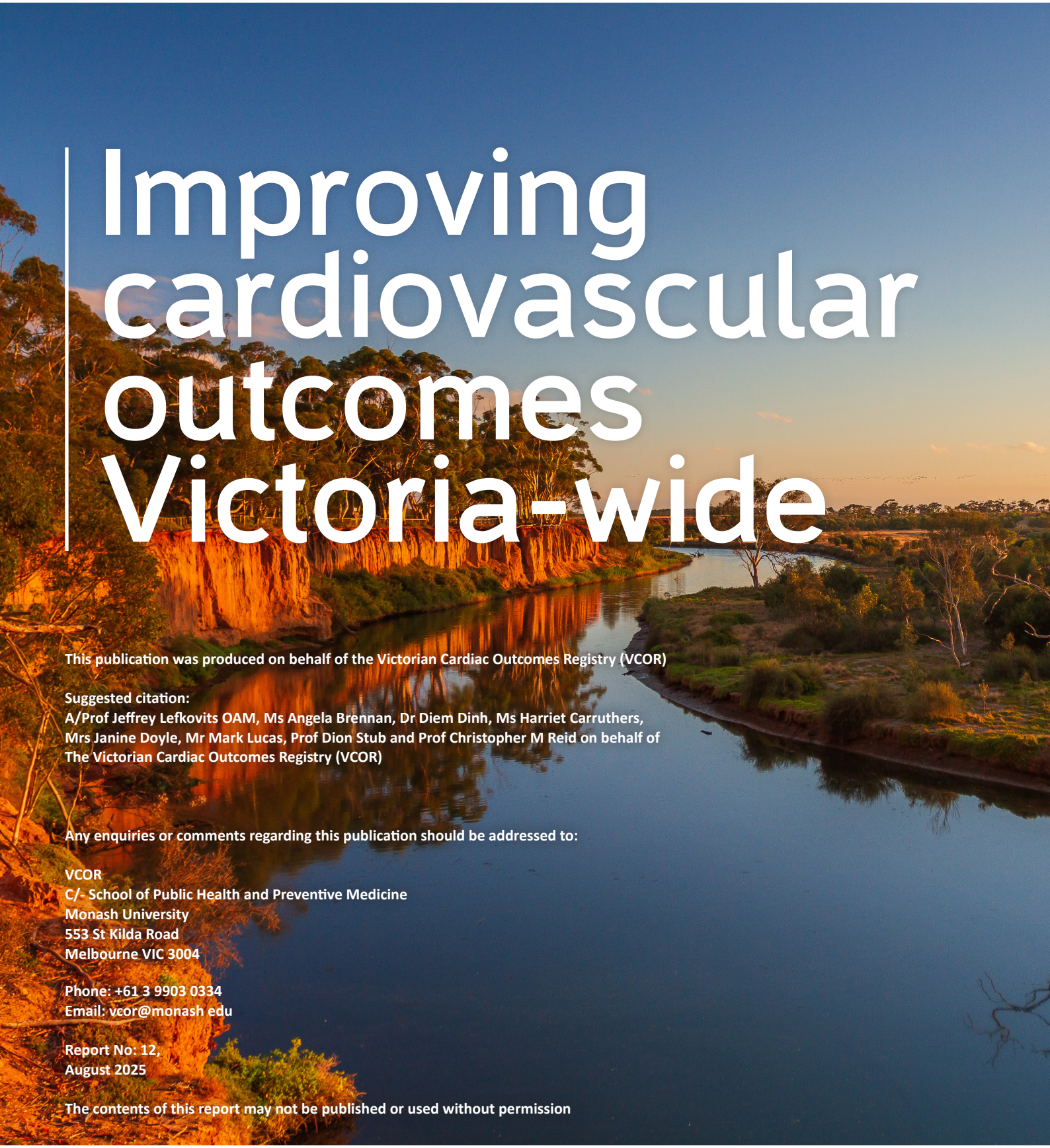
VCOR

VICTORIAN CARDIAC OUTCOMES REGISTRY

ANNUAL PUBLIC REPORT

2024



Improving cardiovascular outcomes Victoria-wide

This publication was produced on behalf of the Victorian Cardiac Outcomes Registry (VCOR)

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VAHI Victorian Agency for Health Information | VICTORIA State Government | SCV Safer Care Victoria

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Acknowledgements

The Victorian Cardiac Outcomes Registry (VCOR) is proudly funded by the Department of Health (Victoria), with additional in-kind support provided by Monash University. VCOR is operated by the Centre of Cardiovascular Research and Education in Therapeutics (CCRET), located within the School of Public Health and Preventive Medicine (SPHPM) at Monash University. The registry operates in close collaboration with Safer Care Victoria (SCV), ensuring alignment with state-wide quality and safety initiatives in cardiovascular care.

We would like to express our sincere appreciation to the members of the VCOR Steering Committee, the VCOR Clinical Quality Committee, and the VCOR Data Research and Publications Committee for their ongoing leadership and contributions throughout the year.

Special thanks to our key leadership team:

- Professor Dion Stub, VCOR Registry Custodian
- Associate Professor Jeffrey Lefkovits OAM, VCOR Clinical Director
- Professor Chris Reid, Co-Director, Centre of Cardiovascular Research and Education in Therapeutics

Professor Dion Stub's work is supported by the National Heart Foundation and NHMRC Investigator Grants, which provide essential salary support for his contributions to VCOR initiatives.

We also acknowledge the dedicated efforts of the VCOR Data and Project Management Committee at SPHPM:

- Ms Angela Brennan
- Dr Diem Dinh
- Ms Harriet Carruthers
- Mrs Janine Doyle
- Mr Mark Lucas

We are deeply grateful to the doctors, nurses, data managers, and hospital staff across participating sites who support VCOR's data collection and quality improvement activities. The commitment of lead clinical staff at each participating hospital has been instrumental in the continued success and growth of the registry.

Foreword

Now in its twelfth year, no one attending the initial planning meeting for the establishment of the Victorian Cardiac Outcomes Registry (VCOR) would have thought that the registry would continue to grow and play a vital role in strengthening the safety, quality, and equity of cardiac care in Victoria. “Not at my hospital” were the cries from the floor. The change in attitude of clinicians and health services over time has been remarkable and is a testament to the work undertaken by senior clinicians and registry operators to provide a transparent and trusted operation. Importantly, it has supported the Victorian hospital system (both public and private) to better understand and strengthen the quality of cardiac care. This has resulted in a sustained and strategic investment in clinical quality registries in a number of high-cost, high-risk and high-volume clinical areas. VCOR has been at the forefront of the shift in national priorities, as articulated in the National Strategy for Clinical Quality Registries and Virtual Registries 2020–2030 and supported by federal funding of an additional 10 clinical quality registries, including the National Cardiac Registry.

Operating within this supportive environment, VCOR remains focused on its core mission: monitoring the performance and safety of Victorian hospitals in delivering percutaneous coronary intervention (PCI) and cardiac implantable electronic devices (CIED). In 2024, the registry captured data from all 34 PCI-capable hospitals and 16 hospitals performing CIED implants across the state, reflecting comprehensive coverage of PCI activity and a significant proportion of device procedures. We also welcome the contribution from 3 Tasmanian centres.

VCOR operates as a mature clinical quality registry, with benchmarking and quality assurance processes now deeply integrated into routine clinical practice across both public and private sectors. This maturity has resulted from an excellent governance structure with contributions from clinicians and registry operators to Steering, Clinical and Data Quality, and Research Committees. This year’s report confirms that PCI procedures in Victoria are being delivered to a consistently high standard, comparable to leading registries both nationally and internationally. It presents detailed demographic data, procedural profiles, clinical appropriateness metrics, and outcome indicators across participating hospitals. For the first time, this year’s report contains additional risk-adjusted major bleeding events and 30-day mortality associated with PCI.

Importantly, Victorians can have confidence that the quality of cardiac care—regardless of where it is delivered—is being transparently measured and benchmarked. Any emerging variation in practice or outcomes can be swiftly identified and addressed through the collaborative efforts of hospitals, Safer Care Victoria (SCV), and the Victorian Agency for Health Information (VAHI).

We are deeply grateful for the ongoing support of the Department of Health Victoria, whose commitment to clinical quality and patient safety makes the work of VCOR possible. I would also like to acknowledge the exceptional efforts of the VCOR Management Team at Monash University, whose dedication and professionalism underpin the continued success of the registry.

We hope this report serves as a valuable resource for clinicians, health administrators, policymakers, and all those committed to improving cardiovascular care in Victoria.

Prof Chris Reid

CCRET Co-Director
Monash University

Introduction

This report presents a comprehensive overview of percutaneous coronary intervention (PCI) activity and a detailed analysis of the use of cardiac implantable electronic devices (CIEDs) across Victoria. In 2024, 34 Victorian PCI hospitals and 16 CIED-implanting hospitals were actively contributing to VCOR, representing all the PCI activity and a substantial proportion of CIED implants across the state. The report focuses on evolving patient demographics, treatment patterns, hospital performance, and key quality indicators.

In line with goals set out in the *National Strategic Action Plan for Heart Disease and Stroke* by the Federal Government[1] and the recently released National Heart Foundation's 25-year vision for heart health in Australia[2] this year's report provides an in-depth analysis of the treatment and outcomes of patients presenting with acute coronary syndromes (ACS). We evaluate hospital efficiency in the timely management of both ST-elevation myocardial infarction (STEMI) and non-ST-elevation acute coronary syndromes (NSTE-ACS), two key indications where timely revascularisation is critical.

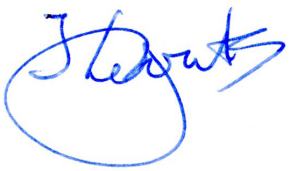
With respect to PCI for acute STEMI, at the time of writing this report, the *Australian Clinical Guideline for Diagnosing and Managing Acute Coronary Syndromes 2025* [3] had just been released, with its endorsement of a benchmark of 60 minutes or less from arrival at a PCI capable centre to balloon time rather than the 90-minute benchmark that has been widely used previously. This report reflects that shift by exclusively assessing hospital performance against this more stringent 60-minute target and no longer referring to the older 90-minute benchmark. As anticipated, achieving this tighter timeframe is challenging, and this report provides detailed analysis of overall and hospital-level performance. Importantly, we also highlight the positive role of pre-hospital notification by ambulance services in helping to reduce time delays to treatment. In the NSTE-ACS setting, we continue to monitor hospital efficiency through reporting of time-to-procedure data, with an emphasis on achieving PCI within 24–48 hours of presentation, in line with current best practice.

In addition to our regular reporting of risk-adjusted mortality outcomes, this year we introduce, for the first time, risk-adjusted in-hospital major bleeding rates. This new metric enhances our quality assessment framework by accounting for variations in patient comorbidity, bleeding risk profiles, and procedural complexity. It also allows more equitable inter-hospital comparisons, ensuring that centres treating higher-risk populations are not unfairly disadvantaged.

With respect to the CIED population, we report on demographic details, characteristics of the types of activity being undertaken, how clinically appropriate these procedures are and provide measures of patient and hospital outcomes.

As in previous years, our work at VCOR aims to provide a robust, data-driven foundation for quality improvement, benchmarking, and ongoing collaboration across the cardiology community. We are committed to identifying and helping to address unwanted variation in the quality of cardiac healthcare delivered to Victorians and our activities are closely aligned with those of the Victorian Agency for Health Information (VAHI) and Safer Care Victoria (SCV)

With the release of this report, VCOR gratefully acknowledges the invaluable support of the Department of Health Victoria. Our work would not be possible without their steadfast commitment to ensuring all Victorians have access to safe, effective, and equitable healthcare. I would also like to extend my personal thanks to the VCOR Management Team at Monash University for their professionalism, dedication, and tireless efforts in overseeing the many complex functions of the registry.



A/Prof Jeffrey Lefkovits OAM
VCOR Clinical Director

[1] National Strategic Action Plan for Heart Disease and Stroke September 2020, accessed 1 July 2025. https://www.health.gov.au/sites/default/files/documents/2021/09/national-strategic-action-plan-for-heart-disease-and-stroke.pdf

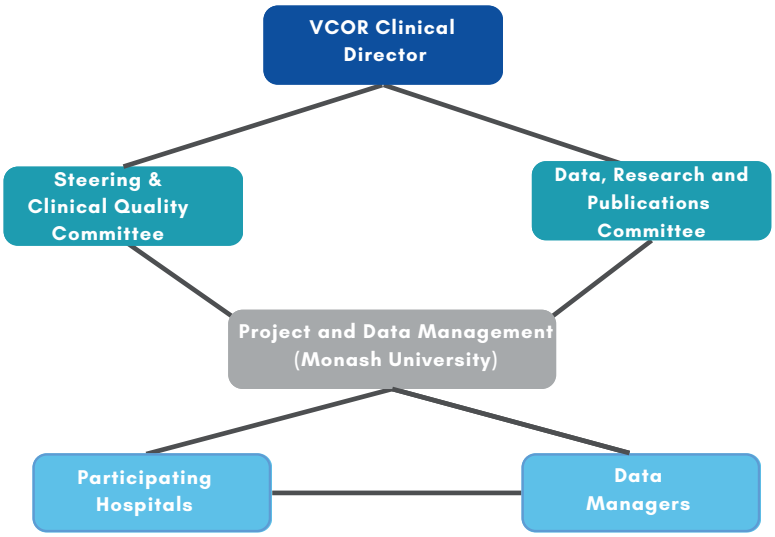
[2] Heart Foundation- Our Vision and Strategy, accessed 1 July 2025. https://www.heartfoundation.org.au/about-us/our-vision-and-strategy

[3] National Heart Foundation of Australia & Cardiac Society of Australia and New Zealand: Comprehensive Australian clinical guideline for diagnosing and managing acute coronary syndromes 2025, accessed 1 July 2025. https://www.heartfoundation.org.au/for-professionals/acs-guideline

Registry Governance and Structure

VCOR's governance structure and processes have been previously outlined. VCOR continues to conform to the principles set out in both the Framework for Australian Clinical Quality Registries and the National Operating Principles for Clinical Quality Registries. All relevant standards related to security and protection of the data housed and managed by VCOR are strictly adhered to.

Figure 1: VCOR Governance Structure



Steering Committee

The Steering Committee (SC) met four times in 2024. At the October 2024 meeting discussion and agreement was reached whereby the activity of the Steering Committee (SC) would expand in 2025 to encompass the Clinical Quality Committee (CQC). The impetus for this was to reduce the burden of committee meetings for hospital representatives. The SC comprises representatives from all participating hospitals, a representative from Safer Care Victoria and representatives from the School of Public Health and Preventive Medicine at Monash University. The SC is chaired by A/Prof Jeffrey Lefkovits OAM.

Clinical Quality Committee

The Clinical Quality Committee (CQC) has responsibility for the oversight, analysis, interpretation, and release of hospital performance data. The CQC is central to VCOR's overall function as a clinical quality registry. For the PCI module the CQC undertakes quarterly and biannual review of hospital Key Performance Indicators (KPIs) and other relevant data. Results and outcomes pertaining to the CIED module are also undertaken and presented to the CIED Expert Working Group. Reports are provided to participating hospitals and the Victorian government.

Data, Research and Publications Committee

The Data, Research and Publications Committee (DRP) has an important and complementary role in VCOR. The DRP reviews and approves research requests. The DRP comprises representatives from health services, Ambulance Victoria and the SPHPM.

Data Quality

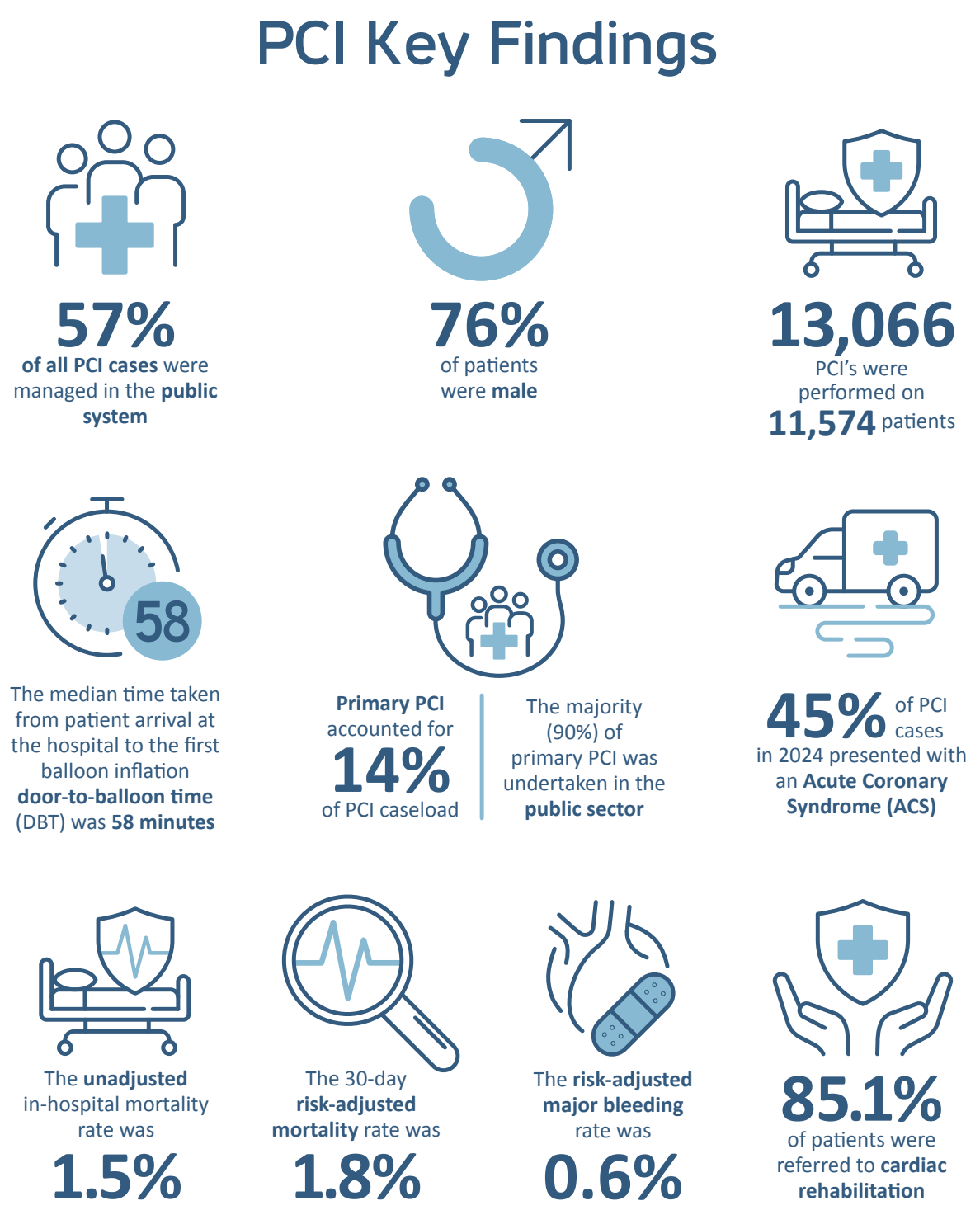
In 2024, self-audits for case ascertainment were conducted at 34 sites. The overall rate of missing cases was 0.4%. VCOR remains dedicated to ensuring data accuracy, a critical operational focus of clinical quality registries. This commitment is upheld through annual case ascertainment audits, quarterly reporting, routine data cleaning, and addressing data queries. Refer to Table 1 for a detailed list of hospitals contributing to VCOR and its modules.

Table 1: Hospitals contributing to VCOR

Victorian Hospitals	Hospital type	PCI Module	CIED Module
Albury Hospital	Public	•	
Alfred Hospital	Public	•	
Austin Hospital	Public	•	•
Ballarat Base Hospital	Public	•	•
Bendigo Hospital	Public	•	•
Box Hill Hospital	Public	•	•
Cabrini Hospital Malvern	Private	•	•
Epworth Hospital Eastern	Private	•	
Epworth Hospital Geelong	Private	•	
Epworth Hospital Richmond	Private	•	
Footscray Hospital	Public	•	•
Frankston Hospital	Public	•	•
Holmesglen Private Hospital	Private	•	
Jessie McPherson Private Hospital	Private	•	•
Knox Private Hospital	Private	•	
Latrobe Regional Hospital	Public	•	
Melbourne Private Hospital	Private	•	
Monash Heart (Victorian Heart Hospital)	Public	•	•
Mulgrave Private Hospital	Private	•	•
The Northern Hospital	Public	•	
Northern Private Hospital	Private	•	
Peninsula Private Hospital	Private	•	
St John of God Hospital (Ballarat)	Private	•	
St John of God Hospital (Bendigo)	Private	•	
St John of God Hospital (Berwick)	Private	•	
St John of God Hospital (Geelong)	Private	•	•
St Vincent's Hospital Melbourne	Public	•	•
St Vincent's Private Hospital	Private	•	
St Vincent's Private Hospital (Werribee)	Private	•	
The Royal Melbourne Hospital	Public	•	•
Sunshine Hospital	Public	•	•
The University Hospital, Geelong	Public	•	•
Warringal Private Hospital	Private	•	
Western Private Hospital	Private	•	•

Key Findings PCI Module

Figure 2: PCI Key Findings

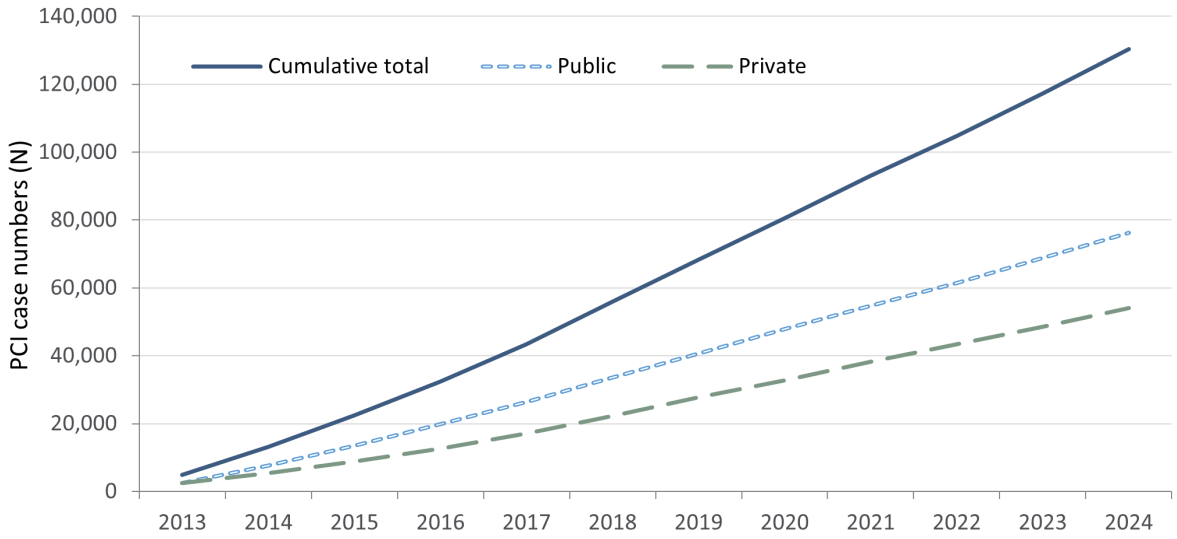


Percutaneous Coronary Intervention (PCI)

Registry Module Activity

This report provides an overview of percutaneous coronary intervention (PCI) activities across Victoria throughout the 2024 calendar year, spanning from January 1st to December 31st. Over the past eight years, all PCI-capable hospitals in Victoria have contributed. In 2024, an additional new private hospital began contributing, bringing the overall number of sites to 34, of which 15 are public and 19 are private hospitals. The total number of PCI cases entered into VCOR in 2024 was 13,066. Based on case ascertainment audits, the number of PCIs entered into VCOR represents 99.6% of PCI cases undertaken in the state of Victoria in 2024. This is an unparalleled achievement across all the state-based PCI registries nationally. As of December 31, 2024, the cumulative caseload in VCOR was 130,346. By hospital sector there were 76,240 public sector cases and 54,106 private sector cases. The cumulative recruitment rates by year and hospital sector are graphically depicted in Figure 3. Similar to previous reporting, the number of patients opting out of registry inclusion remained minimal, and in 2024 the opt-off rate was 0.14%. Since registry establishment the overall opt-off rate was 0.16%.

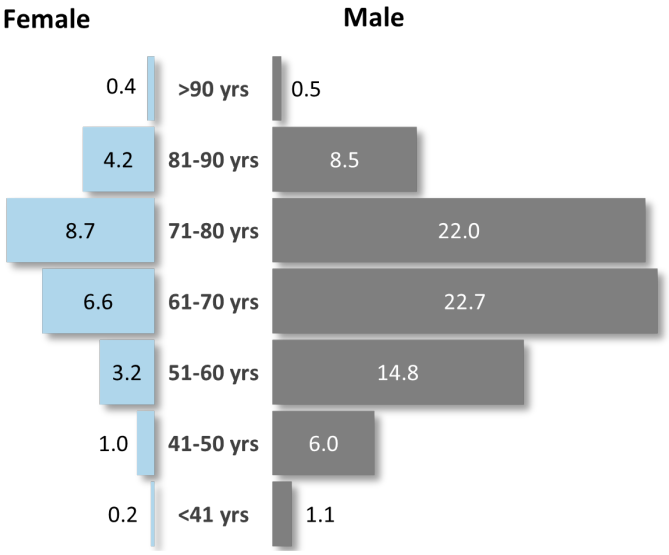
Figure 3: Cumulative case numbers by year: 2013 - 2024



Patient Characteristics

Data were collected from 13,066 PCI procedures, involving 11,574 individual patients. There were 1,492 (11.4%) patients who underwent multiple procedures. The proportion of females undergoing PCI was similar to previous years and represented 24.3% of the overall cohort. The median age for female PCI patients was 72 years (interquartile range [IQR]: 63-79). In contrast, male patients were younger, with a median age of 68 years (IQR: 59-76), (Figure 4). The treated patient population appeared to be getting older, with the median ages for both sexes having increased by 1 year and the proportion of patients 60 years and younger lower when compared to the previous reporting period.

Figure 4: Age and sex distribution of patients undergoing PCI



Selected demographic characteristics of patients across a five-year time span are presented in Table 2. Across the 2020 to 2024 time period minor variations have been observed, including a consistent increase in the proportion of patients with diabetes and cerebrovascular disease.

Table 2: Comparison of selected patient characteristics: 2020 - 2024

Patient characteristics	2020 (N=12,349)	2021 (N=12,478)	2022 (N=11,651)	2023 (N=12,564)	2024 (N=13,066)
Age- years (Mean ±SD)	66.9 ±11.9	67.3 ±11.9	66.9 ±11.7	67.4 ±11.7	67.8 ±11.7
	%	%	%	%	%
Sex - female	24.5	25.2	22.8	24.7	24.3
Diabetes	23.8	23.6	24.1	25.2	26.4
Peripheral Vascular Disease	3.4	3.4	3.2	3.3	3.6
Cerebrovascular Disease	3.5	3.0	2.8	3.1	3.6
Previous PCI	33.6	32.7	31.3	32.3	32.6
Previous CABG	5.9	6.0	5.4	5.5	5.3

Patient characteristics stratified by hospital sector are presented in Table 3. With respect to severe obesity (defined as BMI ≥35 kg/m²), the rate in public sector patients declined from the previous year (13.2% in 2024 vs 13.6% in 2023), whereas a slight increase was observed in private sector patients. Overall, the public sector treats a younger cohort with fewer risk factors compared to the private sector.

Table 3: Selected patient characteristics by hospital sector

Patient characteristics	Public (n=7,471)	Private (n=5,595)
Age- years (Mean ±SD)	65.1 (±12.1)	71.4 (±10.1)
	%	%
Sex - female	24.6	23.8
Diabetes	27.9	24.5
Peripheral Vascular Disease	3.0	4.3
Cerebrovascular Disease	3.6	3.6
Previous PCI	26.5	40.9
Previous CABG	4.5	6.5
Hypertension	60.1	71.4
Chronic Lung Disease	12.0	12.8
Body Mass Index (BMI) ≥35kg/m²	13.2	10.1

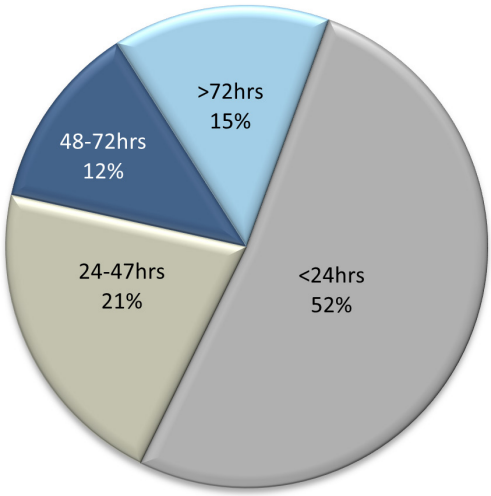
Case Presentation

The majority of cases were performed during standard working hours[4]. In total, 2,254 cases (17.3%) were performed out-of-hours, reflecting a decrease compared to previous years (18% in 2023 and 19.2% in 2022). The majority of the after-hours workload was undertaken in the public sector (n=1,525, 67.7%) and most of the out-of-hours procedures were for acute STEMI (n=1,387, 61.5%).

[4] In-hours: 8.00am- 6.00pm (Mon-Fri excluding public holidays). Out-of-hours: 6.00pm- 8.00am (Mon-Fri, public holidays and weekends).

The time intervals from hospital admission to PCI for cases of non-ST-elevation acute coronary syndrome (NSTE-ACS) across four-time frames are presented in Figure 5. There was further improvement in the proportion of patients treated <24 hours, and overall, since 2021 there has been a 5% improvement for this metric (47% in 2021 vs 52% in 2024). However, the proportion of NSTE-ACS patients treated within 24-47 hours decreased by 2%. Further, there was a slight increase (1%) in patients experiencing delays exceeding 72 hours compared to the preceding year.

Figure 5: Time delays from hospital admission to PCI for NSTE-ACS cases



Timely access to PCI for patients presenting with NSTE-ACS remains a key quality benchmark across the state. Table 4 outlines sector-specific performance in 2024. The proportion of public patients receiving PCI within 24 hours improved to 53.7%, up from 51.8% in 2023. In contrast, the private sector recorded a slight decline in early treatment, with 46.0% treated within 24 hours compared to 48.3% the previous year.

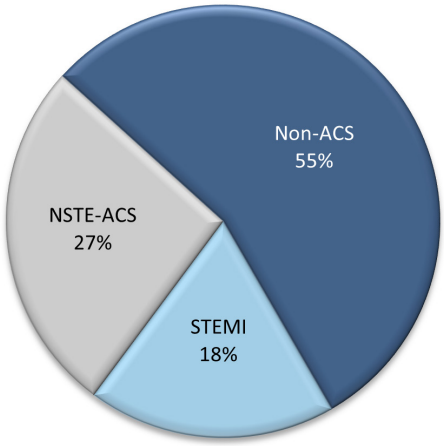
Treatment delays in the 24–72-hour range showed minor reductions across both sectors. Importantly, the rate of very delayed interventions (>72 hours) fell in the public sector to 12.7% in 2024, down from 14.1% in 2023. In contrast, the private sector saw an increase in this category, rising to 20.0% from 14.6% the year prior. These findings highlight ongoing variability in timely access to PCI and reinforce the importance of sector-wide strategies to address treatment delays.

Table 4: Time delays from hospital admission to PCI for NSTE-ACS cases by hospital sector

	All sites (N=3,469)	Public (n=2,540)	Private (n=929)
	N (%)	N (%)	N (%)
<24hrs	1,792 (51.7)	1,365 (53.7)	427 (46.0)
24-47hrs	734 (21.2)	538 (21.2)	196 (21.1)
48-72hrs	435 (12.5)	315 (12.4)	120 (12.9)
>72hrs	508 (14.6)	322 (12.7)	186 (20.0)

Compared to the previous year, PCI for non-ACS indications increased by 1% and represented 55% of the procedural workload (Figure 6).

Figure 6: Procedures by clinical presentation



Marked variation was observed in the proportion of acute coronary syndrome (ACS) cases managed across PCI hospitals in Victoria. In 2024, the ACS caseload as a proportion of total PCI activity ranged widely—from 3.9% to 79% across individual hospitals. A total of 11 hospitals reported an ACS caseload comprising less than 20% of their total PCI volume, indicating a predominant focus on elective procedures. In contrast, 14 hospitals managed a high proportion of ACS cases, with more than half of their PCI procedures performed in the context of an acute coronary syndrome.

Indications for PCI

The indications for PCI among patients with ACS, stratified by hospital sector are presented in Table 5. Consistent with the findings in previous years, the majority of primary PCI (90%) and rescue PCI (98%) were undertaken in the public sector. The proportion of NSTE-ACS cases by hospital ranged from 3.9% to 52.0%.

Table 5: PCI indications by ACS category and hospital sector

PCI indications	All sites (N=6,440)	Public (n=4,997)	Private (n=1,443)
ACS Category	N (%)	N (%)	N (%)
Primary PCI*	1,847 (28.7)	1,660 (33.2)	187 (13.0)
STEMI PCI 12-24 hours after symptom onset	112 (1.7)	94 (1.9)	18 (1.2)
Pharmaco-invasive PCI	105 (1.6)	99 (2.0)	6 (0.4)
Rescue PCI	157 (2.4)	154 (3.1)	3 (0.2)
PCI For STEMI (1-7 days no prior lysis)	148 (2.3)	129 (2.6)	19 (1.3)
PCI For STEMI (1-7 days following lysis)	48 (0.7)	47 (0.9)	1 (0.1)
PCI for OHCA/shock (non-MI)	47 (0.7)	41 (0.8)	6 (0.4)
PCI for NSTE-ACS	3,976 (61.7)	2,773 (55.5)	1,203 (83.4)
NSTE-ACS sub-category	N (%)	N (%)	N (%)
NSTEMI	2,998 (75.4)	2,313 (83.4)	685 (56.9)
UAP	473 (11.9)	227 (8.2)	246 (20.4)
Recent ACS 8-30 days ago	505 (12.7)	233 (8.4)	272 (22.6)

**Primary PCI for STEMI presentations includes all inter-hospital transfers and patients with onset of STEMI whilst a current in-patient.*

The indications for PCI in the non-acute coronary syndrome (non-ACS) patient cohort by hospital sector are presented in Table 6. In both sectors, the primary indication for PCI in non-ACS cases was stable angina, with two thirds of these cases undertaken in private hospitals.

Table 6: Non-ACS PCI indications

PCI indications	All sites (N=6,626)	Public (n=2,474)	Private (n=4,152)
	N (%)	N (%)	N (%)
Stable angina	4,459 (67.3)	1,698 (68.6)	2,761 (66.5)
No symptoms and positive functional test	714 (10.8)	88 (3.6)	626 (15.1)
No symptoms and no functional test	247 (3.7)	82 (3.3)	165 (4.0)
Staged PCI after ACS (≤30 days after first procedure)	601 (9.1)	402 (16.2)	199 (4.8)
Staged PCI after ACS (>30 days after first procedure)	225 (3.4)	132 (5.3)	93 (2.2)
Staged PCI after original non-ACS indication	380 (5.7)	72 (2.9)	308 (7.4)

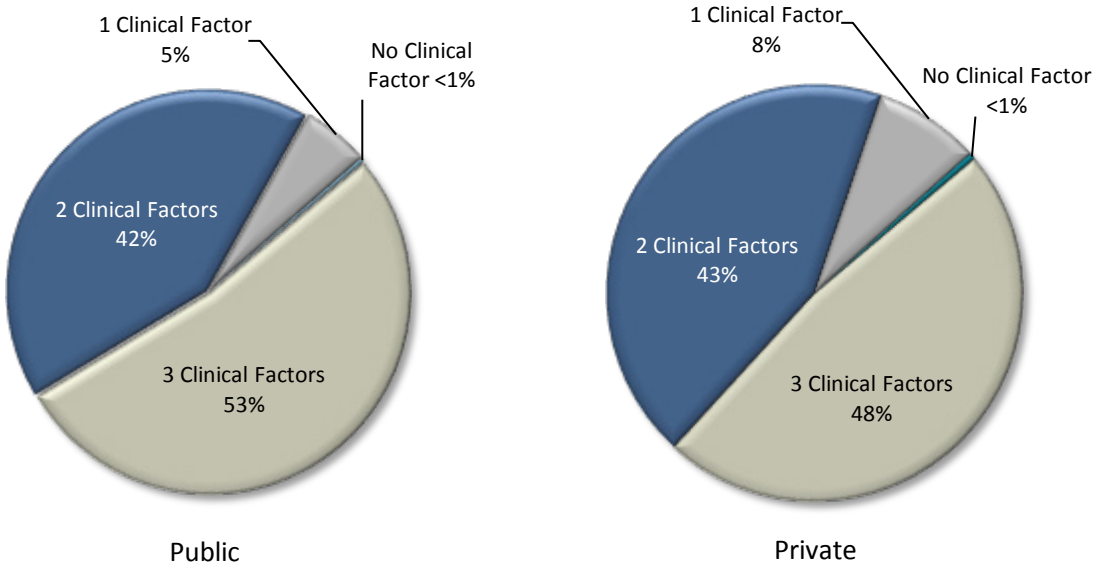
For over a decade, VCOR has monitored the clinical appropriateness of percutaneous coronary intervention (PCI) performed for non-ACS indications. Three key clinical criteria are assessed: the presence of symptoms, a positive functional test, and a high-grade coronary stenosis. These factors collectively inform the justification for proceeding with PCI in stable patients. In the current reporting period, 49.5% of non-ACS PCI cases met all three criteria, reflecting a 4% decline from the previous year. Despite this, a high proportion (92.3%) of cases had at least two of the three clinical factors present. The proportion of patients presenting with only one or none of the specified clinical factors increased to 7.7%, representing a 1% rise compared to the prior reporting cycle. Of note, a small subset of 21 cases proceeded with PCI despite the absence of any documented clinical justification. These findings reinforce the importance of ongoing scrutiny of non-ACS PCI indications to ensure procedural appropriateness and alignment with evidence-based practice.

Table 7: Key clinical factors pertaining to non-ACS PCI indications

Symptoms	Positive functional test	High grade stenosis	Total
			N (%)
●	●	●	2,682 (49.5)
○	●	●	660 (12.2)
●	●	○	324 (6.0)
●	○	●	1,339 (24.7)
●	○	○	114 (2.1)
○	○	●	226 (4.2)
○	●	○	54 (1.0)
○	○	○	21 (0.4)
			5,420 (100)

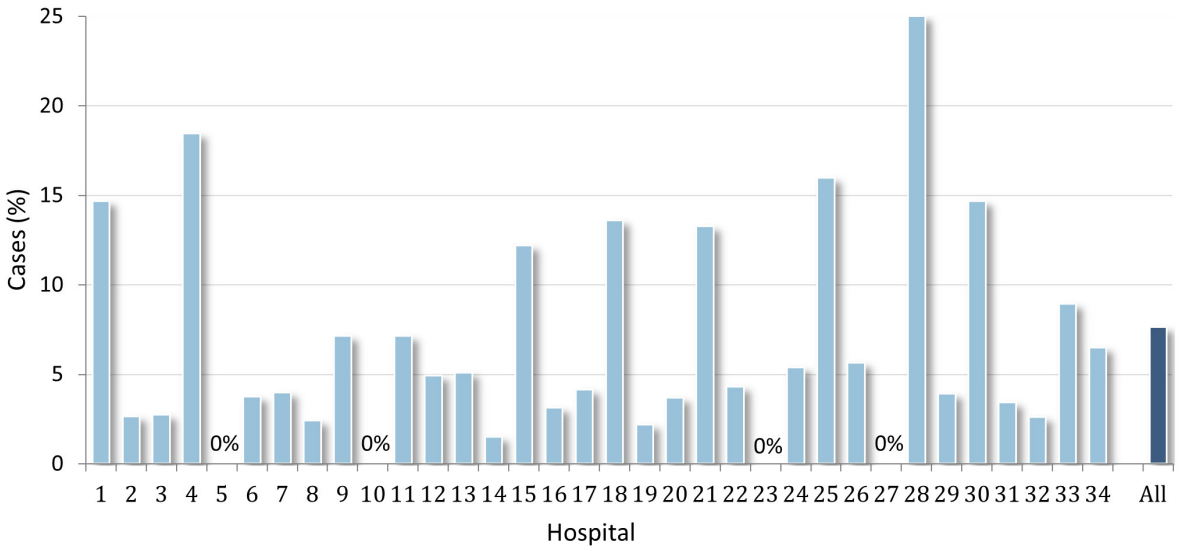
The key clinical factors by sector are shown in Figure 7. Overall, in public sector hospitals 95% of cases had at least two clinical factors to support an appropriate PCI compared to 91% in private sector hospitals. There was further decline in the number of patients with none or only one clinical factor compared to the previous year, see Figure 7.

Figure 7: Key clinical factors in non-ACS patients by hospital sector



The distribution of non-ACS cases with either one or no clinical factors by hospital is shown in Figure 8. The range was 0% to 25% and similar to the previous report. Overall, there were 415 cases where there was just one or no clinical factor present, the majority of which (74%) were treated in the private sector.

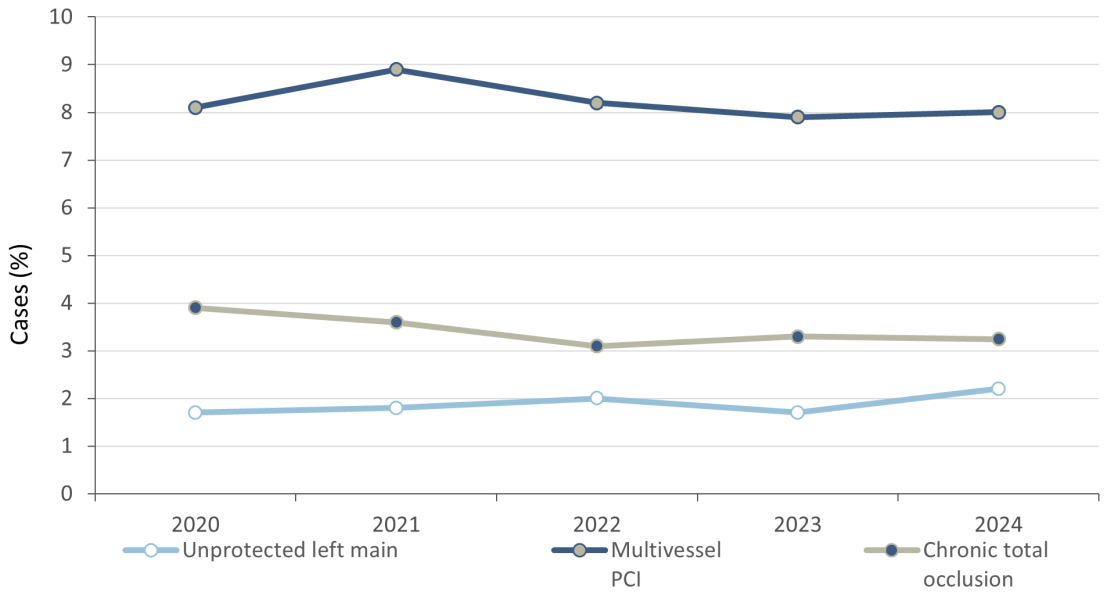
Figure 8: Proportion of non-ACS cases with 0-1 key clinical factor for PCI by hospital



Lesion and Clinical Subsets

Trends in the treatment of specific lesion subsets over the 2020–2024 period are presented in Figure 9. In 2024, the rates of unprotected left main (ULM) coronary artery PCI, chronic total occlusion (CTO) and multivessel PCI remained stable compared with 2023. Notably, the use of plain old balloon angioplasty (POBA) for the management of in-stent restenosis (ISR) continued to increase, reaching 53% in 2024—up from 44.7% in 2023 and 38.3% in 2022, marking a 15% increase over two years. Similarly, utilisation of drug-coated balloons (DCB) for ISR treatment showed a sustained upward trend, rising to 45.7% in 2024. This represents an overall increase of 18% since 2022 (32.2% in 2023; 27.7% in 2022), highlighting the growing preference for this modality in the management of restenotic lesions.

Figure 9: Comparative trends in PCI for selected lesion subsets: 2020 - 2024



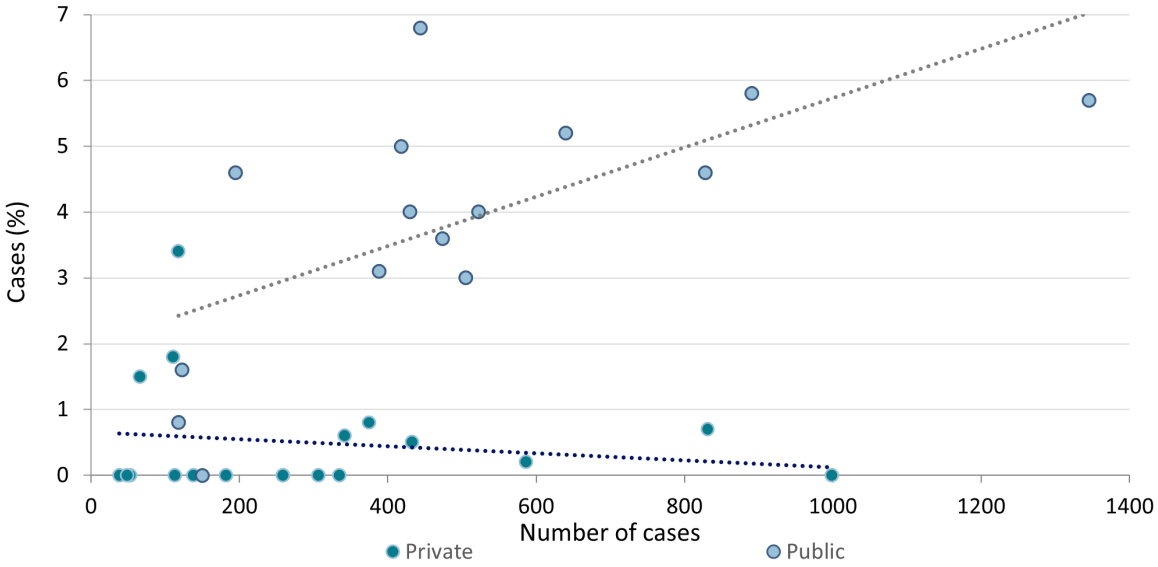
The proportion of patients undergoing PCI in the context of cardiogenic shock and/or out-of-hospital cardiac arrest (OHCA) over the past five years is summarised in Table 8. These medically high-risk cases have remained consistently stable during the reporting period. In 2024, the majority of these critically unwell patients (96.9%) were treated within the public hospital system, representing 3.7% of total public sector PCI activity. By contrast, such cases accounted for only 0.2% of the overall PCI workload in the private sector.

Table 8: Rates of cardiogenic shock and/or intubated OHCA: 2020 - 2024

Presentation type	2020 (N=12,347)	2021 (N=12,478)	2022 (N=11,651)	2023 (N=12,564)	2024 (N=13,066)
	N (%)	N (%)	N (%)	N (%)	N (%)
Cardiogenic shock	273 (2.2)	246 (2.0)	305 (2.6)	277 (2.2)	303 (2.3)
Intubated OHCA	129 (1.0)	138 (1.1)	155 (1.3)	134 (1.1)	159 (1.2)
Shock and/or intubated OHCA	326 (2.6)	300 (2.4)	356 (3.1)	328 (2.6)	365 (2.8)

Figure 10 illustrates the distribution of hospital PCI volume dedicated to the management of patients presenting with cardiogenic shock and/or intubated out-of-hospital cardiac arrest (OHCA), stratified by sector. In 2024, the number of hospitals where these high-acuity cases comprised more than 3% of total PCI activity increased to 13, up from 9 in the previous year. This group included one private sector hospital. Conversely, 12 hospitals—comprising one public and 11 private facilities—did not manage any cases of cardiogenic shock or intubated OHCA during the reporting period. Notably, at one public hospital, these cases accounted for nearly 7% of their overall PCI workload, underscoring its role as a high-volume centre for critically ill patients. These findings highlight the concentration of complex case management within a limited number of centres, particularly in the public sector.

Figure 10: Cardiogenic shock and/or intubated OHCA cases by hospital volume and hospital



Coronary Device Use

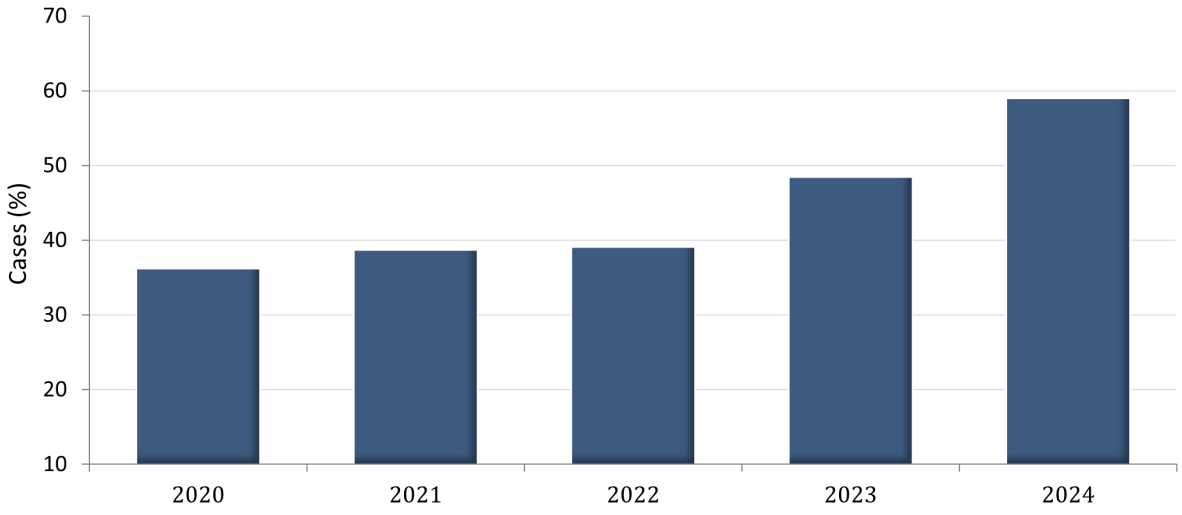
Stents were deployed in 90.3% of PCIs, while 7.4% of cases involved balloon angioplasty only. Detailed utilisation rates of adjunctive devices by hospital sector are provided in Table 9. Overall, intravascular ultrasound (IVUS) and optical coherence tomography (OCT) were utilised more frequently in the public sector. In 2024, the Medical Benefits Scheme (MBS) added IVUS as a rebatable adjunctive service for patients undergoing PCI in the private sector. There was a substantial increase in use of IVUS in private hospitals from 5.6% of cases in 2023 to 10.4% in 2024. However, there was also a similar increase in use in public hospitals, even though the MBS listing did not impact this sector (public hospital IVUS cases 6.5% in 2023 and 11.5% in 2024). In line with practice guidelines strongly recommending adjunctive imaging in cases of left main PCI, IVUS was used in 59.1% of unprotected left main (ULM) coronary artery PCIs - a 10.6% increase compared to the previous year. Trends in the use of IVUS in ULM PCI over the last five years are shown in Figure 11 with significant variation in use among hospitals (Figure 12).

Table 9: Adjunctive device use by hospital sector

Adjunctive device type	All sites (N=13,066)	Public (n=7,471)	Private (n=5,595)
	N (%)	N (%)	N (%)
Intravascular ultrasound	1,436 (11.0)	856 (11.5)	580 (10.4)
Optical coherence tomography	349 (2.7)	268 (3.6)	81 (1.4)
Thrombus aspiration device	218 (1.7)	193 (2.6)	25 (0.4)
Rotational atherectomy	261 (2.0)	106 (1.4)	155 (2.8)
Pressure wire	813 (6.2)	302 (4.0)	511 (9.1)
IABP	26 (0.2)	22 (0.3)	4 (0.1)
ECMO	26 (0.2)	26 (0.3)	0 (0.0)

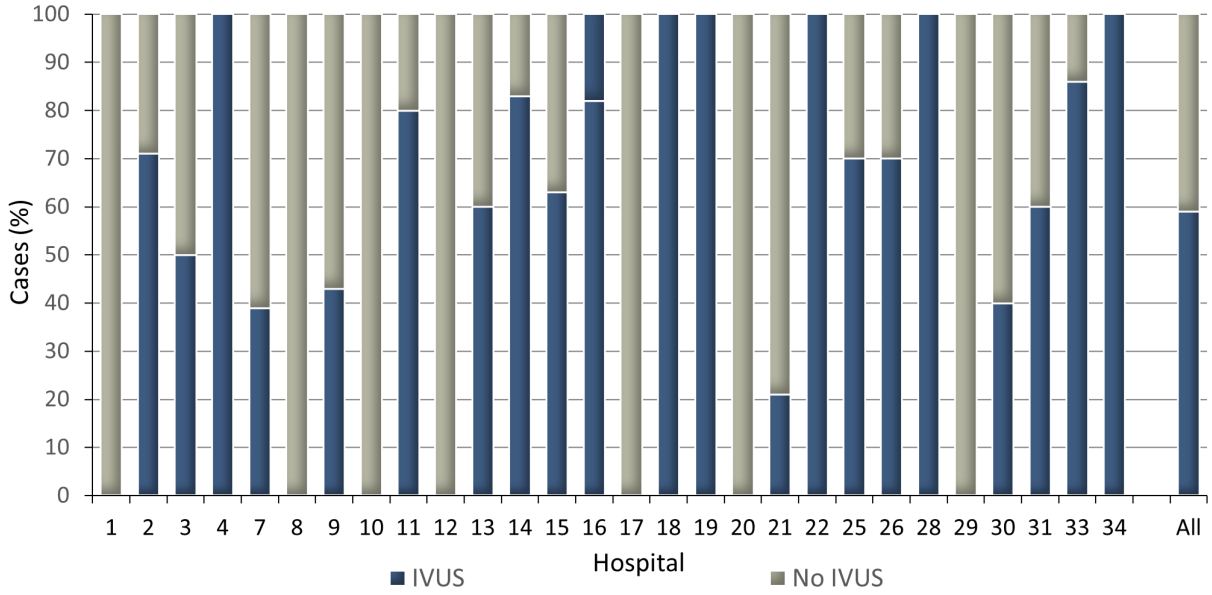
The utilisation rates of optical coherence tomography (OCT), thrombus aspiration devices and rotational atherectomy were all similar to previous years. Glycoprotein IIb/IIIa receptor inhibitors were used in 5.4% of cases, mostly in acute STEMI cases (18.8% of STEMI cases).

Figure 11: IVUS use in unprotected left main 2020 - 2024



In line with practice guidelines strongly recommending adjunctive imaging in cases of left main PCI, IVUS was used in 59.1% of unprotected left main (ULM) coronary artery PCIs - a 10.6% increase compared to the previous year. Trends in the use of IVUS in ULM PCI over the last five years are shown in Figure 11 with significant variation in use among hospitals (Figure 12).

Figure 12: Rate of IVUS use in unprotected left main by hospital



Hospital	1	2	3	4	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	25	26	28	29	30	31	33	34	All
Case N	1	7	6	3	18	1	21	6	5	4	25	18	41	22	1	1	2	1	19	6	23	23	1	3	5	5	7	1	276

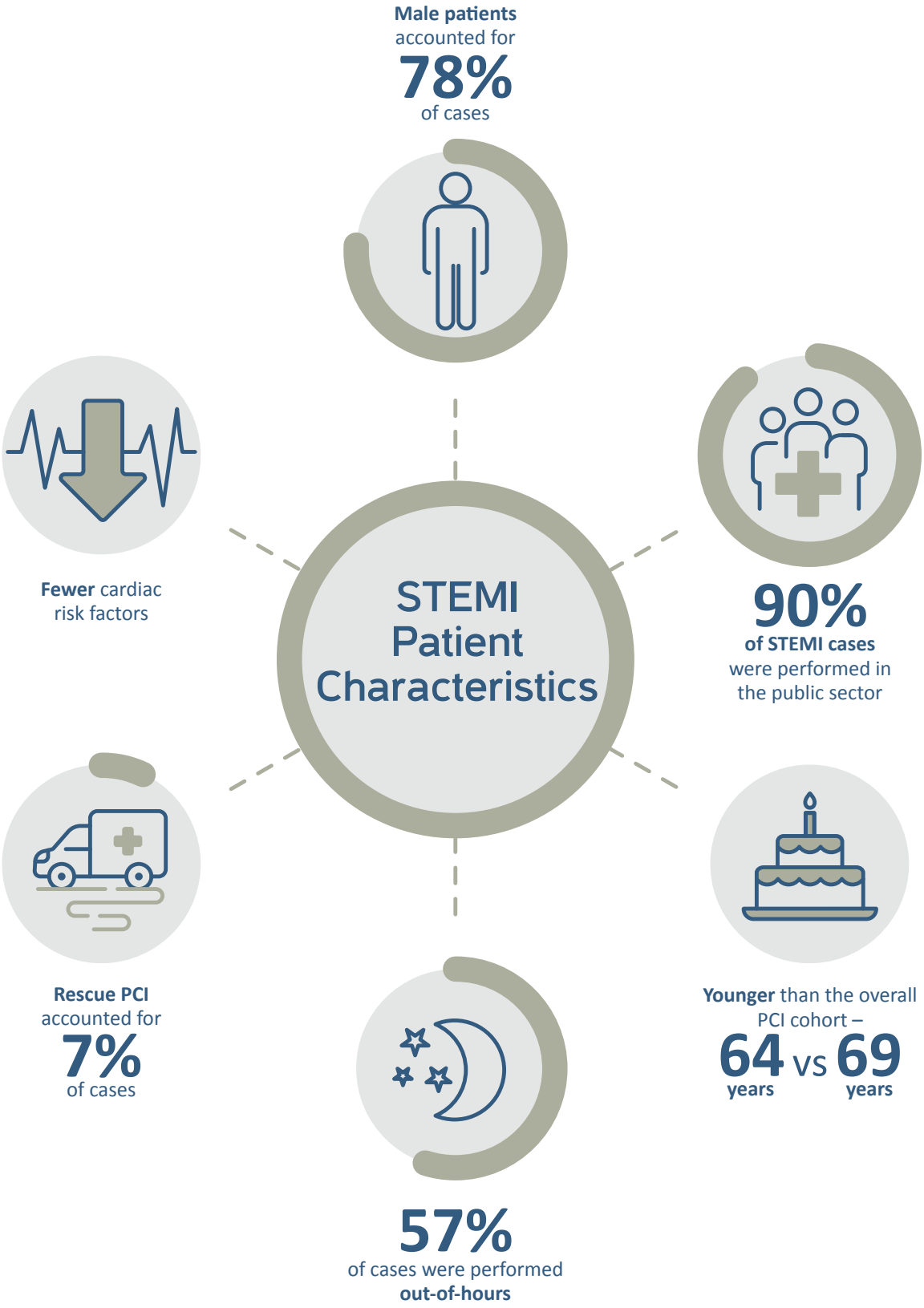
Hospitals 5, 6, 23, 24, 27, 32 had no ULM cases.

Arterial access

In 2024, the radial artery was used for vascular access in 80.2% of all PCI cases, reflecting a modest year-on-year increase of 1.2%. This continues the upward trend observed since 2018, when utilisation was recorded at 66%. Consistent with previous reports, public hospitals maintained higher rates of radial access (81.4%) compared to private hospitals (78.7%), although the gap between sectors continues to narrow. Radial access remained more common in male patients (81.7%) than in female patients (75.5%), mirroring trends seen in prior years.

In the setting of ST-elevation myocardial infarction (STEMI), radial access was used in 83.9% of cases, a rate comparable to the previous year. Hospital-level variation was observed, with utilisation ranging from 50% to 92%. Notably, 85.6% of hospitals achieved radial access in ≥75% of their acute STEMI cases, representing a 1.4% increase from the prior reporting period.

Figure 13: STEMI patient characteristics



PCI for STEMI

A total of 2,417 patients underwent PCI for ST-elevation myocardial infarction (STEMI). The majority of these cases (90.3%) were treated in the public sector. Primary PCI was undertaken in 76.4% of STEMI cases. The subcategories of PCI for the management of STEMI are shown in Table 10. The distribution of STEMI PCI caseload varied widely among hospitals, ranging from 0% to 45.1%. Overall, 57.4% of PCI procedures for STEMI were performed out-of-hours.

Table 10: Subcategories of patients undergoing PCI for STEMI

PCI for STEMI categories	All sites (N=2,417)	Public (n=2,183)	Private (n=234)
	N (%)	N (%)	N (%)
Primary PCI* (<12 hrs, no thrombolysis)	1,847 (76.4)	1,660 (76.0)	187 (79.9)
PCI for STEMI 12-24 hours (no thrombolysis)	112 (4.6)	94 (4.3)	18 (7.7)
Pharmaco-invasive PCI (<24 hrs, previous thrombolysis, stable)	105 (4.3)	99 (4.5)	6 (2.6)
Rescue PCI (<24 hrs, previous thrombolysis, unstable)	157 (6.5)	154 (7.1)	3 (1.3)
PCI for STEMI 1-7 days no prior lysis	148 (6.1)	129 (5.9)	19 (8.1)
PCI for STEMI 1-7 days following lysis	48 (2.0)	47 (2.2)	1 (0.4)

Patients presenting with ST-elevation myocardial infarction (STEMI) continued to display a distinct clinical profile compared to the broader PCI cohort. The mean age of STEMI patients was 64.1 ± 12.5 years, notably younger than the non-STEMI cohort (68.6 ± 11.4 years). STEMI patients also demonstrated a lower prevalence of several cardiovascular risk factors, including diabetes (23.0% vs 27.2%), peripheral vascular disease (1.9% vs 3.9%), prior stroke (2.7% vs 3.8%), hypertension (50.3% vs 68.2%), and chronic lung disease (9.4% vs 13.0%). Consistent with previous years, prior revascularisation procedures were significantly less common in the STEMI group. Rates of prior PCI and coronary artery bypass grafting (CABG) were 13.0% and 1.7%, respectively, compared to 37.1% and 6.1% in the rest of the cohort.

Differences in demographic and clinical characteristics were also evident between public and private sector STEMI patients. On average, STEMI patients in the private sector were older (69.6 ± 11.6 years) than those treated in the public system (63.5 ± 12.5 years). The prevalence of diabetes was lower in the private sector (17.1% vs 23.6%), while rates of previous PCI (24.8% vs 11.7%) and CABG (4.3% vs 1.4%) were higher. Public sector STEMI patients exhibited higher rates of hypertension (56.0% vs 49.7%) and chronic lung disease (12.8% vs 9.0%) compared to their private sector counterparts. Key characteristics of the STEMI cohort and associated management practices are summarised in Figure 13.

Time Delays to Treatment

The door-to-balloon time (DBT) serves as a benchmark for assessing hospital performance in managing patients with STEMI and is a key performance measure. There was a notable improvement in the proportion of cases treated within ≤60 minutes of hospital arrival (Table 11).

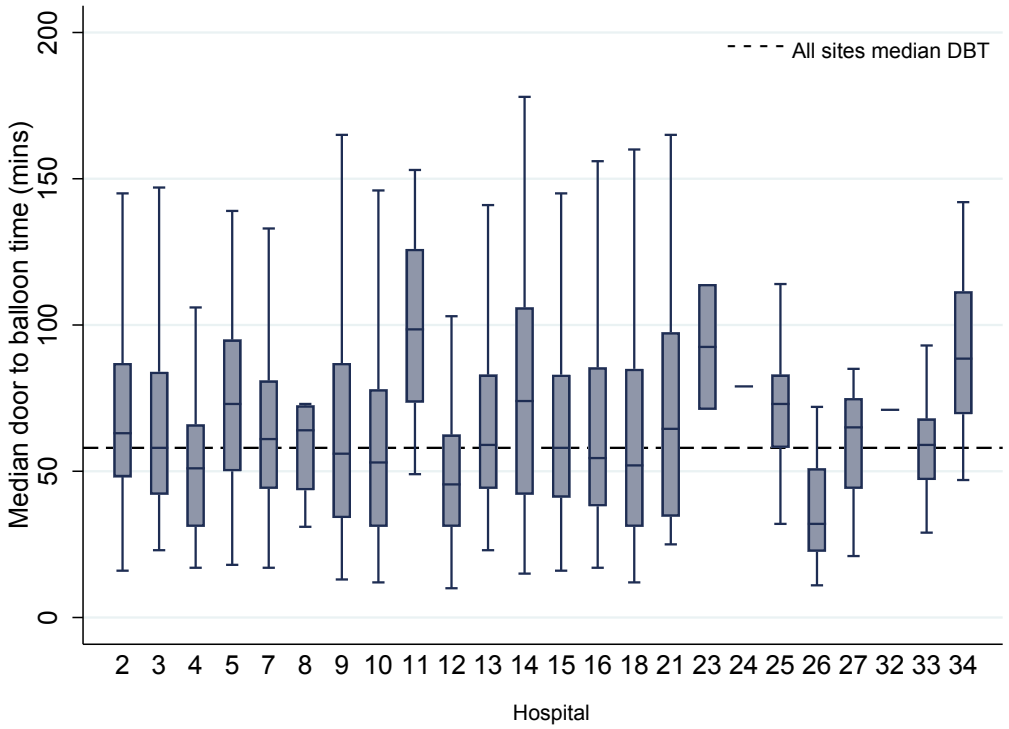
Table 11: Door-to-balloon times for primary PCI cases: 2019 - 2024

Door-to-balloon time	2019	2020	2021	2022	2023	2024
	(N=1,495)	(N=1,623)	(N=1,565)	(N=1,469)	(N=1,532)	(N=1,552)
Median – mins (IQR)	58 (40, 84)	62 (43, 91)	61 (43, 92)	62 (43, 90)	61 (42, 84)	58 (41, 83)
Proportion of cases ≤60mins (%)	54	48.4	49.3	47.6	49.3	53.5

Primary PCI for STEMI presentations excluding all inter-hospital transfers and patients with STEMI onset whilst a current in-patient.

The DBT times for primary PCI cases by hospital are presented in Figure 14. The median DBT across all hospitals was 58 minutes.

Figure 14: Door-to-balloon time for primary PCI cases by hospital

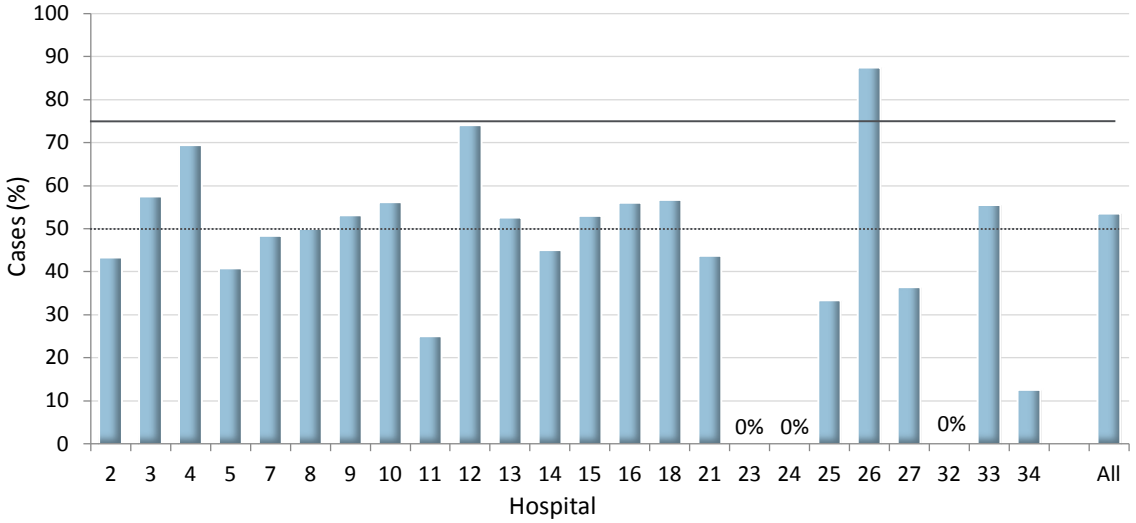


Hospital	2	3	4	5	7	8	9	10	11	12	13	14	15	16	18	21	23	24	25	26	27	32	33	34	All
Case N	143	94	72	54	234	4	49	155	4	100	213	91	85	100	30	16	2	1	18	40	11	1	27	8	**1,552**

Primary PCI for STEMI presentations excluding all inter-hospital transfers and patients with STEMI onset whilst a current in-patient. Hospitals 8, 11, 23, 24 & 32 had low primary PCI cases ≤5. Hospitals 1, 6, 17, 19, 20, 22 ,28,29,30 & 31 had no primary PCI cases.

Analysis of door-to-balloon time (DBT) performance revealed significant variability across hospitals performing primary PCI (Figure 15). Only one hospital met the recommended benchmark of achieving DBT ≤60 minutes in at least 75% of cases. When the compliance threshold was adjusted to ≥50% of cases treated within 60 minutes, 11 of the 24 hospitals met this target. Of particular concern, three of the five hospitals with low procedural volumes (≤5 primary PCI cases) failed to achieve a DBT ≤60 minutes in any case. These findings underscore the association between procedural volume and timely reperfusion, reinforcing the importance of supporting low volume centres in their efforts to adhere to clinical guidelines in STEMI care.

Figure 15: Proportion of primary PCI cases with door-to-balloon time ≤60 minutes by hospital



Hospital	2	3	4	5	7	8	9	10	11	12	13	14	15	16	18	21	23	24	25	26	27	32	33	34	All
Case N	143	94	72	54	234	4	49	155	4	100	213	91	85	100	30	16	2	1	18	40	11	1	27	8	**1,552**

Primary PCI for STEMI presentations excluding all inter-hospital transfers and patients with STEMI onset whilst a current in-patient. Hospitals 8, 11, 23, 24 & 32 had low primary PCI cases ≤5. Hospitals 1, 6, 17, 19, 20, 22 ,28,29,30 & 31 had no primary PCI cases.

A total of 204 primary PCI cases presented with cardiogenic shock and/or intubated out-of-hospital arrest and 37.7% achieved a DBT ≤60 minutes. Excluding these high-acuity and clinically demanding cases from the analysis, there was an increase in the proportion of patients with DBT ≤60 minutes- 55.9% cases were treated in ≤60 minutes.

Pre-hospital notification (PHN)

Pre-hospital notification (PHN) was provided in 76.9% of primary PCI cases (Table 12). Consistent with previous reports, PHN was associated with a reduction in median door-to-balloon time (DBT), and an increase in the proportion of cases treated ≤60 minutes. In cases where there was no PHN, just 26% of primary PCI cases were treated in ≤60 minutes.

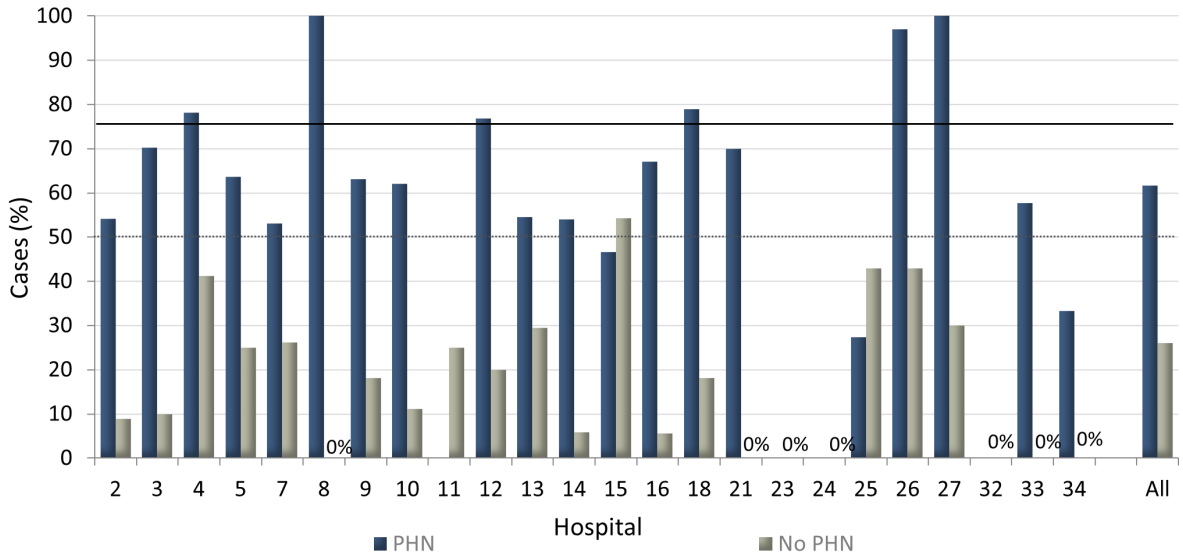
Table 12: Door-to-balloon times for Primary PCI cases by pre-hospital notification status

Door-to-balloon time	Primary PCI*	Primary PCI* (PHN†)	Primary PCI* (no-PHN†)
	(N=1,552)	(n=1,194)	(n=358)
Median – mins (IQR)	58 (41, 83)	52 (38,72)	84 (60, 115)
Proportion of cases ≤60mins (%)	53.5	61.7	26.0

**Primary PCI for STEMI presentations excluding all inter-hospital transfers and patients with STEMI onset whilst a current in-patient.*
†Pre-hospital notification (PHN).

Figure 16 illustrates the impact of PHN on compliance with a door-to-balloon time (DBT) of ≤60 minutes across hospitals. Using a compliance threshold of at least 50% of cases, only one hospital was able to achieve this metric in cases without PHN.

Figure 16: Proportion of primary PCI cases with door-to-balloon time ≤ 60 minutes - pre-hospital notification vs no pre-hospital notification



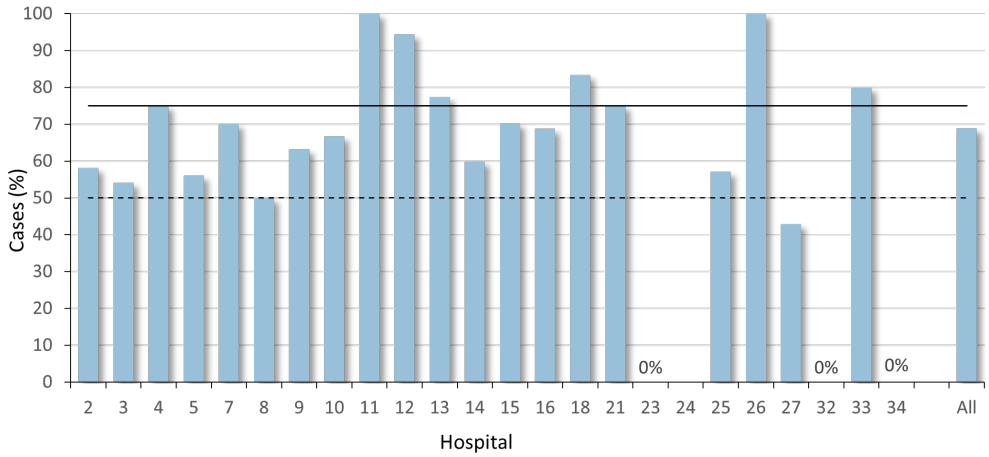
Hospital	2	3	4	5	7	8	9	10	11	12	13	14	15	16	18	21	23	24	25	26	27	32	33	34	All
Case N	109	74	55	22	192	2	38	137	0	95	196	74	15	100	82	10	0	0	11	33	1	0	26	3	1,194
Hospital	2	3	4	5	7	8	9	10	11	12	13	14	15	16	18	21	23	24	25	26	27	32	33	34	All
Case N	34	20	17	32	42	2	11	18	4	5	17	17	70	18	11	6	2	1	7	7	10	1	1	5	358

Primary PCI for STEMI presentations excluding all inter-hospital transfers and patients with STEMI onset whilst a current in-patient.
Hospitals 11, 23, 24 and 32 had no PHN cases. Hospitals 8, 11, 23, 24 & 32 had low primary PCI cases ≤5.
Hospitals 1, 6, 17, 19, 20 ,22 ,28, 29, 30 & 31 had no primary PCI cases.

In-hours versus out-of-hours presentation

In 2024, 60.2% of all primary PCIs were performed outside regular working hours. As in previous years, substantial inter-hospital variation was observed in the proportion of out-of-hours cases, ranging from 0% to 75%. Performance analysis by time of presentation revealed that in-hours procedures were more likely to meet the recommended door-to-balloon (DBT) time of ≤60 minutes.

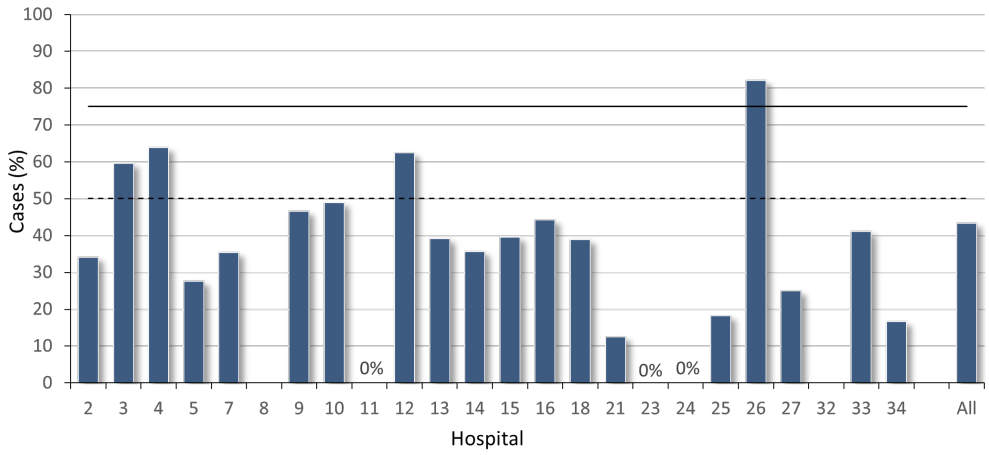
Figure 17a: Proportion of primary PCI cases with door-to-balloon time ≤60 minutes - in-hours presentation



Hospital	2	3	4	5	7	8	9	10	11	12	13	14	15	16	18	21	23	24	25	26	27	32	33	34	All
Case N	55	37	36	25	87	4	19	63	1	36	75	35	37	48	12	8	1	0	7	12	7	1	10	2	618

Nineteen of the 24 hospitals achieved this benchmark for in-hours cases. In contrast, only 4 hospitals met the same target during out-of-hours periods (Figures 17a and 17b). These findings highlight ongoing challenges in delivering timely reperfusion outside regular hours.

Figure 17b: Proportion of primary PCI cases with door-to-balloon time ≤60 minutes - out-of-hours presentation



Hospital	2	3	4	5	7	8	9	10	11	12	13	14	15	16	18	21	23	24	25	26	27	32	33	34	All
Case N	88	57	36	29	147	0	30	92	3	64	138	56	48	52	18	8	1	1	11	28	4	0	17	6	934

Primary PCI for STEMI presentations excluding all inter-hospital transfers and patients with STEMI onset whilst a current in-patient. Hospitals 8 & 32 had NIL out-of-hours cases. Hospital 24 had NIL in-hours cases. Hospitals 1, 6, 17, 19, 20 ,22 ,28, 29, 30 & 31 had no primary PCI cases. In-hours: 8.00am - 6.00pm (Mon-Fri excluding public holidays). Out-of-hours: 6.00pm - 8.00am (Mon-Fri, public holidays and weekends).

Times from symptom onset to first medical contact, diagnostic ECG and reperfusion

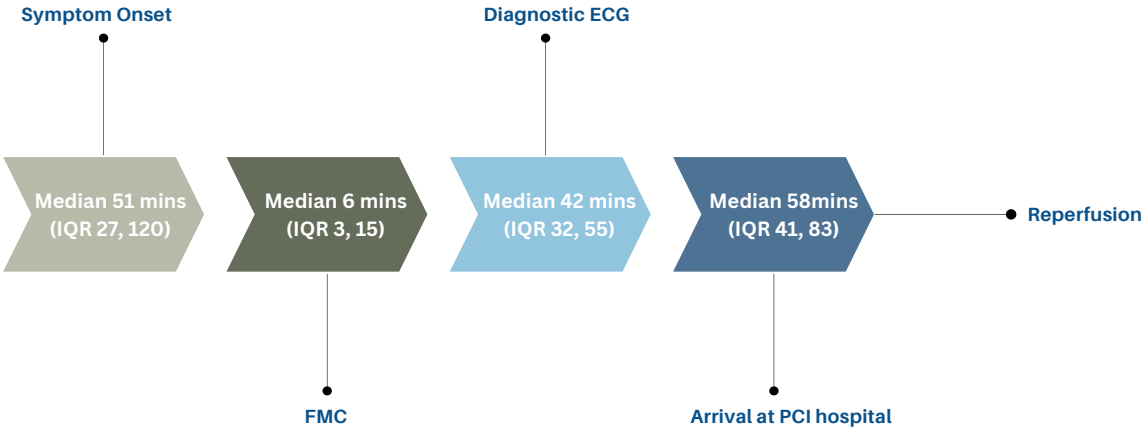
Timely recognition and treatment of ST-elevation myocardial infarction (STEMI) remain key priorities in acute coronary care. The interval from symptom onset to first medical contact (FMC)—reflecting patient recognition and initial access to care—is a critical determinant of total ischaemic time. In 2024, the median symptom onset to FMC time was 51 minutes (IQR: 27, 120), (Figure 18). This interval is influenced by both patient factors, such as symptom awareness and health literacy, and system-level factors including emergency medical service responsiveness.

System delay, defined as the time from FMC to reperfusion, encompasses several essential intervals: time from FMC to diagnostic electrocardiogram (ECG), time from ECG to arrival at a PCI-capable facility, and door-to-balloon time (hospital arrival to device deployment).

Figure 18 also illustrates total ischaemic time comprising both patient and system delays, culminating in the time from symptom onset to device activation. Australian practice guidelines for acute coronary syndrome recommend that STEMI patients presenting within 12 hours of symptom onset undergo primary PCI within 120 minutes of FMC.

Encouragingly, 2024 saw a reduction in median time intervals across the entire symptom-to-reperfusion pathway, reflecting improved system performance and increased public responsiveness to STEMI symptoms.

Figure 18: Median times from symptom onset to reperfusion



The various components of total ischaemic time, both overall and by hospital sector are presented in Table 13. The median FMC to balloon time was 104 mins. Overall, 66.5% of primary PCI cases were performed ≤120mins of FMC (range 50-100%). The median FMC to arrival (door) time was 50 mins (IQR: 39, 63), with 91.4% of primary PCI cases arriving at the PCI centre ≤90mins from FMC (range 50-100%).

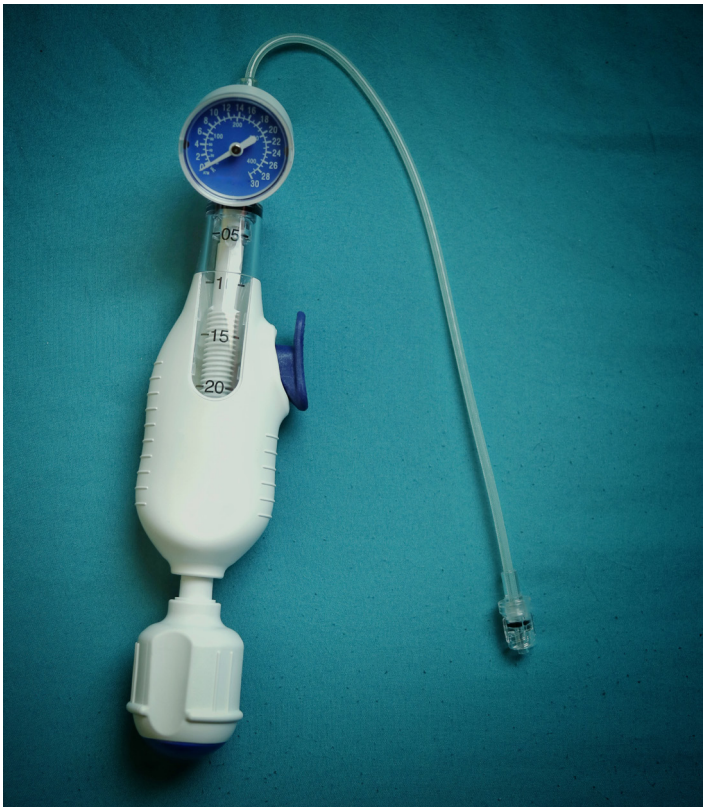
Table 13: Median times from symptom onset to reperfusion - public/private and PHN and No PHN

	All	Public	Private	PHN	No PHN
All Primary PCI*	(N=1,535)	(n=1,384)	(n=151)	(n=1,184)	(n=351)
Median Symptom onset to FMC- mins (IQR)	51 (27,120)	50 (26,120)	53 (30,126)	45 (24,102)	82 (41,182)
Median FMC to Diagnostic ECG- mins (IQR)	6 (3,15)	6 (3,15)	5 (3,10)	5 (3,11)	11 (5,27)
Median Diagnostic ECG to door- mins (IQR)	42 (32,55)	42 (32,55)	43 (32,54)	42 (32,55)	35 (25,52)
Median Diagnostic ECG to Balloon/Device time- mins (IQR)	93 (75,117)	94 (77,119)	84 (63,101)	96 (79,118)	81 (64,112)
Median FMC to Balloon/Device time - mins (IQR)	104 (84,133)	105 (85,135)	93 (70,115)	105 (86,130)	102 (76,150)

**Primary PCI for STEMI presentations excluding all inter-hospital transfers and patients with STEMI onset whilst a current in-patient.*

Time delays for patients presenting with acute STEMI to non-PCI capable centres

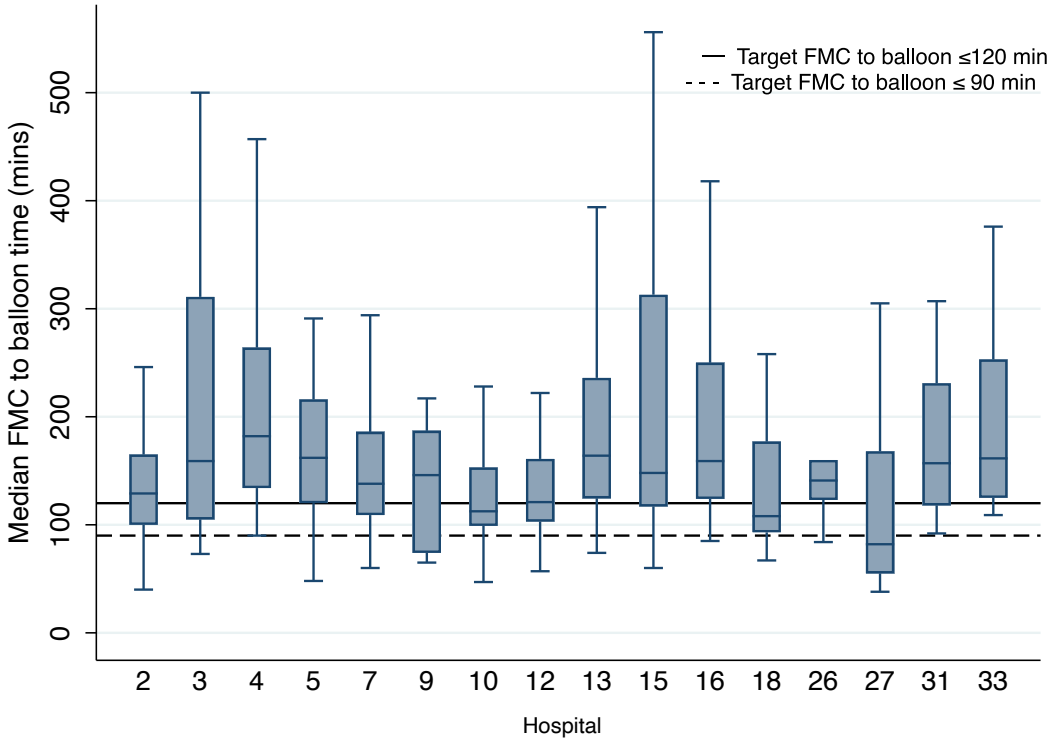
For patients with acute STEMI presenting to a non-PCI capable facility, Australian practice guidelines recommend primary PCI as the preferred reperfusion strategy if transfer and balloon inflation can be achieved within 120 minutes of first medical contact (FMC). This timeframe incorporates delays associated with interhospital transfer. If timely PCI is not achievable, fibrinolytic therapy is recommended. Given the relatively small number of patients meeting these criteria each year, outcomes from 2021–2024 have been aggregated to evaluate performance across Victorian hospitals.



Over the four-year reporting period (2021–2024), 785 patients presented to a non-PCI capable centre within 12 hours of symptom onset. The median FMC-to-reperfusion time for the cohort was 149 minutes (Figure 19). Only 4 hospitals achieved a median FMC-to-reperfusion time ≤120 minutes, and just one hospital met the more stringent ≤90-minute benchmark (Table 14). PHN reduced the FMC-to-reperfusion time by 8 mins. Metropolitan patients demonstrated shorter reperfusion delays compared to those from non-metropolitan areas (median 136 minutes vs 187 minutes).

Despite modest improvements following the PHN initiative, most patients transferred from non-PCI capable centres continue to experience reperfusion delays exceeding recommended guideline targets. These findings highlight the geographic and system-level challenges faced by the state's healthcare networks in delivering timely care to all patients irrespective of their location. Further optimisation of prehospital triage, transport logistics, and interhospital transfer pathways will be crucial to improving outcomes for this high-risk cohort.

Figure 19: FMC-to-balloon time for interhospital transferred primary PCI cases by hospital



Hospitals 8, 11, 14, 21, 25, 29 & 34 had n<5 primary PCI cases and were excluded from analysis.

Table 14: FMC-to-balloon times for primary PCI patients presenting to non-PCI centres (2021 - 2024 combined data)

First medical contact to Balloon/Device time	All	PHN	No-PHN	Metro	Non-Metro	Public	Private
	(N=785)	(n=434)	(n=351)	(n=563)	(n=212)	(n=718)	(n=67)
Median – mins (IQR)	149 (113, 218)	144 (108, 208)	152 (120, 228)	136 (109, 189)	187 (137, 307)	149 (113, 218)	144 (108, 232)
Proportion of cases ≤90 mins (%)	8.7	12.7	3.7	9.4	6.6	7.8	17.9
Proportion of cases ≤120 mins (%)	31.8	36.6	25.9	37.5	17.5	31.3	37.3

Outcomes

Lesion and procedure success rates

Procedural success remains a fundamental indicator of the quality and effectiveness of PCI. Defined as the successful treatment of all target lesions without the occurrence of major in-hospital complications, this metric continues to demonstrate consistently high performance across the state. In 2024, the overall procedural success rate was 92.6%, maintaining a stable trend in line with previous years. Success rates were comparable between hospital sectors, with the public sector reporting a rate of 91.3% and the private sector achieving 94.4%. Across individual institutions, success rates ranged from 85.6% to 100%.

Gender-based analysis also showed comparable procedural outcomes, with success rates of 92.8% in males and 92.1% in females. Encouragingly, the gender gap narrowed further in 2024, and overall success rates for both groups were the highest recorded to date.

Factors associated with reduced procedural success included procedures performed outside of regular hours, patients with severely impaired left ventricular function, and interventions involving high-complexity lesions such as chronic total occlusions. Patients presenting in cardiogenic shock or requiring intubation following out-of-hospital cardiac arrest (OHCA) continued to represent the highest-risk group. However, outcomes in this cohort improved significantly, with a procedural success rate of 55.6% in 2024, up from 48.8% in the previous year (see Table 15).

At the lesion level, success is defined as residual stenosis of less than 10% following stent implantation, and less than 50% following balloon angioplasty. The overall mean lesion success rate in 2024 was 95.1%, remaining consistent with previous reporting. Inter-hospital variation was again noted, with rates ranging from 90.9% to 100%. These results reflect the continued delivery of high-quality PCI care across Victoria and highlight areas for ongoing focus, particularly in the management of high-risk patients and complex lesions.

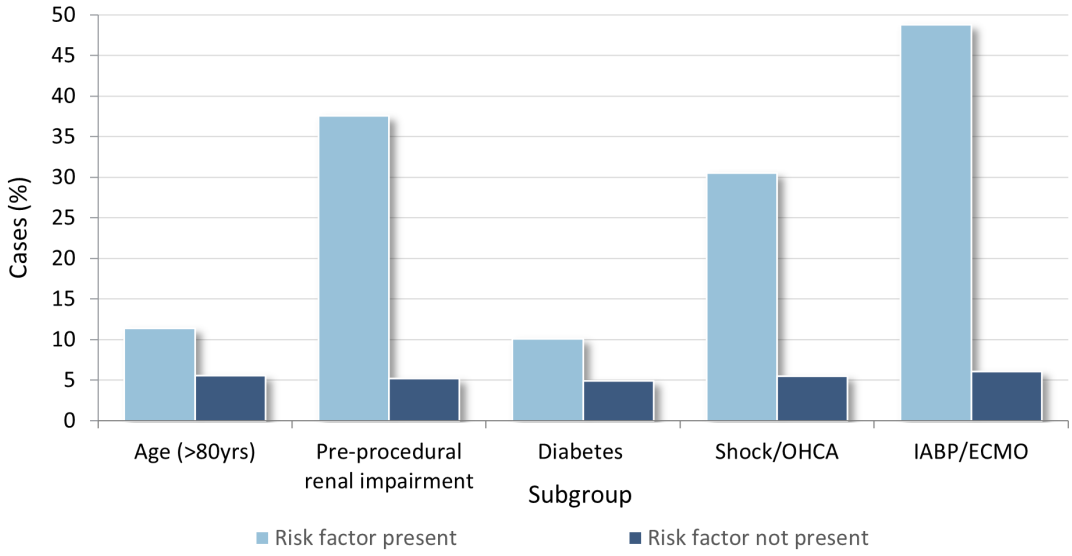
Table 15: Comparison of clinical features among successful PCI cases

Clinical characteristics	Characteristic present	Characteristic NOT present
	Procedure success (%)	Procedure success (%)
Cerebrovascular Disease	91.2	92.7
Chronic total occlusion	62.7	93.6
Severe LVEF (<35%)	76.0	94.7
Shock and/or intubated OHCA	55.6	93.7
ACC/AHA B2/C lesion	90.5	95.8
Out-of-hours	88.5	93.5

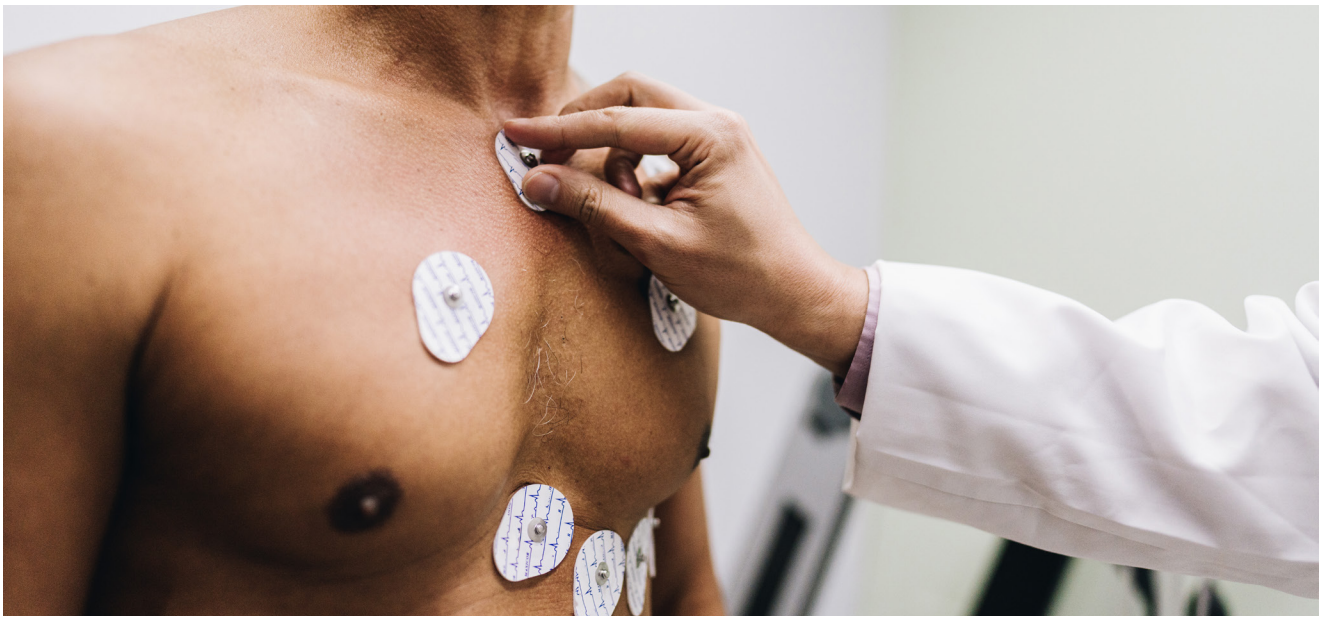
New renal impairment

Post-procedural renal function was assessed in 7,543 patients, representing 57.7% of the cohort. New renal impairment (NRI) was identified in 6.4% of cases overall. Consistent with previous years, the incidence of NRI was highest among patients undergoing PCI for ST-elevation myocardial infarction (STEMI), at 9.8%. This was followed by patients treated for non-ST-elevation acute coronary syndromes (NSTE-ACS), with an NRI rate of 5.9%. NRI outcomes in high-risk subgroups, including patients with significant pre-existing renal impairment and those requiring mechanical circulatory support, are detailed in Figure 20. Notably, the incidence of NRI among patients presenting with cardiogenic shock and/or out-of-hospital cardiac arrest requiring intubation decreased from 34.5% in 2023 to 30.5% in 2024.

Figure 20: New renal impairment in selected high-risk subgroups



Data available for 7,543 cases.

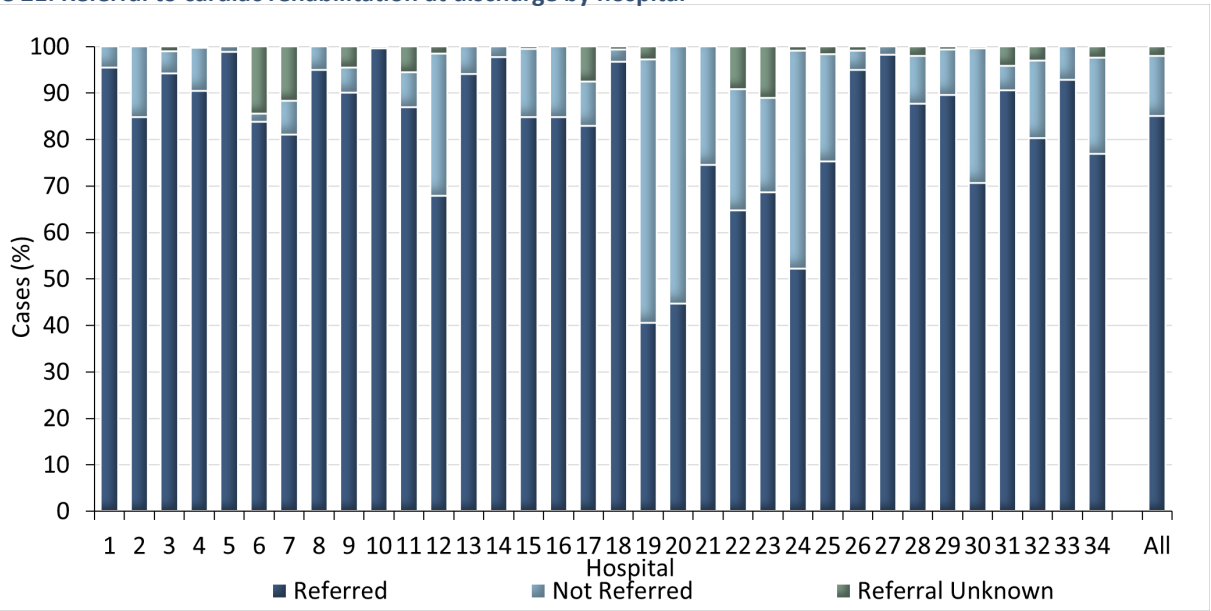


Referral to cardiac rehabilitation

Australian practice guidelines strongly advocate for the routine referral of all patients undergoing PCI to cardiac rehabilitation (CR) programs. In 2024, the overall rate of referral to CR reached 85.1% — the highest recorded in VCOR to date. This represents a 6.8% increase from the previous year, and a cumulative improvement of 12.7% since 2021. The proportion of patients not referred to CR declined to 12.8%, while referral status was recorded as "unknown" in 2.0% of cases. Referral rates differed by treatment sector, with higher referral observed in the public sector (88.7%) compared to the private sector (80.4%). At the institutional level, referral rates continued to show wide variation, ranging from 40.6% to 99.6% across participating hospitals (Figure21).

Referral was highest in the acute coronary syndrome (ACS) population, particularly those treated for STEMI and NSTE-ACS. Encouragingly, referral rates for these groups improved markedly over the past year — from 82.4% to 91.9% in the STEMI cohort, and from 80.5% to 88.6% in the NSTE-ACS cohort. Among patients undergoing PCI for non-ACS indications, 81.3% were referred to CR. While institutional variability in referral practices remains, the overall gap appears to be narrowing, reflecting ongoing improvements in system-wide adherence to guideline-recommended care.

Figure 21: Referral to cardiac rehabilitation at discharge by hospital



Compliance with guideline-recommended medications at discharge

Guideline-recommended medical therapy following PCI includes the prescription of dual antiplatelet therapy (DAPT) and statins, with additional consideration for beta blockers (BB) and angiotensin-converting enzyme inhibitors or angiotensin receptor blockers (ACE-I/ARB), particularly in patients with acute coronary syndromes. Table 16 summarises the utilisation of these therapies across clinical presentations. Overall, the prescribing patterns for DAPT, statins, ACE-I/ARB, and BB have remained consistent with previous years. However, a decline in beta blocker use was observed among patients presenting with non-ST-elevation acute coronary syndromes (NSTE-ACS), decreasing from 72.3% in 2023 to 64.8% in 2024. The use of beta blockers and ACE-I/ARB remains lowest in the non-ACS cohort undergoing PCI.

Table 16: Rates of prescription of selected medications at discharge by clinical presentation

	DAPT	Statin	BB	ACE-I/ARB
	%	%	%	%
STEMI	95.3	96.9	80.7	78.9
NSTE-ACS	95.6	95.7	64.8	72.1
Non-ACS	94.1	92.3	51.3	61.2

A subset of patients undergoing PCI require concurrent oral anticoagulation (OAC), typically with warfarin or a direct-acting oral anticoagulant (DOAC), in addition to antiplatelet therapy. When OAC is combined with a single antiplatelet agent (such as aspirin, clopidogrel, or ticagrelor), the regimen is referred to as “double therapy.” The addition of a second antiplatelet agent constitutes “triple therapy,” a strategy that is potentially associated with an increased bleeding risk.

Table 17 details the rates of double and triple therapy at discharge and 30 days post-procedure, stratified by clinical presentation and patient factors. The overall rate of double therapy at discharge remained consistent with the previous year and continued to be the more commonly prescribed regimen. Triple therapy was more frequently observed in patients with non-acute coronary syndromes (non-ACS), consistent with trends reported in prior years.

In terms of comprehensive medical management, 90.7% of patients with ST-elevation myocardial infarction (STEMI) were discharged on at least four of the five guideline-recommended therapies — comprising aspirin, a second antiplatelet agent, statin, beta blocker, and ACE inhibitor or ARB. This represents a modest decline of 1.5% compared to the previous reporting period. The rate of optimal medical therapy was lower in NSTE-ACS and non-ACS cases being 83.8% and 71.9% respectively.

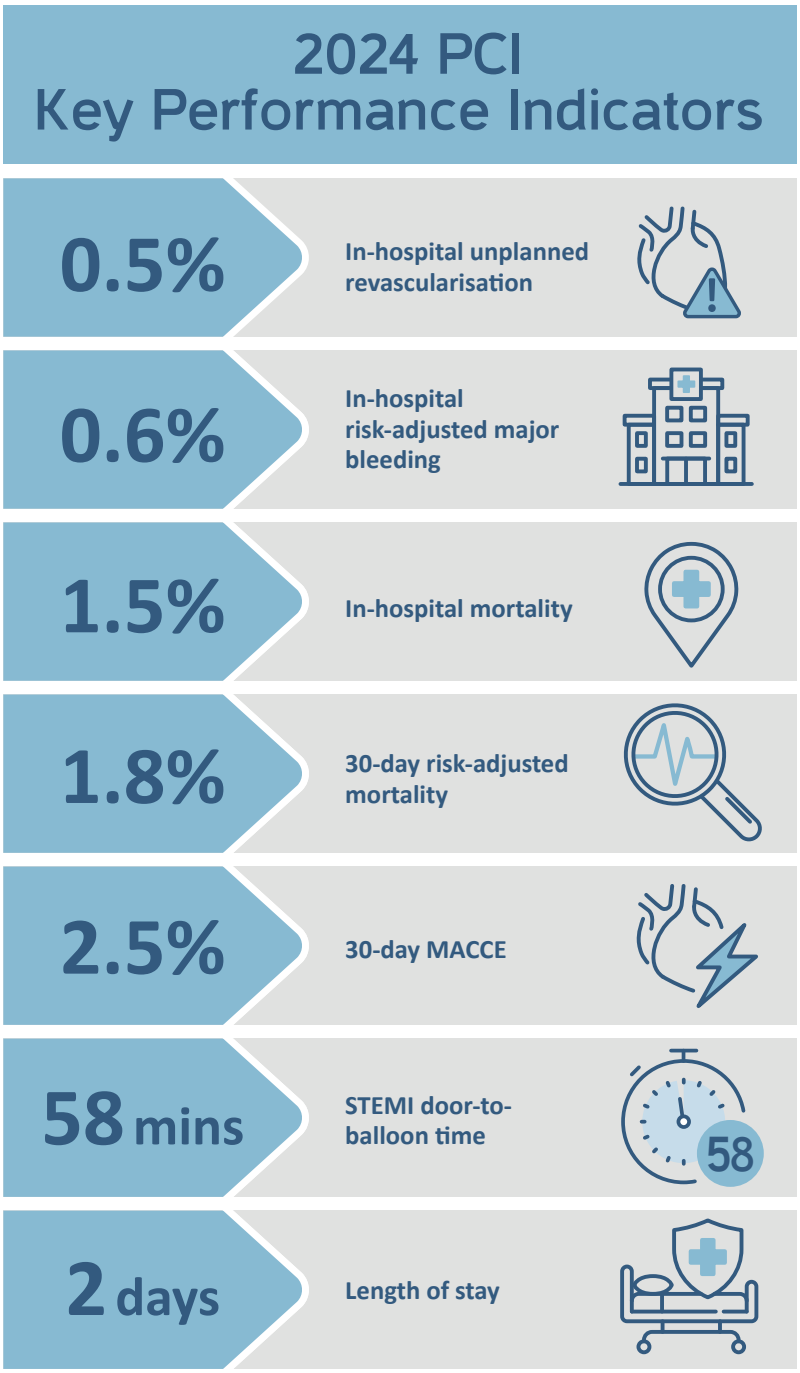
Table 17: Rates of double and triple therapy at discharge and 30-days

Characteristics	Discharge		30-Day	
	Double Therapy	Triple Therapy	Double Therapy	Triple Therapy
	%	%	%	%
Sex- male	13.0	9.7	12.2	4.8
Sex- female	9.7	8.8	11.8	4.4
Age <60 years	5.1	4.1	5.5	2.8
Age 60-69 years	9.2	7.1	9.2	3.7
Age 70-79 years	16.2	12.2	15.0	5.6
Age >79 years	25.1	16.5	21.5	7.4
STEMI	10.9	8.7	10.7	4.2
NSTE-ACS	12.5	9.5	11.9	4.4
Non-ACS	13.8	9.7	12.6	5.0
Public	11.2	9.1	10.6	3.9
Private	15.3	10.0	14.0	5.7

Key Performance Indicators

The key performance indicators (KPIs) are shown in Figure 22.

Figure 22: VCOR PCI Key Performance Indicators



Risk-adjustment models

VCOR continues to refine its risk-adjustment models to ensure accurate outcome assessments. In 2024 work was undertaken to update the model for 30-day all-cause mortality. Further, a new risk-adjustment model for in-hospital major bleeding was developed. Both models were developed utilising artificial intelligence (AI), with assessment of multiple AI programs undertaken.

The revised model using advanced machine learning techniques outperforms the traditional regression model and provides better accuracy for predicting 30-day mortality (unpublished observations). The clinical characteristics used to construct the VCOR risk-adjustment model for 30-day mortality were:

- Left ventricular ejection fraction
- Cardiogenic shock
- Acute coronary syndrome
- Intubated out-of-hospital cardiac arrest
- Glomerular filtration rate
- Mechanical ventricular support
- Age
- Complex lesions
- Body mass index
- Peripheral vascular disease
- Lesion location
- Sex

Major bleeding is recognised as a significant prognostic marker in PCI. Accurate identification and reporting of these events, along with systematic benchmarking of hospitals based on bleeding outcomes, are essential for identifying performance gaps and driving continuous quality improvement.

VCOR has developed its own risk-adjustment model for in-hospital major bleeding post-PCI using advanced machine learning methods (unpublished observations). The predictors of in-hospital major bleeding were:

- Glomerular filtration rate
- Cardiogenic shock
- Acute coronary syndrome
- Mechanical ventricular support
- Left ventricular ejection fraction
- Glycoprotein IIb/IIIa inhibitor
- Sex
- Intubated out-of-hospital cardiac arrest
- Age

Both risk prediction models for 30-day all-cause mortality and in-hospital major bleeding were developed with high accuracy using machine learning algorithms. It's essential to underscore the need for further validation with external data to ensure the applicability of the models to other populations.

In-hospital mortality

In 2024, the unadjusted in-hospital mortality rate was 1.5%, similar to previous reports. Excluding cases where patients had cardiogenic shock and/or intubated out-of-hospital cardiac arrest (OHCA), the in-hospital mortality rate was 0.7%. The in-hospital mortality rate for the STEMI cohort was 6.0%. When STEMI's and cases involving shock and/or intubated OHCA were removed, the in-hospital mortality rate reduced to 0.3%. The trends for in-hospital mortality rates over the past five years across various patient subgroups are presented in Table 18.

Table 18: Trends in in-hospital mortality rates for selected clinical presentations: 2020 - 2024

Patient category	2020 (N=12,349)	2021 (N=12,478)	2022 (N=11,651)	2023 (N=12,564)	2024 (N=13,066)
	N (%)	N (%)	N (%)	N (%)	N (%)
All PCI patients	184 (1.5)	180 (1.4)	197 (1.6)	203 (1.6)	196 (1.5)
STEMI	140 (5.4)	118 (4.8)	135 (5.7)	133 (5.4)	144 (6.0)
Shock and/or intubated OHCA	116 (35.6)	113 (37.7)	127 (35.7)	119 (36.3)	105 (28.8)
NSTE-ACS	19 (0.5)	32 (0.9)	37 (1.2)	33 (1.0)	34 (1.0)
Non-ACS	25 (0.4)	30 (0.5)	25 (0.4)	37 (0.5)	18 (0.3)

In-hospital major bleeding

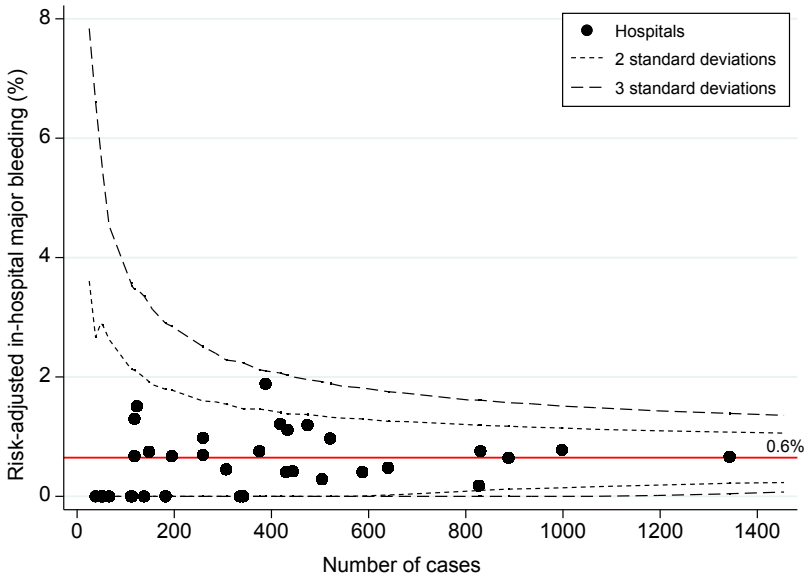
Data on in-hospital major bleeding across a range of clinical presentations, clinical and procedural characteristics are summarised in Table 19. Among patients requiring extracorporeal membrane oxygenation (ECMO), the incidence of major bleeding was 26.9% (n=26). Although in 2024 the number of patients supported with ECMO was similar to previous years, there was a rise in bleeding complications in this high-risk group (26.9% in 2024 vs 20.0% in 2023).

Table 19: In-hospital major bleeding rates for selected patient groups

Sub-group	N	Major bleeding rate
Clinical Presentation		N (%)
STEMI	2,413	38 (1.6)
NSTE-ACS	3,466	18 (0.5)
Non-ACS	7,177	36 (0.5)
Sex		N (%)
Male	9,888	55 (0.6)
Female	3,168	37 (1.2)
Arterial Access Route		N (%)
Radial access	10,475	41 (0.4)
Femoral access	2,554	50 (2.0)
Brachial access	27	1 (3.7)
Total	13,056	92 (0.7)

Risk-adjusted major bleeding rates by hospital are presented in Figure 23. The rate range among hospitals was 0-1.8%. No hospitals were outliers for risk-adjusted in-hospital major bleeding.

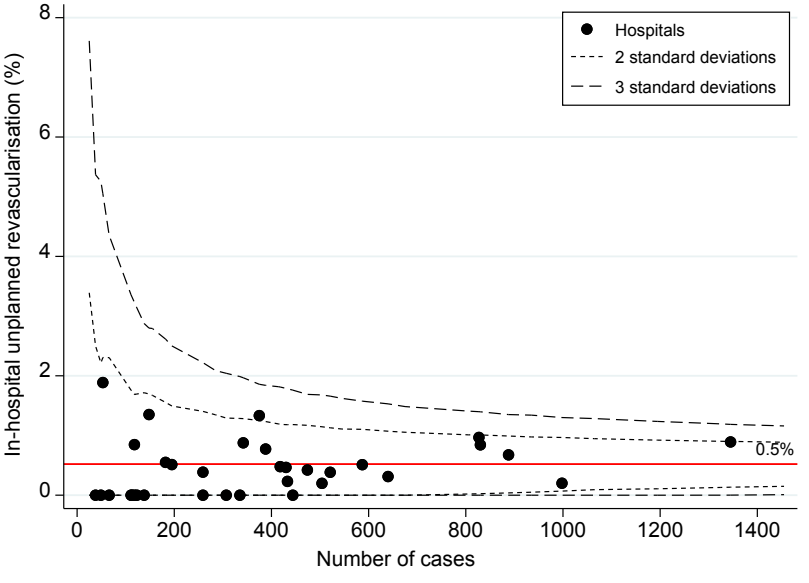
Figure 23: Risk-adjusted in-hospital major bleeding by hospital



In-hospital unplanned revascularisation

Unplanned revascularisation—defined as an unexpected, non-scheduled PCI or coronary artery bypass graft (CABG) procedure following the index PCI—occurred in 0.5% of cases during the 2024 reporting period. This represents a reduction from the previous year and continues a favourable trend in procedural safety and clinical outcomes. All participating hospitals remained within established control limits for this indicator, as illustrated in Figure 24.

Figure 24: In-hospital unplanned revascularisation by hospital



A total of 18 unplanned CABG procedures were performed following the index PCI in 2024 (Table 20). This reflects a continued decline in unplanned surgical revascularisation over the past two years. Among patients requiring unplanned CABG, inter-hospital transfer to a surgery-capable facility was infrequent, with only three cases requiring transfer.

Table 20: In-hospital CABG by clinical presentation

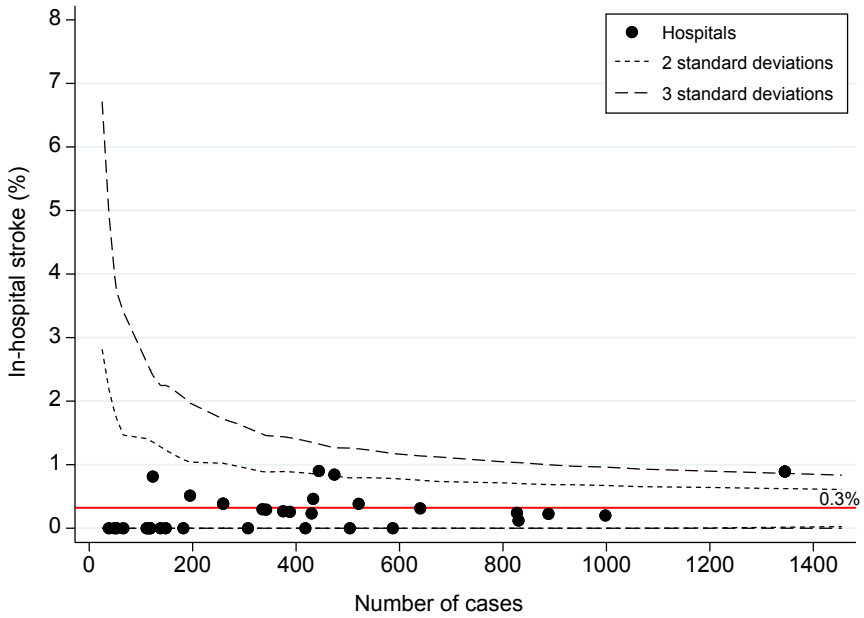
In-hospital CABG	All patients (N=13,066)	Planned CABG (n=60)	Unplanned CABG (n=18)
	N	N (%)	N (%)
Non-ACS	7,179	16 (0.2)	7 (0.1)
NSTE-ACS	3,469	17 (0.5)	6 (0.2)
STEMI	2,418	27 (1.1)	5 (0.2)

Planned CABG following PCI was performed in 60 patients during the 2024 reporting period, including 27 patients who initially presented with STEMI. One-third of planned CABG cases required inter-hospital transfer, reflecting the absence of on-site surgical facilities at the initial PCI centre. The in-hospital mortality rate for patients undergoing planned CABG was 3.3%. In contrast, patients requiring emergency CABG experienced a higher in-hospital mortality rate of 5.6%, highlighting the increased risk associated with unplanned surgical intervention

In-hospital stroke

In-hospital stroke occurred in 0.3% of patients (range 0-0.9%). No hospitals were outliers for this key indicator, see Figure 25.

Figure 25: In-hospital stroke by hospital

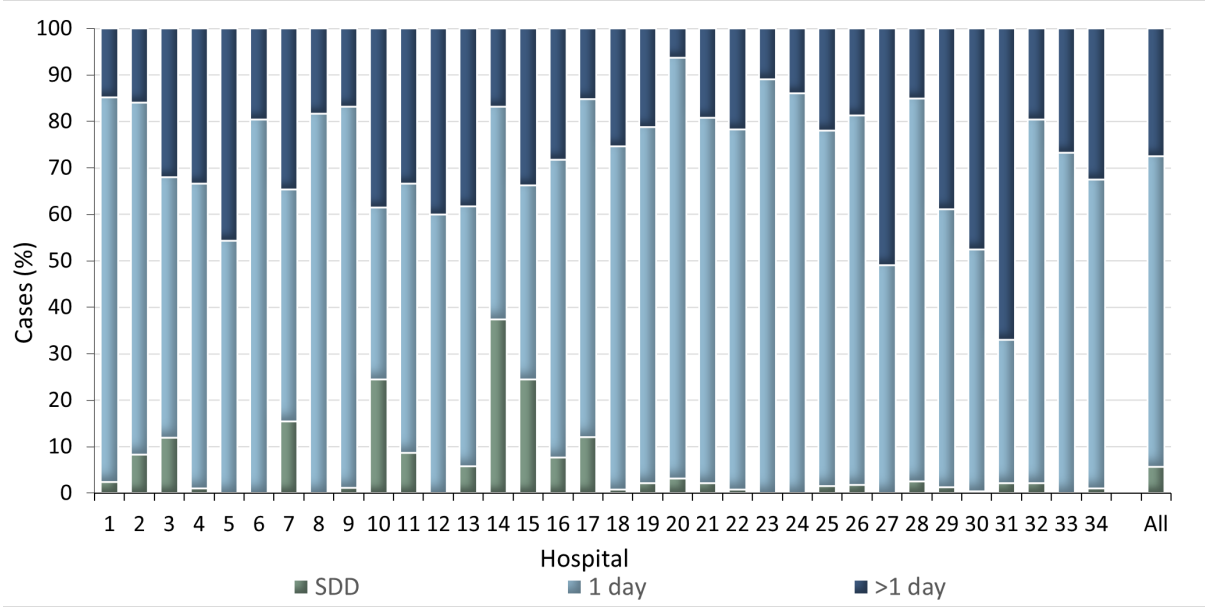


Length of stay

Consistent with previous reporting, the overall median length of stay following PCI in 2024 was 2 days (interquartile range: 1 to 4 days), with variation based on clinical presentation. The overall mean length of stay was 3.1 days. Patients presenting with an acute coronary syndrome had a longer average stay of 4.2 days, with the mean increasing to 4.7 days in the STEMI subgroup. For those with NSTE-ACS, the mean stay was 3.9 days, while patients without an ACS diagnosis had a shorter average stay of 2.2 days.

Same day discharge (SDD) following elective PCI continues to gain acceptance as a safe, efficient, and cost-effective strategy in appropriately selected patients. In 2024, SDD rates showed a modest increase compared to previous years. Utilisation remained higher in the public sector, with 12.5% of elective cases discharged on the same day, compared to 1.5% in the private sector. Among elective PCI cases, two-thirds of patients were discharged within 24 hours, with the proportion higher in private hospitals (72.4%) compared to public hospitals (57.6%). The distribution of SDD by hospital is presented in Figure 26.

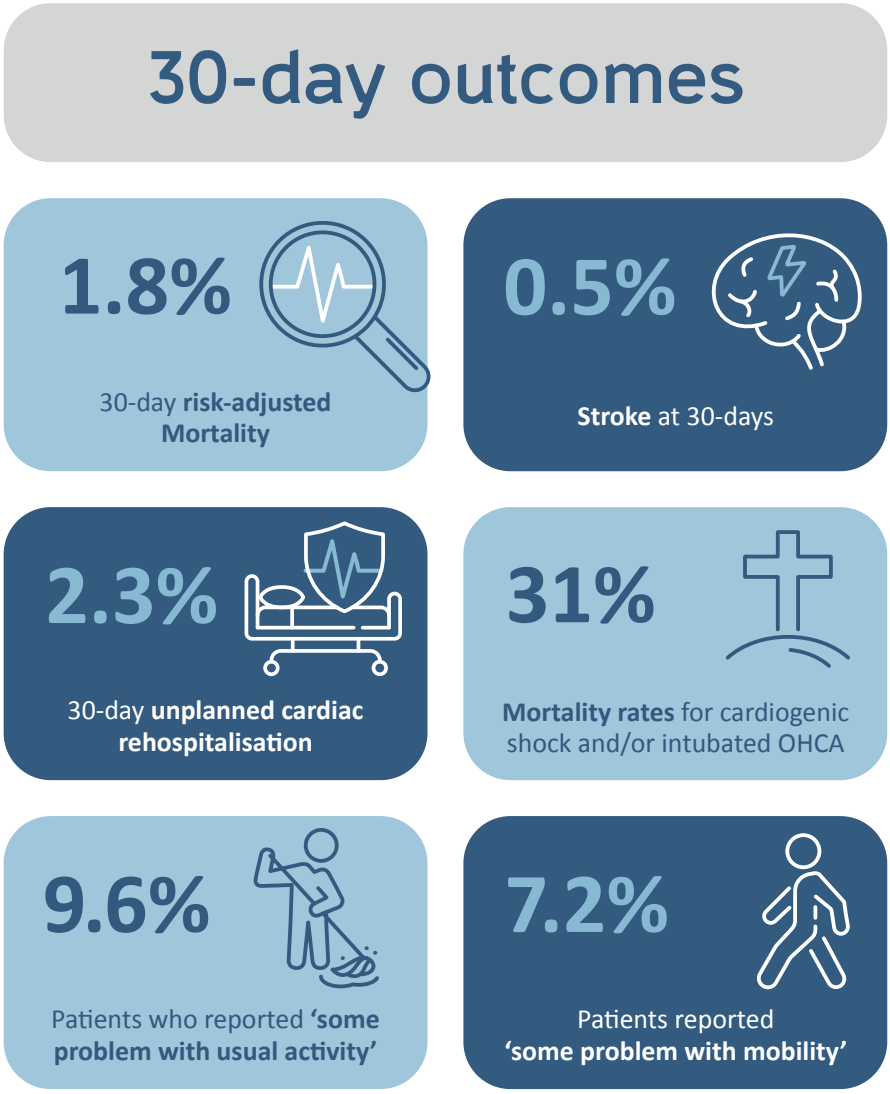
Figure 26: Discharge to home in elective patients by hospital



30-Day Outcomes

An overview of 30-day outcomes are shown in Figure 27.

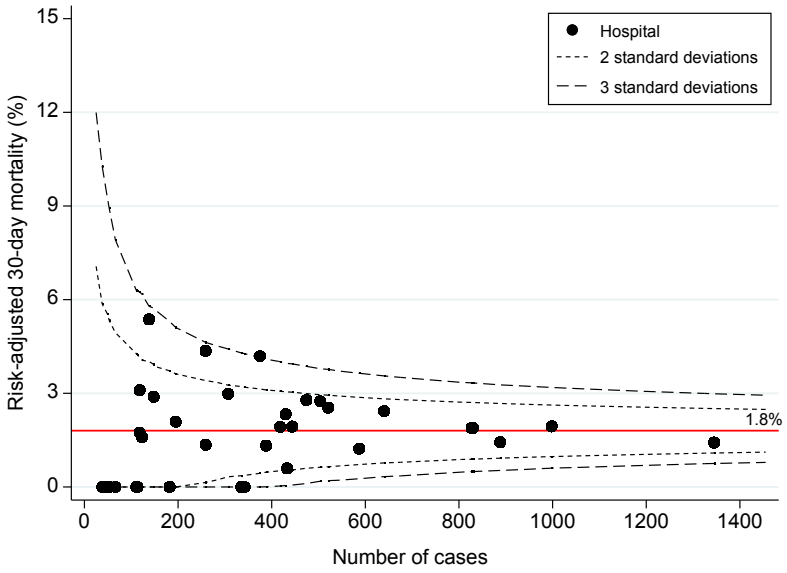
Figure 27: 30-day outcomes



Risk-adjusted mortality at 30-days

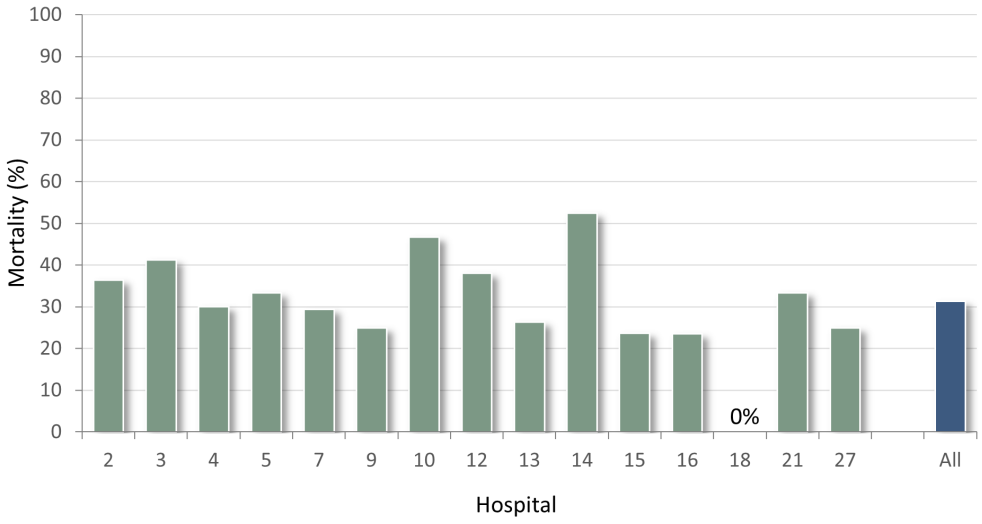
The 30-day risk-adjusted mortality rate was 1.8% a reduction compared to the previous year. All participating hospitals were within control limits (Figure 28).

Figure 28: Risk-adjusted mortality by hospital at 30-days



Unadjusted 30-day mortality outcomes for patients presenting with cardiogenic shock and/or intubated out-of-hospital cardiac arrest (OHCA) are presented in Figure 29. In 2024, a total of 365 cases were recorded, with a mean 30-day mortality rate of 31.3%, representing a reduction compared to previous years. Twelve hospitals did not treat any patients within this high-acuity condition, and an additional seven hospitals treated two or fewer cases. These centres were excluded from comparative analysis. No association was observed between hospital procedural volume and mortality outcomes in this patient group.

Figure 29: Mortality rates for cardiogenic shock and/or intubated OHCA patients by hospital at 30-days



Hospitals 1, 11,17,19,20,22,23,26,28, 29 & 30 had NIL cases with cardiogenic shock and/or intubated OHCA.
Hospitals 6,8,24,25,31,32 & 33 had ≤2 cases with cardiogenic shock and/or intubated OHCA and were excluded.

Major cardiac and cerebrovascular events at 30-days

The composite endpoint of major adverse cardiac and cerebrovascular events (MACCE) includes all-cause mortality, new or recurrent myocardial infarction, stent thrombosis, target vessel revascularisation, and stroke. In-hospital and 30-day MACCE rates are summarised in Table 21. The overall 30-day MACCE rate was 3.4%, remaining similar to previous reporting periods. Mortality was the predominant contributor to 30-day MACCE, with an observed increase of 0.5% between hospital discharge and 30 days (1.5% at discharge vs 1.9% at 30 days).

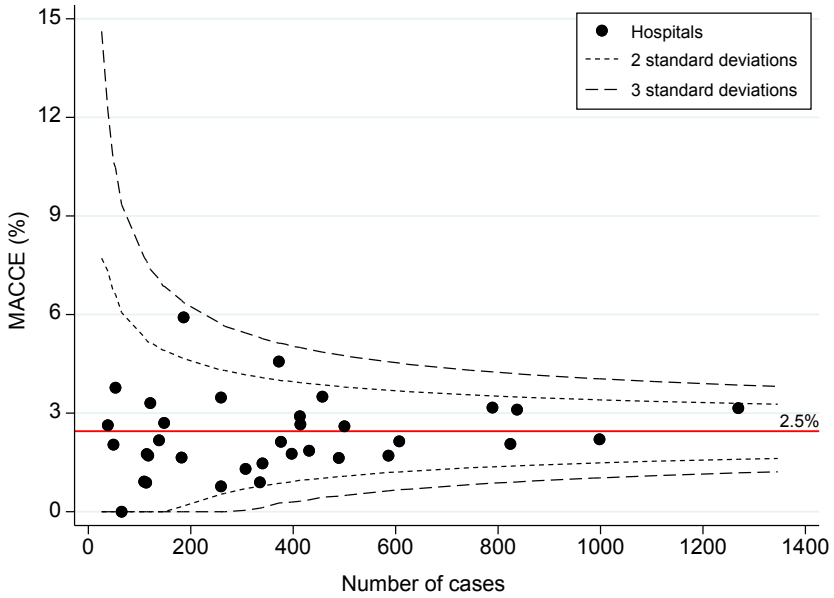
Table 21: Major adverse cardiac and cerebrovascular events at 30-days

MACCE component**	In-hospital events	30-day events*
	N (%)	N (%)
Mortality	188 (1.4)	245 (1.9)
Myocardial infarction	44 (0.3)	78 (0.6)
Stroke	42 (0.3)	63 (0.5)
Definite stent thrombosis	17 (0.1)	29 (0.2)
Probable stent thrombosis	4 (<0.1)	6 <(0.1)
Target vessel revascularisation (TVR)†	68 (0.5)	122 (0.9)
MACCE	294 (2.3)	444 (3.4)

**30-day events reported include in-hospital events.*
***Cases with multiple procedures were excluded to avoid mortality being counted more than once (n=18).*
†TVR refers to any 'unplanned' PCI or CABG revascularisation of the target vessel.
Categories are not mutually exclusive.

The 30-day MACCE rates (excluding the high-acuity cases of cardiogenic shock and/or intubated OHCA) by hospital are shown in Figure 30. The rate overall of 2.5% was slightly lower than the previous year. All hospitals were within control limits.

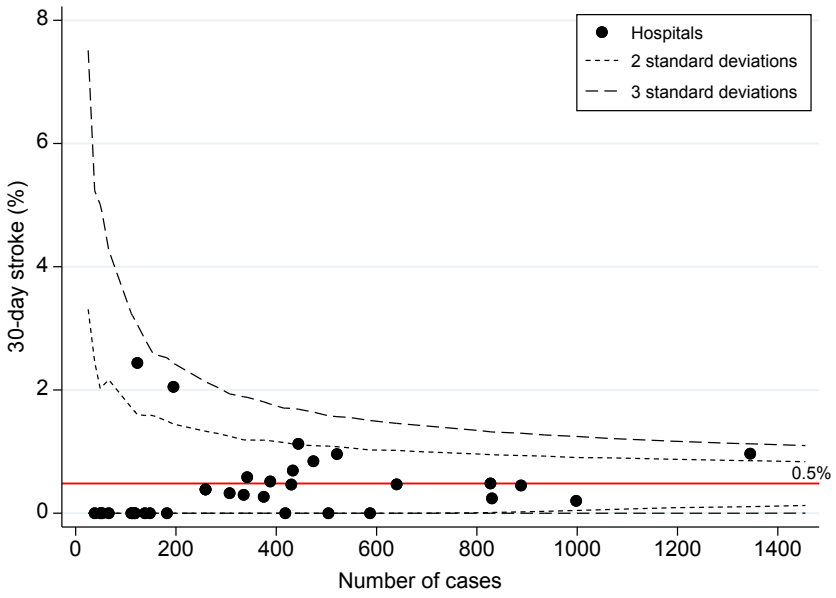
Figure 30: MACCE by hospital at 30-days



Stroke at 30-days

The overall 30-day stroke rate was 0.5%, with all participating hospitals within control limits (Figure 31). Across hospitals, the 30-day stroke rate ranged from 0% to 2.4%. During the post-discharge period (from hospital discharge to 30 days), 21 additional stroke events were recorded. These included 16 ischaemic strokes, 3 haemorrhagic strokes, and 2 strokes where the subtype was not specified.

Figure 31: Stroke by hospital at 30-days



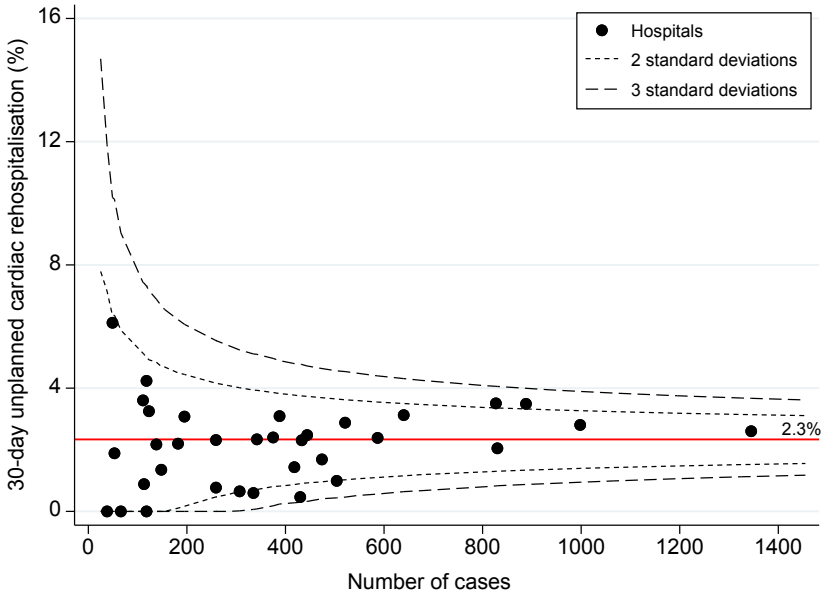
Rehospitalisation at 30-days

The overall rate of rehospitalisation within 30 days of discharge was 9.8% (Table 22). Consistent with prior reports, rehospitalisation rates were higher in the private sector. Unplanned cardiac readmissions accounted for 306 cases (2.3%) of all 30-day rehospitalisations. Figure 32 illustrates the distribution of 30-day unplanned cardiac rehospitalisation by hospital. No outlier hospitals were identified for this performance indicator.

Table 22: Rehospitalisation by hospital sector

	All patients (N=12,782)	Public (n=7,239)	Private (n=5,543)
	N (%)	N (%)	N (%)
Rehospitalisations	1,256 (9.8)	599 (8.3)	657 (11.9)
Non-cardiac rehospitalisations	417 (3.3)	249 (3.4)	168 (3.1)
Cardiac rehospitalisations	839 (6.5)	350 (4.8)	489 (8.8)
Unplanned cardiac rehospitalisations	306 (2.3)	192 (2.6)	114 (2.1)
Planned cardiac rehospitalisations	533 (4.2)	158 (2.2)	375 (6.7)

Figure 32: Unplanned 30-day cardiac rehospitalisation by hospital



Quality of life

The EQ-5D Quality of Life (QoL) tool was administered by participating hospitals at the 30-day follow-up. This validated instrument assesses five key domains: mobility, self-care, pain or discomfort, and anxiety or depression. Responses were obtained in 77.7% of cases (n=12,702) across all hospitals. Table 23 presents EQ-5D QoL domain outcomes stratified by socio-economic status (SES) and patient location (metropolitan versus non-metropolitan). Consistent with previous reports, minimal differences were observed across the domains within these categories, indicating broadly comparable patient-reported outcomes across demographic and geographic groups.

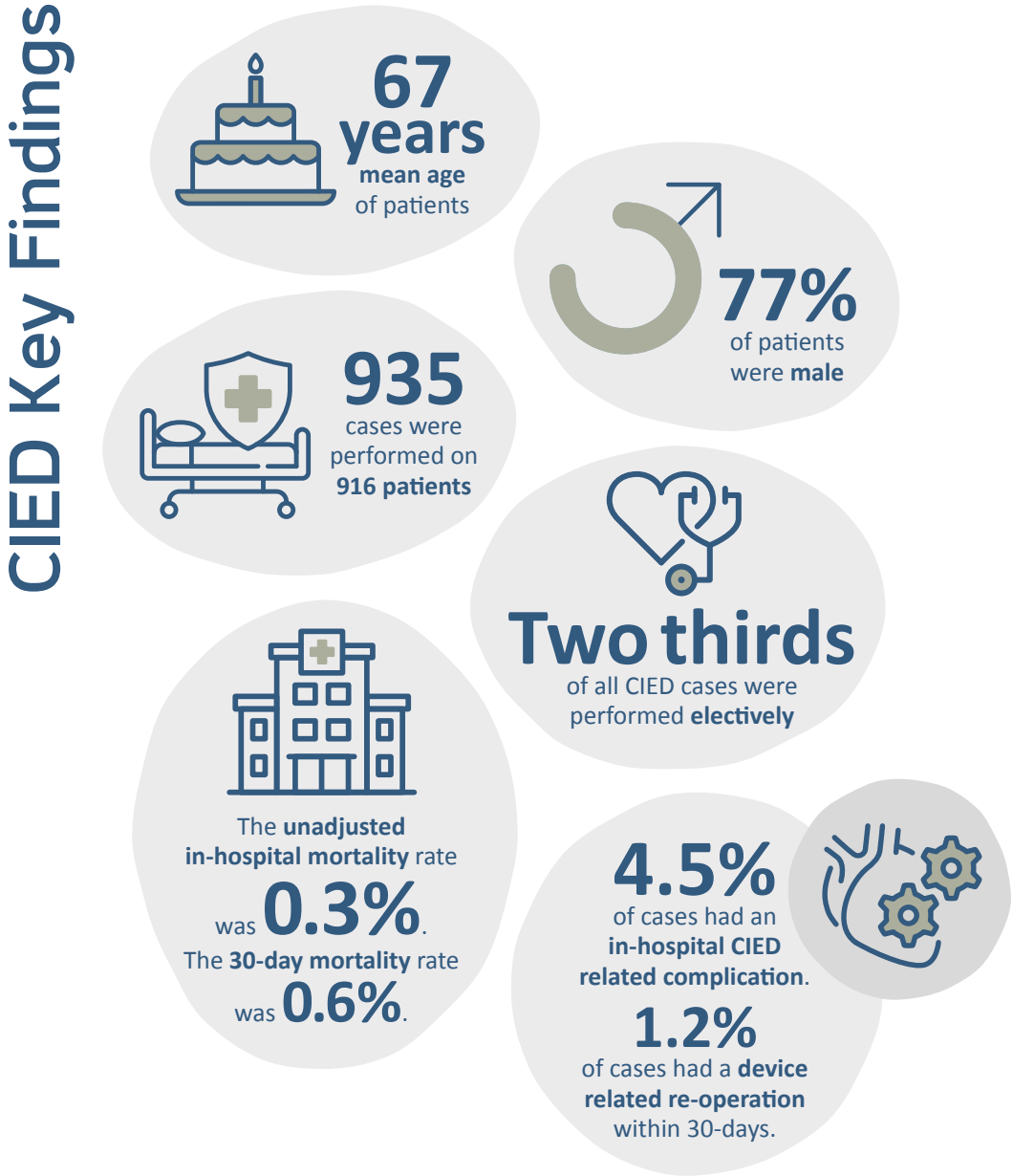
Table 23: Patients reported experience by socio-economic status and in non-metro/metro areas

Quality of Life components	Low SES (n=2,761)	High SES (n=9,941)	Non-metro (n=3,647)	Metro (n=8,929)	All (N=12,702)
	%	%	%	%	%
Some problem with mobility	9.8	6.5	10	6.0	7.2
Some problem with personal care	4.3	3.2	4.7	2.9	3.4
Some problem with usual activity	12.1	8.9	13.1	8.1	9.6
Moderate/extreme pain/discomfort	8.6	7.4	9.3	7.0	7.6
Moderate/extreme anxiety/depression	8.3	7.0	8.0	6.9	7.3
Assessment of own health status (score 0-100)	77.3	77.9	78.3	77.4	77.7

Cardiac Implantable Electronic Devices (CIED)

Key Findings CIED Module

Figure 33: CIED Key Findings



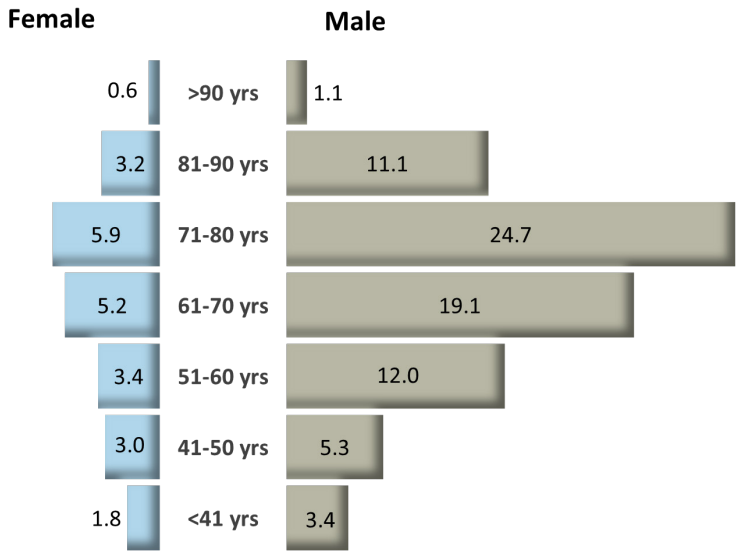
Registry Module Activity

In 2024, VCOR's CIED module included data collection from 12 public hospitals and 4 private hospitals. Since its inception in 2018, a total of 4,971 CIED cases had been recorded as of December 31, 2024. The CIED module specifically monitors two therapy types: implantable cardiac defibrillators (ICD) and cardiac resynchronisation therapy (CRT), providing insights into the utilisation and outcomes of these device-based interventions.

Patients and procedures

In the 2024 reporting period, 935 CIED procedures were performed in 916 patients. The mean patient age was 67 ± 14 years, with males representing 77% of cases (Figure 34). Female patients were, on average, nearly three years younger than their male counterparts (65 ± 16 vs. 68 ± 14 years). Elective procedures accounted for approximately two-thirds of all interventions. First-time device implants comprised the majority of cases, representing 53.5% of procedures, while generator replacements accounted for 41.0%. System explants and revisions constituted 3.6% of procedures, and new lead insertions comprised 1.9% of the total.

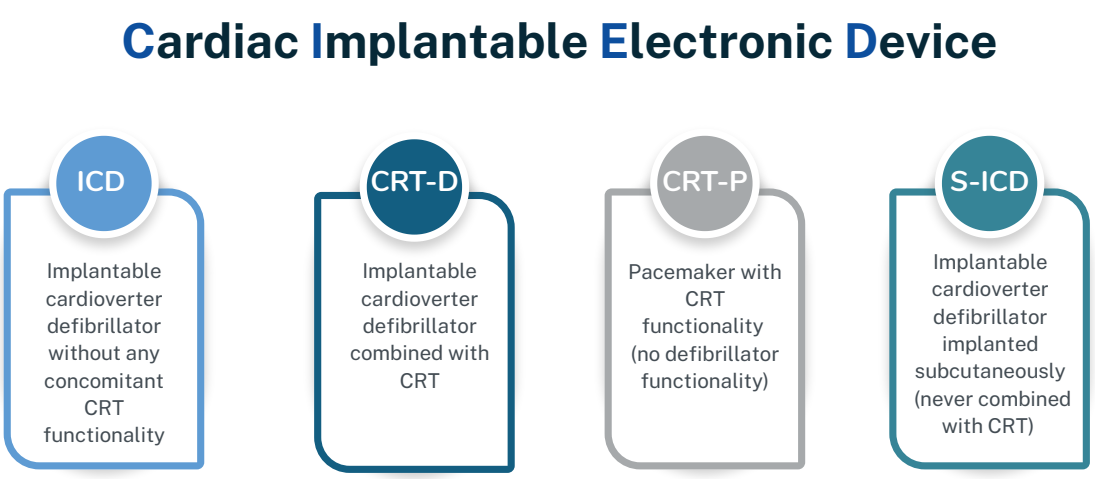
Figure 34: Age and sex distribution of patients undergoing CIED implantation



Device types

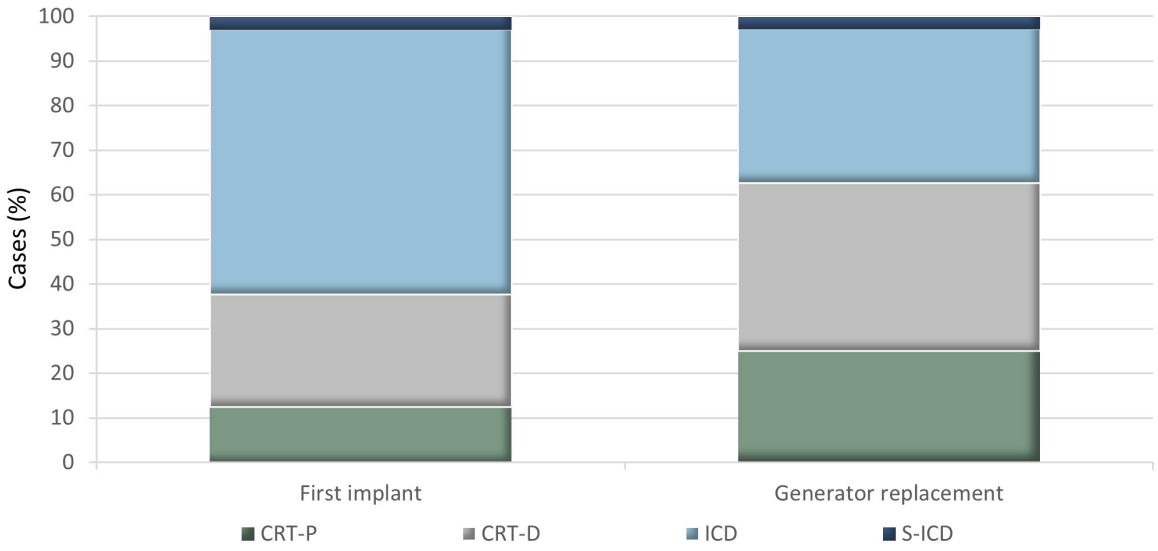
The four types of CIED devices that are monitored by VCOR are shown in Figure 35.

Figure 35: CIED Device Types



ICD devices (ICD, S-ICD or CRT-D) represented 87.6% of first implants and 75.1% of generator replacements (Figure 36). Similar to previous years, CIEDs were implanted most commonly in the left pre-pectoral region (CRT 88.1% and ICD 87.0%). The remainder were implanted in either the left sub-pectoral region (CRT 5.6% and ICD 5.9%) or the right pre-pectoral region (CRT 5.1% and ICD 2.2%).

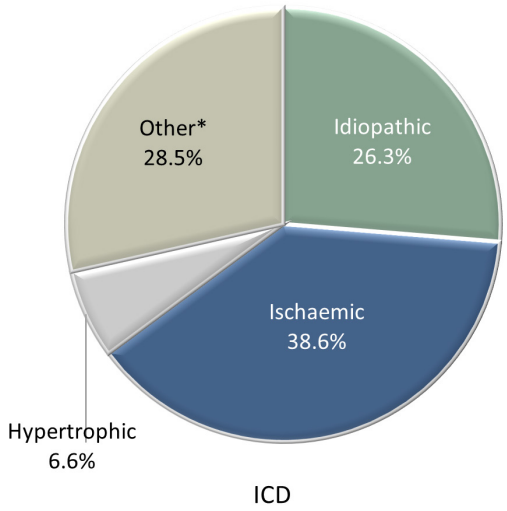
Figure 36: Device type - first implant and generator replacement



Cardiomyopathy aetiology

Figures 37 and 38 detail the underlying cardiomyopathy aetiology among patients receiving their first CIED implant. Ischaemic cardiomyopathy was the predominant cause, accounting for 38.6% of implantable cardioverter defibrillator (ICD) devices. Idiopathic cardiomyopathy was identified in 26.3% of cases. Other aetiologies (as detailed in the figure footnote) comprised 28.5% of the cohort. A smaller subset of patients (6.6%) undergoing their initial CIED implantation had hypertrophic cardiomyopathy.

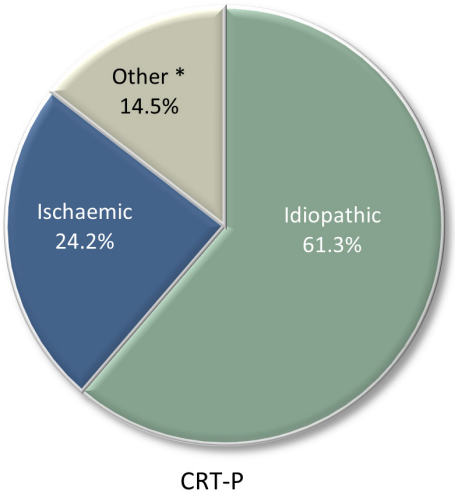
Figure 37: Aetiology in patients undergoing first CIED implant - ICD



**Includes familial/congenital & idiopathic ventricular fibrillation*

Idiopathic cardiomyopathy was the most prevalent underlying aetiology, accounting for 61.3% of the CRT-P group. Ischaemic heart disease contributed to 24.2% of cases, while other causes were present in 14.5% of patients (refer to figure footnote).

Figure 38: Aetiology in patients undergoing first CIED implant - CRT-P

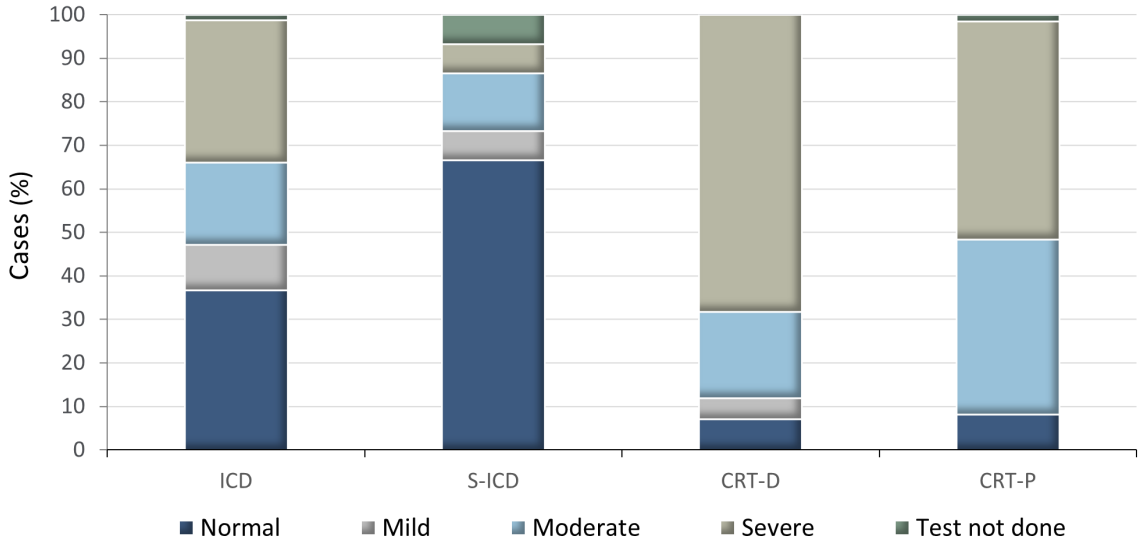


**Includes valvular, familial/congenital & structurally normal heart.*

Left ventricular function

The distribution of the degree of left ventricular impairment among patients undergoing CIED therapy is illustrated in Figure 39. The highest proportion of cases having severe LV dysfunction was amongst those receiving CRT-D therapy (68.3%). Patients who received S-ICD mostly had normal or mildly reduced LV function (73.3%).

Figure 39: Left ventricular function by CIED type (first implants only)



Indications for CIED therapy

ICDs

ICD devices are primarily implanted to prevent sudden cardiac death, either as primary or secondary prevention. In 2024, primary prevention accounted for 54.2% of all ICD implants, with ischaemic cardiomyopathy representing 38.6% of these cases. Among secondary prevention indications, just over half of ICD implants (51%) were performed in patients with a history of ventricular tachycardia, while 40% were for prior ventricular fibrillation. Other secondary prevention indications included previous cardiac arrest (5.5%) and syncope (3.5%).

Cardiac resynchronisation therapy

National and international guidelines for cardiac resynchronisation therapy (CRT) specify key inclusion criteria, including a QRS duration ≥120 milliseconds, severe left ventricular dysfunction, and New York Heart Association (NYHA) Class II or higher symptoms. Table 24 summarises the application of these guideline criteria among patients receiving CRT with defibrillator (CRT-D) and CRT with pacemaker (CRT-P) devices. Compliance with the recommended criteria was lower in the CRT-P cohort compared to the CRT-D group.

Table 24: Inclusion criteria for CRT by device type

	CRT-D (N=126)	CRT-P (N=62)
	N (%)	N (%)
QRS width ≥120 msec	103 (82)	49 (79)
Severe left ventricular dysfunction (LVEF<35%)	86 (68)	31 (51)
NYHA Class II or greater	107 (86)	56 (97)

Assessing the strength of recommendation for CIED therapy

While the decision to implant a cardiac implantable electronic device (CIED) must be based on a comprehensive clinical assessment that considers the full range of patient-specific factors, clinical practice guidelines play an important role in supporting evidence-based decision-making. To assist clinicians and provide structured feedback to operators and hospitals on their CIED use, VCOR has developed a suite of evidence-based clinical algorithms. These are designed to evaluate the strength of recommendations for CIED implantation to promote consistency with national and international best practice standards and support ongoing quality improvement initiatives.

Figure 40 presents the distribution of recommendation strength for implantable defibrillator therapy, classified as +, ++, or +++. Among the 424 cases involving ICD, CRT-D, or S-ICD devices, the majority (67%) were assigned a strong recommendation rating (+++), with a further 22% classified as moderate (++). These findings reflect a high level of alignment with guideline-based indications for defibrillator therapy.

Figure 40: Strength of recommendation for ICD therapy

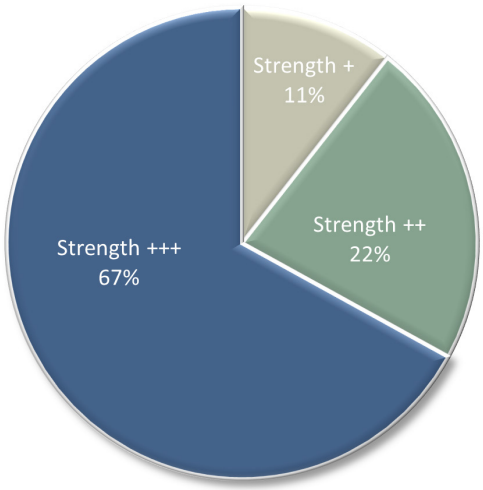


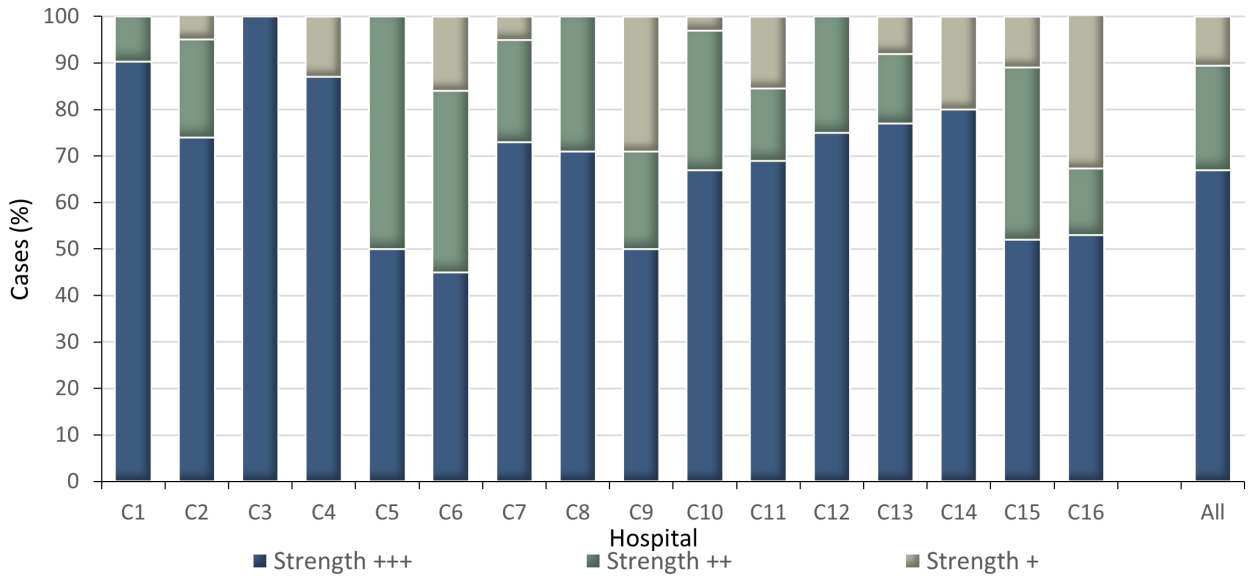
Table 25 displays further analysis of the strength of recommendation by ICD device type. The majority of all CRT-D (66%) and ICD (69%) had a strength +++ recommendation, whereas 71% of S-ICD devices had a strength ++ recommendation for use.

Table 25: Strength of recommendation for ICD therapy by form of therapy

Strength of Indication	CRT-D (N=119)	ICD (N=291)	S-ICD (N=14)
	N (%)	N (%)	N (%)
Strength +++	79 (66)	201 (69)	4 (29)
Strength ++	21 (18)	64 (22)	10 (71)
Strength +	19 (16)	26 (9)	0 (0)

Figure 41 presents hospital-level benchmarking data on the strength of recommendation for defibrillator therapy. All but one hospital reported a strong (+++) recommendation in at least 50% of cases, with the proportion ranging from 45% to 100% across participating sites. This reflects a high degree of alignment with evidence-based criteria in the majority of institutions.

Figure 41: Strength of recommendation for ICD therapy by hospital



A strength of recommendation +++ (32%) and ++ (33%) among patients who received a CRT device (n=182), is shown in Figure 42.

Figure 42: Strength of recommendation for CRT therapy

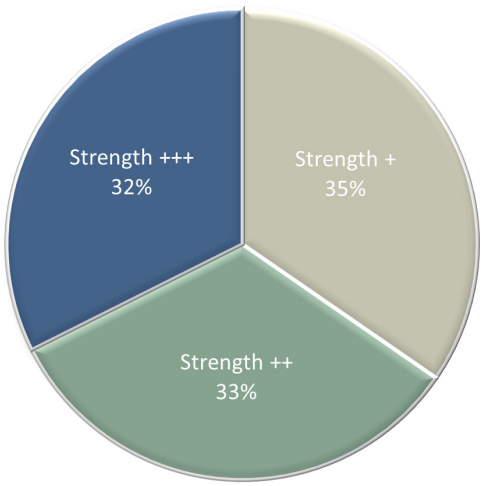


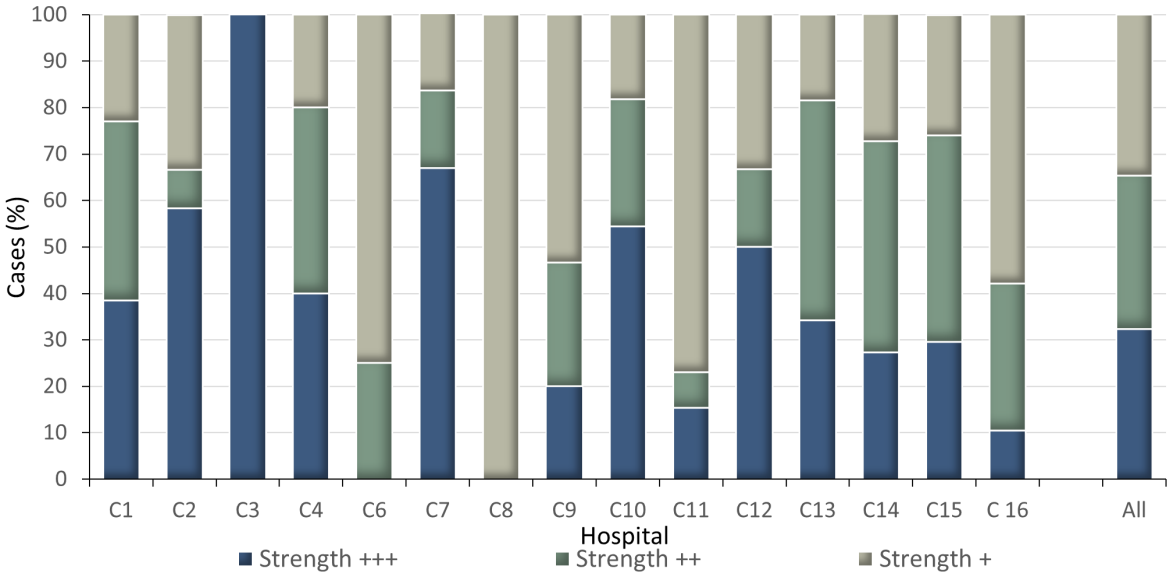
Table 26 compares the strength of recommendation for cardiac resynchronisation therapy with pacemaker (CRT-P) and defibrillator (CRT-D) devices. Variability in recommendation strength likely reflects underlying differences in patient characteristics between the two groups. Overall, a higher proportion of CRT cases received a single-strength (+) recommendation compared to those undergoing ICD implantation, suggesting more selective application of CRT in certain clinical contexts.

Table 26: Strength of recommendation for CRT by device type

Strength of Indication	CRT-D (N=123)	CRT-P (N=59)
	N (%)	N (%)
Strength +++	44 (36)	15 (25)
Strength ++	36 (29)	24 (41)
Strength +	43 (35)	20 (34)

Figure 43 illustrates the variation in the strength of recommendation for CRT device implantation across hospitals. There was significant inter-hospital variability, although with overall case numbers low at several institutions, the proportion of single-strength (+) recommendations in these settings should be interpreted with caution.

Figure 43: Strength of recommendation for CRT by hospital

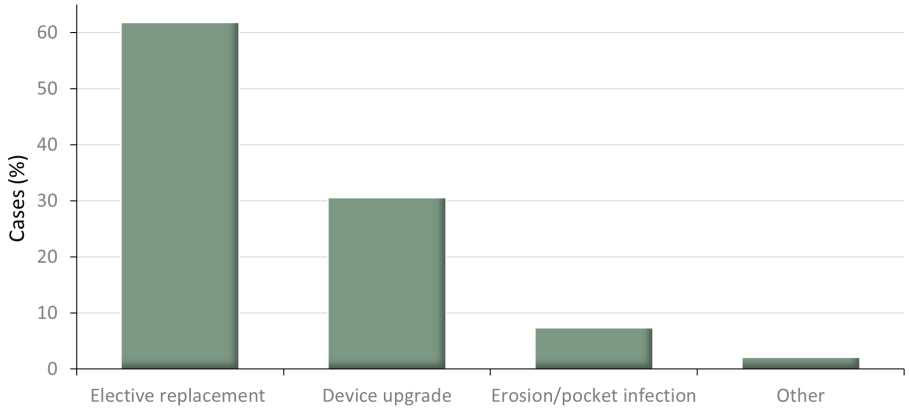


Hospital 5 had no CRT cases.

Replacements and revisions

CIED generator replacements were mostly performed for end-of-life elective replacements (62%). Device upgrade (31%), erosion/pocket infection and other reasons accounted for 7.4% of generator replacements as shown in Figure 44.

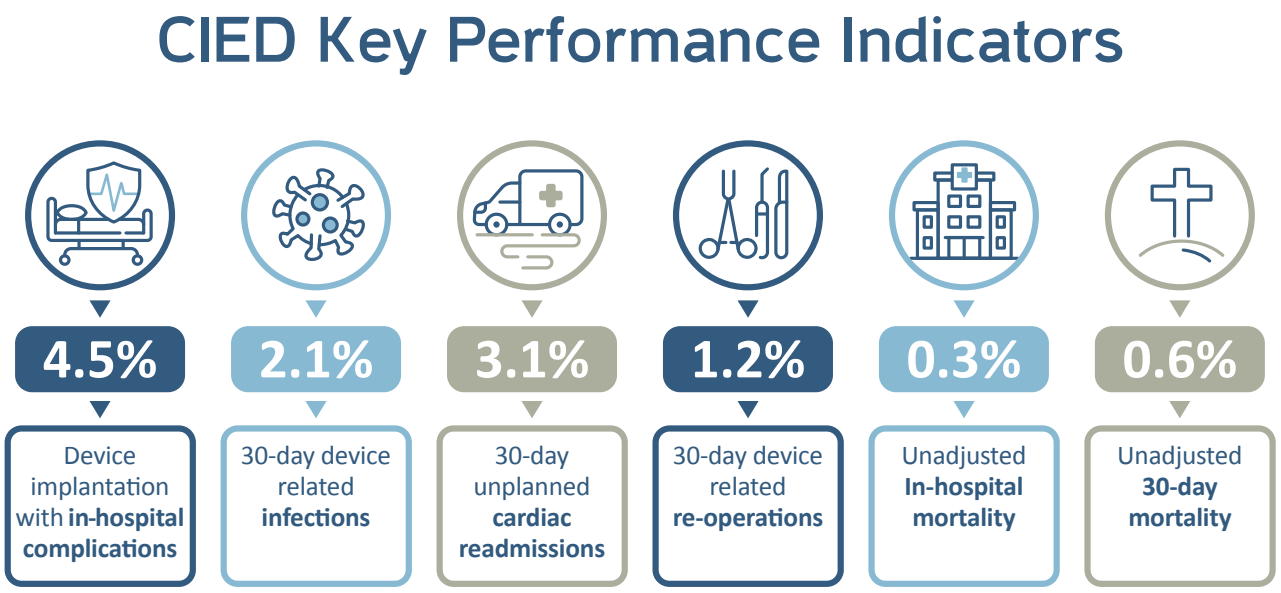
Figure 44: Indications for generator replacement, explant or revision



Outcome measures

The key performance indicators (KPIs) used to monitor and benchmark hospital performance in relation to CIED therapy are shown in Figure 45.

Figure 45: CIED Key Performance Indicators



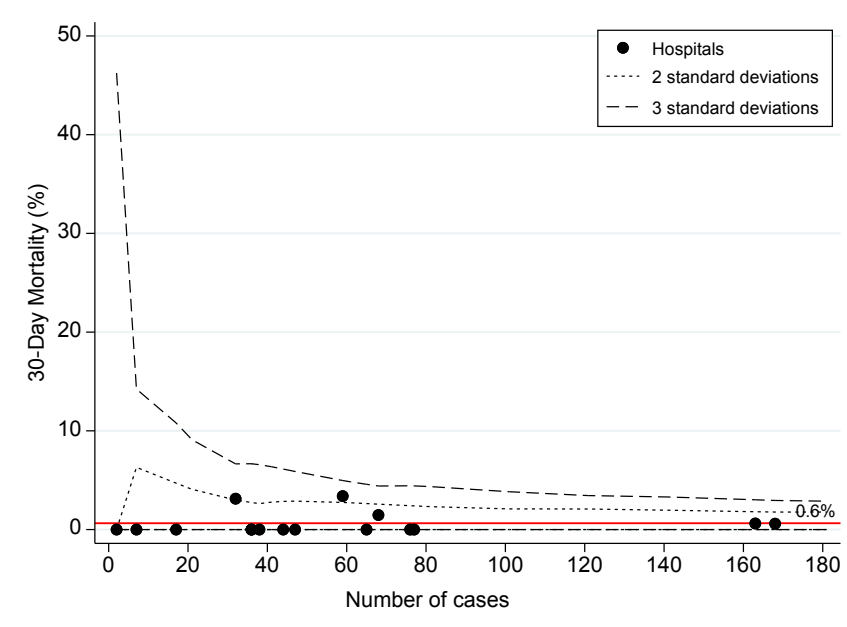
In-hospital mortality

There were 3 in-hospital deaths recorded in 2024. Only one of these was a cardiac death, unrelated to the device.

30-day mortality

The overall 30-day mortality rate following device implantation was 0.6%. Three deaths occurred after hospital discharge but within 30 days of the procedure. Among these, two deaths were attributed to cardiac causes unrelated to the device, while the cause of death in the remaining case was unknown. Figure 46 illustrates that all hospitals were within control limits for this outcome measure.

Figure 46: CIED Mortality at 30-days



Successful device implantation without in-hospital complications

Table 27 outlines the in-hospital complications by hospital and device type.

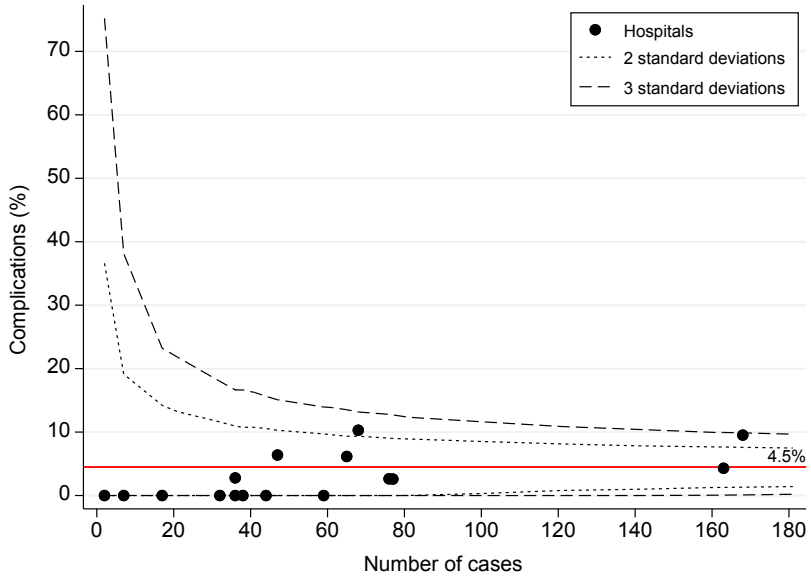
In hospital complications included severe hypotension, wound hematoma, pain requiring intervention, phrenic nerve pacing, cardiac arrest, cardiac perforation, failure to position leads and pericardial effusion. In 2024, 95.5% of all CIED cases were successfully implanted without any in-hospital complications.

Table 27: In-hospital complications by hospital and device type

Hospital	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10	C11	C12	C13	C14	C15	C16	Total
	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N (%)
CRT-P	0	0	0	0	0	0	0	0	0	0	2	0	4	1	1	0	8 (5.1)
CRT-D	1	1	0	0	0	0	0	0	0	0	1	0	1	0	3	0	7 (2.6)
ICD	1	0	0	0	0	0	4	0	0	1	3	0	2	2	5	0	18 (4.2)

Hospitals were benchmarked by frequency of complications as shown in Figure 47. There were no outliers for this outcome measure.

Figure 47: In-hospital rates of CIED related complications



Unplanned cardiac readmissions, device-related re-operations and infections at 30-days

The 30-day unplanned cardiac readmission rate was 3.1%. The 30-day device-related re-operations rate was 1.2%. There were no outliers for any of these outcome measures (Figures 48 and 49).

Figure 48: CIED related unplanned cardiac readmissions at 30-days

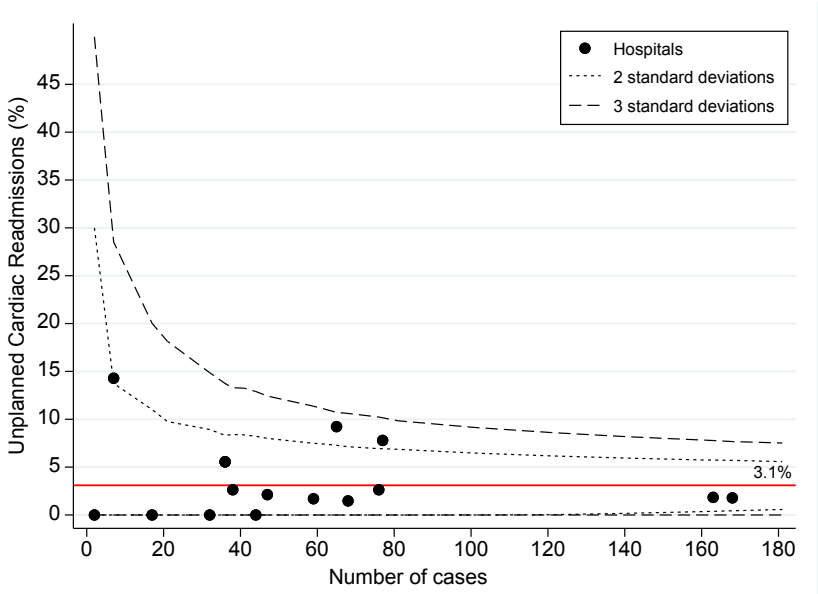
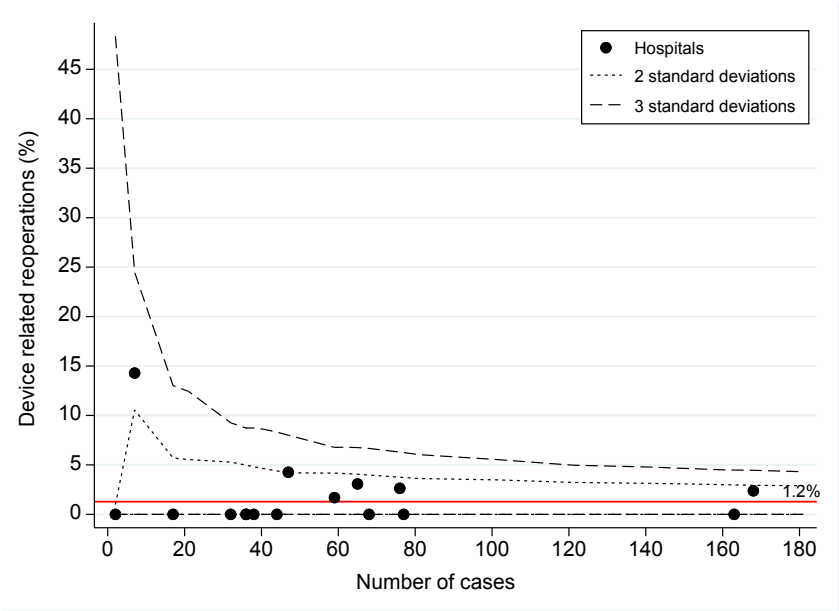
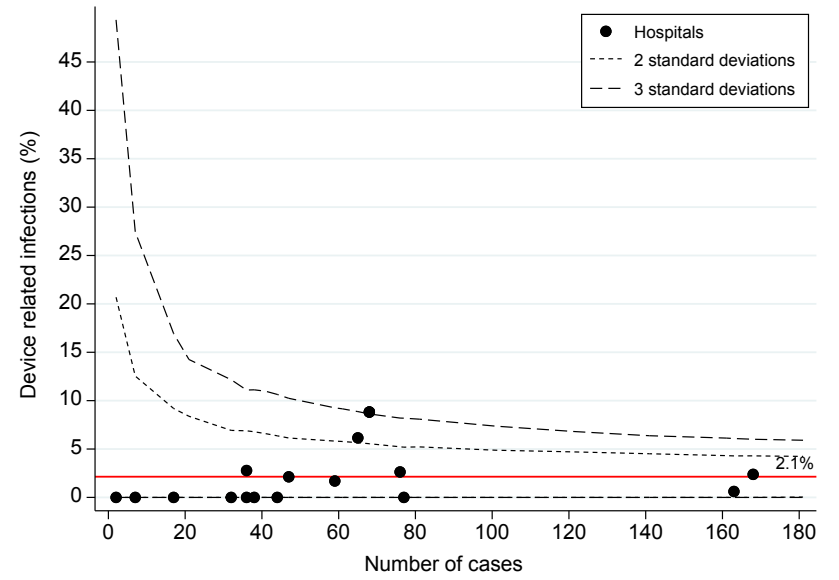


Figure 49: CIED device-related re-operations 30-days



The 30-day device-related infection rate was 2.1% and included superficial wound infections, pocket infections and endocarditis/ septicaemia. Figure 50 illustrates that all hospitals were within control limits for this outcome measure.

Figure 50: CIED device-related infections at 30-days



The Future: Innovating for enhanced healthcare outcomes

VCOR's future initiatives are closely aligned with the priorities of the Victorian Heart Health Action Plan, particularly in supporting equitable access to high-quality cardiovascular care and enabling data-informed decision-making. As VCOR continues to mature, it looks to the future for technical improvements and other enhancements to strengthen its utility as a contemporary and clinically integrated cardiovascular quality registry. Future developments will hopefully support more timely, accurate, and actionable data, while expanding the registry's reach across public, private, regional, and metropolitan services.

Progressive automation of data capture is a key priority for future development. Leveraging integration with hospital electronic medical record (EMR) systems and procedural software platforms, including catheter laboratory information systems will potentially enable real-time or near real-time data feeds, VCOR hopes to significantly reduce manual data entry burden over time, improve data completeness and accuracy, and support rapid feedback to clinicians and health service administrators.

To strengthen its capacity for long-term outcome tracking, VCOR will explore opportunities for expanded data linkage infrastructure. This includes continued connections with the National Death Index to enable comprehensive mortality tracking, as well as with administrative datasets such as the Victorian Admitted Episode Dataset (VAED), Emergency Minimum Dataset (VEMD), and the Pharmaceutical Benefits Scheme (PBS). These linkages will support analysis of the entire patient journey and enable longitudinal evaluation of treatment effectiveness, health service use, and medication adherence.

VCOR also plans to assess the feasibility of incorporating patient-reported outcome and experience measures (PROMs and PREMs) into its dataset. Digital platforms, including web and mobile interfaces can facilitate patient follow-up and functional outcome capture. It is envisaged that these measures will provide a more patient-centred perspective on recovery and care quality and contribute to value-based care assessments.

Further initiatives being considered include:

- A role for AI to help identify high-risk patients in advance, applied risk stratification tools and potentially use predictive modelling to anticipate adverse events, readmissions or resource needs. Predictive modelling may also facilitate automated identification of outlier performance metrics using statistical anomaly detection.
- VCOR can look towards the future for a more detailed or granular reporting system, potentially extending benchmarking methods to operator level or specific demographic subgroups.
- Reporting systems will be adapted to enable stratified outputs across population subgroups and service types, thereby identifying unwarranted variation and informing equity-focused planning and intervention.

Through these enhancements, we believe that VCOR is well-positioned to evolve beyond its role as a data repository into an active leader in cardiac care quality assurance. VCOR remains firmly committed to innovation and to driving sustained improvements in the quality of cardiac care and patient outcomes—supporting safer, more effective, and more equitable cardiovascular care for all Victorians.

Glossary

ACC/AHA	American College of Cardiology and the American Heart Association
ACEI	Angiotensin Converting Enzyme Inhibitors
ACS	Acute Coronary Syndrome
ARB	Angiotensin Receptor Blockers
BB	Beta adrenergic Blockers
BMI	Body Mass Index
CABG	Coronary Artery Bypass Graft
CIED	Cardiac Implantable Electronic Devices
CRT	Cardiac Resynchronisation Therapy
CTO	Chronic Total Occlusion
DAPT	Dual Anti platelet Therapy
DBT	Door-to-balloon time
ECG	Electrocardiograph
ECMO	Extracorporeal Membrane Oxygenation
IABP	Intra-Aortic Balloon Pump
ICD	Implantable Cardiac Defibrillator
IQR	Interquartile Range
IVUS	Intravascular Ultrasound
KPI	Key Performance Indicator
LOS	Length of stay
LVEF	Left Ventricular Ejection Fraction
MACCE	Major Adverse Cardiac and Cerebrovascular Event
MACE	Major Adverse Cardiac Event
MI	Myocardial Infarction
NHMRC	National Health & Medical Research Council
NRI	New Renal Impairment
NSTE-ACS	Non-ST elevation acute coronary syndrome
NSTEMI	Non-ST Elevation Myocardial Infarction
NYHA	York Heart Association
OCT	Optical Coherence Tomography
OHCA	Out of Hospital Cardiac Arrest
PCI	Percutaneous Coronary Intervention
PHN	Pre-hospital notification
POBA	Plain Old Balloon Angioplasty
PVD	Peripheral Vascular Disease
SD	Standard Deviation
STEMI	ST-elevation myocardial infarction
TVR	Target Vessel Revascularisation
UAP	Unstable Angina Pectoris
VCOR	Victorian Cardiac Outcomes Registry

Publications

Baradi A, Dinh DT, Brennan A, Stub D, Somaratne J, Palmer S, Nehme Z, Andrew E, Smith K, Liew D, Reid CM, Lefkovits J, Wilson A. Prevalence and Predictors of Emergency Medical Service Use in Patients Undergoing Primary Percutaneous Coronary Intervention for ST-Elevation Myocardial Infarction. *Heart Lung Circ.* 2024 Jul;33(7):990-997. doi: 10.1016/j.hlc.2024.02.011. Epub 2024 Apr 3. PMID: 38570261.

Chowdhury MRK, Stub D, Dinh D, Karim MN, Siddiquea BN, Billah B. Preoperative Variables of 30-Day Mortality in Adults Undergoing Percutaneous Coronary Intervention: A Systematic Review. *Heart Lung Circ.* 2024 Jul;33(7):951-961. doi: 10.1016/j.hlc.2024.01.021. Epub 2024 Apr 3. PMID: 38570260.

D'Elia N, Vogrin S, Brennan AL, Dinh D, Lefkovits J, Reid CM, Stub D, Bloom J, Haji K, Noaman S, Kaye DM, Cox N, Chan W. Electrocardiographic patterns and clinical outcomes of acute coronary syndrome cardiogenic shock in patients undergoing percutaneous coronary intervention - A propensity score analysis. *Cardiovasc Revasc Med.* 2024 Aug;65:58-64. doi: 10.1016/j.carrev.2024.02.022. Epub 2024 Mar 4. PMID: 38448259.

Haji K, Vogrin S, D'Elia N, Noaman S, Bloom JE, Lefkovits J, Reid C, Brennan A, Dinh DT, Nicholls S, Nehme E, Nehme Z, Smith K, Stub D, Ball J, Zaman S, Oqueli E, Kaye D, Cox N, Chan W. Effect of COVID-19 Pandemic Lockdown on Emergency Medical Service Utilisation, and Percutaneous Coronary Intervention Volume-An Australian Perspective. *Heart Lung Circ.* 2024 Aug;33(8):1151-1162. doi: 10.1016/j.hlc.2024.02.018. Epub 2024 Jul 2. PMID: 38955597.

Suo E, Driscoll A, Dinh D, Brennan A, Kaye DM, Stub D, Lefkovits J, Reid CM, Hopper I. Comparison of Characteristics and Outcomes in Patients With Acute Decompensated Heart Failure Admitted Under General Medicine and Cardiology Units. *Heart Lung Circ.* 2024 Jul;33(7):983-989. doi: 10.1016/j.hlc.2024.01.016. Epub 2024 Mar 7. PMID: 38458933.

Zheng WC, Evans N, Dinh D, Bloom JE, Brennan AL, Ball J, Lefkovits J, Shaw JA, Reid CM, Chan W, Stub D. Clinical Outcomes of Renal Transplant Recipients Undergoing Percutaneous Coronary Intervention. *Heart Lung Circ.* 2024 Jul;33(7):998-1008. doi: 10.1016/j.hlc.2024.01.033. Epub 2024 Apr 1. PMID: 38565437.

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VCOR
VICTORIAN CARDIAC OUTCOMES REGISTRY