directed perfusion (GDP) strategy aimed at maintaining oxygen delivery (DO_2) at $\geq$280 mL·min^{-1}·m^{-2} reduces the incidence of acute kidney injury (AKI).

Methods: This multicenter randomized trial enrolled a total of 350 patients undergoing cardiac surgery in 9 institutions. Patients were randomized to receive either GDP or conventional perfusion. A total of 326 patients completed the study and were analyzed. Patients in the treatment arm were treated with a GDP strategy during cardiopulmonary bypass (CPB) aimed to maintain DO_2 at $\geq$280 mL·min^{-1}·m^{-2}. The perfusion strategy for patients in the control arm was factored on body surface area and temperature. The primary endpoint was the rate of AKI. Secondary endpoints were intensive care unit length of stay, major morbidity, red blood cell transfusions, and operative mortality.

Results: Acute Kidney Injury Network (AKIN) stage 1 was reduced in patients treated with GDP (relative risk [RR], 0.45; 95% confidence interval [CI], 0.25-0.83; $P = .01$). AKIN stage 2-3 did not differ between the 2 study arms (RR, 1.66; 95% CI, 0.46-6.0; $P = .528$). There were no significant differences in secondary outcomes. In a prespecified analysis of patients with a CPB time between 1 and 3 hours, the differences in favor of the treatment arm were more pronounced, with an RR for AKI of 0.49 (95% CI, 0.27-0.89; $P = .017$).

Conclusions: A GDP strategy is effective in reducing AKIN stage 1 AKI. Further studies are needed to define perfusion interventions that may reduce more severe levels of renal injury (AKIN stage 2 or 3). (J Thorac Cardiovasc Surg 2018;156:1918-27)



Acute kidney injury in the goal-directed perfusion and control groups.

Central Message

A goal-directed perfusion strategy aimed at preserving oxygen delivery during cardiopulmonary bypass is effective in reducing AKIN class 1 postoperative acute kidney injury.

Perspective

Acute kidney injury (AKI) is a major complication of cardiac surgery. This study demonstrates that minor patterns of AKI in medium- to low-risk patients may be limited by a strategy of cardiopulmonary bypass based on a target oxygen delivery. Further studies are needed to define perfusion interventions that may reduce more severe levels of renal injury (AKIN stage 2 or 3).

See Editorial Commentary page 1928.

Goal-Directed Oxygen Delivery versus Conventional Perfusion:

- Reduced Stage 1 AKI
- No difference in Stage 2 or 3 AKI

Acute Renal Failure in High-Risk Patients: Conventional versus GDP

2020-2021 Iso Cabg Patients

422 patient assessed for AKI risk using the Cleveland Clinic ARF Score

- Excluding re-operation and patients with creatinine ≥4.0 +/- HD
- 122 Patients with risk score of 3-10
  - 10 patients with ARF

2022 – Q3 2023 Iso Cabg Patients

247 patients assessed for AKI risk using the Cleveland Clinic ARF Score

- Excluding re-operations and patients with creatinine ≥4.0 +/- HD
- 48 Patients with risk score of 3-9 (Mean 4.1)
  - 0 patients with ARF

How much value can your perfusion team bring to your program: GDP

Goal-Directed Perfusion: July 2022

✓Goal-Directed Oxygen Delivery

✓Arterial Perfusion Blood Temp ≤ 36.9°C

✓Mean Arterial Pressure ≥ 65 mmHg

Barriers:

- Venous drainage/High CPB arterial line pressure
- Appropriate arterial and venous cannulation size
- Volume management on CPB

✓DO2i % >270 ml O2/min/m^2→*94.1%*

✓Arterial perfusion blood temperature management 4.3% ↓ *0.54%*

✓*53.5%* improvement in blood pressure management

What did we change?

- Consult nephrology for **GFR<45** or new post-cath AKI.
- Revised and expanded protocol for discontinuation of nephrotoxic meds.
- Clear liquids until 2 hours before general anesthesia.
- Adopted Goal-Directed Perfusion Initiative.
- Revised intra-op glucose management protocol.
- Moved “towards the middle” for intra-op fluid management.
- “Liberal” transfusion trigger for “high risk” or DO2i < 270 ml O2/min/m2.
- Revised post-op fluid resuscitation and vaso-active medication orders.

In process:

Implementing Edwards LS Hemosphere monitor to improve goal-directed hemodynamic and fluid management with integrated algorithm and order set.

Dramatic improvement and some compromise

- Improvement in intra-op hyperglycemia management
- Improvement in discontinuation of nephrotoxic meds
- Increase in intra-op RBC transfusion (5.2% to 8.5%)
- 100% Compliance with GDP (Epic reports)
- Significant decrease in post-op RBC transfusion (24.6% to 17.5%)
- **72.6% reduction in Isolated CABG AKI**

Thank You!

Have a Safe and Joyous Holiday Season!