Victorian Cardiac Outcomes Registry

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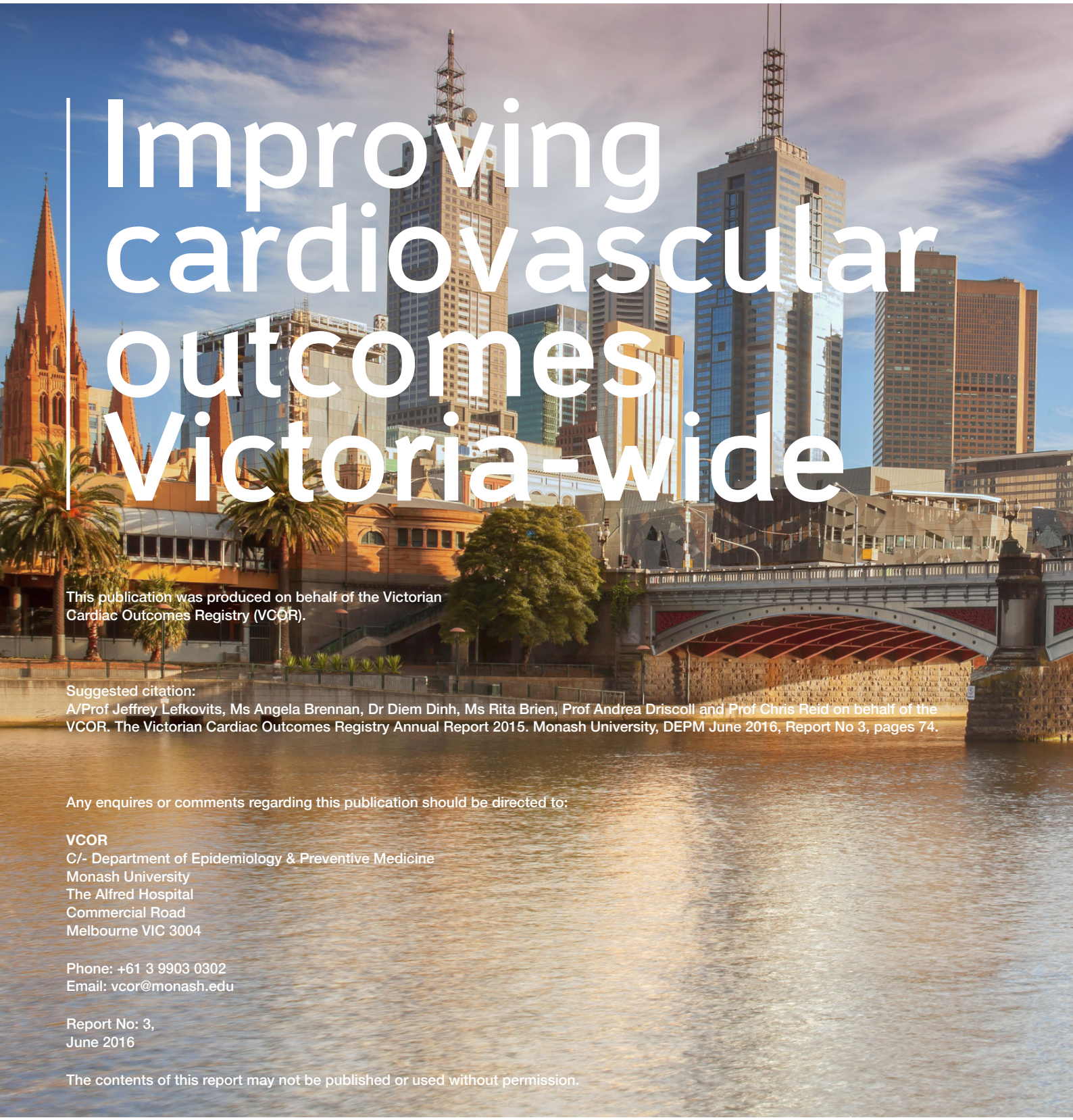
VCOR
VICTORIAN CARDIAC OUTCOMES REGISTRY



Improving cardiovascular outcomes Victoria-wide

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During 2015, the Registry Custodian, Prof Chris Reid was supported by a National Health and Medical Research Council (NHMRC) Fellowship that provided salary support to contribute to initiatives such as the VCOR.

This report would not have been possible without the efforts of doctors, nurses, data managers and other relevant hospital staff who contribute data to the VCOR.

Lead clinical staff from hospitals participating in the VCOR are also gratefully acknowledged.

Foreword

The data from the Victorian Cardiac Outcomes Registry (VCOR) provides a detailed description of contemporary cardiology clinical practice in a large number of Victorian hospitals. This information enables hospitals and doctors to compare their practice and outcomes of care and is critical for future health system planning and for ensuring our ability to improve the way we work and to improve outcomes for our patients.

The important work of VCOR is occurring at a time of significant change in the Victorian Health System. There is a strengthened focus on the quality and safety of the Victorian Health System and the ability to collect and analyse data, compare performance and outcomes and benchmark in a transparent way across the system is a key element in this process.

The VCOR team are to be congratulated on the quality of this comprehensive dataset. The department of Health and Human Services recognises the contributions of the VCOR team, all the clinicians involved, health services and most importantly, the patients in developing this important document.

Associate Professor Andrew Wilson
Chief Medical Officer | Quality & Safety | Health Service Performance & Programs
Department of Health & Human Services

Executive Summary

Despite the steady decline in cardiovascular-related deaths over the last five decades, the management of heart disease in all its various forms remains a key public health priority. In 2014, coronary heart disease was still the leading underlying cause of death among Australians, accounting for 13.1% of all deaths registered in that year(1). Large numbers of Australians are also living with cardiovascular disease, sometimes for extended periods. It is estimated that the overall prevalence of heart disease is around 5% of the total community, rising to two in every five people (40%) among those aged 85 years and over(2). This burden of disease is associated with an ever-increasing demand for effective treatment. The number of major cardiovascular procedures continues to climb, with 50,000 more coronary procedures in 2011–2012 than in 2000–2001. Expenditure on drugs for cardiovascular disease also consumes a large proportion of federal health budget, with the PBS paying approximately $1.8 billion for cardiovascular system medicines in 2012-13, representing 21% of total PBS benefits paid in that year(3).

Given the impact of heart disease on both the individual and the community, it is critical that public health initiatives and policies are directed at delivering treatment with high levels of safety and quality.

The Victorian Cardiac Outcomes Registry (VCOR) was established in 2012 to ensure the safety and quality of cardiac based therapies across Victoria. As a clinical quality registry, VCOR monitors the performance of health services in both the public and private sectors. The aim of the registry is to measure and report on trends in the quality of patient care over time, within individual hospitals, comparatively with other hospitals, and aggregated at the state level. The goal is to foster continuous improvement in patient care and outcomes across the entire Victorian health system.

In this 2015 Annual Report, VCOR presents performance data on three separate areas of interest in cardiovascular care. These include percutaneous coronary intervention (PCI), the early treatment of acute myocardial infarction in rural and regional settings, and for the first time, data relating to in-hospital management of heart failure. The first two directly relate to management of coronary artery disease, primarily in its acute form (heart attacks and angina). The third focuses on chronic heart disease (both coronary and non-coronary) that places significant burdens on the individual and society in terms of disability, reduced quality of life, high healthcare resource consumption and costs.

This report highlights significant findings on the performance of the majority (23 of 29) of health services undertaking PCI in Victoria, including comparisons between public and private hospitals. While the focus is on performance measures related to safety and quality of healthcare delivery, potentially significant trends in treatment patterns are also reported on, including the uptake of radial artery access and use of drug-eluting stents. These may guide future service improvement and development.

The second section of the Annual Report provides performance and outcome measures relating to early management of acute myocardial infarction for six regional and rural centres. VCOR initially engaged this number of hospitals as the first phase of its planned state-wide rollout. The results underscore areas of strength and areas for improvement among the participating sites, and VCOR continues to engage other hospitals across the state in this registry module.

The third section of the Report deals with hospital performance relating to in-patient management of heart failure. The data were collected in the form of a “snapshot”, enrolling consecutive patients at participating health services for a limited period of time (1 month), in order to obtain a cross-sectional picture of heart failure-related treatment and outcomes. A total of seven hospitals were engaged in the pilot phase (completed in 2014) and resulted in the development of a functional minimum dataset for an ongoing heart failure clinical quality registry.

Key Findings

PCI Registry

- 79% of Victorian PCI hospitals participated in VCOR in 2015, representing approximately 100 interventional cardiologists. A total of 9,166 completed cases were collected.
- The majority of patients undergoing PCI were male (77%). The mean age of patients was 66 years. Patients treated in private hospitals were six years older on average than public patients. Approximately one in five patients were diabetic. Almost one-third of patients had a history of previous PCI.
- The very elderly (>80 years) were a growing patient subgroup. The proportion of females in this cohort was higher (36% vs 21%); they were more likely to have had a prior history of stroke (8% vs 4%). A femoral access approach was more common than a radial artery approach in the elderly.
- Just over half of all PCI cases in 2015 were for treatment of an acute coronary syndrome (ACS). The majority of these cases (78%) were treated in public hospitals, and ACS cases accounted for 65% of all work done in the public sector. In contrast, ACS cases accounted for 32% of the private sector's caseload.
- Drug-eluting stent use remained at around the same level as 2014, at 77% of cases overall. Bio-resorbable scaffolds were implanted in very small numbers in 2015.
- There was a continuing move towards a preference for radial artery access, now at 45% of cases overall. This represented an absolute 8% increase over 2014. Rates still varied quite widely among hospitals, with public hospitals generally having a higher uptake at 51% compared with private hospital radial access uptake at 35%.
- Emergency treatment for acute STEMI accounted for 18% of the overall PCI workload among VCOR hospitals. The majority (59%) were treated out-of-hours and in the public hospital system (87%). PCI for STEMI accounted for around 25% of the public sector's caseload and 6% of private hospitals' case volume.
- For PCI for acute STEMI, the median time taken from patient arrival at the hospital to the first inflation of the balloon to re-open the artery (door-to-balloon time) was 72 min, within the recommended threshold of <90 mins. However, a door-to-balloon time <90 mins was achieved in only 66% of cases overall, which is below the expected target of 75% or more cases. Hospitals' performance improved when they had effective systems for pre-hospital notification of arriving STEMI cases from ambulances in the field.
- The unadjusted in-hospital mortality rate overall was 1.6%. For patients presenting with STEMI, the rate was 5.6%. For patients with cardiogenic shock or out-of-hospital cardiac arrest requiring endotracheal intubation, the rate was 40%. For all other patients, the unadjusted in-hospital mortality rate was 0.8%.
- The risk-adjusted 30-day mortality rate for the overall PCI cohort in 2015 was 2.7%.
- The incidence of major bleeding complications following PCI was 1.2%, and lower among radial access cases (0.9% radial vs 1.4% femoral). Major bleeding was higher in STEMI cases (2.9%), in part related to more intensive anti-thrombotic therapy used in these patients.
- Benchmarking of hospitals' performance demonstrated that all hospitals achieved acceptable results within control limits for all major key performance outcome measures. There were no outliers in any of the key performance indicators for 2015.
- Overall length of stay was longer for the more acute conditions (STEMI and NSTEMI), but similar among public and private hospitals. Unplanned cardiac rehospitalisations at 30 days were more frequent among private patients (7.2%) than public patients (2.7%).

Key Findings continued …

Management of Acute STEMI in Rural and Regional Centres

- The 2015 cohort comprised 138 patients with suspected STEMI, presenting to six rural or regional health services across Victoria. 77% were eligible for thrombolytic therapy and all but one of the 106 eligible patients received the medication, either at the treating hospital or prior to arrival.
- The median time from pain onset to first medical or ambulance contact was 102 minutes. The median time taken for an ambulance to arrive was 21 minutes.
- More than two-thirds of patients were transported by ambulance to hospital, while 27% were driven in by friends or family (self-presenters). Most (84%) patients were located within 50km of their treating hospital at symptom onset.
- Pre-hospital thrombolysis, given by trained mobile intensive care (MICA) paramedics in the field to selected STEMI patients, was administered to 10% of cases, but this facility was not available at all regional locations.
- The median door-to-needle time (time from patient arrival to time thrombolytic drug administered) was 38 minutes (IQR: 23-74). Just 1 of 6 hospitals was able to achieve a median door-to-needle time within the Australian guidelines recommendation of <30 minutes, and overall, only 40% of cases reached the ideal target of delivery of thrombolysis within 30 minutes.
- Nearly every patient (98%) treated with thrombolysis was subsequently transferred to a PCI capable hospital within 24 hours, indicating high compliance with national guidelines for early treatment of STEMI.
- The in-hospital mortality (before transfer) for the overall cohort was 3.6%. There were no cases of major bleeding or intra-cerebral haemorrhage.

Key Findings continued …

Heart Failure Snapshot

- The registry collected data on 289 patients admitted to hospital with acute decompensated heart failure. Overall, 66% of patients had left ventricular dysfunction. Of these, 52% of patients were diagnosed with predominantly systolic dysfunction and 14% had predominantly diastolic dysfunction. Ischaemic cardiomyopathy was the principal diagnosis in 46% of patients.

- Co-morbid conditions were common in this cohort including previous arrhythmias (54%), diabetes mellitus (39%), anaemia (24%) and moderate to severe chronic kidney disease in 45%. Just over one-third were in atrial fibrillation on admission.

- Nearly all the patients (90%) were admitted through the Emergency Department. Just over half were admitted under General Medicine and 30% under a specialist Cardiology unit. Fluid overload was the main reason for admission in 48% of patients.

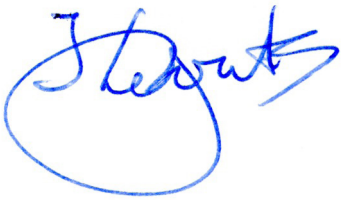
- In patients with impaired systolic function, increases of 10-25% in the prescription of key medications including beta blockers, ACE inhibitors/angiotensin receptor blockers and aldosterone antagonists were observed during the index admission. Intravenous diuretics were used in 80% of the entire cohort.

- Median length of hospital stay was six days (IQR: 4-11). Overall, 73% were discharged to home. Outpatient appointments were scheduled in 61%. At 30 days post-discharge, less than half of these patients had been seen in outpatients (49%). Referrals to a heart failure program were low at 34%.

- The unadjusted 30-day all-cause mortality for the entire cohort was 9%, with a range from 0%-19.2%.

- The 30-day all cause readmission rate was 26%, with two hospitals having readmission rates >40%. The majority of these re-admissions were between 14-21 days post discharge.

The Victorian Cardiac Outcomes Registry, through its work in the areas of percutaneous coronary intervention, ST elevation myocardial infarction and heart failure, is committed to assisting health services across the state in their quality assurance activities. It is hoped that the information in this Report will assist these hospitals in providing high quality cardiovascular healthcare to all Victorians and help identify opportunities for continuous improvement in service delivery and patient outcomes.



A/Prof Jeffrey Lefkovits
VCOR Clinical Director

Introduction

The Victorian Cardiac Outcomes Registry (VCOR) was established in 2012 as a clinical quality registry to monitor the performance of health services in Victoria in the delivery of high quality, cardiac-based therapies. The registry encompasses hospitals in both the public and private sectors and reports on the quality and effectiveness of cardiovascular health care in Victoria.

The broad aim of this registry is to provide information to clinicians, hospitals, health funders and consumers that can be utilised to ensure patients receive the highest quality cardiac care possible. The data from our registry facilitates the benchmarking of hospitals' performance against one another - an effective tool for the identification of health services whose performance is below standard, or is exemplary to the point that it is a standout among its peers. Additionally, the registry can assist in assessing overall compliance with national standards of care and evidence-based guidelines while contributing to continuing development.

The design and implementation of VCOR as a clinical quality registry is based around the Framework for Australian Clinical Quality Registries(4), developed by The Australian Commission for Safety and Quality in Health Care, in collaboration with the states and territories and expert registry groups. This framework was endorsed by the Australian Health Ministers' Advisory Council (AHMAC) in March 2014. Its application provides assurance to all key stakeholders that registry data and its supporting systems satisfy minimum security, technical and operating standards.

The Department of Epidemiology and Preventive Medicine, Monash University, conducted a pilot registry for cardiac procedures in 2009-10, which was the forerunner to VCOR. In late 2011, funding was obtained to set up a state-wide cardiac outcomes registry in Victoria and VCOR was established. Primary management of the registry is undertaken at the Department of Epidemiology & Preventive Medicine, Monash University, in association with the Victorian Cardiac Clinical Network, Department of Health and Human Services Victoria.

Governance and Registry Structure

Governance

VCOR conforms to the National Operating Principles for Clinical Quality Registries as set out by the Australian Commission on Safety and Quality in Health Care. All registry-related matters are governed by the VCOR Steering Committee, in liaison with two subcommittees - the Clinical Quality Committee and the Data Access, Research & Publications Committee. Day-to-day project management is undertaken by the Department of Epidemiology & Preventive Medicine at Monash University.

Steering Committee

In 2015 the Steering Committee (SC) continued to provide oversight and strategic direction for VCOR. The committee's membership now comprises representatives from each of the participating PCI sites, the Cardiac Clinical Network, the Department of Epidemiology & Preventive Medicine at Monash University and a consumer representative. The Committee's activities included the integration of additional registry modules for ST elevation myocardial infarction (STEMI) and heart failure, establishment of data linkages with Ambulance Victoria and the Department of Health and Human Services, Victoria and continued focus on facilitating quality assurance activities into daily hospital practice.

Data, Research and Publications Committee

The Data, Research and Publications Committee (DRP) reviews requests for access to group de-identified data. The Committee approved five abstracts for submission to the Cardiac Society of Australia and New Zealand (CSANZ) 2016 Scientific Sessions. All were accepted and will be presented in Adelaide in August 2016.

Clinical Quality Committee

The Clinical Quality Committee (CQC) reviews hospital key performance indicators (KPIs) on a quarterly basis. Health services are provided with individualised performance reports that identify their site, while keeping all other sites anonymous. In 2015, the CQC was active in identifying and managing sites that were outliers in key performance measures including procedure-related major bleeding. The CQC provided feedback to the sites and offered assistance to facilitate the sites' own analysis of their results. Hospitals that were notified in this manner generally undertook their own in-house case reviews. They also provided feedback of their findings and action plans to address the concerns raised in their own internal reviews. The subsequent performance of each of the hospitals managed in this way showed a return to within confidence limits by the following quarterly reporting period.

Percutaneous Coronary Intervention (PCI)

Registry Module Activity

For the period covered by this report from 1 January, 2015 to 31 December, 2015, there were 23 PCI hospitals contributing data - all 13 public hospitals and 10 of 16 private hospitals (Figure 1). Three further private hospitals were engaged with VCOR but had not yet commenced active data entry into the registry. A list of all eligible Victorian PCI hospitals and their engagement status with VCOR is shown in Table 1.

Figure 1: PCI Site engagement and participation in VCOR in 2015

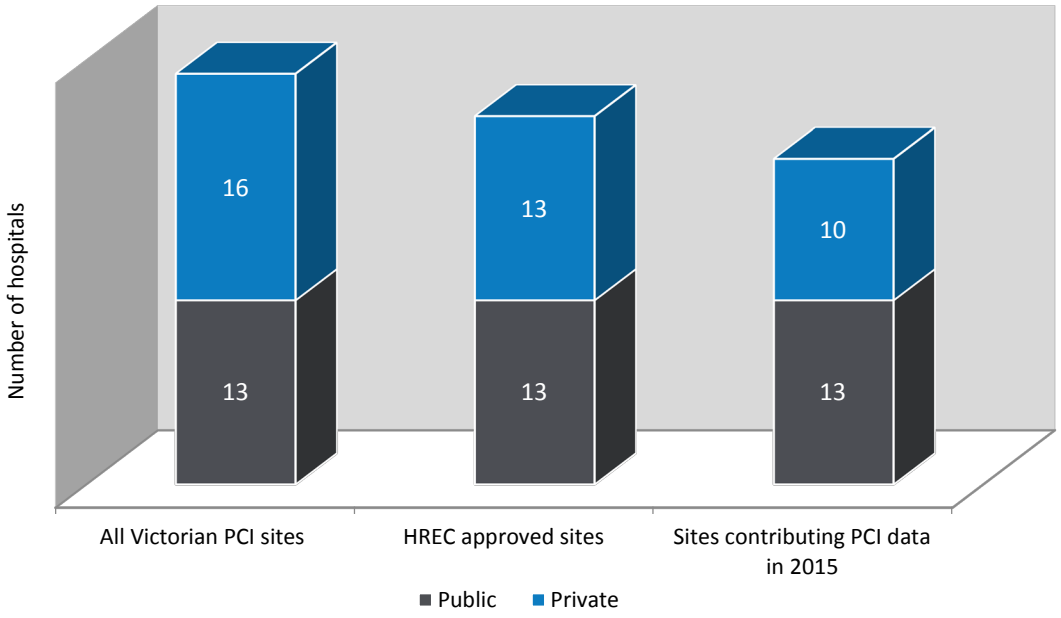


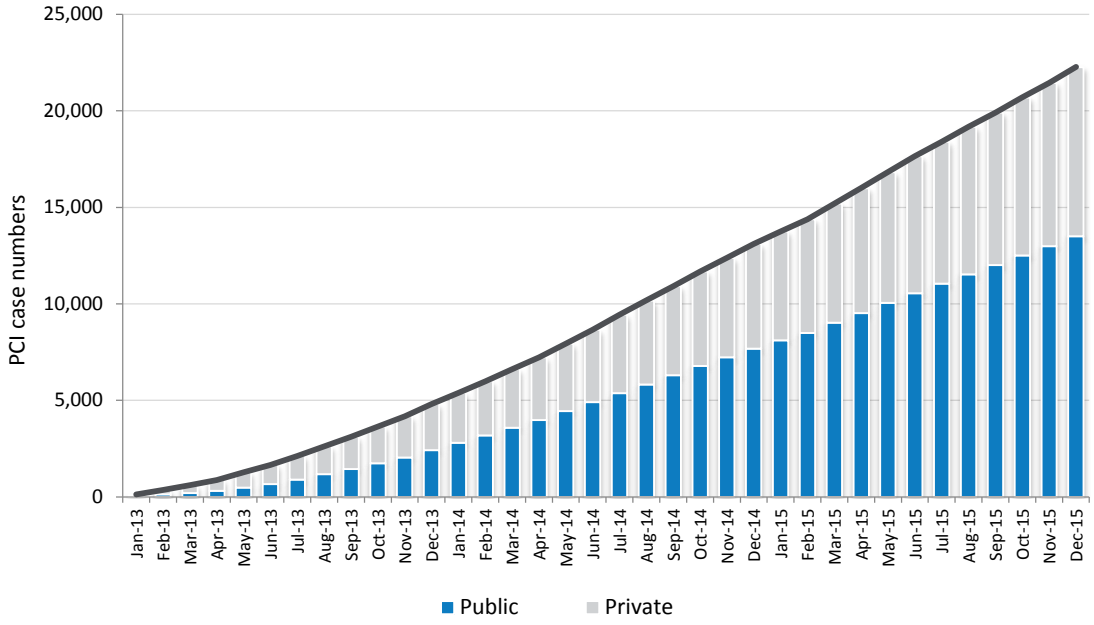
Table 1: Participation of Victorian PCI hospitals

Victorian PCI hospitals	Hospital type	2013	2014	2015
Alfred Hospital, The	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 Richmond	Private	●	●	●
Frankston Hospital	Public	●	●	●
Geelong Private Hospital	Private		●	●
Jessie McPherson Private Hospital	Private	●	●	●
Knox Private Hospital	Private	●	●	●
Melbourne Private Hospital	Private		●	●
MonashHeart	Public	●	●	●
Peninsula Private Hospital	Private			
St John of God Hospital (Ballarat)	Private			○
St John of God Hospital (Bendigo)	Private			●
St John of God Hospital (Geelong)	Private			○
St Vincent's Hospital Melbourne	Public	●	●	●
St Vincent's Private Hospital	Private	●	●	●
The Avenue Hospital	Private			
The Northern Hospital	Public	●	●	●
The Royal Melbourne Hospital	Public	●	●	●
The University Hospital, Geelong	Public	●	●	●
The Valley Private Hospital	Private			○
Warringal Private Hospital	Private			
Western Hospital (Footscray)	Public	●	●	●
Western Hospital (Sunshine)	Public	N/A	N/A	●
Western Private Hospital	Private	●	●	●

Table Legend: ● = contributing data; ○ = engaged but not yet contributing

A total of 9,166 completed cases were collected by VCOR in 2015. Figure 2 shows case number accrual by month since commencement of the registry in 2013. Private hospital cases accounted for 36% of the VCOR caseload in the 2015 cohort, although this does not represent the complete private caseload in Victoria, given that a small number of private hospitals chose not to participate in VCOR in 2015.

Figure 2: Cumulative cases submitted by month from 2013 - 2015



Data Completeness

Data completeness is reported for both baseline and follow-up data (Table 2). Following data entry into VCOR through the web portal, a case record is considered complete when all the fields are entered and relevant criteria ensuring data integrity have been met for both baseline and 30-day follow-up phases. Case records where baseline data have been entered but 30-day follow-up data are still pending are considered incomplete and are not included in the analyses within this report.

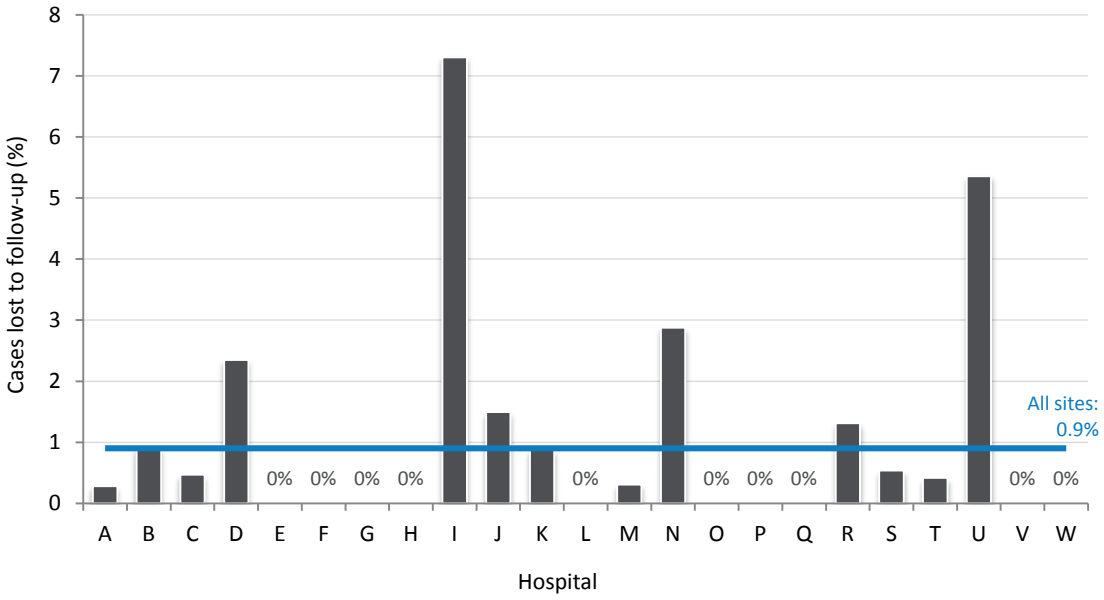
Sites are routinely informed of pending data deadlines and are regularly encouraged to complete baseline data entry and follow-up as comprehensively as possible. Sites are notified of the status of their data completeness on a regular basis. Of the total number of procedures entered in 2015, 99.8% cases were considered complete (n=9166). Data completeness rates for 2013 and 2014 were 95% and 99.5% respectively. All analyses in this report have been based on the 9,166 completed cases.

Table 2: Data completeness by hospital

Hospital	Baseline cases complete	Follow-up cases complete	Whole case (all data) complete
	%	%	%
A	100	100	100
B	100	100	100
C	100	100	100
D	100	100	100
E	100	100	100
F	100	100	100
G	100	100	100
H	100	100	100
I	97.2	94.6	93.2
J	100	100	100
K	100	100	100
L	100	100	100
M	100	100	100
N	100	100	100
O	99.9	100	99.9
P	100	100	100
Q	100	100	100
R	100	100	100
S	100	100	100
T	100	100	100
U	100	100	100
V	100	100	100
W	100	100	100
All sites	99.9	99.8	99.8

Overall, more than 99% of patients were followed up to 30 days after discharge. Figure 3 compares the rate of patients lost to follow-up by hospital, which was generally low for sites. Patients retain the option to withdraw their information from inclusion in the registry. In 2015, the opt-out rate was 0.03%, and the cumulative opt-out rate since commencement of the registry is 0.09%.

Figure 3: Rate of patients lost to follow-up by hospital in 2015



Data Quality – Audit Activities

A key operational activity of a clinical quality registry is the performance of regular audits to ensure accuracy and completeness of data collection and entry into the registry(5). This generally encompasses assessment of eligible cases to ensure all relevant cases are entered, as well as verification of source data.

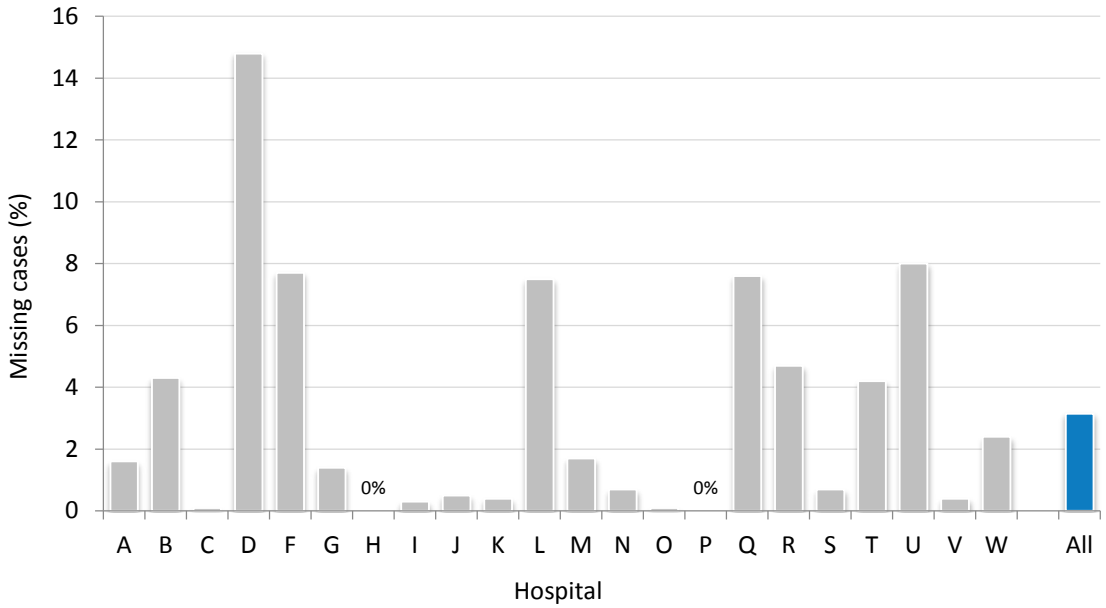
The VCOR Audit Program involves visits to each participating centre, commencing approximately one year after commencing data collection. Initial audit activities include case ascertainment (assessing that all eligible cases are actually entered into the registry) and data quality assessment (accuracy of data as determined by review of source data). Following the initial audit, sites will be re-audited annually for case ascertainment and at least every three years for data quality assessment. If issues are identified with data quality, sites may be re-audited sooner. Sites are given a detailed, individualised report of their audit findings.

The audit process also provides the opportunity for data managers to query registry personnel about data-related issues and discuss any discrepancies. This has emerged as an additional and worthwhile benefit of the process, as data discrepancies have identified misinterpretation of registry definitions that have been subsequently clarified and resolved.

VCOR commenced auditing PCI cases in March 2014 and the process is ongoing. To date, 22 hospitals have been audited for case ascertainment, with seven being audited twice and three sites being audited three times. Overall, the missing case rate was 3.1%, ranging from 0% to 14.8%. For sites audited twice, the missing case rate dropped from 3.6% to 2.1% between audits. For sites audited three times, the missing case rate dropped from 4.8% to 1.8% to 0.8% between audits. This report presents both aggregated results from all sites audited to date, and a comparison of audit outcomes by hospital.

Figure 4 shows the results of the first case ascertainment audit done across sites. High compliance rates were evident across all sites and no systematic omission of cases was seen. The small proportions of missed cases were distributed randomly across the spectrum of acuity and involved all contributing clinicians. There were only three sites whose missing case rate was greater than 5% and all three sites have subsequently instituted process changes to improve case entry compliance. In instances where missing cases were identified, sites were subsequently able to retrieve and enter these cases into the registry.

Figure 4: First audit rates of missing cases by hospital



Site E has not yet undergone audit

With respect to data quality, 5% of case records were randomly selected for comparison with the hospital medical record. Hospital records were reviewed by a trained auditor with a cardiac clinical background not aligned with the hospital being audited. The fields for audit encompass those used for risk-adjustment models and associated with outcome reporting. The overall agreement rate between VCOR data and the hospital medical record was 97.4% from audits at 21 sites, indicating high quality data collection and compares favourably with national and international registries (6, 7).

Some fields were mismatched at a frequency higher than average when case report forms were compared with hospital records. These included ejection fraction, last pre-procedural serum creatinine level, in-hospital bleeding and PCI indication. In order to address frequency of these mismatches, sites are now routinely monitored for data entry compliance with these fields. Whenever hospitals fall below a threshold, they are approached to review their compliance and retrospectively enter any available data. VCOR recognises that registry data must be high quality and is committed to an ongoing thorough and accurate audit program.

Patient Characteristics

The 9,166 procedures included in this report were performed on 8,154 individual patients. Approximately 11% of patients underwent two or more PCI procedures in 2015. The majority of PCI patients were male (77%) and most procedures (78%) were performed on patients aged 51-80 years.

The median age for males was 65 years (IQR: 56-73) and for females was 70 years (IQR: 61-78). Table 3 compares selected patient demographic information from 2015 with previous years. Overall, the demographic profile of the patient cohort was similar over the three year period. Age and gender distributions for the VCOR cohort are shown in Figures 5 and 6.

Table 3: Selected patient characteristics 2013-2015

Patient characteristics	2013 (N=4808)	2014 (N=8299)	2015 (N=9166)
Age – years (Mean ±SD)	65 ±12	65 ±11	65 ±12
	%	%	%
Gender – female	22.9	23.1	23.0
Diabetes medication	22.4	21.6	23.0
Peripheral vascular disease history	3.5	3.8	3.6
Cerebrovascular disease History	3.8	3.7	4.0
Previous PCI	34.7	31.8	32.8
Previous CABG	8.9	8.4	7.6

Patients treated in the private sector tended to have a lower rate of diabetes, yet had considerably higher rates of previous coronary revascularisation procedures (PCI and CABG) (Table 4). Private patients were on average, six years older than public hospital patients. The number of private patients over 80 years was approximately double the rate in public (15.8% vs 8.6%).

Table 4: Selected patient characteristics by hospital sector

Patient Characteristics	Public (n=5831)	Private (n=3335)
Age – years (Mean ±SD)	63 ±12	69 ±11
	%	%
Gender – female	22.8	23.4
Diabetes medication	24.1	21.3
Peripheral vascular disease history	3.6	3.7
Cerebrovascular disease history	4.6	3.0
Previous PCI	26.3	44.3
Previous CABG	6.4	9.5

Although PCI is predominantly performed in males, Figure 5 demonstrates that women comprised an increasing proportion of the cohort in the older age groups. The frequency of PCI peaked a decade later for women than for men. Similarly, the frequency distribution for cases by age group was skewed towards the elderly when private sector patients were compared with the public sector (Figure 6).

Figure 5: Age and gender distribution of patients undergoing PCI

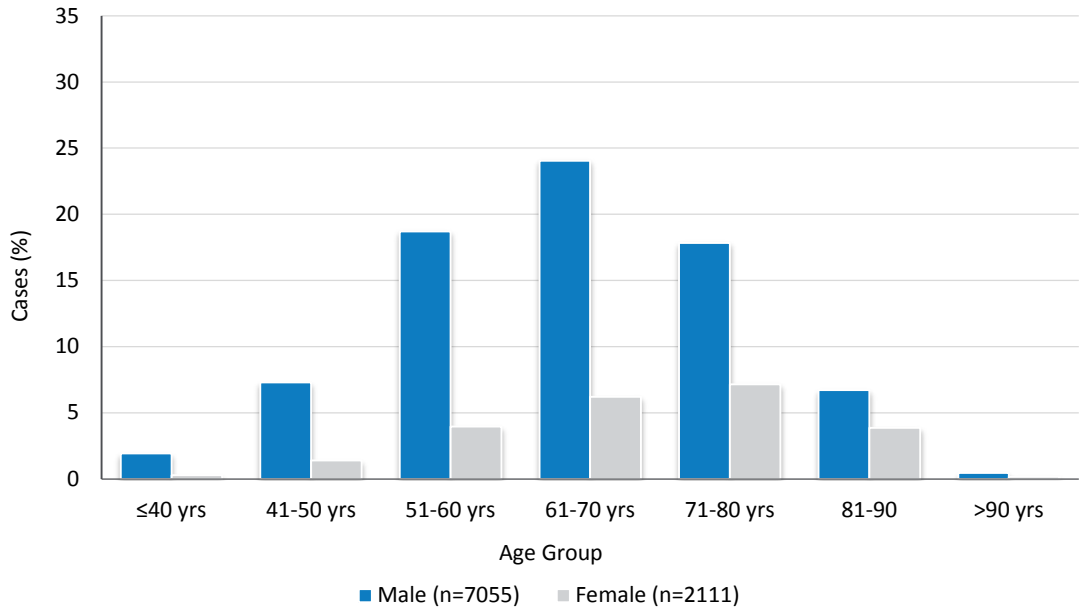
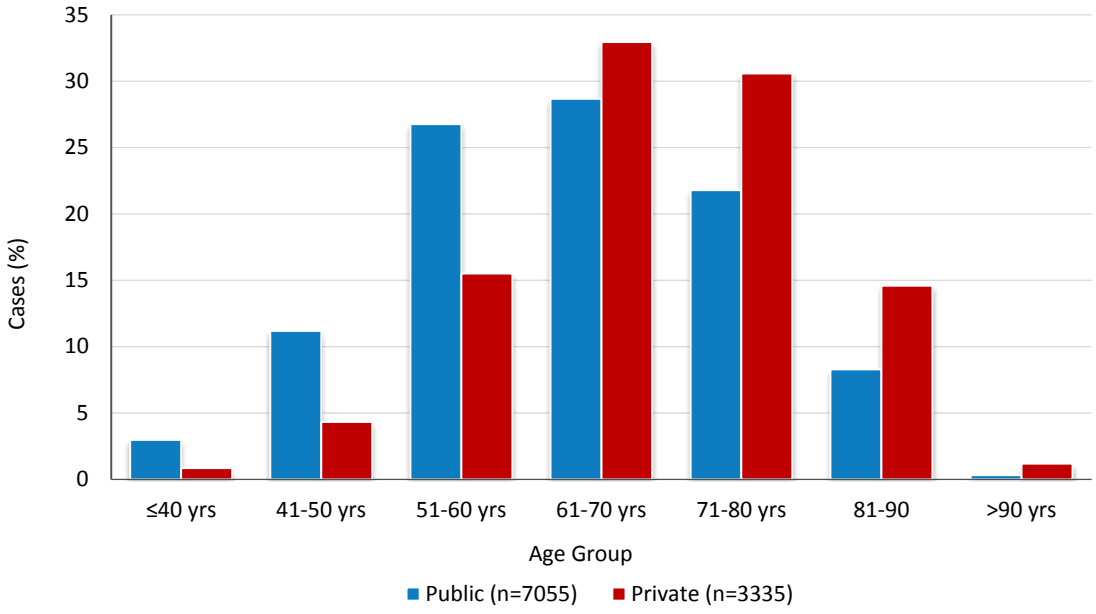


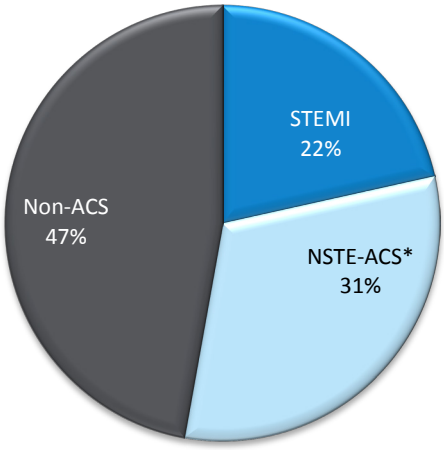
Figure 6: Age distribution for public and private patients



Clinical Presentation

Patients present for PCI treatment in a number of ways. The classification of an acute coronary syndrome (ACS) includes the diagnoses of ST elevation myocardial infarction (STEMI), non-ST elevation myocardial infarction (NSTEMI) and unstable angina. As NSTEMI and unstable angina are quite similar in their presentation and treatment, they are often then grouped together as non-ST elevation ACS (NSTE-ACS). The proportions of ACS subtypes across the VCOR cohort in 2015 are shown in Figure 7.

Figure 7: Procedures by clinical presentation



**NSTE-ACS encompasses both NSTEMI and unstable angina ACS groupings*

Cases are categorised as non-ACS when they present without evidence of an acute coronary syndrome in the previous 7 days. Figure 8 shows the casemix of ACS and non-ACS diagnoses by hospital. Overall the proportion of ACS and non-ACS cases by hospital was similar to previous years, with 53% of PCI cases in 2015 being performed on patients with an acute coronary syndrome.

Figure 8: ACS and non-ACS cases by hospital

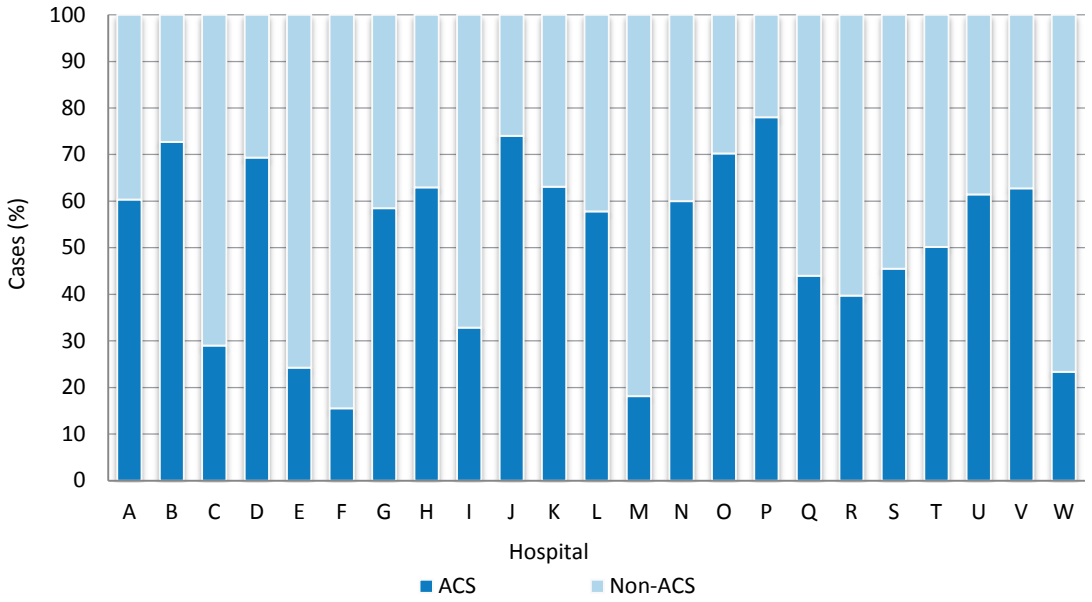
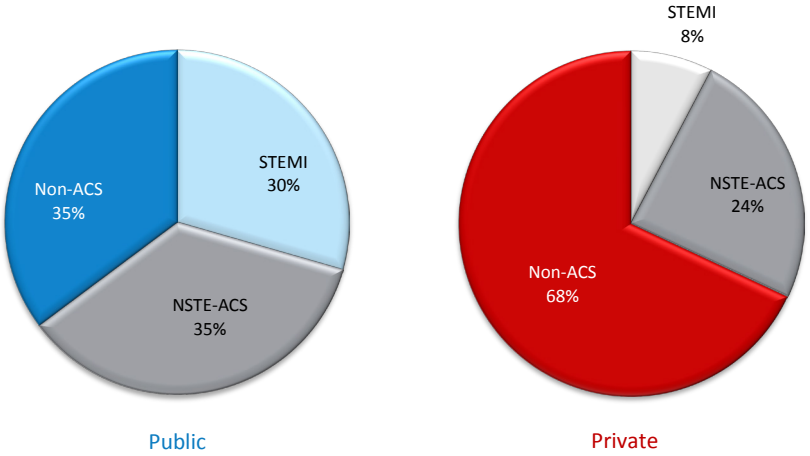


Figure 9 illustrates the differing profiles of clinical presentation across public and private hospitals. As in previous years, the proportion of non-ACS cases in private hospitals was almost double that seen in public hospitals.

Figure 9: Procedures by clinical presentation for public and private hospitals



Indications for PCI

Practice guidelines generally direct health providers towards focusing their treatment on those patients whose health status is most likely to benefit from the intervention. Tracking the indication for a PCI provides one measure of the appropriateness of that procedure. American peak cardiology organisations in particular, have gone further with the assessment of appropriateness of PCI procedures by developing comprehensive sets of criteria for its evaluation(8). Their system remains complex and has a number of limitations to its implementation. Yet, there is a growing body of evidence that monitoring the reasons for performing PCI cases positively influences the overall quality of health care delivery.

VCOR was designed to focus primarily on procedural and patient outcomes, so there are not enough data elements to directly apply appropriateness criteria similar to the US system. Instead, we have provided a breakdown analysis of the indication for PCI to further understand and evaluate the reasons for performing PCI among the VCOR patient cohort.

A diagnosis of ACS was considered a primary indication for PCI in suitable patients with an identifiable culprit lesion, in accordance with Australian practice guidelines(9). Table 5 outlines the various sub-categories of ACS and the proportions of these sub-categories as the indication for PCI. The table also compares the public and private sectors. Overall, primary PCI for acute STEMI accounted for 29% of all ACS indications with the vast majority of these performed in the public sector. The largest ACS indication for PCI overall was NSTEMI (45%), with three times the number of cases treated in public compared with the private sector.

Table 5: PCI indication for ACS cases

PCI Indication (ACS group)	All sites (N=4863)	Public (n=3782)	Private (n=1081)
	N (%)	N (%)	N (%)
Primary PCI for acute STEMI	1428 (29.4)	1230 (86.1)	198 (13.9)
STEMI PCI 12-24 hours after symptom onset	258 (5.3)	221 (85.7)	37 (14.3)
Pharmaco-invasive PCI	205 (4.2)	186 (90.7)	19 (9.3)
Rescue PCI	74 (1.5)	72 (97.3)	2 (2.7)
PCI for OHCA/shock (non-MI)	25 (0.5)	20 (80)	5 (20)
PCI for NSTE-ACS	2873 (59.1)	2053 (71.5)	820 (28.5)
	N (%)	N (%)	N (%)
NSTEMI	2189 (45.0)	1686 (77.0)	503 (23.0)
Unstable angina	684 (14.1)	367 (53.7)	317 (46.3)

Table 6 provides a breakdown of the reasons for PCI among non-ACS patients. There was no clear cut indication in 295 patients – mostly due to sites listing these cases as "staged" PCIs where the indication for the first procedure was either unknown or not provided.

Staged PCIs for multivessel disease in patients initially presenting with an ACS were categorised as an ACS indicator if the second procedure was performed within 30 days. Otherwise, they were grouped as non-ACS indicators.

Table 6: PCI indication for non-ACS cases

PCI Indication (non-ACS group)	All sites (N=4303)	Public (n=2049)	Private (n=2254)
	N (%)	N (%)	N (%)
Stable angina	2875 (66.8)	1377 (47.9)	1498 (52.1)
Recent ACS >7 days ago	357 (8.3)	154 (43.1)	203 (56.9)
Prognostic: No symptoms/no functional test	75 (1.7)	31 (41.3)	44 (58.7)
Prognostic: No symptoms with positive functional test	340 (7.9)	116 (34.1)	224 (65.9)
Staged PCI after STEMI (>30 days after first procedure)	157 (3.6)	111 (70.7)	46 (29.3)
Staged PCI after NSTE-ACS (>30 days after first procedure)	204 (4.8)	101 (49.5)	103 (50.5)
Indeterminate PCI indication	295 (6.9)	159 (53.9)	136 (46.1)

Among patients with a non-acute clinical presentation (non ACS), the indication for the procedure was further examined in terms of 3 clinical indicators for PCI -

1) angina symptoms (or equivalent)
2) positive functional test results
3) angiographic coronary stenosis greater than 70%

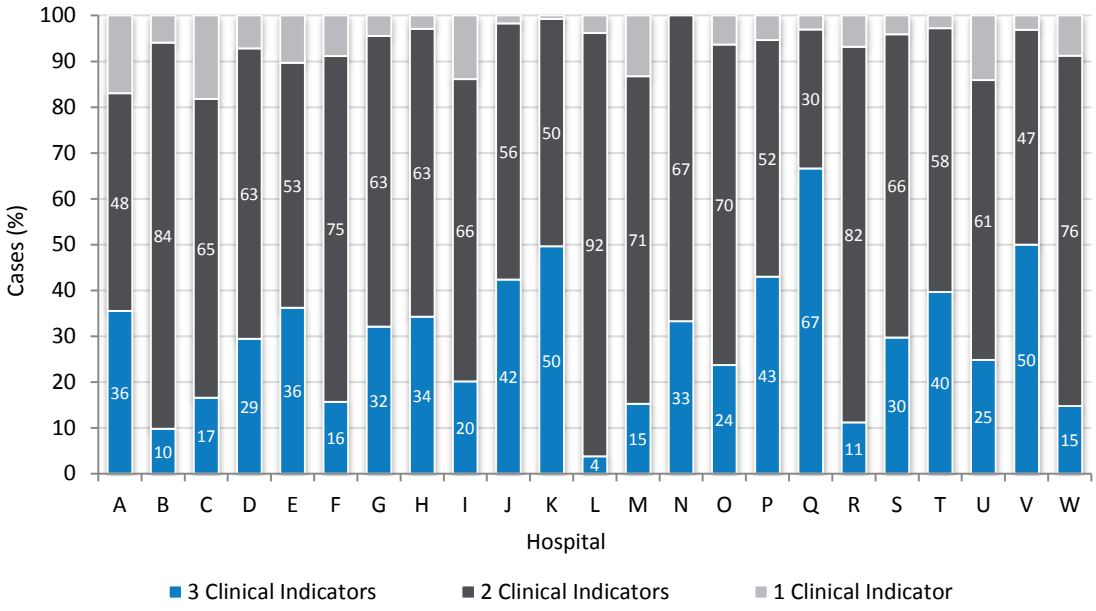
Symptoms of angina or its equivalent were reported in 89% of non-ACS patients, with most non-ACS cases (91%) having either two or three of these clinical PCI indicators (Table 7). A comparison of the proportion of non-ACS cases with one, two or three clinical indicators for PCI is shown in Figure 10. There was variation in PCI indicator patterns among the hospital cohort.

Table 7: Non ACS patients: Clinical indicators for PCI

Symptoms	Positive Functional Test	High Grade Stenosis	Total
			N (%)
●	●	●	1042 (28.5)
○	●	●	269 (7.4)
●	●	○	93 (2.5)
●	○	●	1933 (53.0)
●	○	○	168 (4.6)
○	○	●	108 (3.0)
○	●	○	38 (1.0)
			3651 (100)

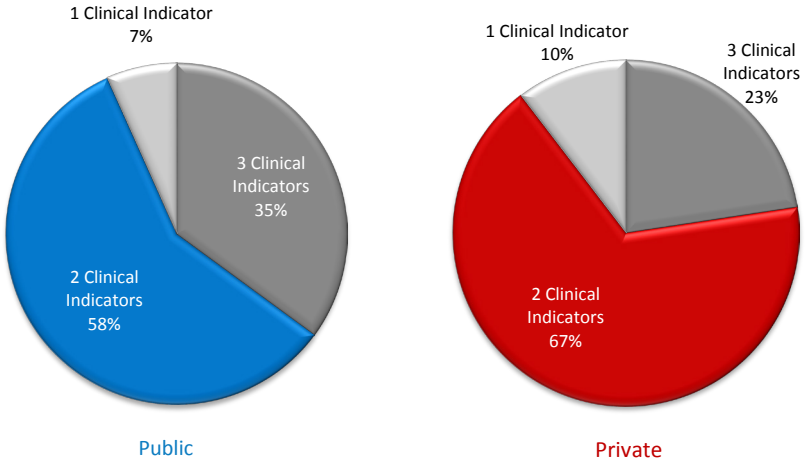
Table Legend: ● = Clinical indicator present; ○ = Clinical indicator not present.

Figure 10: Clinical indicators for PCI in non-ACS patients by hospital



There was also some variation in the pattern of PCI clinical indicators when the public and private sectors were compared. Figure 11 demonstrates that there was a small but definite weighting towards 2 clinical indicators in the private (67% of non-ACS cases) compared with the public sector (58% of non-ACS cases).

Figure 11: Clinical indicators for PCI in non-ACS patients for public and private hospitals



Clinical and Lesion Subsets

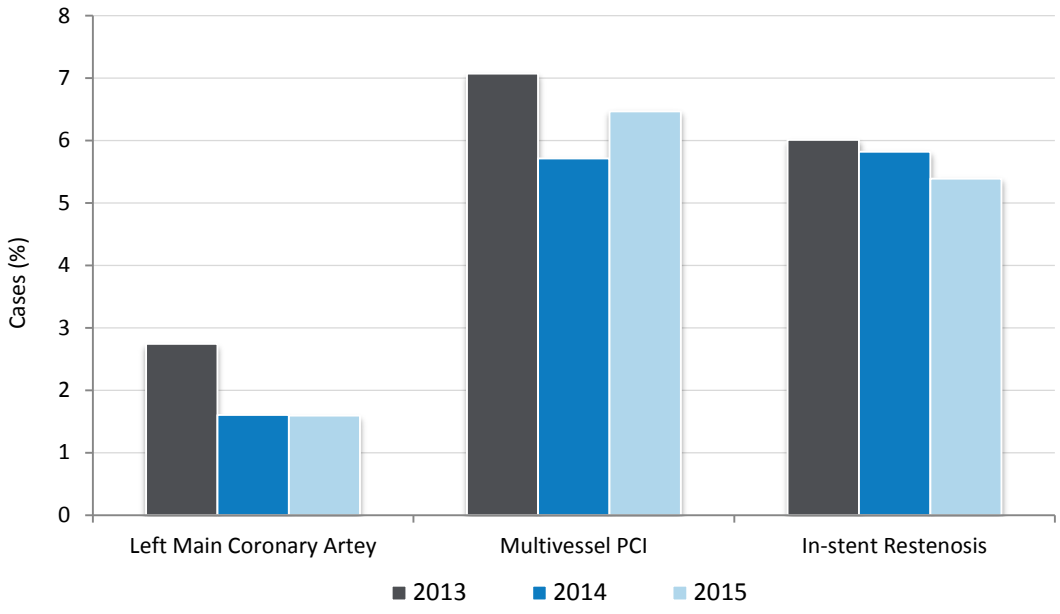
With an increasing interest among some centres in high-risk PCI, the number of cases presenting with cardiogenic shock or out-of-hospital cardiac arrest has remained fairly constant over the last two years (Table 8).

Left main coronary artery PCI remained an uncommon procedure in 2015 comprising only 1.6% of cases, as was multi-vessel PCI (6.5%) and PCI for in-stent restenosis (5.4%) (Figure 12).

Table 8: Patients presenting with cardiogenic shock or out-of-hospital cardiac arrest (OHCA): 2013 - 2015

Year	Total	Cardiogenic shock	Intubated OHCA	Shock and/or intubated OHCA
	N	N (%)	N (%)	N (%)
2013	4808	82 (1.7)	36 (0.7)	95 (2.0)
2014	8299	198 (2.4)	89 (1.1)	239 (2.9)
2015	9166	223 (2.4)	108 (1.2)	253 (2.8)

Figure 12: Comparative trends in incidence over time for selected PCI lesion subsets



In 2015, 22% of the patients undergoing PCI were older than 75 years, 11% were older than 80 years and 3.8% were over 85 years. The oldest person to receive PCI in 2015 was 100 years. These proportions among the elderly were similar to previous years. The elderly cohort also had more vascular co-morbidities (peripheral vascular disease and cerebrovascular disease) as well as double the rate of previous cardiac bypass surgery as shown in Table 9.

Table 9: Elderly patient (>80 years) characteristics compared with patients ≤80 years

Patient characteristic	<80 years (n=8137)	>80 years (n=1029)
	%	%
Gender – female	21.4	36.1
Diabetes medication	23.3	21.4
Peripheral vascular disease history	3.1	7.4
Cerebrovascular disease history	3.6	7.5
Previous PCI	32.4	36.2
Previous CABG	6.9	12.5
STEMI	22.1	16.6
NSTE-ACS	31.1	32.7
Stable angina	26.0	23.9
Radial access	46.8	32.3
Femoral access	53.0	67.7
DES use	77.2	74.1

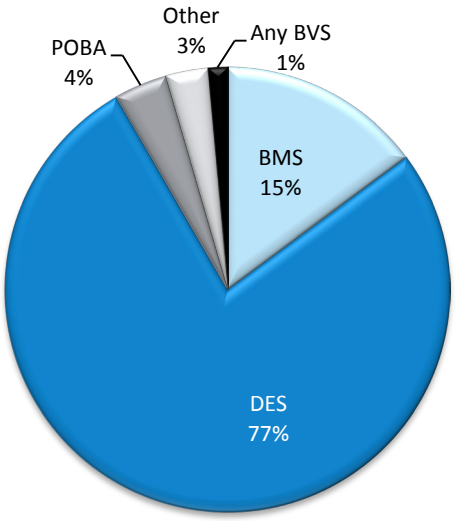
Care of PCI Patients

While the technique of PCI is based on the use of specialised balloon catheters to dilate blockages in coronary arteries, nearly all cases now also involve the implantation of coronary stents. Over the last decade, advances in coronary stent design have led to drug-eluting stent implantation outstripping the use of the older conventional bare metal stents and an increasing utilisation of bio-resorbable vascular scaffolds (BVS) that function in a similar manner to metallic stents, but are resorbed completely over a one-to-two year period. These devices have a number of potential advantages over conventional stents and they are currently in an early phase of uptake in the Australian marketplace. VCOR is ideally placed to monitor and report on the changing patterns in stent and other device usage and track the outcomes of these evolving procedures.

Figure 13 demonstrates that in 2015, the overwhelming majority (92%) of PCI patients received stents, either as conventional bare metal stents or drug-eluting stents. Compared with the previous years, the proportion of cases utilising bare metal stents continued to fall. Only a small number of Victorian hospitals had commenced implantation of bio-resorbable stent scaffolds in 2015, most of which were also drug-eluting. Overall, the uptake of this new technology has been quite conservative in the Victorian arena, and the registry will continue to monitor their usage and outcomes.

Approximately 4% of patients were treated with balloon angioplasty without stenting (POBA) - usually as a consequence of small vessel size or difficulty advancing a stent to the area of narrowing. The rate of balloon angioplasty alone was comparable with other international registries(10) and similar to previous years.

Figure 13: Device use across PCI cases



Drug Eluting Stents

Drug-eluting stents (DES) have been available in Victorian hospitals since 2003 and have demonstrated superiority to bare metal stents in relation to the risk of stent re-narrowing (restenosis). Second generation versions in current usage are also considered safe, with no excess risk of stent thrombosis compared with bare metal stents. The cost of these stents has also fallen significantly in the last 12 months, reducing one of the principal barriers to their widespread uptake.

In 2015, drug-eluting stents were used in 77% of cases overall in VCOR. This rate remained similar to previous years (77% in 2013 and 75% in 2014). Also, as seen previously, there was marked variation in DES usage among hospitals with rates ranging from 51% to 94% (Figure 14). The cost of these stents is recognised as a key factor limiting their use, particularly in the public sector. DES stent usage remained lower in the public sector (71% public vs 87% private, Figure 15), and while there has been a price drop over the last year, it may still be too early to see any change in DES usage patterns resulting from lower costs.

Figure 14: DES use by hospital

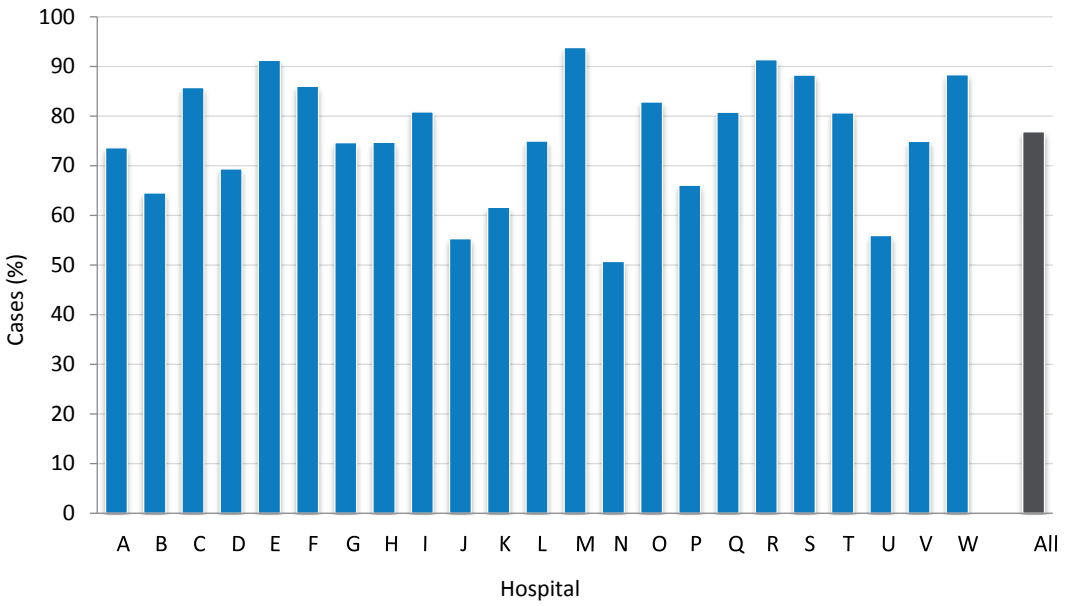
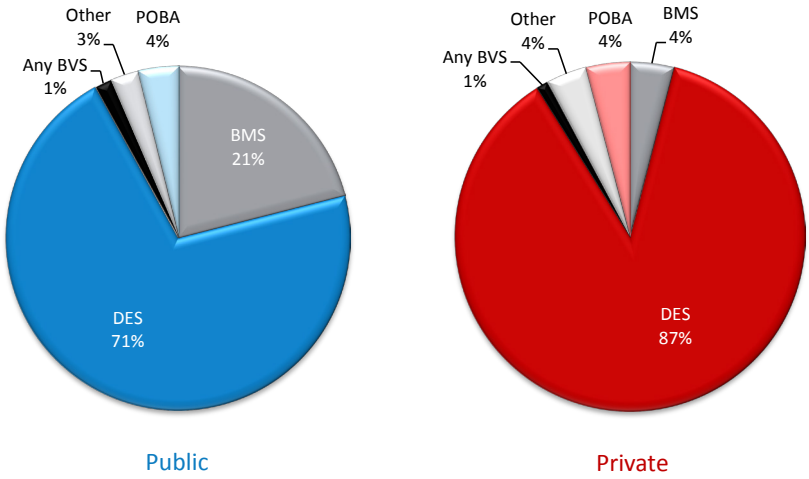


Figure 15: Device use in public and private hospitals



Particular subgroups of patients and lesions at high risk of restenosis are often the focus for DES use. These include diabetics, patients with renal failure and specific lesion subgroups including chronic total occlusions (CTOs), complex lesions and prior in-stent restenosis. Each of these subgroups had DES rates above the cohort average (Table 10).

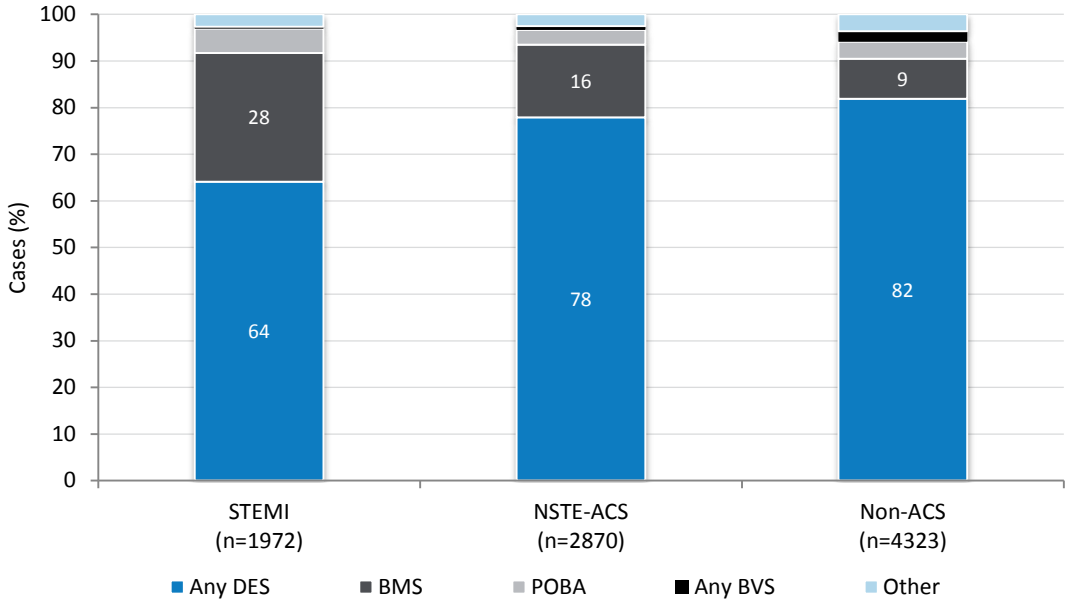
Table 10: DES use in different patient and lesion subgroups

	All PCI cases (N=9166)	Stented cases (n=8532)	DES stented cases (n=7041)
Patient group	**N**	**N (%)**	**N (%)**
Diabetes medication	2112	1934 (91.6)	1696 (87.7)
Renal failure	182	157 (86.3)	129 (82.2)
Lesion subgroups	**N**	**N (%)**	**N (%)**
Chronic Total Occlusion	407	232 (57.0)	217 (93.5)
Complex lesion	5039	4503 (89.4)	3853 (85.6)
In-stent restenosis	494	379 (76.7)	364 (96.0)

Subgroups are not mutually exclusive
Stented cases = one or more lesions treated with a stent
DES use = one or more lesions treated with a DES or mixed stent strategy

Interestingly, when comparing DES use across different clinical presentations, DES rates were lowest among PCI cases for acute STEMI at 64%. The rate increased for NSTE-ACS and was highest in Non-ACS cases (Figure 16). One possible explanation for this is a continuing preference for avoiding DES in cases with a high coronary thrombus burden because of residual concern about increased stent thrombosis risk. This potential excess risk over bare metal stents has now been largely disproven(11), yet DES rates in STEMI still remain below average across the 2015 cohort.

Figure 16: Device use based on clinical presentation



DES group includes one or more lesions treated with a DES or mixed stent strategy
BVS group includes any BVS (drug eluting or not)
Other category = no stent used/no balloon deployed

Arterial Access

Radial artery access for PCI has a number of potential advantages over the traditional femoral artery approach, including lower bleeding rates, greater patient comfort and improved outcomes – particularly in patients presenting with acute STEMI(12). Previous annual reports have demonstrated that patterns of practice in Victoria are changing, with increasing number of cases being performed via the radial approach.

The uptake of the radial access has been occurring at differing rates among the various health services and the registry continues to closely follow the trends and monitor any effects on outcomes.

For 2015, the overall rate of radial access for PCI was 45% (Figure 17), representing an 8% absolute rate increase compared with the previous year. However, wide variation still exists among hospitals, with rates ranging from 6% to 76% (Figure 18).

Figure 17: Arterial access route for all PCI procedures

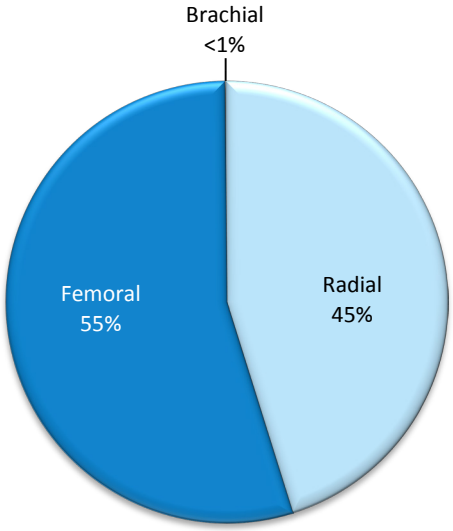
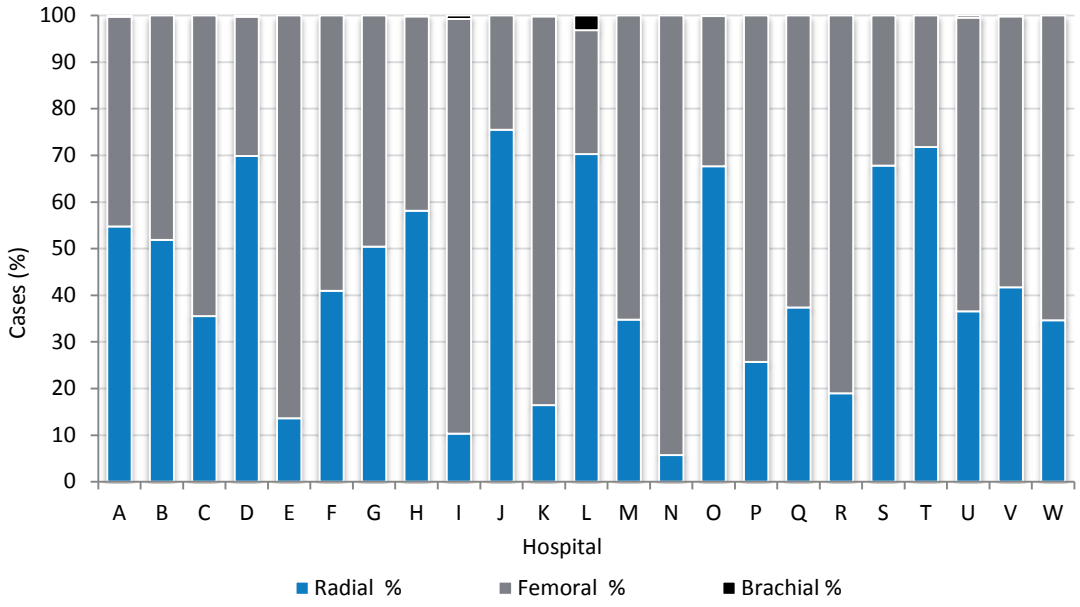


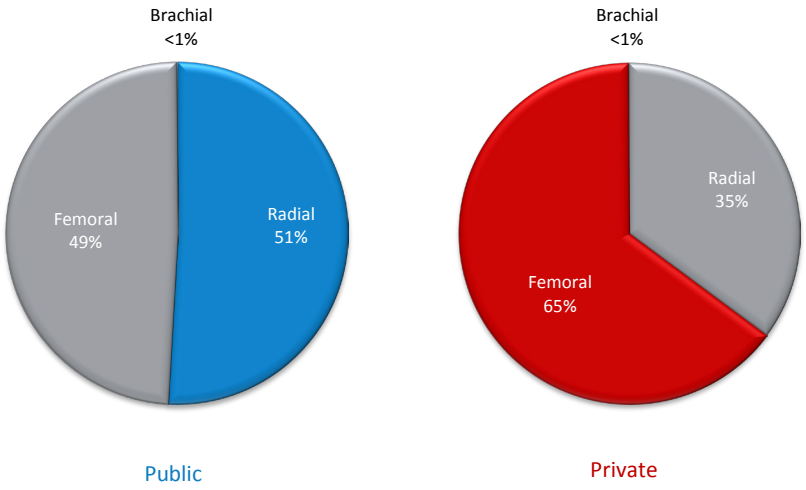
Figure 18: Arterial access route by hospital



Previous reports have demonstrated that the radial approach was used less frequently in the private sector. In 2015, the observed increase in radial access was apparent across both hospital sector types. Yet, there was still a substantial difference in radial access rates when public and private sectors were compared - 51% of public cases and 35% in private sector (Figure 19).

The report was unable to identify any clear cut explanation for the lower radial access uptake in private hospitals. Operator preference is unlikely to be a factor, as a majority of Victoria's interventional cardiologists work in both sectors. Other factors that may play a part include patient demographics and clinical presentation and this remains an area of interest for ongoing monitoring and assessment.

Figure 19: Arterial access route in public and private hospitals



As in previous years, radial access rates were higher in male patients, although overall rates rose in both males and females, and the gap between the sexes narrowed (Table 11). This may reflect some operator bias against the radial approach in women due to concerns about smaller arterial calibre and greater predilection to radial artery spasm. However, the radial approach in women has been shown to be safe and effective, especially as females are at greater risk of femoral access-related complications and bleeding(13).

Table 11: Arterial access route by gender

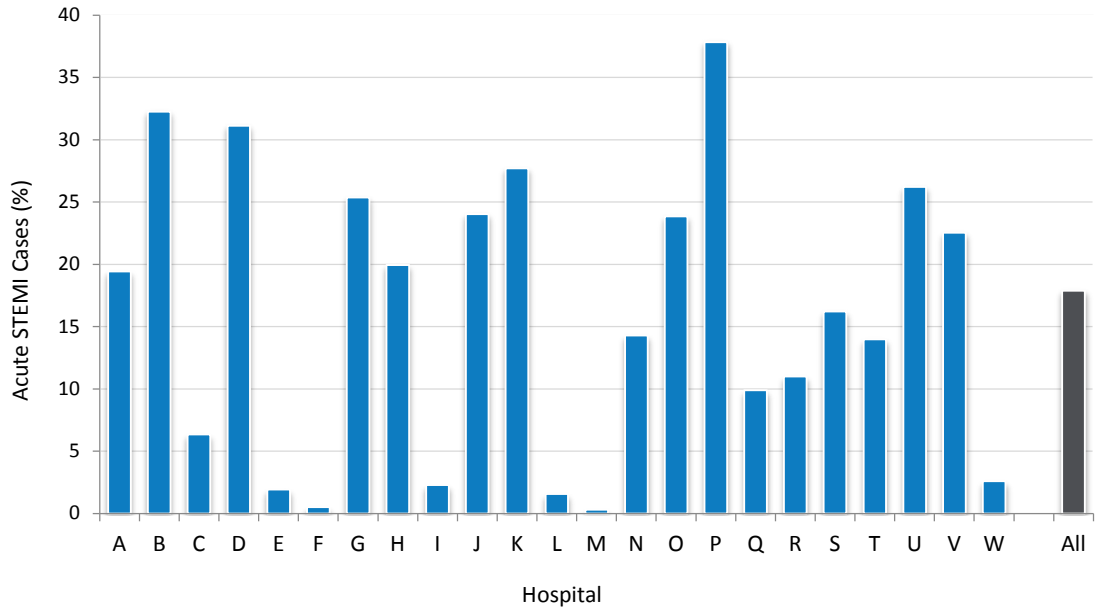
Access Route	All PCI cases	Male	Female
	N (%)	N (%)	N (%)
Radial access	4141 (45.2)	3301 (46.8)	840 (39.8)
Femoral access	5012 (54.7)	3742 (53.0)	1270 (60.2)
Brachial access	13 (0.1)	12 (0.2)	1 (<0.1)

PCI for Acute STEMI

Acute STEMI cases comprise a substantial proportion of the overall workload of many hospitals – particularly in the public sector. This condition is associated with significant morbidity and mortality, and its diagnosis and management challenges hospitals' systems and processes to deliver timely, efficient care in order to achieve the best patient outcomes.

In 2015, 1640 patients presented directly to a PCI hospital with an acute STEMI and underwent PCI, representing 18% of the total caseload of the registry for the year. Overall, 59% of cases of acute STEMI were treated out-of-hours (between 6pm and 8am Monday to Friday and weekends). As in previous years, there was significant variation in the proportion of acute STEMI cases across hospitals, ranging from 0% to 37% of the hospital's total PCI workload (Figure 20).

Figure 20: Acute STEMI cases as a proportion of overall case numbers by hospital



Hospitals E, F, I, L & M low acute STEMI case numbers (n≤6)

Selected characteristics of patients undergoing PCI for STEMI are presented in Table 12. STEMI patients tended to be younger and had fewer traditional cardiac risk factors such as diabetes compared with other patients.

Table 12: Selected patient characteristics for the acute STEMI cohort

Patient characteristics	Acute STEMI cohort (n=1640)	Remainder of PCI cohort (n=7526)
Age - years (Mean ±SD)	62 ±12	66 ±11
	%	%
Gender (female)	20.9	23.5
Diabetes medication	16.0	24.6
PVD history	2.2	3.9
Cerebrovascular disease	4.2	4.0
Previous PCI	12.7	37.2
Previous CABG	1.8	8.8

The majority of acute STEMI patients (87%) were treated in the public sector, accounting for approximately 25% of the public sector's caseload compared with just 6% of private hospitals' case volume. Acute STEMI patient characteristics were similar in the public and private sectors, apart from private patients being approximately six years older on average (Table 13).

The current approach to the presentation and management of this resource-intensive condition seems to have ended up placing uneven demands on the public sector, despite many private hospitals having well-developed systems to manage acute STEMI. Public and private hospitals already participate equally in the Ambulance Victoria program of pre-hospital notification of a suspected STEMI to expedite emergency treatment. Further analysis may assist in a better understanding of this trend towards uneven caseload distribution and promote the development of a coordinated system of care to manage available resources in a more equitable and efficient state-based system.

Table 13: Selected patient characteristics for the acute STEMI cohort: public vs private sector

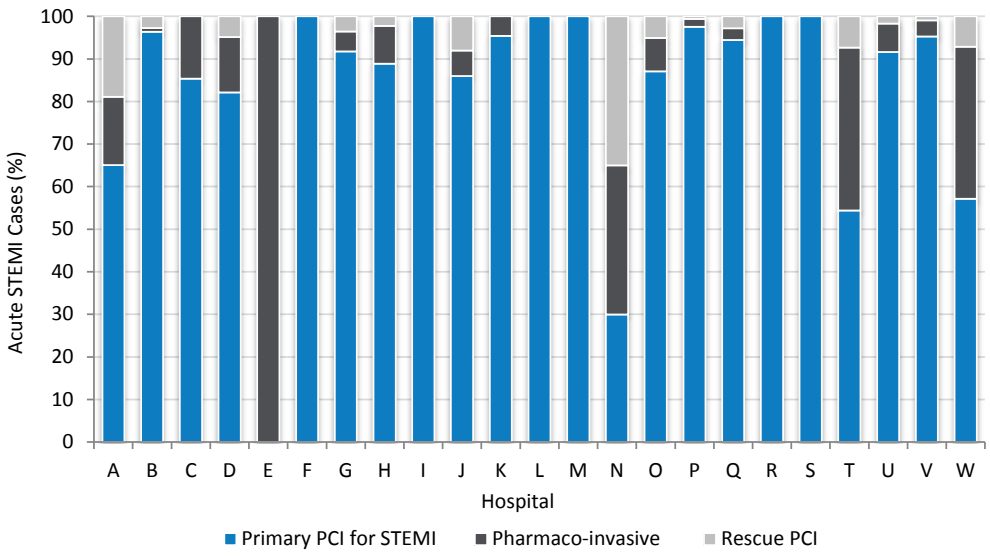
Patient characteristics	Public Acute STEMI patients (n=1426)	Private Acute STEMI patients (n=214)
Age - years (Mean ±SD)	61 ±12	67 ±12
Demographics	%	%
Gender - female	20.7	22.0
Diabetes Medication	16.7	11.2
Peripheral vascular disease history	2.1	2.8
Cerebrovascular disease history	4.2	4.2
Previous PCI	11.3	22.6
Previous CABG	1.5	3.7
Inter-hospital transfer	22.9	24.3
Treatment	%	%
Primary PCI	86.1	92.5
Rescue PCI	8.8	6.5
Pharmaco-invasive therapy	5.1	0.9
Proportion 'out-of-hours' cases	59.9	56.1

The majority (87%) of acute STEMI patients were treated with primary PCI, whereby angioplasty and stenting are used as first-line reperfusion therapy (re-opening the acutely occluded artery). This is the preferred method for treating acute STEMI, having been proven more effective and safer than the alternative reperfusion treatment of clot-dissolving thrombolytic drugs.

For those STEMI patients who are not located close enough to a PCI-capable hospital to undergo timely PCI, initial treatment of STEMI usually involves thrombolytic drugs, followed by rapid transfer to a PCI-capable hospital to undergo PCI within 24 hours, as long as they are clinically stable. This is known as pharmaco-invasive therapy. If patients are unstable after thrombolysis, particularly if there is evidence that the occluded artery has not been successfully re-opened with the thrombolytic drugs, urgent transfer and rescue PCI are recommended, preferably within the first 12 hours.

A comparison of hospitals and the differing methods employed for treatment of acute STEMI is shown in Figure 21.

Figure 21: PCI treatment type for acute STEMI patients by hospital

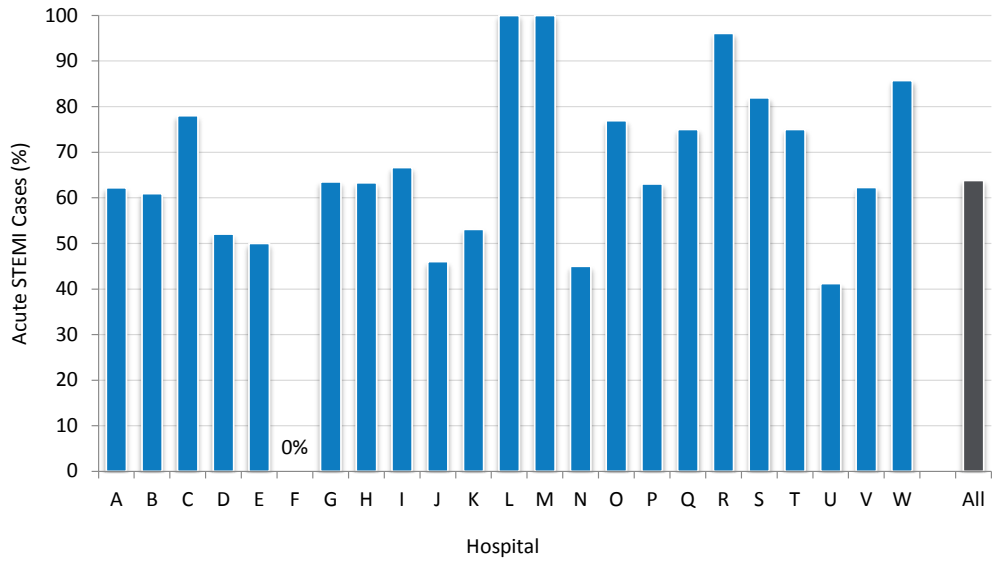


Low acute STEMI case numbers for hospitals E, F, I, L & M: I (n≤6)

A comparison of the rates of DES use and radial access among hospitals is depicted in Figures 22 and 23. Both these treatment approaches are now supported with a strong evidence base for their use. Yet, significant variation still exists among the various health services. The benefit of the radial approach in particular, is arguably greatest in this patient cohort, with lower bleeding rates and improved outcomes including lower mortality(14, 15).

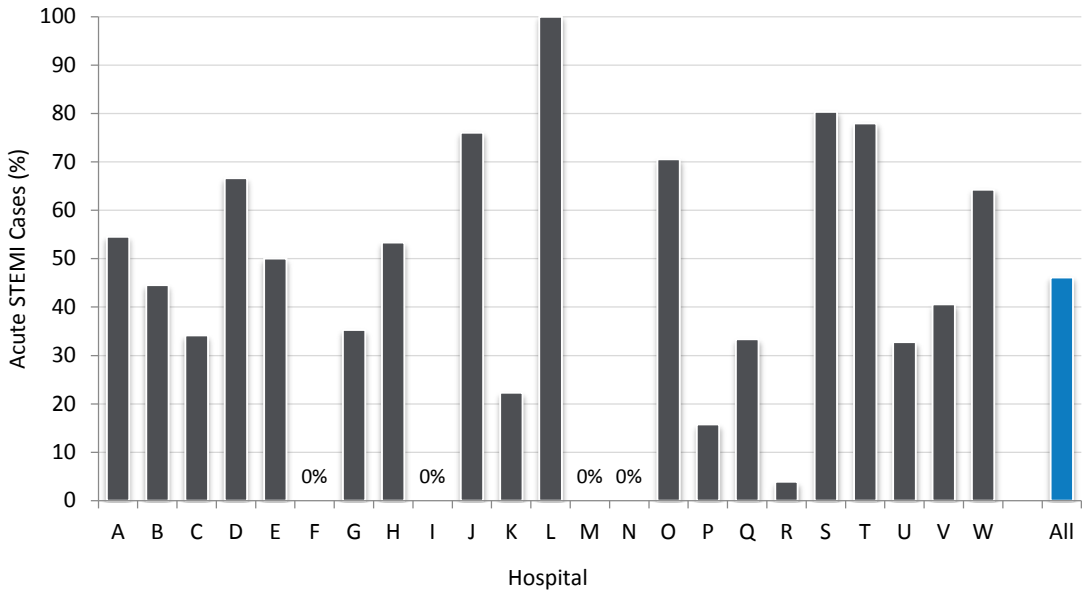
It is noteworthy that the radial approach for acute STEMI has increased to 47% overall in 2015, an absolute increase of 10% since the previous report and comparable to the overall cohort radial access rate. Some hospitals clearly favour this approach in the majority of their STEMI cases. VCOR will continue to monitor the trends in use of DES and radial access in future reports.

Figure 22: DES use in acute STEMI patients by hospital



Low acute STEMI case numbers for hospitals E, F, I, L & M: I (n≤6)

Figure 23: Radial access rates in acute STEMI cohort



Low acute STEMI case numbers for hospitals E, F, I, L & M: I (n≤6)

Door-to-balloon times for Primary PCI

For patients presenting with STEMI and undergoing primary PCI, the time taken from their arrival to the hospital until the insertion of a device to unblock the vessel (usually a balloon catheter or other device to extract clot) is known as the door-to-balloon time (DBT). This is a key performance measure that assesses the ability of hospital systems and processes to treat acute STEMI in a timely and efficient manner. It is generally accepted that the benchmark door-to-balloon time that hospitals should aim for is <90 minutes, in 75% or greater of cases(16).

The median door-to-balloon time for the overall cohort was 72 minutes (IQR: 48-103) (Table 14). The range for site median door-to-balloon-time was 45 – 95 minutes, with all but two hospitals achieving an overall median door-to-balloon time within the recommended 90 minutes benchmark (Figure 24).

In contrast, the overall rate of compliance with DBT<90 mins across the whole cohort was 66.4%, (range 39.3%-83.3%), which was below the recommended benchmark of >75% of cases (Figure 25). Only four of the 23 hospitals were able to achieve the guideline-recommended compliance rate of >75% cases with DBT<90 mins.

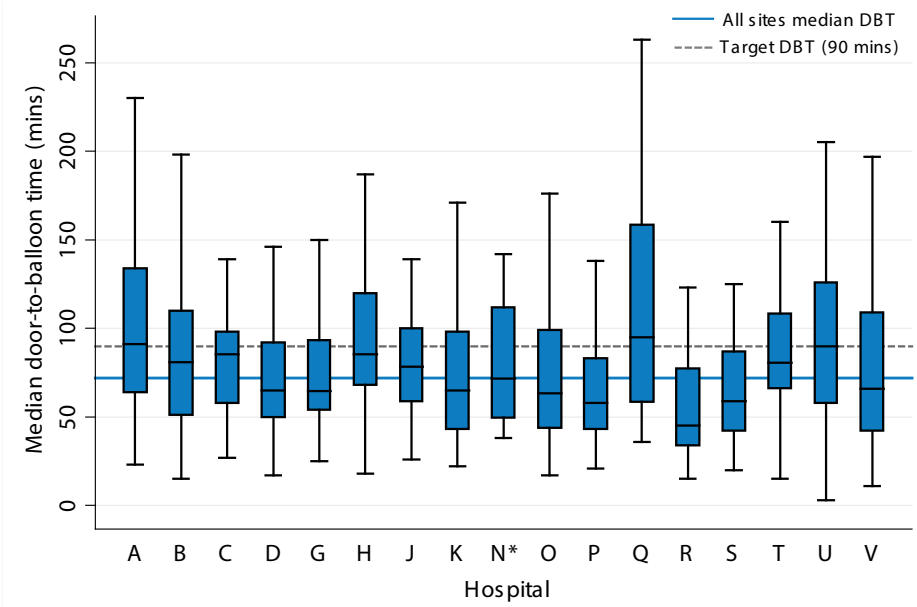
VCOR believes that the use of the compliance benchmark of >75% cases achieving a DBT<90 mins is the preferred benchmark for performance assessment and comparison. While median door-to-balloon times are more frequently reported in national and international reports, our data are just one example of how this benchmark can be misleading and "over-estimate" the performance of hospitals in achieving timely reperfusion in acute STEMI.

Table 14: Door-to-balloon times for primary PCI cases

Door-to-Balloon Time	Primary PCI* (all)	Primary PCI* (pre-hospital notification only)	Primary PCI* (no pre-hospital notification)
	(N=1168)	(n=598)	(n=570)
Median - mins (IQR)	72 (48-103)	54 (39-76)	92 (69-125)
Proportion of cases ≤90 mins	66%	84%	48%

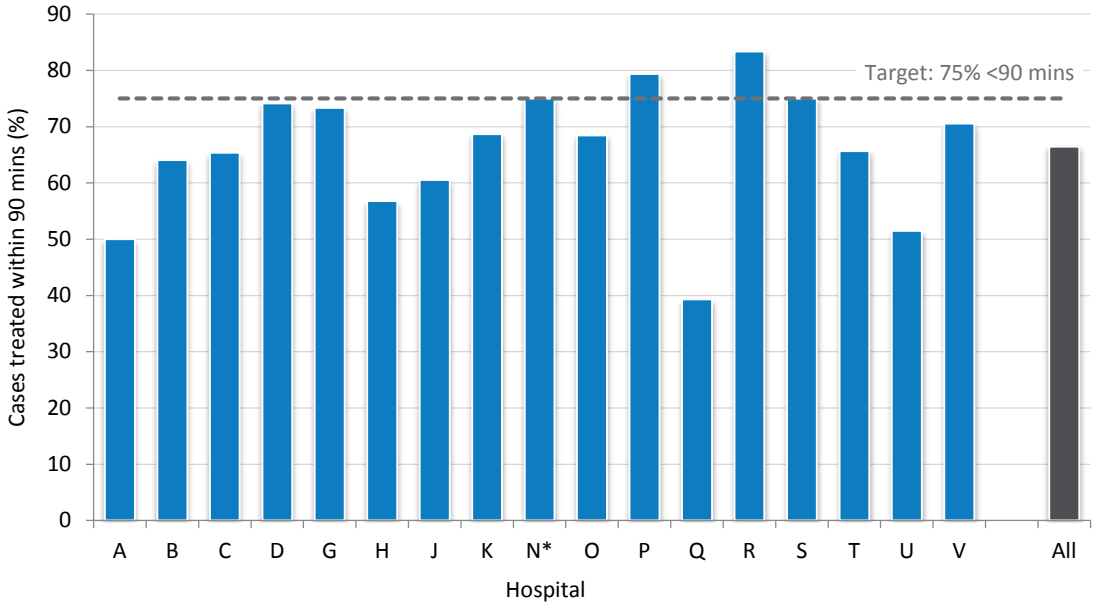
**Primary PCI for STEMI presentations excluding all inter-hospital transfer arrivals*

Figure 24: Door-to-balloon time for primary PCI cases by hospital



Hospitals E, F, I, L, M & W not included (Primary PCI cases n<2)
**Hospital N low numbers (n<5)*

Figure 25: Proportion of primary PCI cases with door-to-balloon time ≤90 minutes by hospital



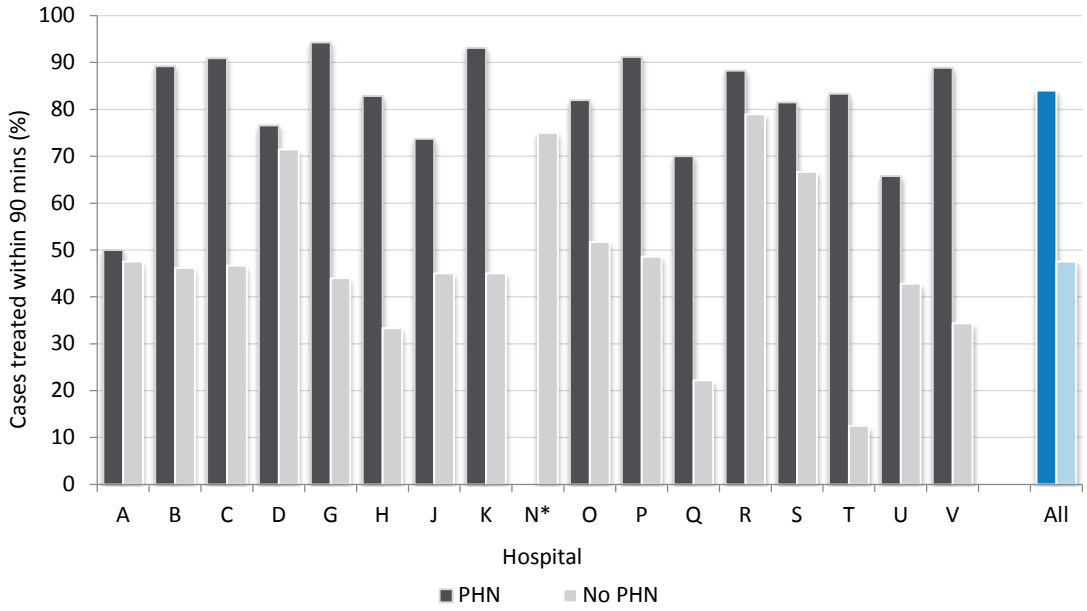
Hospitals E, F, I, L, M & W not included (Primary PCI cases n<2)
**Hospital N low numbers (n<5)*

Pre-hospital notification and door-to-balloon times

The process of pre-hospital notification (PHN) involves field triage by ambulance to identify patients with acute STEMI, followed by transmission of the diagnostic 12-lead ECG to the receiving hospital. The hospitals are then able to mobilise their cardiac catheter laboratory teams while the patient is still being transported to hospital, shortening delays to commencement of the case.

Figure 26 compares the proportion of primary PCI cases achieving DBT within 90 mins for patients triaged with and without pre-hospital notification for each hospital. Compliance rates for DBT<90 mins were higher in patients triaged with pre-hospital notification. With 84% achieving a door-to-balloon time of less than 90 minutes compared with 48% where there was no pre-hospital notification (Table 14). Most hospitals achieved DBT <90 mins in more than 80% of their caseload when pre-hospital notification was received.

Figure 26: Proportion of primary PCI cases with door-to-balloon time ≤90 minutes for pre-hospital notification (PHN) and no PHN presentations by hospital

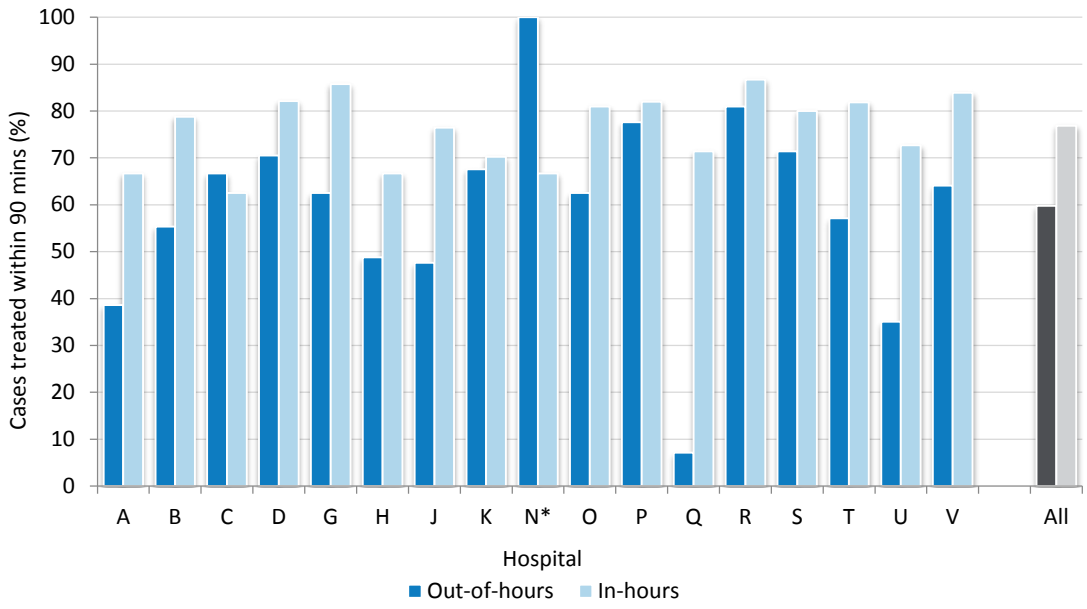


Hospitals E, F, I, L, M & W not included (Primary PCI n<2)
**Hospital N had low numbers (n<5) and zero cases with pre-hospital notification*

Effect of presentation time (in-hours vs out-of-hours) on door-to-balloon times

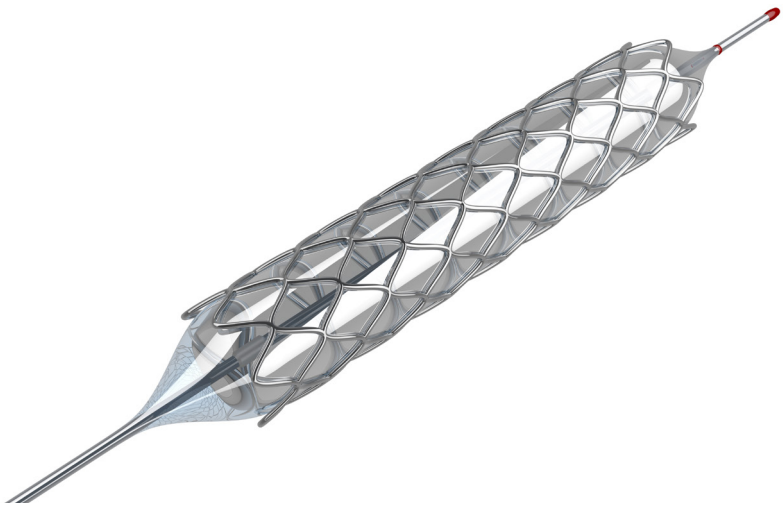
When comparing the DBT compliance rates for in-hours with out-of-hours, the majority of hospitals showed a fall-off in performance outside of normal working hours (8:00am – 6:00pm Monday to Friday). This was predominantly due to increases in the time taken to transfer patients to the cardiac catheter laboratory after hours (Figure 27).

Figure 27: Proportion of primary PCI cases with door-to-balloon time ≤90 minutes for in-hours and out-of-hours presentations by hospital



Hospitals E, F, I, L, M & W not included (Primary PCI n<2)
** Hospital N had low numbers for in and out-of-hours (n≤2 cases)*

In-hours: 8:00am – 6:00pm Mon – Fri
Out-of-hours: 6:00pm – 8:00am Mon – Fri (and weekends)



Outcomes

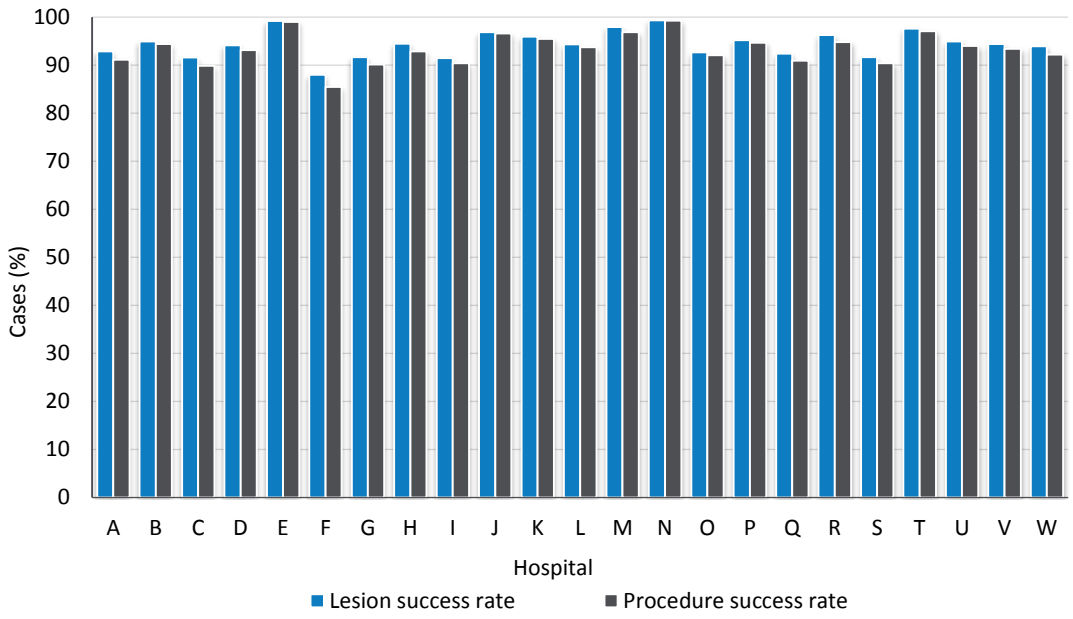
Lesion and Procedure Success Rates

The success of a PCI procedure relates to the re-opening of narrowed or blocked coronary arteries with a coronary stent or balloon free of complications and a strong likelihood of a durable long-term result. Success can be further measured in terms of individual lesion success where the lesion is reduced to less than 10% residual stenosis following stenting, or less than 50% residual stenosis following balloon angioplasty alone.

Procedure success is defined as all attempted lesions successfully treated, without any significant in-hospital complications.

In 2015, hospitals reported 94% of lesions attempted were successfully treated, while the overall procedure success rate for the cohort was 93%. Figure 28 displays lesion success and procedure success rates for each hospital. Both rates are similar to previous years.

Figure 28: Lesion and procedure success by hospital



Key Performance Indicators (KPIs)

VCOR has adopted a number of key performance indicators (KPIs) based on clinically relevant procedural outcomes to monitor and benchmark the performance of hospitals in their delivery of quality cardiac care.

The KPIs reported for the VCOR PCI module are:

- In-hospital mortality
- In-hospital major bleeding
- Length of stay
- In-hospital unplanned revascularisation
- Door to balloon/device time for STEMI patients
- 30-day risk-adjusted mortality
- 30-day major adverse cardiac and cerebrovascular event (MACCE)

For 30-day risk adjusted mortality rates, a risk-prediction scoring tool, developed with the Melbourne Interventional Group multi-centre PCI registry mortality risk-adjustment models, was applied to the 2015 VCOR patient cohort. The clinical characteristics used to construct the risk-adjustment model were:

- Age ≥80 years
- Acute coronary syndrome
- Glomerular filtration rate
- Left ventricular ejection fraction
- Cardiogenic shock
- Left anterior descending coronary artery disease

A. In-hospital Mortality

The overall unadjusted in-hospital mortality rate for 2015 was 1.6%. However as expected, mortality was higher in particular patient subgroups. Table 15 demonstrates that the highest mortality (40%) was found in patients presenting with cardiogenic shock or out-of-hospital cardiac arrest requiring endotracheal intubation (OHCA). In contrast, patients presenting with low-risk clinical presentations had an in-hospital mortality rate of just 0.8%, a good indication of the overall safety of modern PCI.

The in-hospital mortality for patients presenting with STEMI (including STEMI patients with shock or OHCA) was 5.6%, representing a 1.8% decrease compared with 2014 results.

Table 15: Unadjusted in-hospital mortality rates

Patient category	Total	In-hospital mortality rate
	N	N (%)
All PCI patients	9155	150 (1.6)
All patients without STEMI* or shock/intubated OHCA	8598	70 (0.8)
STEMI* patients	1970	111 (5.6)
Shock/intubated OHCA patients	249	99 (39.8)

**Any STEMI with symptom onset within previous 7 days*
11 cases excluded from outcome analyses to avoid double counting of mortality

B. In-hospital Bleeding Events

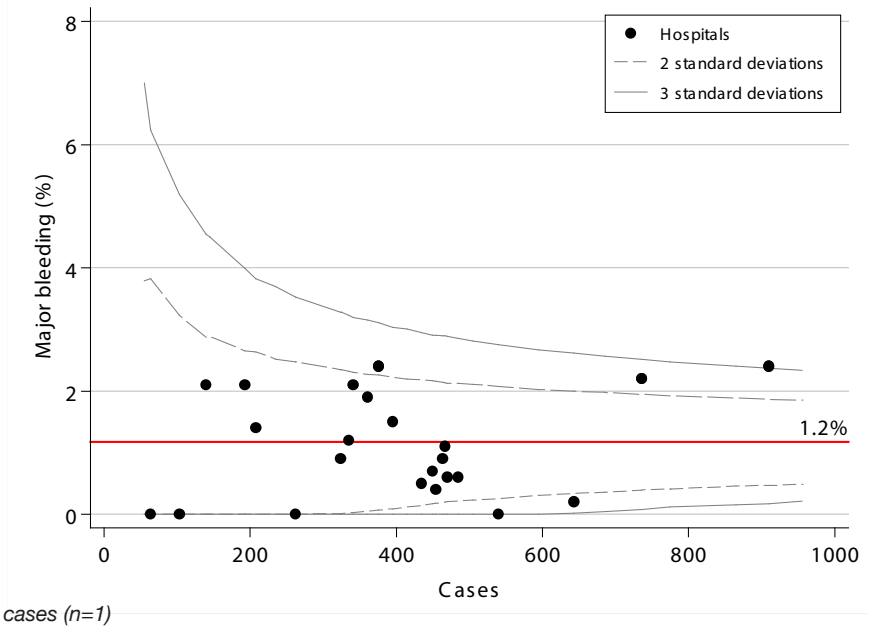
In-hospital major bleeding is a key performance measure associated with adverse short and long-term outcomes, including increased mortality(17). Many different classifications of major bleeding are in current use, making comparisons across trials and registries difficult. In an attempt to improve the reporting of bleeding events, the international Bleeding Academic Research Consortium (BARC) has developed standardised bleeding definitions for cardiovascular clinical trials(18). VCOR has adopted the BARC criteria, with major bleeding defined as bleeding that requires blood transfusion, cardiac tamponade, intracranial haemorrhage and/or any fatal bleeding.

The overall in-hospital major bleeding rate in 2015 was 1.2%. Highest bleeding rates were seen in patients presenting with STEMI (Table 16). Bleeding rates were higher in females and with femoral access when compared with radial access (1.4% vs 0.9%). Comparative in-hospital major bleeding rates among participating hospitals are shown in the funnel plot in Figure 29. For this reporting period, all hospitals had rates of in-hospital major bleeding within control limits.

Table 16: In-hospital major bleeding rates by subgroup

Subgroup	N	Major Bleeding Rate
Clinical Presentation		**N (%)**
STEMI	1970	58 (2.9)
NSTE-ACS	2869	31 (1.1)
Non-ACS	4316	19 (0.4)
Gender		**N (%)**
Male	7046	76 (1.1)
Female	2109	32 (1.5)
Arterial Access Route		**N (%)**
Radial access	4139	38 (0.9)
Femoral access	5003	70 (1.4)
Brachial access	13	0 (0.0)
Total	**9155**	**108 (1.2)**

Figure 29: Rates of in-hospital major bleeding*



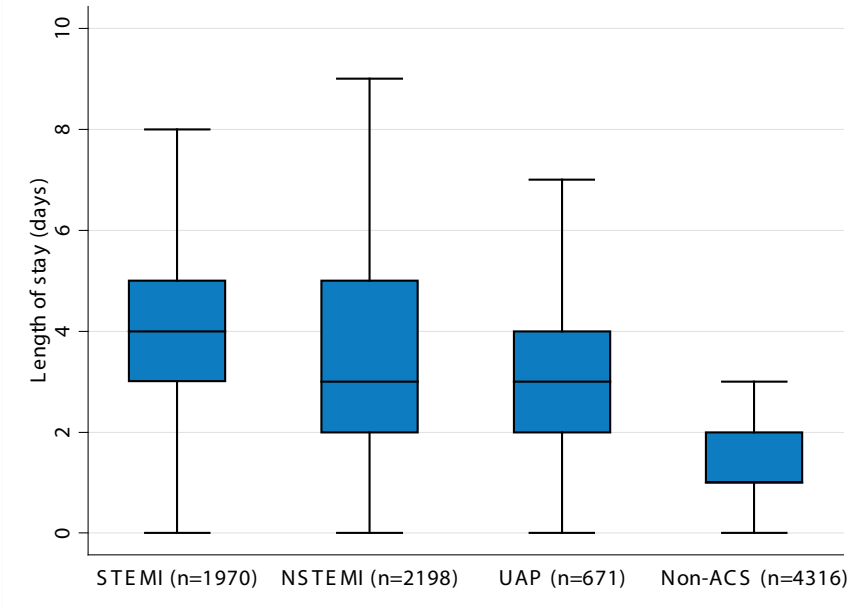
NB: Excludes all ECMO cases (n=1)

C. Length of Stay

While the length of stay is affected by various patient-related factors, it is still generally considered a useful process measure of the efficiency of hospitals in managing particular conditions. For most elective PCI cases, length of stay is expected to be one day, whereas patients undergoing PCI for an acute coronary syndrome typically have multi-day hospital stays, usually related to the overall management of the underlying condition.

Figure 30 shows the median length of stay (in days) by clinical presentation. As in previous years, length of stay varied by clinical presentation, being longest for patients presenting with STEMI, decreasing as the acuity of the presentation decreased. A shorter median length of stay was observed among all patients treated in private hospitals (3 days public vs 2 days private).

Figure 30: Length of stay by clinical presentation



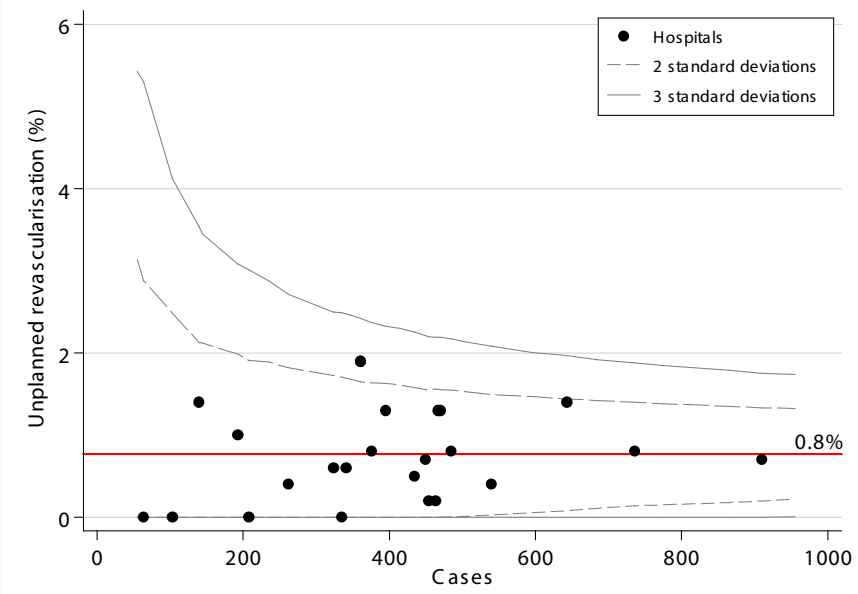
D. In-hospital Unplanned Revascularisation

In-hospital unplanned revascularisation refers to any unexpected revascularisation procedure (either PCI or CABG surgery) the patient undergoes following the index PCI, but within the same admission. Typically, this occurs as a result of the complication of acute or subacute stent thrombosis, often presenting as an evolving acute myocardial infarction.

The metric of unplanned in-hospital revascularisation also includes unplanned procedures on coronary vessels other than the one initially treated with PCI.

The overall rate of in-hospital unplanned revascularisation was 0.8%. Figure 31 demonstrates that all hospitals had rates of unplanned revascularisation within control limits.

Figure 31: Rates of in-hospital unplanned revascularisation



E. 30-Day risk-adjusted mortality

In keeping with the approach of major clinical quality registries(19, 20), the key metric of 30-day mortality is presented with risk adjustment. The overall risk-adjusted 30-day mortality for 2015 was 2.7%. A comparison of observed versus predicted mortality for each hospital is shown in Figure 32. Adjusted mortality rates at 30 days for all hospitals were within control limits (Figure 33).

Figure 32: Observed mortality versus predicted mortality by hospital

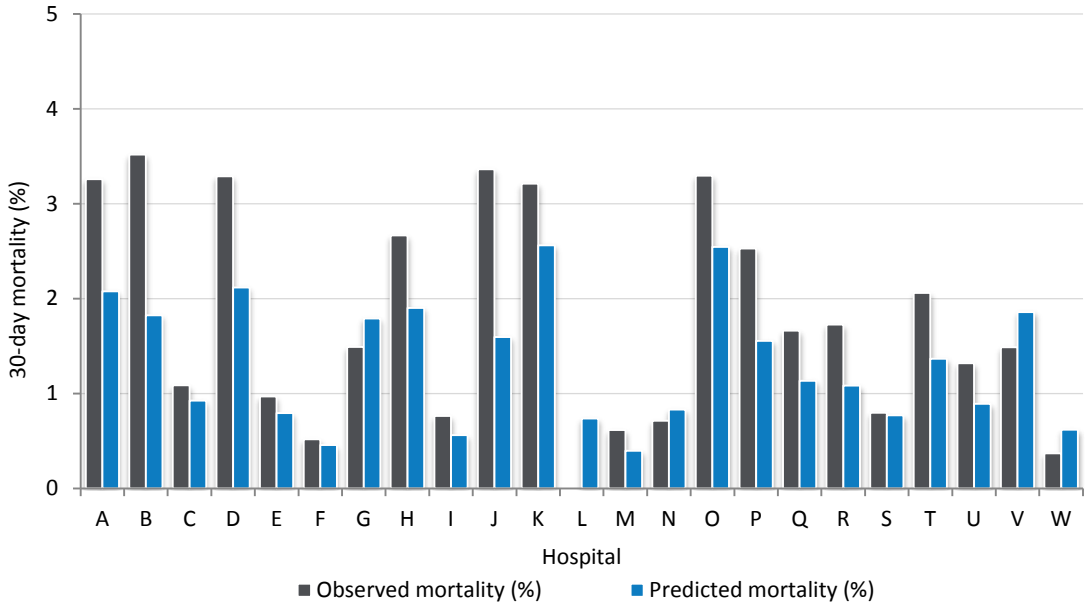
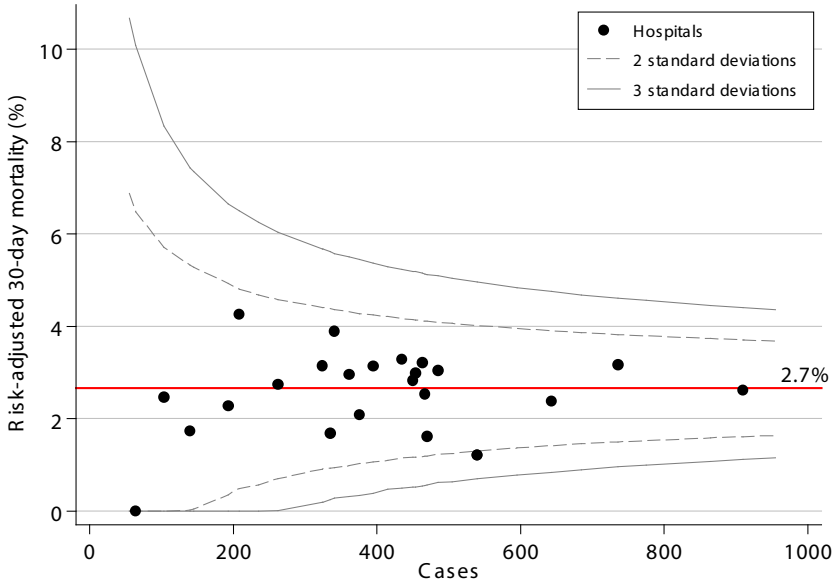
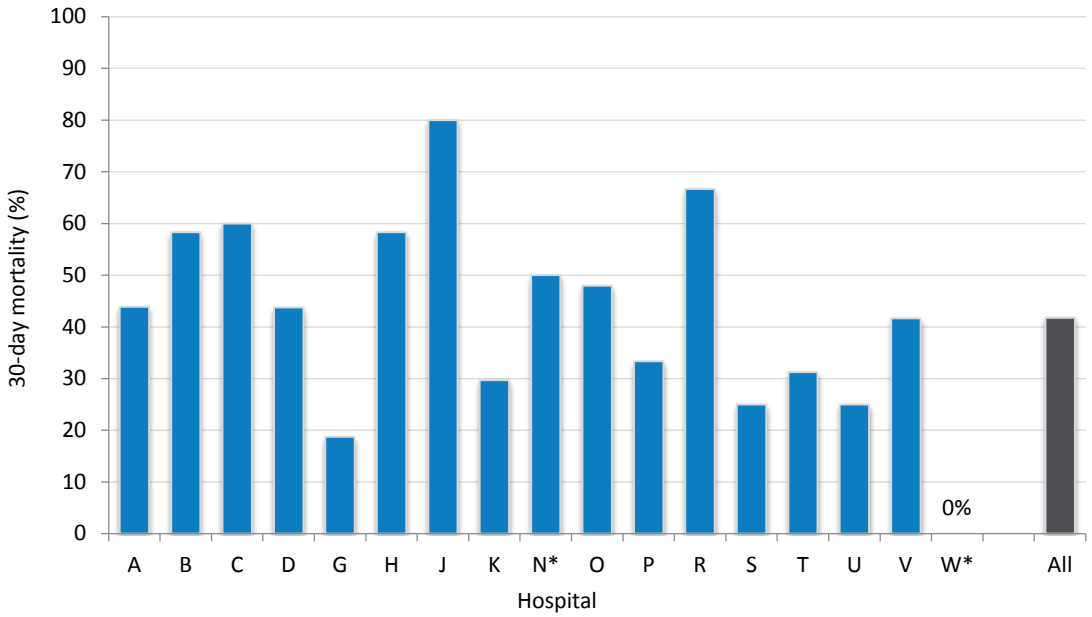


Figure 33: Risk-adjusted 30-day mortality



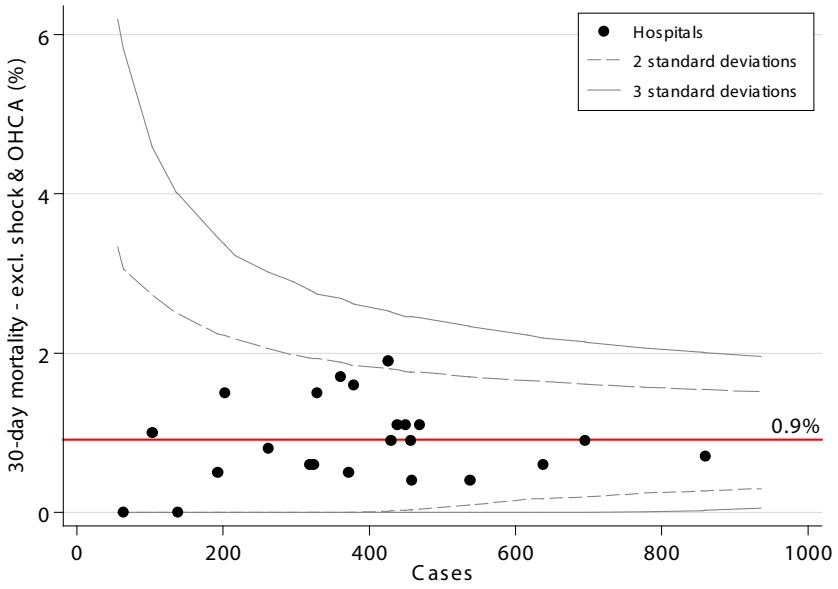
Rates of death at 30 days are known to be strongly influenced by clinical presentation(19, 20). Arguably, cardiogenic shock and out-of-hospital cardiac arrest are special cases with significantly higher mortality rates compared with other clinical presentations (Figure 34), and may not be appropriately adjusted for in any risk adjustment model. In an analysis where these cases were excluded, the overall (unadjusted) 30-day mortality rate was 0.9% (Figure 35).

Figure 34: 30-day mortality rates for cardiogenic shock and intubated OHCA patients by site



Sites E, F, I, L, M and Q had no shock or intubated OHCA patients
**Sites N & W experienced low numbers (n=2 shock/intubated OHCA patient)*

Figure 35: Unadjusted 30-day mortality excluding cardiogenic shock & intubated OHCA patients



F. 30-Day Major Adverse Cardiac Cerebrovascular Events (MACCE)

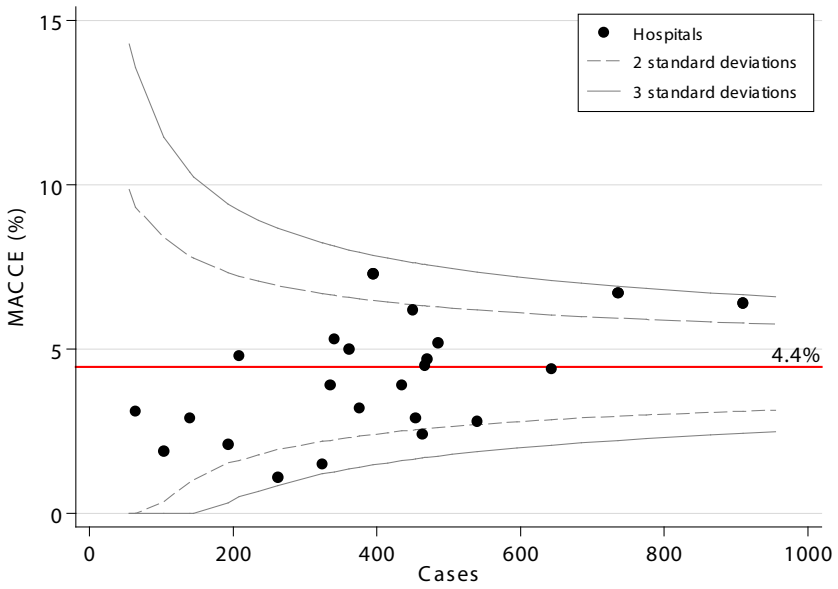
The composite endpoint of major adverse cardiac and/or cerebrovascular events (MACCE) includes all cases of death, new or recurrent myocardial infarction or stent thrombosis, target vessel revascularisation or stroke. The overall MACCE rate of 4.4% was similar to 2014 (4.7%). Table 17 shows MACCE rates at 30 days among participating VCOR hospitals. All hospitals participating in VCOR in 2015 had MACCE rates within acceptable control limits (Figure 36).

Table 17: 30-day MACCE rates

MACCE component	In-hospital events	30-day events*
	N (%)	N (%)
Total mortality	150 (1.6)	185. (2.0)
Myocardial Infarction	75 (0.8)	123 (1.3)
Stroke	21 (0.2)	26 (0.3)
Definite stent thrombosis	25 (0.3)	44 (0.5)
Probable stent thrombosis	6 (0.1)	9 (0.1)
Target vessel revascularization (TVR) ǂ	70 (0.8)	136 (1.5)

**30-day events reported include in-hospital events*
Categories are not mutually exclusive
ǂTVR refers to any 'unplanned' PCI or CABG revascularisation of the target vessel

Figure 36: 30-day MACCE



Other Outcomes

30-day stent thrombosis rates

The Academic Research Consortium (ARC)(21) definitions for stent thrombosis were applied. As this registry currently reports outcomes to 30 days, only the categories of a "definite event" (symptoms suggestive of an acute coronary syndrome and angiographic or pathologic confirmation of stent thrombosis) or a "probable event" (unexplained death within 30 days or target vessel myocardial infarction without angiographic confirmation of stent thrombosis) were used.

In 2015, the definite 30-day stent thrombosis rate was 0.5% (comparable with 2014). The probable stent thrombosis rate at 30 days was same as for 2014 at 0.1%. There were no major differences in stent thrombosis rates among hospitals overall or when the public private sectors were compared.

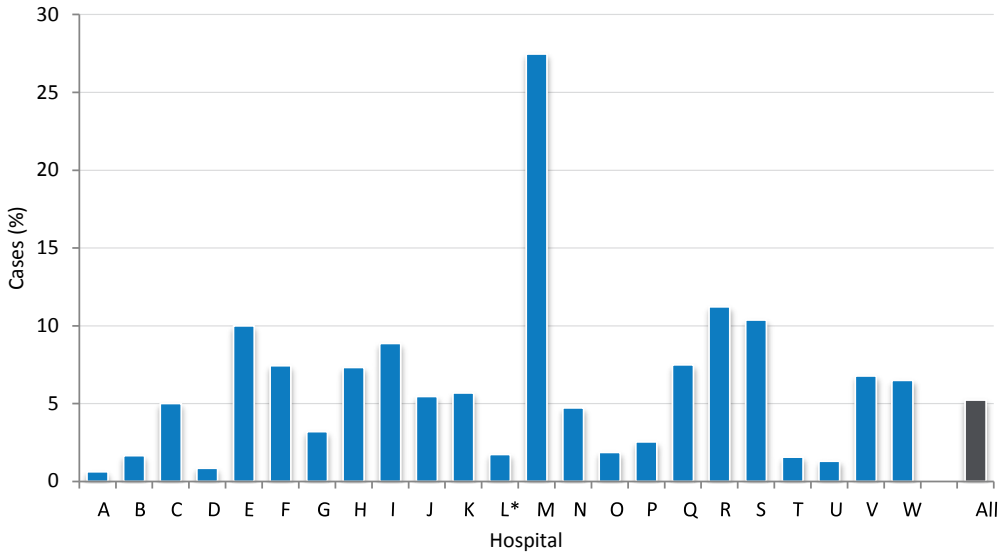
30-day rehospitalisation rates

At 30 days following a PCI, the overall rate of rehospitalisation was 13%, similar to the previous year. Of those rehospitalisations, 6.5% were re-admitted more than once during that period. Re-admission for cardiac causes occurred in 69% of cases – slightly more than half of these were unplanned cardiac readmissions (Table 18). There was variation among hospitals in unplanned cardiac readmission rates (Figure 37).

Table 18: 30-day rehospitalisation rates

Rehospitalisation type	All patients
	%
Total readmissions (any)	13.3
Non-cardiac readmissions	4.0
Cardiac readmissions	9.3
Unplanned cardiac readmissions	5.3
Planned cardiac readmissions	4.0

Figure 37: 30-day unplanned cardiac rehospitalisation by hospital



**Hospital L had low rehospitalisation number (n=2)*

A comparison of 30-day rehospitalisation rates by hospital sector is shown in Table 19. In the public sector, 11% of patients were readmitted within 30 days, with 8.3% re-admitted more than once during this period. The 30-day rehospitalisation rate was higher among private patients, with 15% readmitted within 30 days, although fewer private patients were readmitted more than once during the 30 days (3.9%).

Patterns of unplanned cardiac rehospitalisations after PCI – including variations among hospitals and differences by hospital sector - remain an area of ongoing interest among hospitals and funders. A better understanding of these findings can facilitate service improvement and more efficient delivery of high quality cardiac care. VCOR will continue to track these trends.

Table 19: 30-day rehospitalisations rates for public and private hospitals

Rehospitalisation type	Public	Private
	%	%
Total readmission rates (any)	10.7	14.8
Cardiac readmissions	6.3	11.2
Unplanned cardiac readmissions	2.7	7.2
Planned cardiac readmissions	3.6	4.0

3.2 Quality of Life Metrics

Patients were requested to rate their perceived quality of life at 30-day follow-up, in a series of questions based on a standardised measure, the EQ-5D(22). Patients reported on their mobility, ability to perform usual domestic and personal care tasks, level of pain or discomfort and whether they experienced any anxiety or depression. The results are shown in Figures 38-42. Overall, the majority of patients reported "no problem" in these areas.

Patients were also asked to rate their own health status on a scale from 1-100, with 100 being the best a patient could remember ever feeling. The mean score across the 2015 cohort was 75.99 ±18.5. Fifty percent of patients reported their own health status in a range of 70 – 90.

Figure 38: Quality of life (mobility)

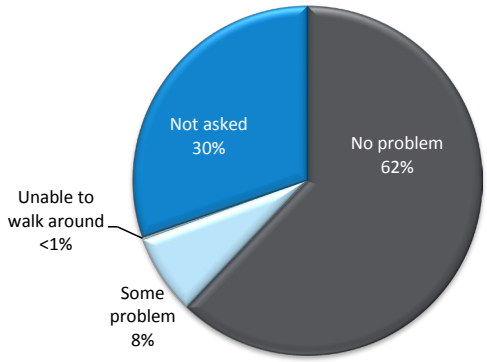


Figure 39: Quality of life (personal care)

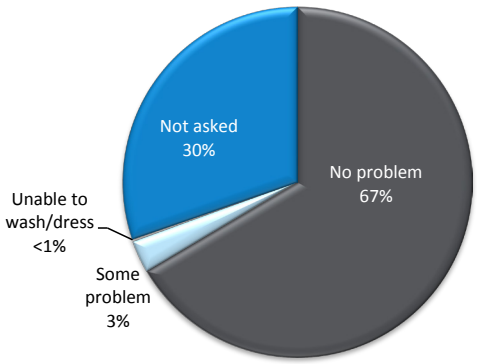


Figure 40: Quality of life (usual activities)

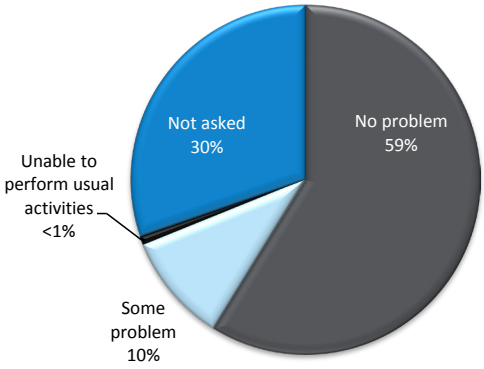


Figure 41: Quality of life (pain/discomfort)

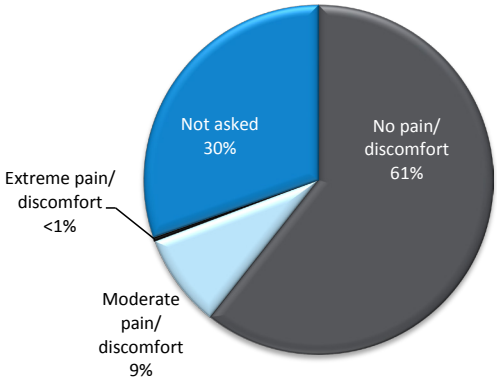
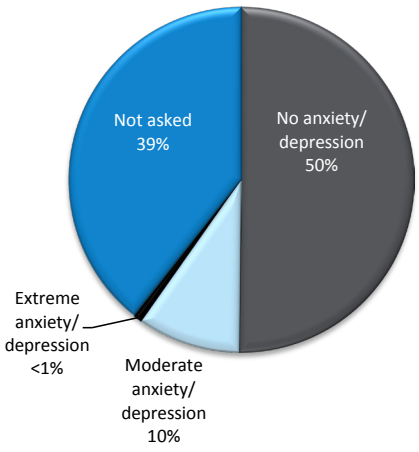


Figure 42: Quality of life (anxiety/depression)



Management of Acute ST-Elevation Myocardial Infarction (STEMI) in Regional Victoria (Early STEMI Management)

Background

The Victorian Cardiac Outcomes Registry was designed to study and report on multiple areas of cardiac care, and while PCI has been the main focus of interest at the registry's outset, a second major area of interest has been the early management of STEMI in non-metropolitan hospital settings. A growing body of evidence indicates patients presenting with acute coronary syndromes away from large metropolitan centres face significant additional challenges related to timely access to treatment, quality and appropriateness of treatment(23). VCOR developed its second module on early management of acute STEMI because of the strong evidence base for effective treatment, well-developed standards of care and measurable process and outcome performance indicators. This module was designed to focus particularly on the delivery of timely and effective reperfusion therapy, and the eventual disposition of these patients.

Registry Module Activity

The STEMI Early Management module was designed to enrol all patients with suspected STEMI presenting to the Emergency department or as current in-patients at the index rural or regional hospital, irrespective of whether they are deemed suitable for thrombolysis. The registry was modelled on the VCOR PCI module with a standard set of essential and epidemiologically sound variables collected. Data elements included details on reperfusion therapy, in-hospital clinical events, complications and clinical outcomes. Special focus was also given to data on inter-hospital transfers, as Victorian rural and regional health services typically identify delays in timely inter-hospital transfer to metropolitan hospitals as the single biggest obstacle to efficient and cost-effective treatment of STEMI.

The registry commenced activities in 2013, with four sites in the Hume and Gippsland regions recruited to pilot the module. The number of hospitals either actively contributing to the registry or engaged with VCOR but yet to commence data entry has now expanded to nine (Table 20). One regional centre withdrew from the registry at the end of 2015, citing difficulties with finding staff to continue data entry management. The registry plans to continue the rollout of the module to other major regional centres across Victoria in 2016.

Table 20: Participation of regional Victorian hospitals in STEMI Early Management module

Victorian regional hospital	Hospital type	2013	2014	2015	2016
Albury Wodonga Health (Albury & Wodonga)	Public				○
Bairnsdale Regional Health Service	Public		●	●	
Bendigo Health	Public				○
Central Gippsland Health Service (Sale)	Public		●	●	●
Goulburn Valley Health (Shepparton)	Public	●	●	●	●
Latrobe Regional Health (Traralgon)	Public	●	●	●	●
Mildura Base Hospital	Public				○
Northeast Health (Wangaratta)	Public		●	●	●
West Gippsland Healthcare group (Warragul)	Public	●	●	●	●
Wimmera Base Hospital (Horsham)	Public				○

Table Legend: ● = contributing data; ○ = engaged but not yet contributing

Patient Characteristics

In 2015, a total of 138 patients presenting with suspected STEMI to participating regional hospitals were entered into the registry. Of those, 30 (22%) were ineligible for thrombolysis. These included late presentation (n=10), significant comorbidities (n=5), uncertain diagnosis (n=2) or resolution of ECG changes (n=5), contra-indication to thrombolysis (n=7). Of the remaining 106 patients, all but one appropriately received thrombolytic therapy, either in the hospital Emergency Department (n=90) or through the pre-hospital thrombolysis scheme administered by Ambulance Victoria (n=14). This program has been rolling out in a sequential fashion across regional Victoria since 2014.

The average age for the 2015 regional STEMI cohort was 66 years, ranging from 36 to 95 years. Table 21 shows selected characteristics of the patients.

Table 21: Regional STEMI patient characteristics

Patient characteristic	2014 (N=64)	2015 (N=138)
Age – years (mean ±SD)	61 ±14	66 ±12
Presenting heart rate - BPM (mean ±SD)	79.4 ±21.3	79.1 ±24.8
	%	%
Gender – female	31.3	34.1
Pre-hospital thrombolysis (ambulance presentation only)	9.1	10.1
Site of infarction - anterior	34.4	40.6
Site of infarction - inferior	48.4	51.4
Site of infarction posterior	6.3	2.2
Site of infarction – other	10.9	5.1

The majority of regional STEMI patients arrived by ambulance (72%). A further 27% self-presented to the hospital Emergency Department and approximately 1% of patients arrived from another treating hospital (inter-hospital transfer). The distance travelled by most patients was within 50km from the treating hospital (84%) but almost 10% of patients did travel more than 75kms for treatment.

Time Delays to Treatment

For all patients except those with in-hospital STEMI, the median time from pain onset to first medical contact (patient delay) was 102 minutes (IQR: 50-311). The median time from first medical contact to hospital arrival (pre-hospital delay) was 63 minutes (IQR: 45-84). For those patients who travelled less than 25kms to hospital, the median pre-hospital delay was shorter at 50 minutes (IQR: 35-72); for those travelling between 26 and 50kms, the median time was 67 minutes (IQR: 51-83). And for patients travelling more than 50kms, the median time was 84 minutes (IQR: 67-120). Time intervals related to ambulance calls are noted in Table 22.

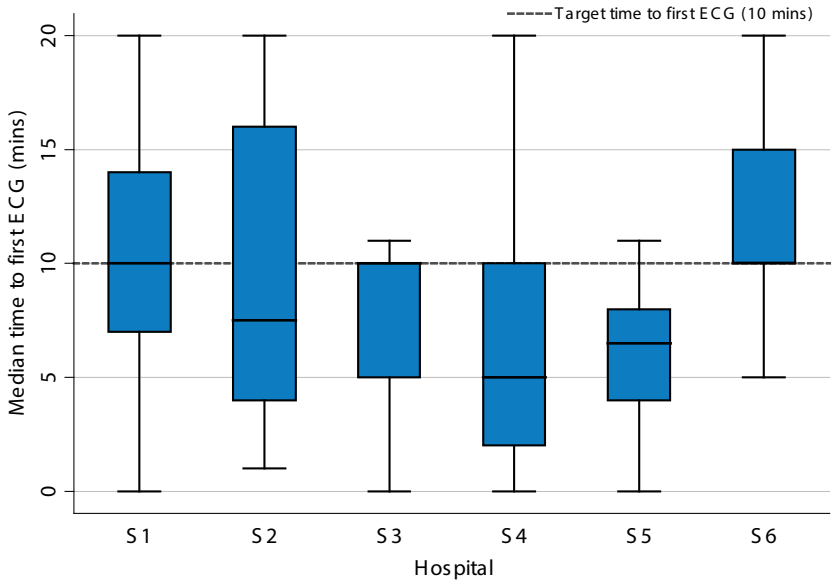
Table 22: Regional STEMI ambulance times

Ambulance times	Median time (N=99)
	Mins (IQR)
Time from symptom onset to ambulance call	74 mins (IQR: 23-240)
Time from call receipt to ambulance arrival	21 mins (IQR: 12-30)
Time from ambulance arrival to hospital arrival	55 mins (IQR: 39-77)

In-hospital Process Times (Arrival to ECG time, Door-to-Needle Time and Overall System Delay)

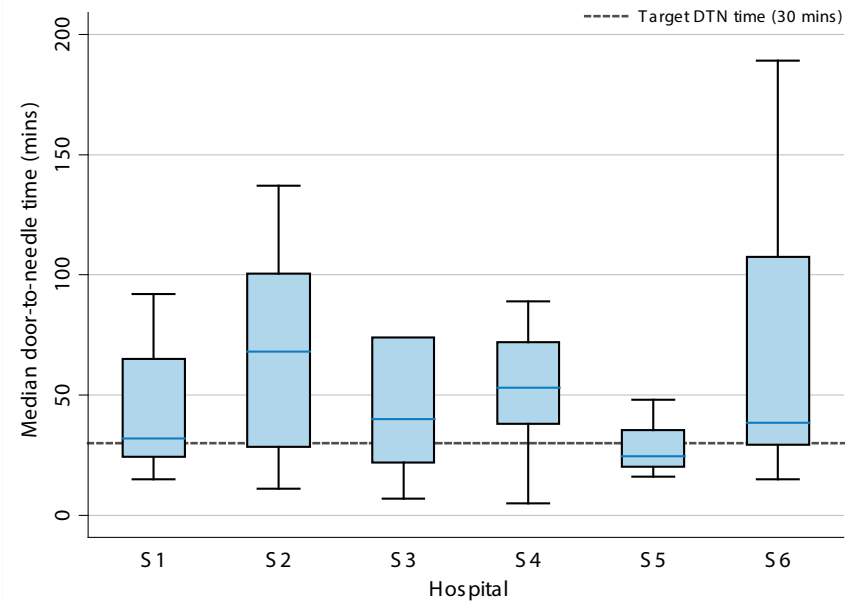
The efficient and timely delivery of reperfusion therapy is a key performance outcome and can be evaluated with a number of specific process measures. These include the time to first ECG and the time taken from hospital presentation to administration of thrombolytic drug, known as the door-to-needle time. For the six participating hospitals in the 2015 cohort, all achieved median first ECG times below the benchmark of <10 minutes (Figure 43).

Figure 43: Time from arrival to first ECG time by regional hospital



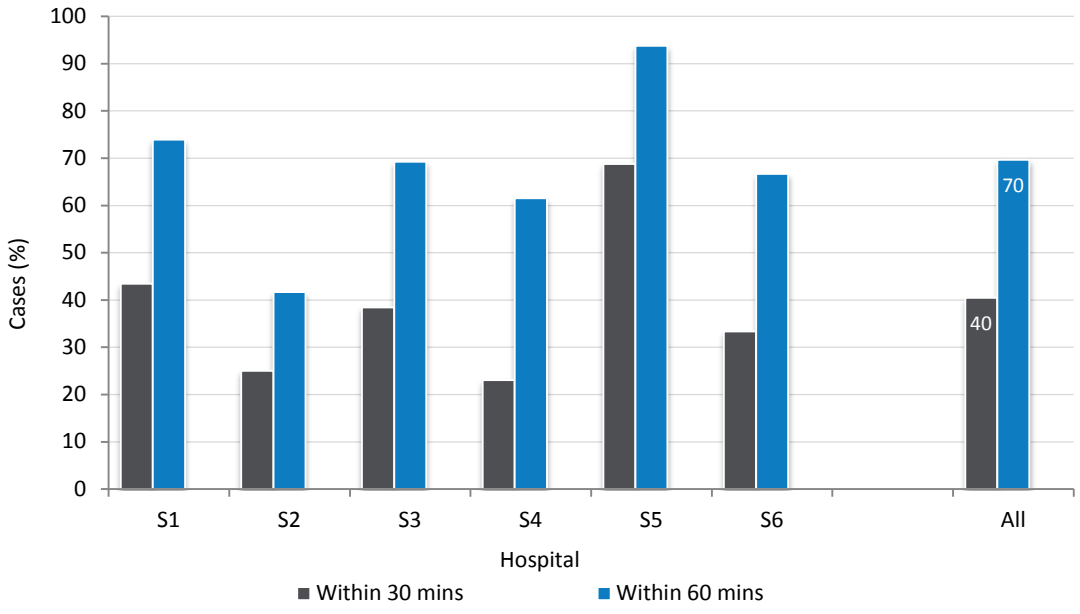
The median door-to-needle time for VCOR regional STEMI sites was 38 minutes (IQR: 23-74). Only one of six hospitals was able to achieve a median door-to-needle time less than 30 minutes (Figure 44), which is the ideal target door-to-needle time recommended by Australian National Heart Foundation/Cardiac Society of Australia and New Zealand Guidelines(24).

Figure 44: Door-to-needle times by regional hospital



When hospital performance was analysed by compliance rates for door-to-needle times <30 min, only 40% cases were managed within this benchmark rate. The proportion of compliant cases rose to 70% when a door-to-needle time delay of <60 minutes was applied (Figure 45).

Figure 45: Proportion achieving door-to-needle times within 30 and 60 mins (regional STEMI patients)



Door-to-needle times improved when pre-hospital notification of the arriving STEMI patient was received from field ambulance services. The median door-to-needle time with pre-hospital notification was 29 minutes (IQR: 19-47) among the 36 patients who were triaged in the field. Four of the six hospitals were able to achieve a median door to needle time within 30 minutes in this group (Table 23).

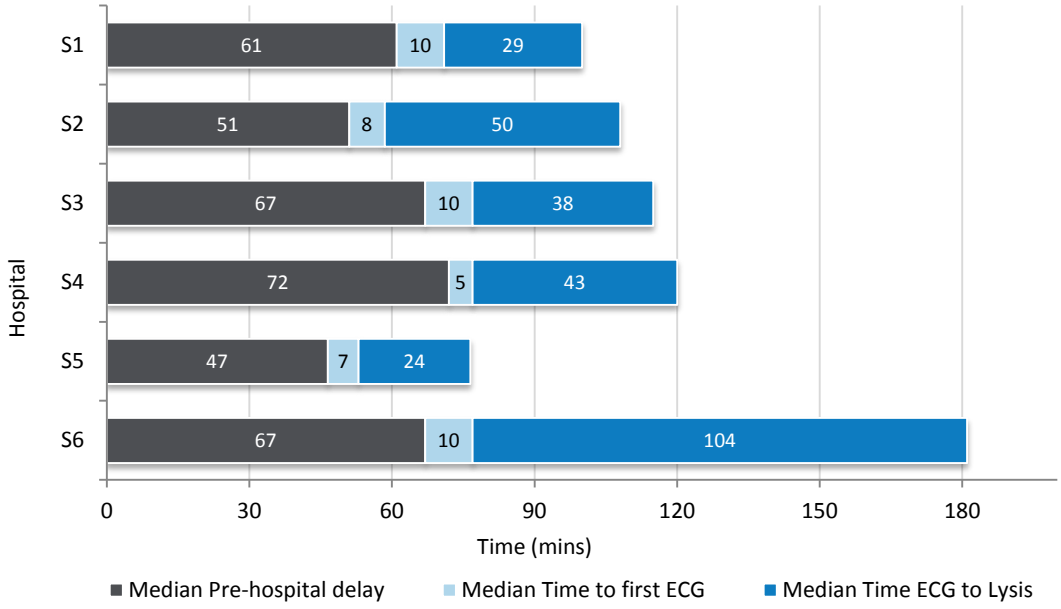
Table 23: Door-to-needle times for ambulance pre-hospital notification (PHN) and no PHN

Hospital	Total cases	Median door-to-needle time (all cases)	Median door-to-needle time (with PHN)	Median door-to-needle time (no PHN)
	N	Mins (IQR)	Mins (IQR)	Mins (IQR)
S1	23	32 (24-65)	28 (21-56)	n/a*
S2	12	68 (24-112)	16 (11-74)	78 (38-137)
S3	13	40 (20-74)	30 (14-43)	40 (23-66)
S4	13	53 (34-81)	n/a*	55 (44-89)
S5	16	24.5 (20-37)	28 (16-46)	25 (20-31)
S6	12	38.5 (29-121)	34.5 (19-120)	n/a*
All sites	89	38 (23-74)	29 (19-47)	40 (23-78)

**Hospitals S1, S4 and S6 had low numbers (n<2)*

A comparison of the system delay (comprising pre-hospital delay plus door-to-needle time) for the six participating hospitals is shown in Figure 46. The median system delay for the entire cohort was 74.5 minutes, substantially longer than the median door-to-needle time of 38 minutes. This measure is arguably a better performance metric than the door-to-needle time, as it emphasises the urgency of commencing treatment the moment the patient comes into contact with the medical system. International guidelines are now recommending ideal time delays from first medical contact to thrombolysis of <30 min(25), underscoring the importance of continued development of pre-hospital thrombolysis programs to shorten pre-hospital delays to reperfusion.

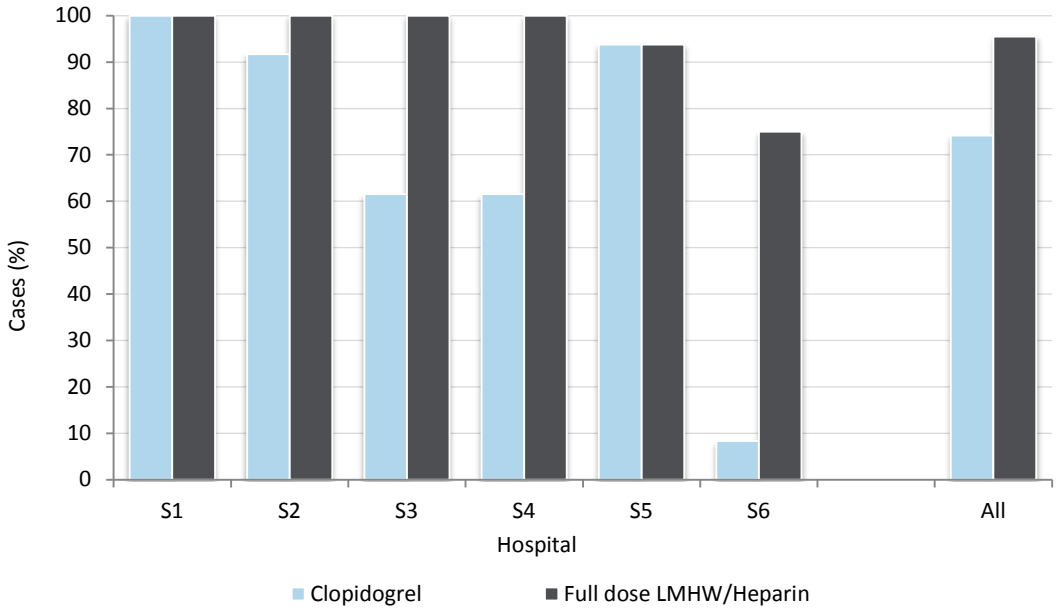
Figure 46: Overall system delay times (regional STEMI patients)



Adjunctive Therapies

The Australian National Heart Foundation/Cardiac Society of Australia and New Zealand Guidelines provide strong recommendations for antithrombotic therapy (unfractionated heparin or low molecular weight heparin), and anti-platelet therapy with clopidogrel following thrombolysis(9, 26). Figure 47 shows that most hospitals treated more than 80% of patients with antithrombotic therapy. Compliance rates for concomitant anti-platelet therapy with clopidogrel were somewhat lower overall, ranging from 8% to 100%.

Figure 47: Treatment and outcomes: adjunctive therapies (regional STEMI patients)



In-hospital Outcomes and Transfer Rates

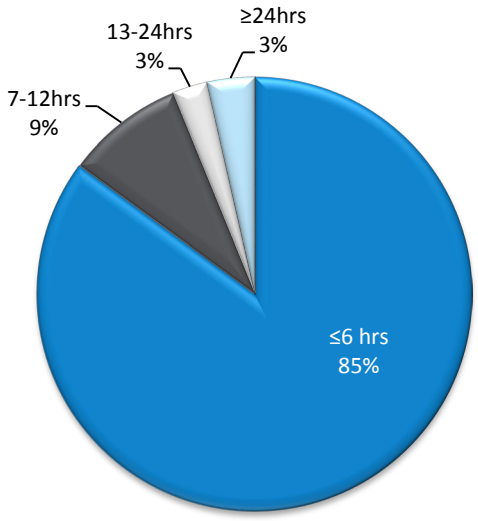
The mean unadjusted in-hospital mortality rate for the 6 participating hospitals was 3.6%, comparable to other international registries of STEMI(27, 28) (Table 24). Cardiogenic shock occurred in 13.8% of patients, and was associated with an in-hospital mortality rate of 26.3%. There were no major bleeding episodes and no cases of intra-cerebral haemorrhage among thrombolysis treated patients during their stay at the index hospital. It is important to note that this registry was not able to track outcomes once patients were transferred to metropolitan hospitals.

Table 24: In-hospital outcomes for regional STEMI patients

In-hospital outcomes	S1 (n=47)	S2 (n=14)	S3 (n=21)	S4 (n=20)	S5 (n=17)	S6 (n=19)	All Hospitals (N=138)
	N (%)	N (%)	N (%)	N (%)	N (%)	N (%)	N (%)
Mortality	3 (6.4)	0 (0.0)	0 (0.0)	0 (0.0)	2 (11.8)	0 (0.0)	5 (3.6)
Cardiogenic shock	4 (8.5)	1 (7.1)	4 (19.0)	4 (20.0)	2 (11.8)	4 (21.1)	19 (13.8)
Myocardial re-infarction	3 (6.4)	0 (0.0)	1 (4.8)	2 (10.0)	0 (0.0)	0 (0.0)	6 (4.3)
Major bleeding	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)
Stroke	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)

Most patients (98%) were transferred to a PCI capable hospital within 24 hours of thrombolytic therapy. The median time from referral request to the actual transfer from VCOR regional STEMI sites to metropolitan PCI hospitals was 2.3 hours (IQR: 1.3-4.0) (Figure 48).

Figure 48: Patient transfer times to metro VCOR hospital (regional STEMI patients)



Heart Failure (HF) SNAPSHOT

Background

Heart failure (HF) represents a major public health problem, associated with high mortality, frequent hospitalisation and major utilisation of health care costs (29). Thus, optimal utilisation of resources to impact the public burden of heart failure is an urgent public health priority. This requires a clear understanding of the epidemiology of the condition, the scope of currently available management strategies and demographic characteristics that may predict rehospitalisation. Although considerable data exist from international sources, there is only limited data collection on the epidemiology and public burden of heart failure in Victoria.

In 2014, VCOR received funding to commence a pilot project with heart failure patients in Victoria. The overall aim was to improve the safety and quality of health care provided to these patients through the collection and analysis of key clinical information from individual healthcare encounters. The pilot project, entitled HF-SNAPSHOT, was designed as a data collection project, enrolling consecutive patients at participating health services for a limited period of time (1 month), in order to obtain a "snapshot" of heart failure-related treatment and outcomes. The pilot phase was successfully completed in 2014 and resulted in the development of a functional minimum dataset for a heart failure clinical quality registry.

Registry Module Activity

In 2015, work proceeded on all aspects of the project, including the updating of all data elements. HF-SNAPSHOT was rolled out to 13 hospital sites with completion of data collection for 2015 achieved by year's end. Overall, there was strong engagement and interest shown by hospitals in the HF-SNAPSHOT project.

Participating hospitals enrolled patients admitted to hospital with acute decompensated heart failure over a one month period during November-December 2015 (Table 25). All patients were followed up at 30 days post-discharge.

Table 25: Hospitals participating in HF-SNAPSHOT

Hospital	Hospital type	2014	2015
Alfred Hospital, The	Public	●	●
Austin Hospital	Public	●	●
Bairnsdale Regional Health Service	Public		●
Bendigo Hospital	Public	●	●
Box Hill Hospital	Public		●
Central Gippsland Health Service (Sale)	Public		●
Frankston Hospital	Public	●	
Latrobe Regional Hospital (Traralgon)	Public		●
Northern Hospital, The	Public		●
MonashHeart (Monash Medical Centre Clayton)	Public	●	●
Royal Melbourne Hospital, The	Public		●
St Vincent's Hospital Melbourne	Public	●	●
University Hospital, Geelong	Public		●
Western Hospital (Footscray)	Public	●	●

Table Legend: ● = contributing data; ○ = engaged but not yet contributing

Patient Demographics

In 2015, the 13 participating hospitals enrolled 289 patients admitted to hospital with acute decompensated heart failure. The majority of the patients were male (57%) with a median age of 77 years. The most common co-morbidities were atrial fibrillation (54%), a previous history of heart failure (66%), history of angina (41%), diabetes (39%), chronic obstructive pulmonary disease (COPD) /asthma (35%), and moderate chronic kidney disease (32%) (Table 26).

For patients with a previous history of heart failure, 81% had experienced a previous hospitalisation for heart failure. Ischaemic cardiomyopathy was present in 46% of these patients, and in a further 20%, the heart failure was due to hypertension. Overall, 66% of patients had left ventricular dysfunction. Of these, 52% of patients were diagnosed with predominantly systolic dysfunction and 14% had predominantly diastolic dysfunction on echocardiography. The median time from admission to diagnostic echocardiogram was one month (IQR: 0-9).

Table 26: HF-SNAPSHOT patient characteristics

Patient characteristics	2015 cohort (N=289)
Age – years (Mean ±SD)	77 +13
	%
Gender – female	42.9
Diabetes medication	39.1
Cardiovascular Medical History	%
Cerebrovascular disease	15.6
History of angina	41.2
History of MI	28.7
History of heart failure	65.7
Arrhythmia	54.3
History of PCI or CABG	30.1
CIED therapy	22.1
Non-cardiovascular Medical History	%
COPD/Asthma	34.9
Obstructive sleep apnoea	15.3
Anaemia	24.2
Iron deficiency	12.5
Depression	16.3
Liver disease -Mild	4.9
Liver disease -Moderate/severe	3.1
Chronic Kidney disease -Mild	13.8
Chronic Kidney disease -Moderate	31.5
Chronic Kidney disease -Severe/dialysis	13.5

Clinical Presentation to Hospital

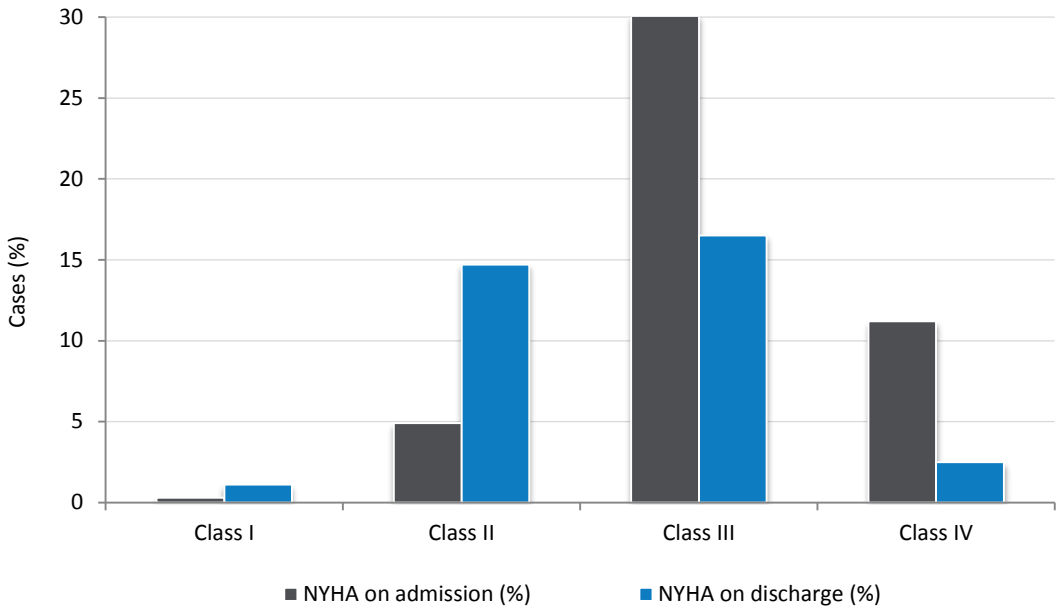
Nearly all the patients (90%) were admitted to hospital through the Emergency Department. Overall, 52% were admitted under General Medicine and 30% under Cardiology (Table 27). Three hospitals had a specific heart failure unit. Yet, even in those hospitals, the majority of heart failure patients were still admitted under General Medicine.

Table 27: HF-SNAPSHOT clinical presentation

Clinical presentation	2015 cohort (N=289)
	%
Admission location – Emergency Department	90.3
Admitting speciality	**%**
Heart failure unit	8.0
Cardiology	29.8
General medicine	52.2
Gerontology	3.1
Precipitant for admission	**%**
Ischaemia	10.0
Medication-non-compliance	7.3
Medication-precipitating drugs	1.4
SOB	57.8
Rhythm disturbance	14.9
Infection	20.8
Fluid overload	48.4

On admission, 48% of patients were in sinus rhythm and 36% were in atrial fibrillation. There was no substantive change in heart rhythm at time of discharge. In contrast, there was a notable improvement in patients' functional status (as assessed by the New York Heart Association (NYHA) class) by the time of discharge (Figure 49). During hospital admission, many patients that were NYHA III/IV on presentation had an improvement in NYHA class with treatment, resulting in a higher proportion of patients in NYHA class II at discharge.

Figure 49: New York Heart Association (NYHA) class rates on admission and discharge



During their hospital admission, 80% of patients were prescribed intravenous frusemide and 90% were prescribed oral diuretics. Medications prescribed on admission and discharge for the entire heart failure cohort are listed in Table 28. However, these rates do not take into account the type of heart failure and contra-indications associated with prescribing these medications such as ACE inhibitors (ACEIs), beta-adrenergic blockers (BBs), angiotensin receptor blockers (ARBs), ivabradine and/or aldosterone antagonists in heart failure with reduced ejection fraction (HFrEF). When adjusting for contraindications and only including patients diagnosed with HFrEF, the prescribing of BBs, ACEI/ARBs and aldosterone antagonists all increased from time of admission to time of discharge (Figures 50 and 51).

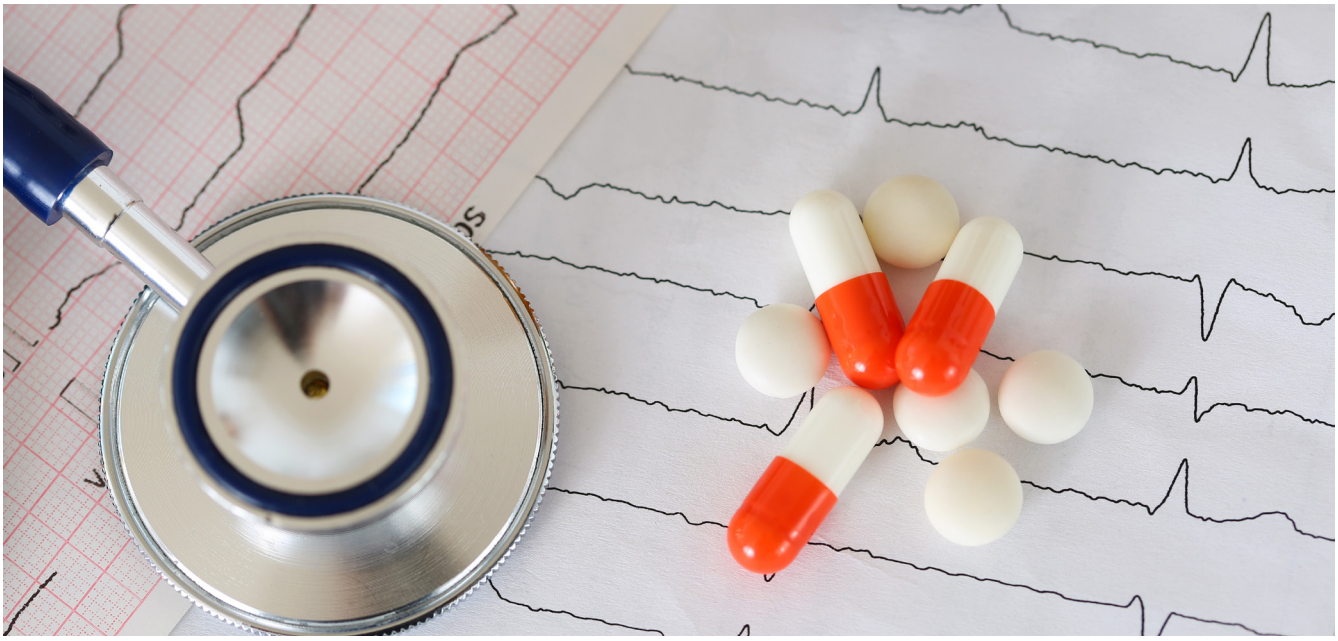


Table 28: Medications prescribed at admission and discharge for all HF-SNAPSHOT patients

Medications	At admission (N=289)	At discharge (N=275)*
	%	%
ACE Inhibitor	37.0	43.6
Beta Blocker	55.6	68.0
Ivabradine	2.4	3.3
ARB	17.0	14.5
Calcium channel antagonist	17.0	13.8
Digitalis	14.9	15.3
Nitrate	19.7	19.3
Other vasodilator	4.2	2.9
Antiarrhythmic	11.4	16.0
Lipid lowering agent	46.7	49.5
Anticlotting agents	%	%
Antiplatelet	46.7	54.9
Anticoagulant	38.4	42.5
Diuretic Agents	%	%
Aldosterone antagonist	27.0	38.5
Loop diuretic	73.4	94.9
Thiazide diuretic	9.7	11.3

**In-hospital mortality cases not included (n=14)*

Figure 50: Medications prescribed at admission and discharge in HFrEF cohort with heart rate >60 BPM: Beta-adrenergic blockers

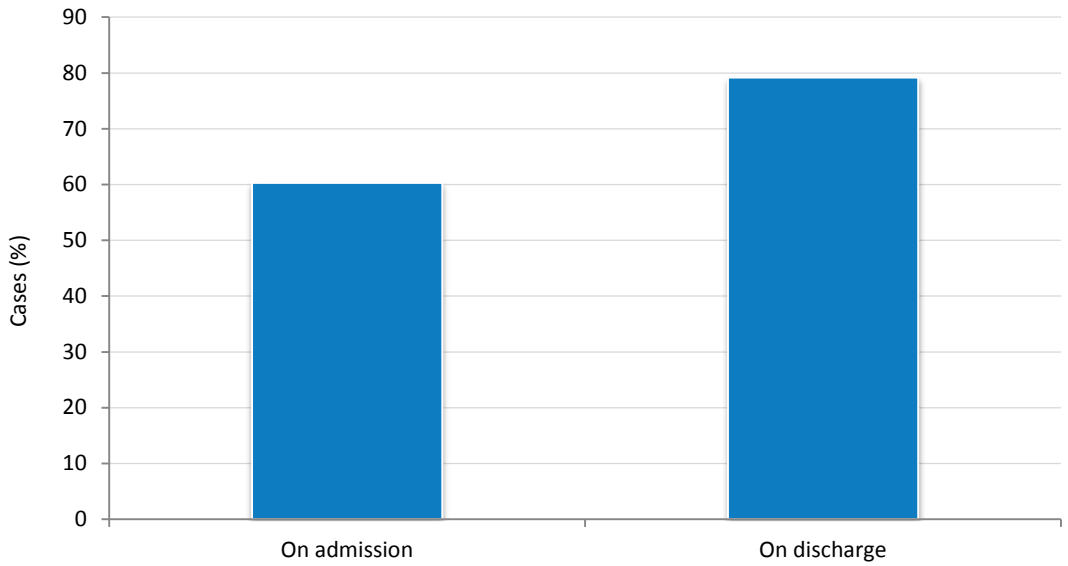
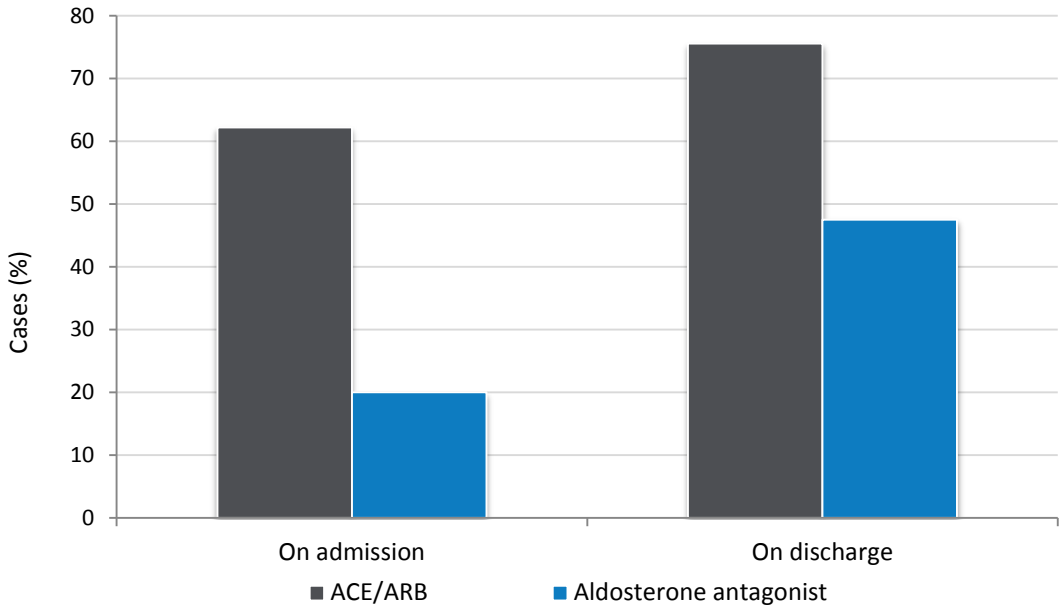
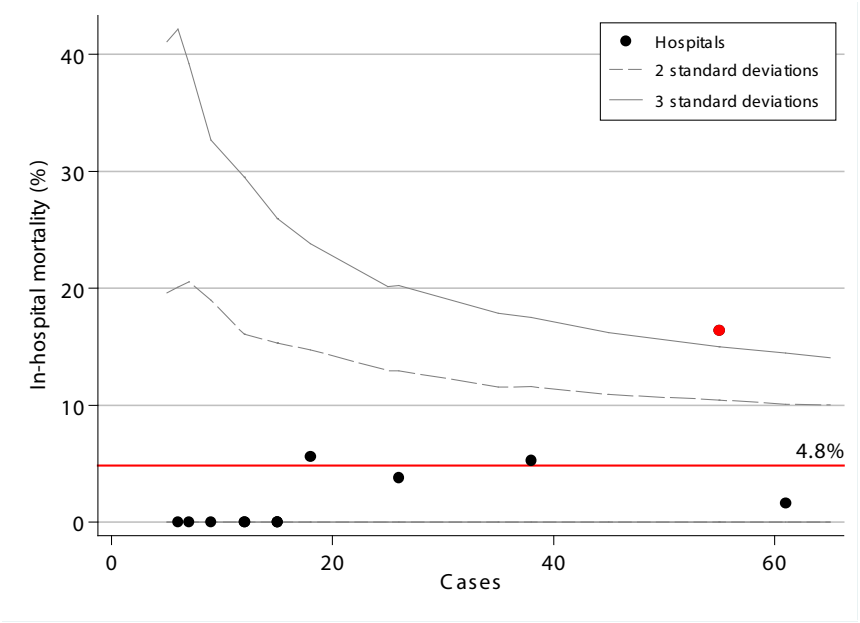


Figure 51: Medications prescribed at admission and discharge in HFrEF with eGFR >60: ACEI/ARB and aldosterone antagonists



Median length of hospital stay was 6 days (IQR: 4-11). Overall, 73% were discharged to home. The overall unadjusted in-hospital mortality for the 2015 cohort was 5%. Figure 52 demonstrates individual rates of in-hospital mortality among hospitals by case volume. One hospital was identified as an outlier with an in-hospital mortality rate at 15%.

Figure 52: In-hospital all-cause mortality during HF-SNAPSHOT 2015



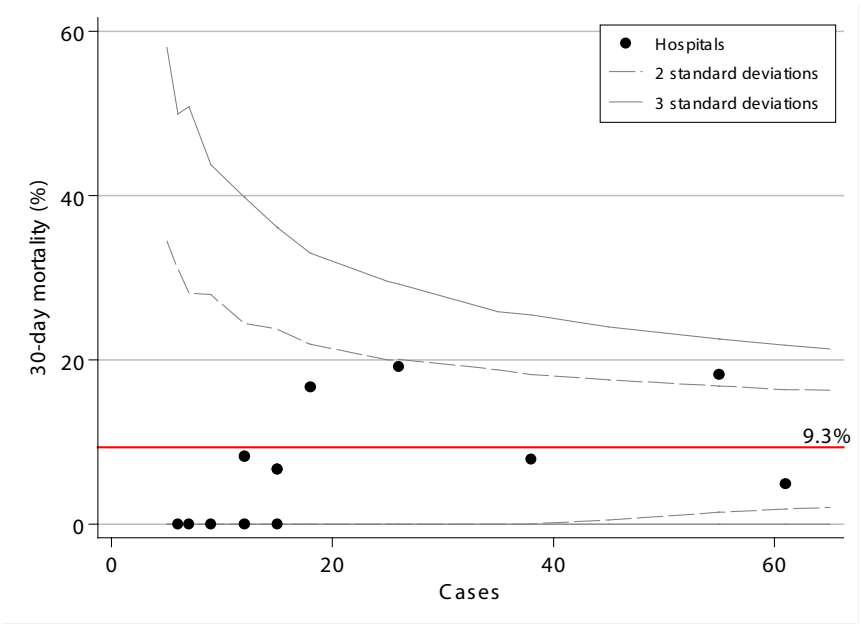
Transitional Care after Discharge from Hospital

At the time of discharge, 61% of patients had an outpatient appointment scheduled. At 30 days post-discharge, less than half of these patients had been seen in outpatients (49%). Referrals to a heart failure program were low at 34%. Only 15% were referred to a pharmacist medication review post-discharge and 10% were referred to a heart failure exercise program. However, it is noteworthy that HF-SNAPSHOT was unable to exclude patients from this analysis who were ineligible for referral to a heart failure program, pharmacist medication review or exercise program as different sites had varying inclusion and exclusion criteria. These results were similar among all hospitals and have been fed back to the participating sites. Deficiencies in transitional care arrangements post-discharge identified in this report highlight the need for improvements in processes relating to timely referrals and outpatient appointments.

Outcome measures

The unadjusted 30-day mortality was 9% for the overall cohort. Three hospitals had a 30-day mortality rate of approximately 15-18%, although all sites' mortality rates were still within control limits (Figure 53).

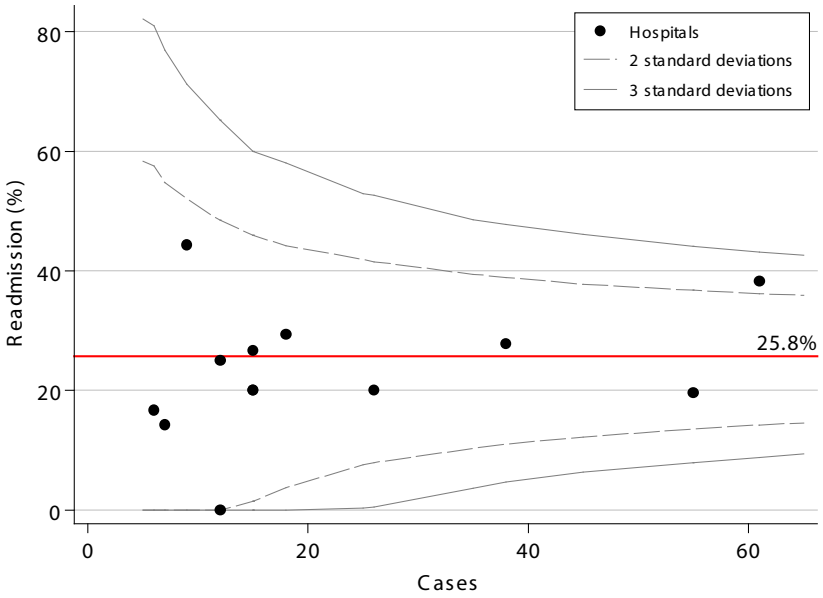
Figure 53: Unadjusted 30-day mortality during HF-SNAPSHOT 2015



At 30 days post-discharge, the all-cause readmission rate was 26% (Figure 54). Two hospitals had a readmission rate of approximately 40% or higher, substantially higher than other hospitals. Both these hospitals were informed of their high readmission rates, with one having already expediting a review of their processes of care, including a re-examination of the hospital records of all readmitted patients.

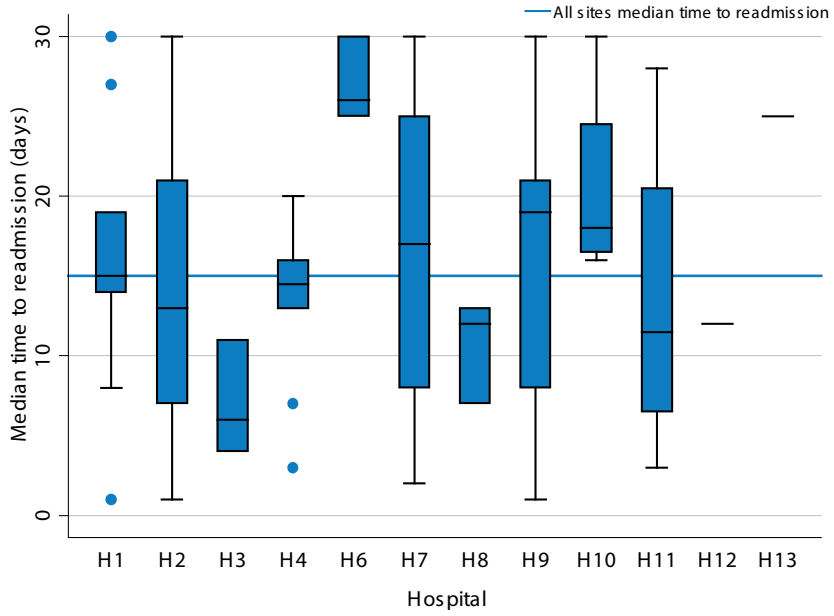
This cycle of data collection, analysis and reporting, followed by sites responding to the findings with further quality assurance activity is the core function of the HF-SNAPSHOT project.

Figure 54: 30-day all-cause hospital readmission during HF-SNAPSHOT 2015



For those patients readmitted to hospital, the median time to readmission was 15 days (IQR: 8, 21) (Figure 55). Few patients were readmitted within 7-10 days of discharge - the majority being readmitted between 13-21 days post-discharge.

Figure 55: Time to readmission by hospital during HF-SNAPSHOT



Future Directions

The Victorian Cardiac Outcomes Registry has grown to comprise almost 10,000 PCI cases per year and expanded its activities to other cardiac-based conditions including acute ST elevation myocardial infarction in non-metropolitan settings and decompensated heart failure admissions to acute hospitals. It has successfully utilised a collaborative model – spanning both public and private sectors – with each hospital responsible for its own data collection and patient follow-up.

Future efforts will be targeted towards enhancing the quality of collected data, expanding the registry's quality assurance activities in terms of number of sites and number of conditions and extend the scope of the information collected through the introduction of new data elements and linkage of our data with other key external data sources.

Continuous improvement of data quality will be supported by a complete review of current data elements, and the release of an updated version of data fields and definitions. Robust clinical auditing activities will continue and roll out to all sites, including sites in the STEMI and heart failure modules. Site engagement for all three modules will proceed, with the aim of achieving near complete participation of Victorian PCI hospitals for the PCI module, all major regional sites for the STEMI module and at least a doubling of the number of health services participating in the heart failure module.

With increased interest in patient-reported outcomes and patient-centred care, VCOR is planning to undertake an expanded role in the collection of patient related outcome measures (PROMs). The quality-of-life metrics already collected by the data collection tool, EQ-5D, will be more comprehensively analysed so that more information can be obtained and fed back to key stakeholders.

VCOR has further plans to forge linkages with other external data sources. Preliminary arrangements with Ambulance Victoria are underway for two-way sharing of data relating to patients treated for acute STEMI. This data sharing will be of mutual benefit to both organisations. We plan to develop formal data linkages with administrative datasets and other registries to enhance our quality assurance activities. VCOR also continues to work collaboratively with other state-based registries and the national Australian Cardiac Outcomes Registry in ongoing clinical quality registry activities in relation to PCI and high-risk implantable cardiac devices.

With all our registry-based activities – current and future - the focus of the Victorian Cardiac Outcomes Registry remains strongly patient oriented. As VCOR continues to build on its early achievements, we look forward to a healthcare environment where patients can rely on receiving cardiac care of the highest quality, with the best outcomes possible, irrespective of their location, insurance status or healthcare provider.

Glossary

ACEI	Angiotensin-Converting-Enzyme Inhibitors
ACS	Acute Coronary Syndrome
ARB	Angiotensin Receptor Blockers
ARC	Academic Research Consortium
BARC	British Academic Research Consortium
BB	Beta-adrenergic Blockers
BMS	Bare Metal Stent
BPM	Beats Per Minute
BVS	Bio-resorbable Vascular Scaffold
CABG	Coronary Artery Bypass Graft
CSANZ	Cardiac Society of Australia and New Zealand
CTO	Chronic Total Occlusion
DEPM	Department of Epidemiology & Preventive Medicine
DES	Drug Eluting Stent
D2N	Door-to-needle
DTB	Door-to-balloon
ECMO	Extracorporeal Membrane Oxygenation
eGFR	Estimated Glomerular Filtration Rate
HF	Heart Failure
HFrEF	Heart Failure with Reduced Ejection Fraction
IQR	Inter Quartile Range
KPI	Key Performance Indicator
MACCE	Major Adverse Cardiac & Cerebrovascular Event
NHMRC	National Health & Medical Research Council
NSTE-ACS	Non-ST Elevation Acute Coronary Syndrome
NSTEMI	Non-ST Elevation Myocardial Infarction
NYHA	New York Heart Association
OHCA	Out of Hospital Cardiac Arrest
PCI	Percutaneous Coronary Intervention
POBA	Plain Old Balloon Angioplasty
STEMI	ST-Elevation Myocardial Infarction
TVR	Target Vessel Revascularisation
UAP	Unstable Angina Pectoris
VCOR	Victorian Cardiac Outcomes Registry

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VCOR Clinical Director
A/Prof Jeffrey Lefkovits

VCOR Site Leads (PCI Hospitals)

Dr Stephen Duffy	Alfred Hospital, The
Dr David Clark	Austin Hospital, The
Prof Ernesto Oqueli	Ballarat Base Hospital
Dr Voltaire Nadurata	Bendigo Hospital
A/Prof Gishel New	Box Hill Hospital
A/Prof Jeffrey Lefkovits	Cabrini Hospital Malvern
A/Prof Ron Dick	Epworth Hospital Richmond
A/Prof Ron Dick	Epworth Hospital Eastern
Dr Geoff Toogood	Frankston Hospital
A/Prof John Amerena	Geelong Private Hospital
Prof Ian Meredith	Jessie McPherson Private Hospital
Dr Michael Rowe	Knox Private Hospital
A/Prof William van Gaal	Northern Hospital, The
Prof Ian Meredith	MonashHeart (Monash Medical Centre Clayton)
Dr Roderic Warren	Melbourne Private Hospital
A/Prof Leeanne Grigg	Royal Melbourne Hospital, The
Dr Chris Hengel	St John of God (Ballarat)
Dr Nimalan Nadarajah	St John of God (Bendigo)
Dr Martin Sebastian	St John of God (Geelong)
A/Prof Jack Gutman	St Vincent's Private Hospital
A/Prof Andrew MacIsaac	St Vincent's Hospital (Melb)
Dr Chin Hiew	University Hospital, Geelong
Dr Jodie-Ann Senior	Valley Private Hospital, The
A/Prof Nicholas Cox	Western Hospital (Footscray)
A/Prof Nicholas Cox	Western Hospital (Sunshine)
Dr Deepak Haikerwal	Western Private Hospital

VCOR Site Leads (Early STEMI Management Hospitals)

Ms Trish Young	Bairnsdale Regional Health Service
Dr Howard Conner	Central Gippsland Health Service (Sale)
Dr Tunde Ibrahim	Goulburn Valley Health (Shepparton)
Dr Alistair Wright & Dr Tony Chan	Latrobe Regional Health (Traralgon)
Dr Robert Krones	Northeast Health (Wangaratta)
Dr Brett Forge	West Gippsland Healthcare group (Warragul)

VCOR Site Leads (HF-SNAPSHOT)

Prof David Kaye	Alfred Hospital, The
Prof Andrea Driscoll & Prof David Hare	Austin Hospital
Dr Justin Mariani & Ms Debbie Gash	Bairnsdale Regional Health Service
Dr Voltaire Nadurata	Bendigo Hospital
A/Prof Gishel New	Box Hill Hospital
Dr Howard Conner	Central Gippsland Health Service (Sale)
Dr Geoff Toogood & Dr Phillip Carrillo	Frankston Hospital
Dr Alistair Wright	Latrobe Regional Hospital (Traralgon)
Dr Gautam Vaddadi	Northern Hospital, The
Dr Siobhan Lockwood & Prof James Cameron	MonashHeart (Monash Medical Centre Clayton)
A/Prof James Wong	Royal Melbourne Hospital, The
A/Prof David Prior	St Vincent's Hospital Melbourne
A/Prof John Amerena	University Hospital, Geelong
Dr Chris Neil	Western Hospital (Footscray)

VCOR Program Manager

Ms Angela Brennan

VCOR Senior Research Fellow

Dr Diem Dinh

VCOR Project Officers

Ms Rita Brien
Ms Harriet Carruthers
Mrs Janine Doyle

VCOR Statistician

Dr Nick Andrianopoulos

Funding

Funding was originally sought and obtained in 2011 from Medibank Private and the Department of Health and Human Services Victoria. Additional funding from the Victorian Cardiac Clinical Network was provided in 2014 and 2015 to support ongoing operations of the PCI, Early Management of Acute STEMI (Regional Victoria) and Heart Failure data collection modules. Considerable in-kind support from Monash University has also been provided.

Table 29: VCOR funding to date

Organisation	Funding by year				
	2011	2012	2013	2014	2015
Medibank Private	$100,000	$400,000	$400,000	$300,000	
Department of Health	$200,000	$200,000	$205,000	$350,000	$256,000
Department of Health - Victorian Cardiac Clinical Network (VCCN)				$159,466	$204,202
Sub total	$300,000	$600,000	$605,000	$809,466	$460,202
Total funding received					**$2,774,668**

Correct at 1 June 2016

Research & Publications

Conference Posters

Lefkovits, J., Brennan, A., Reid, C., Parker, H., Harper, R., Clark, D., Oqueli, E., Gutman, J., Toogood, G. & McNeil, J. (2013). The Victorian Cardiac Outcomes Registry (VCOR) - from Concept to Creation.

Poster session presented at: Heart Foundation Conference; 2013 May 16-18. Adelaide, SA, Australia.

Tsay, T., al Haaq, M.A., van Gaal, W. et al. (2015). Outcomes of Trans-radial Percutaneous Coronary Intervention: A Report from the Victorian Cardiac Outcomes Registry.

Poster session presented at: Cardiac Society of Australia and New Zealand (CSANZ) Conference; 2015 August 14-16. Melbourne, Vic, Australia.

Travella, R. et al. (2015). Contemporary PCI Practice in Australia: Assessment of Acute Myocardial Infarction Performance Measures.

Poster session presented at: Cardiac Society of Australia and New Zealand (CSANZ) Conference; 2015 August 14-16. Melbourne, Vic, Australia.

Conference Presentations

Lefkovits, J. (2014). Victorian Cardiac Outcomes Registry (VCOR): Outcomes of PCI in Victoria.

Presented at: Australia & New Zealand Endovascular Therapies Meeting; 2014 August 20-22, Melbourne, Vic, Australia.

Lefkovits, J. (2015). Victorian Cardiac Outcomes Registry (VCOR): Outcomes of PCI in Victoria.

Presented at: Australia & New Zealand Endovascular Therapies Meeting; 2015 August 11-13, Melbourne, Vic, Australia.

Lefkovits, J. et. al. (2015). Outcomes Following PCI: The Victorian Cardiac Outcomes Registry (VCOR).

Mini-oral presented at: Cardiac Society of Australia and New Zealand (CSANZ) Conference; 2015 August 14-16. Melbourne, Vic, Australia.

Forge, B. & Lefkovits, J et. al. (2015). Quality measures of early STEMI management in regional hospitals: The VCOR Early STEMI Management Registry.

Mini-oral presented at: Cardiac Society of Australia and New Zealand (CSANZ) Conference; 2015 August 14-16. Melbourne, Vic, Australia.

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