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Victoria**



Delivering our patients the right care, at the right time, at the right place

Revised Clinical Response Model Evaluation Report
June 2017



Department of Research and Evaluation

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Executive summary

Ambulance Victoria (AV) is responding faster to patients across all priority levels as a result of changes to better assess and meet the individual needs of Victorians.

The implementation of a revised Clinical Response Model (CRM) has focused on assessment of the individual need of patients and the most appropriate response for those patients to ensure ambulances are available for emergencies.

This has enabled a quicker response to people experiencing a time-critical, life-threatening emergency, with an estimated 7,000 additional Code 1 patients each year now receiving paramedic care within the 15-minute response target.

In addition, a stronger focus on assessing people and referring them to care that is more appropriate to their needs has resulted in improved response times across the board and a decrease in the number of people unnecessarily attending hospital Emergency Departments.

In December 2015, the State Government's Ambulance Performance and Policy Consultative Committee published its final action plan on the future of the Victoria's ambulance service. Victoria's Ambulance Action Plan affirmed Ambulance Victoria's role and focus on treating people with life-threatening emergencies. A key action from the plan was:

- ▶ Implement changes to Ambulance Victoria's Dispatch Grid to provide faster responses to patients experiencing life-threatening emergencies and more appropriate care to a wide range of Triple Zero (000) callers whose need is not urgent.

This action was prioritised under the Ambulance Victoria Corporate Plan January 2016 to June 2017. Work by Ambulance Victoria to review the way ambulances are dispatched under the Dispatch Grid has shown that approximately 50,000 people were receiving an emergency ambulance each year who did not require an ambulance.

Ensuring ambulances are available for time-critical emergencies

Ambulance Victoria's Dispatch Grid is made up of hundreds of case types assigned to patients depending on their symptoms, condition and other factors. The event types are assigned during triage with a Triple Zero (000) call-taker. Each event type gets a specific response, depending on the severity of the patient's condition.

Under the revised Clinical Response Model implemented between October 2015 and October 2016, some event types which previously received an automatic emergency response are now being assessed more thoroughly through a secondary triage process by expert paramedics and registered nurses in the Ambulance Victoria Referral Service.

The Ambulance Victoria Referral Service provides an important safety net to ensure that any emergencies that reach secondary triage are identified and get an emergency response, and that non-emergencies can be safely and appropriately referred to patient transport ambulances or alternative health services to better meet their needs.

Use of triage is a standard approach in the medical sector and is in line with what patients experience within hospital Emergency Departments. This model does not downgrade emergency cases. In fact, emergencies are prioritised for the response they need by ensuring that non-emergency cases are identified and dispatching an emergency response only for those who genuinely need urgent care.

Ambulance Victoria has undertaken a comprehensive evaluation which analyses data for the first three months of the fully implemented revised Clinical Response Model (12 October 2016 – 12 January 2017), with comparisons made to the same time period in the previous year (i.e. the historical period). This document details these findings.



Benefits delivered by the new model

The findings from this evaluation can be categorised into three key areas of improvements to service and patient outcomes:

1 Increased availability of specialist care and improved patient outcomes

The revised Clinical Response Model increased the availability of Mobile Intensive Care Ambulance (MICA), allowing them to attend patients most in need of MICA care and this, along with improved response times is reflected in improved patient outcomes.

- ▶ 92.1% of patients in cardiac arrest were attended by MICA after full Clinical Response Model implementation, compared with 87.7% historically. Cardiac arrests are our sickest and most time-dependent patients and the relationship between response times and survival from cardiac arrest is well established.
- ▶ Clinical outcomes after Clinical Response Model implementation also improved, with survival for cardiac arrest patients in a shockable cardiac rhythm reaching 32.2% for the December 2016 quarter, the highest quarterly survival rate (12-month rolling) recorded by Ambulance Victoria.
- ▶ Early access to definitive care for acute stroke patients has also improved. Stroke patients transported to a stroke unit within 60 minutes travel time from the scene improved from 87.6% in the December 2015 quarter to 92.1% in the December 2016 quarter.
- ▶ Management of severe pain, as evidenced by the percentage of patients who receive a clinically meaningful reduction, has improved to 91.3% in the December 2016 quarter, up from 90.8% for the December 2015 quarter.
- ▶ Further research will be undertaken into the specific patient outcomes for other time-critical patient categories once AV has sufficient sample sizes from the period post-implementation of the revised Clinical Response Model.
- ▶ Patients are getting a faster response across Code 1 (life-threatening, time critical), Code 2 (urgent) and Code 3 (non-urgent) as a result the revised Clinical Response Model ensuring that people get a timely response in line with the urgency of their case.
- ▶ Code 1 response is targeted to patients whose condition is time critical, which means that improving Code 1 performance improves patient outcomes.
- ▶ The proportion of Code 1 cases attended within 15 minutes of the Triple Zero (000) call increased from 75.8% in the historical period to 76.4% after full Clinical Response Model implementation, despite an increase in the number of Triple Zero (000) calls by almost 10,000 (5.9%) between the two periods.





2 Improved Code 1, Code 2 and Code 3 responses

There are more ambulances available in Victoria for people in life threatening, time critical emergencies than ever before.

- ▶ The changes mean response times were more than 2% ahead of where they would have been had no changes to the Grid had taken place.
- ▶ Annually, almost 7000 additional Code 1 cases will now receive a response within 15 minutes than would have been possible previously.
- ▶ The proportion of Triple Zero (000) calls receiving a Code 1 emergency ambulance response decreased from 51.8% in the historical period to 40.5%. This aligns with the proportions seen in ambulance services internationally, such as in the United Kingdom. Annually, this equates to approximately 98,000 cases that would have unnecessarily received a Code 1 ambulance prior to the revised Clinical Response Model, which now receive a Code 2 or 3 emergency ambulance, or referral to an alternative health service or non-emergency patient transport.
- ▶ The proportion of Triple Zero (000) calls which avoided an emergency ambulance dispatch increased from 9.6% in the historical period to 16.5%, bringing Ambulance Victoria in line with ambulance services in the United Kingdom. Annually, approximately 50,000 cases which would have received an emergency ambulance prior to the revised Clinical Response Model, now appropriately receive referral to an alternative health service or non-emergency patient transport, or provision of self-care advice.
- ▶ The proportion of Code 2 cases attended within 30 minutes of the Triple Zero (000) call increased to 76.0% in January 2017 (up from 74.0% in January 2016).
- ▶ The proportion of Code 3 cases attended within 60 minutes of the Triple Zero (000) call increased to 82.0% in January 2017 (up from 77.7% in January 2016).



3 Reduced pressure on hospital Emergency Departments and better links to primary health care

The revised Clinical Response Model contributes to collaborative efforts across the Victorian health sector to reduce pressure on hospital Emergency Departments by safely referring non-urgent patients to more appropriate care.

- ▶ The introduction of the revised Clinical Response Model is estimated to have reduced attendances to hospital emergency departments by approximately 11,600 people per annum who initially called triple zero (000) but did not need emergency care.
- ▶ Members of the community are encouraged to call Triple Zero (000) if they have a significant health concern and expert paramedic and nursing staff will assess their case and determine the right response to their needs.
- ▶ Of the calls during the evaluation period which were found to be non-emergencies, more than 40% could be safely treated at home (34.2% with self-care advice and 7.0% with a locum visit), half (50.1%) could self-present at a doctor or hospital and others (2.5%) were connected to a telehealth provider for consultation with a doctor.

A rigorous, evidence-based change process

Between March and May 2015, Ambulance Victoria undertook a comprehensive review of the way it dispatches ambulances. The key purpose of revising the Dispatch Grid was to make changes that would:

- ▶ Better align response with patient acuity.
- ▶ Provide a faster response to time-critical patients.
- ▶ Reduce the number of cases which are non-time dependent and inappropriately receive a Code 1 response.
- ▶ Increase the number of Triple Zero (000) cases managed through non-emergency transport or alternative health service provision.
- ▶ Reduce the number of cases for which dual dispatch of emergency ambulances is recommended.

The changes were approved by the Ambulance Victoria Medical Advisory Committee which includes six medical specialists, each of whom have substantial experience in ambulance medical care, and the Ambulance Victoria Medical Director.



Further review was undertaken by an independent multi-disciplinary advisory panel convened by the Victorian Minister for Health. This panel comprised of emergency medical specialists, a medical epidemiologist, a senior nurse, primary care physicians, community members, and an independent chair who was also the chair of the Medical Board of Australia. This panel endorsed the process.

As a result, significant changes were made to the way in which Triple Zero (000) calls are triaged and resources dispatched, which has resulted in a revised Clinical Response Model. These changes began in October 2015, with the second stage starting in May 2016, and the third and final stage completed on 12 October 2016. Throughout this process, a comprehensive monitoring strategy was implemented to ensure clinical appropriateness and patient safety.

An important change included re-classifying event types, which would have previously received an emergency ambulance, to:

- ▶ Code 2 (urgent) ambulance (such as some cases of pain, a psychiatric episode, lacerations, alcohol intoxication, headaches) and
- ▶ Code 3 with subsequent triage through the Ambulance Victoria Referral Service (such as bruising, gastrointestinal problems, fainting and some cases of pain, lacerations and psychiatric episodes).

The Ambulance Victoria Referral Service has operated since 2003 and involves a paramedic or registered nurse call-taker seeking further information on a patient's condition to determine the most appropriate treatment. In some cases the caller will still get an emergency ambulance. In other cases they may be referred to their local doctor, provided with a non-emergency ambulance, advised to self-present at hospital or be provided with self-care advice. To support the changes to the Grid, Ambulance Victoria's Referral Service has almost trebled in size, expanding from 25 staff to 69 staff.

Ambulance Victoria has a comprehensive clinical risk management system which has multiple pathways

and methods to identify adverse events. During the evaluation period no serious adverse events related to the revised Clinical Response Model were identified. There were 61 complaints related to not sending an emergency ambulance during the evaluation period. This represents 0.1% of all Referral Service triages and is in line with the level of complaints received during the historical period. Of these, seven were considered after investigation to be valid and steps have been taken to prevent recurrence.

This evaluation also found that there was a very small number of patients transferred to the Referral Service (13 out of the 46,682 Referral Service triages in the evaluation period) who were considered after expert panel review to have a response greater than 15 minutes and a clinical condition which required prompt transfer to hospital. These 13 patients received a Code 1 response and due to secondary triage, the ambulance arrived on average to these cases within 25 minutes. Expert clinical review found there was no definite adverse impact for these patients, whose conditions included acute stroke, heart attack, neurological compromise, trauma and acute pulmonary oedema. Not all of these patients would have received a response within 15 minutes prior to the revised Clinical Response Model. Additional training by ESTA and the Ambulance Victoria Referral Service has improved procedures.

To ensure an independent review of the new Clinical Response Model was undertaken AV requested Safer Care Victoria, the peak state authority for leading quality and safety improvement in healthcare, to examine the change process and outcomes in conjunction with members of the independent multi-disciplinary advisory panel.



Conclusion

The fundamental aim of the revised Clinical Response Model is to provide a clinically-safe, evidence-based improvement to resource allocation in order to improve Code 1 response performance. This enables ambulances to attend the sickest patients faster to improve patient outcomes.

Since the period covered in this Evaluation Report the revised Clinical Response Model has continued to deliver improved performance and clinical outcomes, as detailed in the next section of this report. The survival rate for cardiac arrest patients in shockable cardiac rhythm further improved to 37.4% for the March 2017 quarter, the highest quarterly survival rate recorded by Ambulance Victoria.

Response times across all three priority levels have also continued to improve since the evaluation period. The proportion of Code 1 cases attended within 15 minutes of the Triple Zero (000) call increased to 80% in March 2017 quarter, up from 75.6% for the same period in 2016. For the same comparative time period, Code 2 responses reached 73.4% within

30 minutes, up from 70.5%, and Code 3 responses reached 80.8% within 60 minutes, up from 73.5%. These results have continued to improve in the June 2017 quarter, which will be reported once the quarter ends.

Today, Ambulance Victoria has more ambulances available to respond faster to seriously ill people than ever before. Improvements to the Clinical Response Model have proved safe, with no serious adverse events identified.

The survival rate for our sickest and most time-critical patients – those in cardiac arrest – is the highest ever, with better availability of our MICA resources meaning even more of these patients are getting treatment from our specialist cardiac-trained intensive care paramedics



Ongoing Improvement to Performance and Clinical Outcomes

Ambulance Victoria has continued to record improved response performance and patient outcomes since the implementation of the revised Clinical Response Model.

The changes made to the Clinical Response Model mean that Code 1 emergency responses are focused on the sickest patients with the time-critical needs.

Improved response times can contribute to improved clinical outcomes for these patients, which is evidenced by the data on cardiac arrest survival rates. The number of stroke patients reaching a stroke unit within 60 minutes travel time from the scene has also improved.

An assessment of what it means for patients in other key categories will be possible once Ambulance Victoria has collected sufficient data samples for the period post-implementation of the revised Clinical Response Model.

The changes continue to prove safe and at June 2017, there have been no serious adverse events identified in relation to the revised Clinical Response Model.

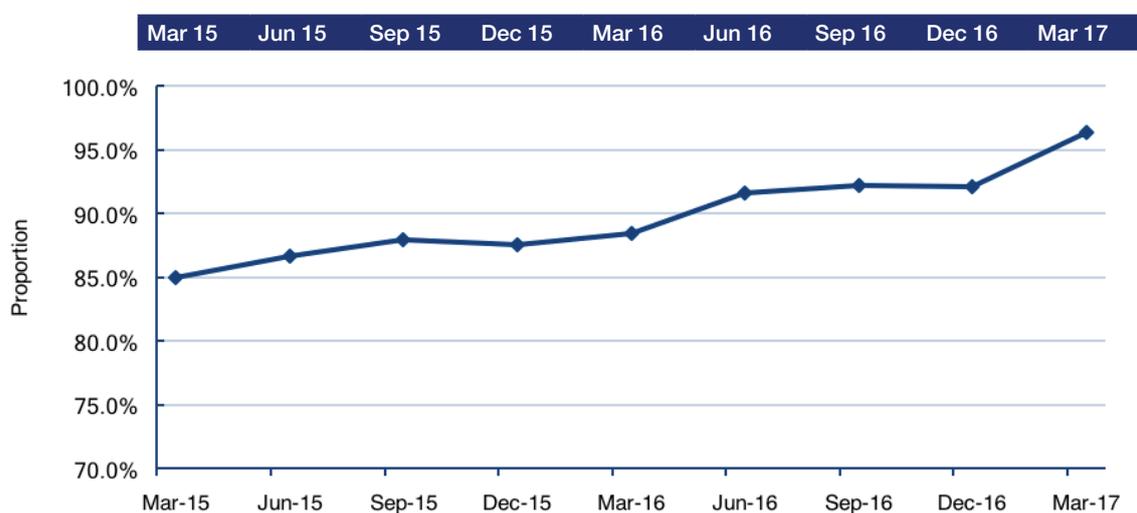
The three key areas of improvement to service and patient outcomes observed during the evaluation period have been maintained, and in some cases further improved, in the months since the evaluation period was completed.

1 Increased availability of specialist care and improved patient outcomes

- ▶ The median response time to out-of-hospital cardiac arrest patients was 7.1 minutes in metropolitan regions and 9.2 minutes in rural regions in the March 2017 quarter, which is the lowest response times observed in the past two years.
- ▶ Clinical outcomes improved further, with survival for cardiac arrest patients in a shockable cardiac rhythm reaching 37.4% for the March 2017 quarter, the highest quarterly survival rate recorded by Ambulance Victoria.
- ▶ Survival for cardiac arrest patients in a shockable cardiac rhythm in rural regions (36.8%) has almost matched metropolitan regions (37.6%) in the March 2017 quarter.
- ▶ Steady improvement in the number of adult stroke patients transported to a stroke unit within 60 minutes travel time from the scene continued, reaching 96.4% in the March quarter 2017, up from 85.0% in the March quarter 2016 (Figure 1).



Figure 1: Proportion of adult (≥ 15 years) stroke patients transported to a stroke unit within 60 minutes travel time from the scene (quarterly results)



2 Improved Code 1, Code 2 and Code 3 responses

Patients continue to get a faster response across all codes (Codes 1, 2 and 3) as a result of the revised Clinical Response Model ensuring that people get a timely response in line with the urgency of their case.

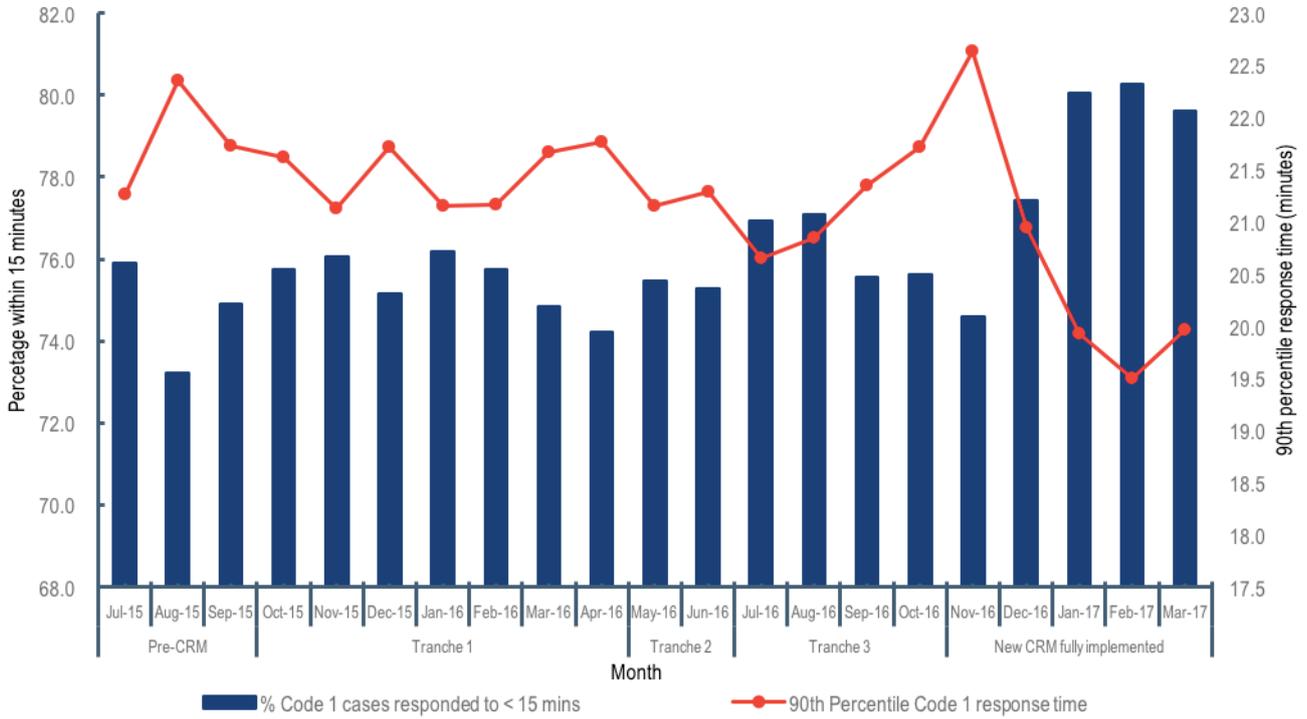
- ▶ The proportion of Code 1 cases attended within 15 minutes of the Triple Zero (000) call increased to 80.0% in March 2017 quarter (up from 75.6% in March 2016 quarter). (Figure 2)
- ▶ The proportion of Code 2 cases attended within 30 minutes of the Triple Zero (000) call increased to 73.4% in March 2017 quarter (up from 70.5% in March 2016 quarter). (Figure 3)

- ▶ The proportion of Code 3 cases attended within 60 minutes of the Triple Zero (000) call increased to 80.8% in March 2017 quarter (up from 73.5% in March 2016 quarter). (Figure 4)

These results have continued to improve in the June 2017 quarter, which will be reported once the quarter ends.



Figure 2: Code 1 performance state-wide*



* The November 2016 performance reflects the unprecedented thunderstorm asthma event.

Figure 3: Code 2 performance state-wide

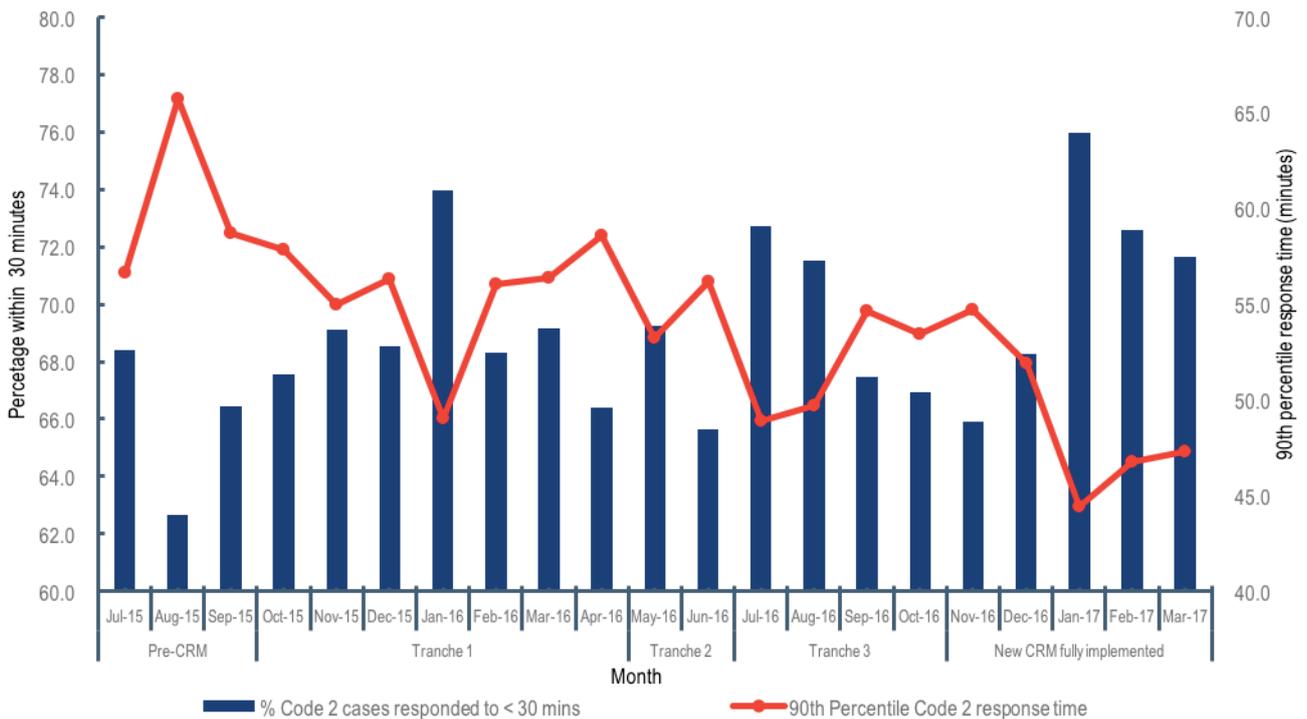
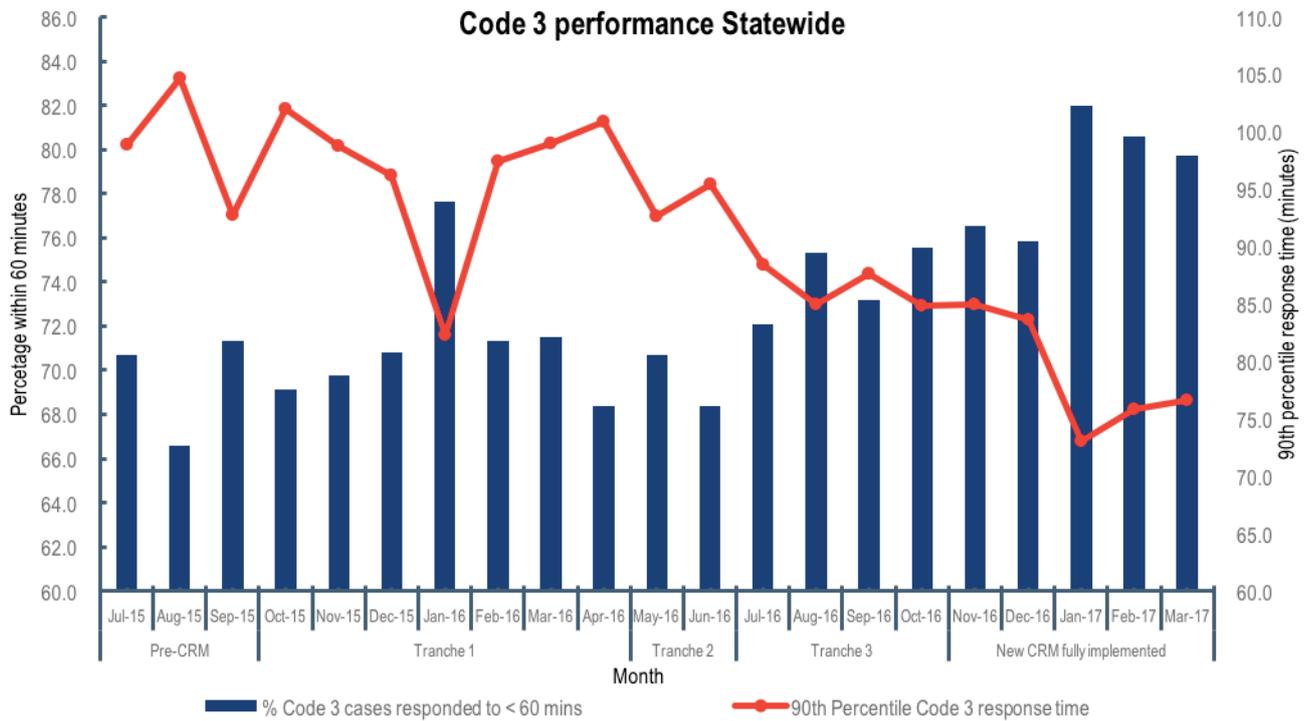


Figure 4: Code 3 performance state-wide



3 Reduced pressure on hospital Emergency Departments and better links to primary health care

- ▶ The introduction of the revised Clinical Response Model is estimated to reduce attendances to hospital emergency departments by approximately 11,600 people per annum who initially called triple zero but did not need emergency care.





The three key areas of improvement to service and patient outcomes ... have been maintained, and in some cases further improved, in the months since the evaluation period was completed.

- 1.** Increased availability of specialist care and improved patient outcomes
- 2.** Improved Code 1, Code 2 and Code 3 responses
- 3.** Reduced pressure on hospital Emergency Departments and better links to primary health care

Evidence-based Change to the Clinical Response Model

Background to the Change and Evaluation Process

Implementing changes to the way Ambulance Victoria dispatches ambulances to provide faster responses to patients experiencing life-threatening emergencies and more appropriate care to non-urgent patients was a key priority in the Ambulance Victoria Corporate Plan January 2016 – June 2017.

This followed the final report of the State Government's Ambulance Performance and Policy Consultative Committee on the future of Victoria's ambulance service in December 2015.

The report, Victoria's Ambulance Action Plan,¹ affirmed Ambulance Victoria's role and focus on treating people with life-threatening emergencies. The Action Plan set an agenda aimed at improving AV's response performance, the physical and mental health, wellbeing and capabilities of its people, and the service's collaboration with the rest of the health system.

A key action from the report was:

- ▶ Implement changes to Ambulance Victoria's Dispatch Grid to provide faster responses to patients experiencing life-threatening emergencies and more appropriate care to a wide range of Triple Zero (000) callers whose need is not urgent.

To address this, Ambulance Victoria undertook a thorough review of the way it dispatches ambulances under the Dispatch Grid. The Dispatch Grid describes the designated level of ambulance response assigned to each Triple Zero (000) call. The purpose of the Dispatch Grid review was to improve Ambulance Victoria's resource allocation, operational performance, clinical alignment of response with patient acuity, and provide a faster response to the sickest patients.

Major change to the Dispatch Grid is not new. In 2009, Ambulance Victoria completed a major realignment of the cases treated by intensive care paramedics, using evidence-based research to safely move tens of thousands of cases away to treatment by Advanced Life Support paramedics.

As a result of the 2015 review, significant changes were made to the way in which Triple Zero (000) calls are triaged and resources are dispatched. This resulted in a revised Clinical Response Model (CRM). These changes were implemented in three stages. The first stage commenced in October 2015, with the subsequent stages commencing implementation in May 2016.

To evaluate the overall effectiveness of the revised CRM in meeting its objectives, Ambulance Victoria has undertaken a comprehensive evaluation. The evaluation encapsulates data for three months of the fully implemented revised CRM (12 October 2016 – 12 January 2017) in addition to data since the commencement of revised CRM.

This evaluation assessed the impact of the revised CRM on:

- ▶ Operational response performance
- ▶ Resource allocation
- ▶ Caseload distribution
- ▶ Alignment of response with patient acuity
- ▶ Patient safety and clinical outcomes



How the Model Operates

Ambulance Victoria's call-taking and dispatch model

The Emergency Services Telecommunications Authority (ESTA) uses a commercial medical triaging system, the Medical Priority Dispatch System (MPDS), to categorise Triple Zero (000) ambulance calls. Each call is assigned an Event Type based on its nature and likely severity, as identified by the triage tool.

The Dispatch Grid, which is determined by AV, is the designated level of ambulance response for each Event Type code. Unless secondary triage is recommended, the Event Type code and designated level of ambulance response is sent to the dispatcher, who uses Computer Aided Dispatch (CAD) to identify

the necessary ambulance unit(s) to respond to the event, in accordance with the designated level of response.

An ideal call-taking and dispatch system will mobilise ambulance (and first-responder) resources in a manner which is timely and appropriate to patient acuity, and will have the ability to positively influence patient outcome. This needs to be balanced by rational use of resources, limiting unnecessary lights and sirens responses.

The current emergency ambulance dispatch codes used by AV are provided in Table 1.

Table 1: AV's emergency ambulance dispatch codes

Code	Priority	Description	Response time target
1	0	Suspected cardiac arrest – life threat (Receives lights and sirens response with dual dispatch of ALS and MICA and, where applicable, a first-responder co-response)	85% within 15 minutes
	1	Time Critical (Receives lights and sirens response)	
2	2	Urgent	
3	3	Non-urgent	

ALS, advanced life support; MICA, mobile intensive care ambulance.

Low-acuity Event Types are sent to the AV Referral Service for secondary triage. Here, non-urgent calls undergo an additional triage by an experienced clinician using the Care Enhance Call Centre (CECC) triage tool which is approved by the AV Medical Advisory Committee. The Referral Service, which has been in operation in Melbourne since 2003 and state-wide since 2012, aims to provide patients with a response appropriate to their level of acuity. In particular, the Referral Service aims to triage non-urgent patients away from an emergency ambulance

dispatch. Secondary triage for lower acuity patients has now been implemented in many services internationally.⁵

Use of triage is a standard approach in the medical sector and is in line with what patients experience within hospital Emergency Departments. This model does not downgrade emergency cases. In fact, emergencies are assured the response they need by ensuring that non-emergency cases are identified and prioritising the emergency response for time-critical, life-threatening cases.



Referral Service Triage Practitioners are paramedics or registered nurses with a minimum of four years post-qualification experience. Triage Practitioners conduct a secondary, more detailed triage with the caller, and this may result in referral to an alternative service (e.g. locum doctor or nurse), provision of self-care advice, or return of the case for either emergency or non-emergency ambulance dispatch. Importantly, the Referral Service also acts as an additional safety net for potential high-acuity patients which may have been missed in the initial primary triage, with Triage Practitioners able to refer cases back for a lights and sirens emergency ambulance dispatch where clinically necessary. To support the changes to the Grid, AV's Referral Service has almost trebled in size, expanding from 25 Full Time Equivalent (FTE) staff to 69 FTE staff.

The vast majority of patients (approximately 75%) who are transferred for secondary triage are directly transferred to a Referral Service Triage Practitioner by the ESTA call-taker. This is called a 'warm transfer'. However, some are called back by the Referral Service when a Triage Practitioner is not immediately available to take the call, and these are called 'call backs'. The maximum wait for a call back is 30 minutes after which an ambulance is automatically dispatched (approximately 3% of referrals). Importantly, prior to any caller being scheduled for a call back, experienced clinicians in primary triage make an assessment about whether this is appropriate for the circumstances of the individual patient and if not, an ambulance is dispatched immediately.

Monitoring and reporting of AV's performance

The Ambulance Victoria Statement of Priorities⁶ is the organisation's annual agreement with the Victorian Minister for Health, which outlines a number of Key Performance Indicators (KPIs) and targets. In terms of response time to emergency patients, AV is required to attend 85% of emergency Code 1 cases within 15 minutes. AV also has a target of triaging a minimum of 10% of clinically appropriate Triple Zero (000) calls away from an emergency ambulance response.

AV is also monitored on a number of quality and safety KPIs. These include, amongst others, out-of-hospital cardiac arrest (OHCA) survival rates, pain reduction for patients with severe pain, and triage of suspected stroke patients to the right hospital within 60 minutes. AV was one of the first ambulance services to focus on measuring and reporting patient outcomes, and also has the most comprehensive cardiac arrest registry in Australia. The Victorian Ambulance Cardiac Arrest Registry (VACAR) is recognised internationally as a leading clinical quality registry.





Rigorous Review and Phased Implementation

The Dispatch Grid Review

Ambulance Victoria is one of a number of ambulance services internationally that have conducted reviews of their clinical response models in the face of increasing demand and decreasing response time performance. Many ambulance services have moved towards call-taking and dispatch models aimed at reducing the number of emergency ambulance responses, and connecting patients with more appropriate care that can meet their clinical needs. For example, services in the United Kingdom identified the need to reform the way in which resources are deployed, and adopt different approaches to responding to calls.^{2, 3, 7} Such models have allowed for a more clinically focused response without any new risk to patient safety.

In Victoria, more than half of all Triple Zero (000) calls for an emergency ambulance have traditionally received a Code 1 (lights and sirens) response. However, this cohort has increasingly been recognised as containing a relatively small proportion of truly time dependent patients. For example, AV data for the period of 12 October 2015 to 12 January 2016 (i.e. prior to implementation of Stage 2 of the new CRM) suggests that only 4.9% of all Code 1 patients had a condition that was truly time dependent. Additionally, only 27.5% of Code 1 patients were considered potential high acuity (i.e. have the potential to deteriorate and are likely to benefit from a timely response).

Further to this, demand for ambulance services in Victoria has increased steadily at a rate of more

than 4% per year since 2008. Increasing demand challenges AV's ability to respond in a timely manner to the sickest patients.

The Ambulance Performance and Policy Consultative Committee and the Victorian Government identified that significant reform was needed to re-affirm AV's core role as an emergency pre-hospital health response provider to support patients to receive 'the right care, at the right time, at the right place'. Given the ever-increasing demand for ambulance services, and the regular misalignment between AV's response and patient acuity, AV identified improvement to the Dispatch Grid as a key initiative in 2015-16.

The key purpose of revising the Dispatch Grid was to:

- ▶ Better align response with patient acuity.
- ▶ Reduce the number of emergency cases which inappropriately receive a Code 1 response.
- ▶ Reduce the total number of Triple Zero (000) calls for which an emergency ambulance is unnecessarily dispatched.
- ▶ Increase the number of Triple Zero (000) cases managed through non-emergency transport or alternative service provision.
- ▶ Reduce the number of cases for which dual dispatch of emergency ambulances is recommended.
- ▶ Simplify the Dispatch Grid in order to improve total time to dispatch.
- ▶ Reduce paramedic frustration and potentially assist in reducing paramedic fatigue.



Importantly, improvement in the AV Dispatch Grid, and the implementation of a revised CRM, would reduce response times to the sickest patients and provide more definitive care to lower acuity patients (e.g. patients managed by locum GPs and effectively treated in the home)

In order to achieve this, a review of the Dispatch Grid was undertaken between March and May 2015 using a combination of research, audit and clinical expertise. The review drew extensively on AV's large body of clinical data, as recorded by paramedics in electronic patient care records. This represents one of the largest electronic pre-hospital datasets worldwide (approximately 5 million patient records).

An epidemiological/clinical profile of all Code 1 (time-critical) and Code 2 (urgent) cases within MPDS Event Type cohorts were constructed. These profiles were then used to assess the suitability of each Event Type's associated Dispatch Grid response. Code 3 events (non-urgent) were not assessed as all suitable Code 3 MPDS Event Types were already triaged by the Referral Service.

The review also assessed Code 1 dispatch rules with respect to dual dispatch of Mobile Intensive Care Ambulance (MICA) and Advanced Life Support (ALS) Paramedics. The basis of this was to reserve MICA responses to very sick patients (Priority 0) and respond ALS paramedics, who have a significant skill set in Victoria, to other Code 1 patients with the option to request MICA assistance if clinically required.

The recommended changes based on the epidemiological profiling of patient cohorts were then assessed by expert panels of senior MICA paramedics. The panels assessed the likely risk

to patients with respect to the proposed changes. This approach is in accordance with the Australian Standard on Risk Management (AS/NZS ISO 31000: 2009). An initial medical consultant level review of proposed changes by the Medical Director of AV also occurred.

In addition, Event Types allocated a Priority 0 response with an annual caseload >1000 were assessed for cardiac arrest caseload using data from the Victorian Ambulance Cardiac Arrest Registry (VACAR).⁸ A Priority 0 response is targeted to suspected cardiac arrest patients and receives a dispatch of ALS, MICA and first responders trained in cardiopulmonary resuscitation and equipped with oxygen and automatic defibrillators. Priority 0 Event Types with a cardiac arrest caseload of <1% were reassigned to a more appropriate Priority 1 response. Both are a subset of Code 1 responses.

As a result of the review, significant changes to the AV Dispatch Grid, and hence a revised CRM, were proposed. The revised CRM was approved by the AV Medical Advisory Committee which includes six medical specialists with expertise in emergency medicine, cardiology, trauma, anaesthesia and intensive care, in addition to the AV Medical Director, each of whom have substantial experience in ambulance medical care.

Further review was undertaken by an independent multi-disciplinary advisory panel convened by the Victorian Minister for Health. This panel comprised of emergency medical specialists, a medical epidemiologist, a senior nurse, primary care physicians, community members, and an independent chair who was also the chair of the Medical Board of Australia. This panel endorsed the revised CRM.



The revised CRM involved:

- ▶ 105 Events Types with a Code 1 response were assessed as suitable for downgrade to Code 2.
- ▶ 150 Code 1 Events Types were assessed as suitable to downgrade to Code 3 with subsequent secondary triage through the Referral Service.
- ▶ 71 Code 2 Events Types were assessed as suitable to downgrade to Code 3 with subsequent triage through the Referral Service.
- ▶ 2 Event Types with a Code 1 Priority 0 response were assessed as suitable to downgrade to a Code 1 Priority 1 response.
- ▶ Dual dispatch of MICA for Code 1 Priority 1 events was removed (i.e. ALS single response dispatch only, with MICA back-up if requested).
- ▶ ALS backup was added when MICA units are dispatched as the closet unit to Code 1 Priority 1 events to free MICA teams up if, on assessment, the patient did not require MICA care.

The revised CRM was also tested by mock-triage of cases through the Referral Service to understand likely triage dispositions. These results were then used to model the likely impact of the revised CRM post-implementation on performance. The estimated disposition from the Referral Service, based on mock triage was:

- ▶ 40% returned for an emergency ambulance dispatch (6% Code 1, 16% Code 2, and 18% Code 3).
- ▶ 30% referred for a non-emergency ambulance dispatch.
- ▶ 30% managed by alternative service providers or self-care advice.
- ▶ This revised CRM brings AV in line with models used in New Zealand⁹ and the United Kingdom²⁻⁴ in which an increasing volume of patients are being referred to alternative services or managed in their own home with telephone advice. It also aimed to bring AV in line with these international models with respect to the proportion of Triple Zero (000) incidents receiving a lights and sirens response.



Staged implementation

The implementation of the revised CRM was closely managed in three stages. The stages were designed so that caseload movement was balanced (i.e. if a certain caseload was moved from a Code 1 to a Code 2 response, an equivalent number of Code 2 cases were moved to Code 3).

The first stage was implemented on 19th October 2015 and involved changing two MPDS Event Types from a Priority 0 response to a Priority 1 response, cancellation of routine dual dispatch of MICA to Code 1 Priority 1 cases (historically, >60% of MICA responses were being cancelled prior to arrival), and simplification of the number of different dispatch determinants.

Stages 2 and 3 consisted of changing the dispatch code of Code 1 and Code 2 Event Types that were deemed suitable for a revised dispatch code. Stage 2 was implemented in four phases commencing on 9 May, 2016, and Stage 3 was implemented over five phases, with the final phase implemented on 12 October 2016.

Monitoring and governance

The revised CRM was implemented as a major project overseen by a Steering Committee which was chaired by the AV Chief Operating Officer. Stage implementation dates were subject to 'go' or 'no go' decision points overseen by the project team and a comprehensive monitoring process was implemented throughout the process to ensure clinical appropriateness and patient safety.

The changes were approved by the Ambulance Victoria Medical Advisory Committee which includes six medical specialists, each of whom have significant experience in ambulance medical care, and the Ambulance Victoria Medical Director.

Further review was undertaken by an independent multi-disciplinary advisory panel convened by the Victorian Minister for Health. This panel comprised of emergency medical specialists, a medical

epidemiologist, a senior nurse, primary care physicians, community members, and an independent chair who was also the chair of the Medical Board of Australia. This panel endorsed the process.

Clinical review and audit of cases managed by the Referral Service was expanded, with particular emphasis on cases which were referred for an emergency ambulance response with lights and sirens.

A comprehensive communication package for AV staff and stakeholders was also developed and implemented prior to Stage 1. Regular updates were also provided to paramedics about the revised CRM including video updates from senior paramedics.

Safer Care Victoria, the peak state authority for leading quality and safety improvements in healthcare, convened an independent clinical panel to review the evaluation of the revised Clinical Response Model.

Based on its review, Safer Care Victoria have advised Ambulance Victoria that:

- ▶ Safer Care Victoria are satisfied with the approach taken by AV to evaluate the impact of the revised clinical response model.
- ▶ Safer Care Victoria are further satisfied that AV have implemented the revised model in a manner that is staged, monitored, and clinically appropriate.
- ▶ Safer Care Victoria support the revised clinical response model as a clinically appropriate, evidence based improvement to resource allocation.
- ▶ Safer Care Victoria acknowledge that changes to the AV Clinical Response Model were delivered safely through a rigorous and evidence based approach, including clear and effective oversight and planning, risk identification and mitigation, staged implementation, and extensive monitoring and audit.



Evaluating the Change and Embedding the Revised Clinical Response Model

Results of the Evaluation

Response performance

The fundamental aim of the revised CRM was to provide a clinically safe evidence-based improvement to resource allocation in order to improve Code 1 response performance and get to the sickest patients faster. The proportion of Code 1 cases attended within 15 minutes for each month between September 2015 and February 2017 is presented in Figure 5 below.

Code 1:

- ▶ The state-wide proportion of Code 1 cases attended within 15 minutes of the Triple Zero (000) call increased from 75.8% in the historical period, to 76.4% after full CRM implementation. This is despite an increased growth in Triple Zero (000) calls of almost 10,000 calls (5.9%) between the two periods.
- ▶ To understand the impact of the revised CRM on Code 1 response performance, modelling was undertaken to estimate what AV's response performance would have been if the revised CRM had not been implemented. Using this approach reduces the bias inherent in historical comparisons (e.g. differences in demand and resourcing) and is a proven and robust way of assessing the impact of operational change.¹⁰

According to this modelling, 74.8% of Code 1 cases would have been attended within 15 minutes between November 2016 and January 2017 if the revised CRM had not been implemented.

- ▶ As such, AV's actual response performance was 2.5 percentage points higher than what it is modelled to have been if CRM had not been implemented. This is a significant improvement in the face of increasing demand and without an increase in the number of emergency ambulances available for response.
- ▶ Annually, this equates to an estimated 6,900 additional Code 1 cases which now receive a response within 15 minutes that would not have been attended within this timeframe if the revised CRM had not been implemented.

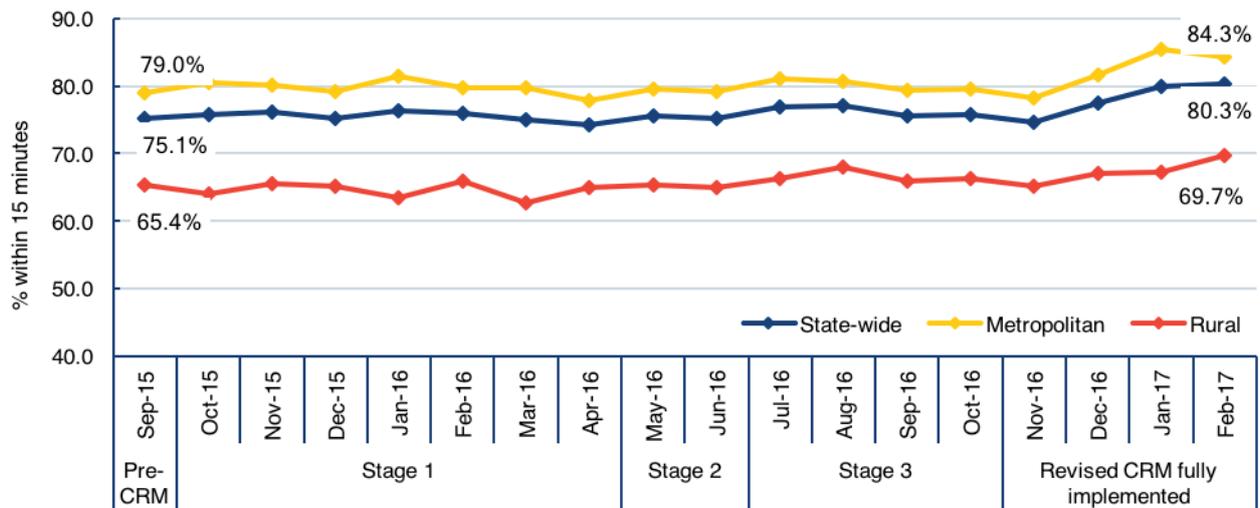
Code 2:

- ▶ State-wide, the proportion of Code 2 cases attended within 30 minutes of the Triple Zero (000) call decreased from 69.7% in the historical period, to 68.3% after full CRM implementation. However, this marginal reduction is explained by the increased number of cases which undergo secondary triage by the AV Referral Service before being sent for Code 2 emergency ambulance dispatch (i.e. the caseload of Code 2 cases increased).

Code 3:

- ▶ State-wide, the proportion of Code 3 cases attended within 60 minutes of the Triple Zero (000) call increased significantly from 71.4% in the historical period, to 77.2% after full CRM implementation.

Figure 5: Proportion of Code 1 cases attended within 15 minutes



Caseload distribution

Between the historical period and the revised CRM evaluation period, the total Triple Zero (000) call volume increased by 5.9%. Given the ever-increasing demand for ambulance services in Victoria, two key aims of the revised CRM were to reduce the number of emergency cases inappropriately receiving a Code 1 response, and to reduce the total number of Triple Zero (000) calls to which an emergency ambulance was unnecessarily dispatched.

To achieve this, the CRM aimed to increase the number of low-acuity patients referred to an alternative health service or non-emergency patient transport service, or provided with self-care advice on the telephone.

Reduction in Code 1 responses:

- ▶ The proportion of Triple Zero (000) calls receiving a Code 1 emergency ambulance response decreased from 51.8% in the historical period, to 40.5% after full implementation of the revised CRM (Figure 2). This brings AV in line with ambulance services in the United Kingdom and New Zealand.^{2, 3, 9}
- ▶ Annually, this equates to approximately 98,000 cases that would have received a Code 1 ambulance response prior to the revised CRM (a response unlikely to be in line with patient acuity), which now receive a Code 2 or 3 emergency ambulance response, or referral to an alternative or non-emergency ambulance service.

Cases avoiding emergency ambulance dispatch:

- ▶ The proportion of Triple Zero (000) calls which avoided an emergency ambulance dispatch increased from 9.6% in the historical period, to 16.5% after full CRM implementation. This is significantly above AV's KPI target of 10%, and is in line with ambulance services in the United Kingdom.⁴
- ▶ Annually, approximately 50,000 cases, which would have received an emergency ambulance prior to implementation of the revised CRM, are now estimated to be referred to an alternative health service, non-emergency patient transport service, or provided with self-care advice (Figure 6).



Figure 6: State-wide monthly caseload distribution

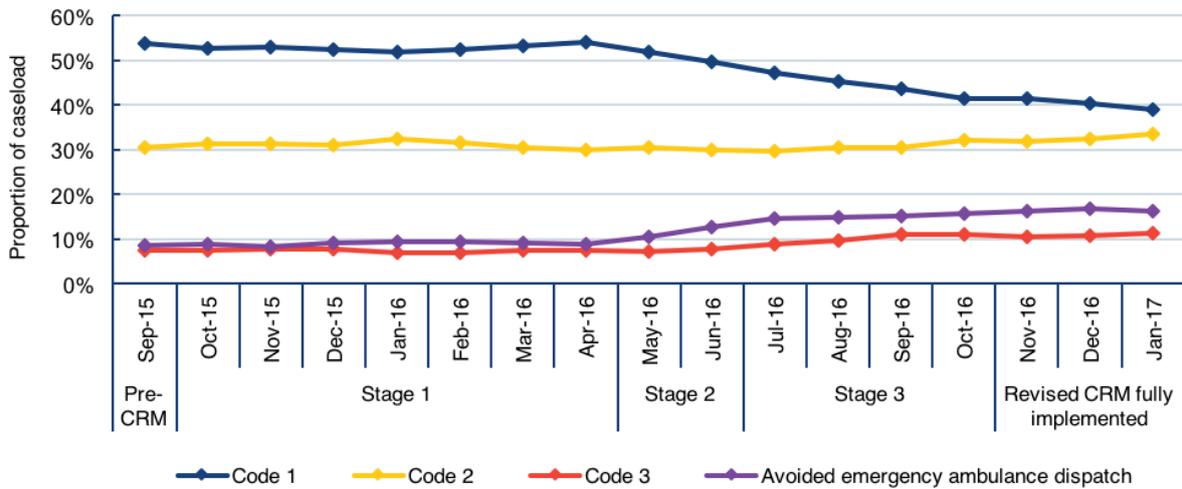


Figure 7: Distribution of cases triaged by Referral Service with a an Event Type downgraded from Code 1 during the CRM

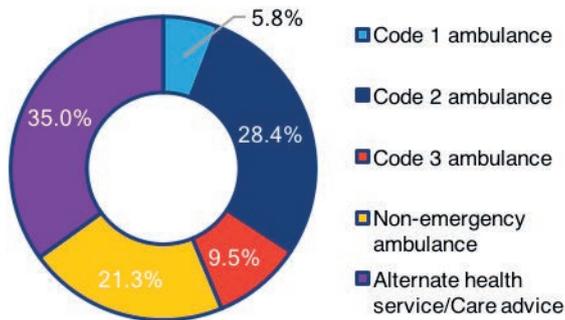
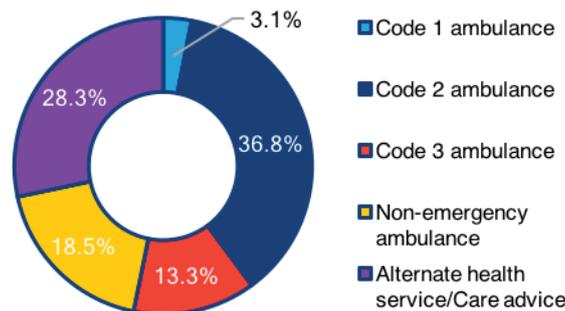


Figure 8: Distribution of cases triaged by Referral Service with a an Event Type downgraded from Code 2 during the CRM



- ▶ Figures 7 and 8 provide the Referral Service outcome of cases that were re-aligned as part of the revised CRM.
- ▶ Among the patients who did not receive an ambulance (emergency or non-emergency), 34.2% were able to be managed in their own home, with self-care advice provided over the telephone by a Referral Service clinician. Additionally, 7.0% of patients had a visit by a locum doctor arranged for them by the Referral Service, and 2.0% by a nurse. A total of 2.5% of patients (more than 400) were connected with a telehealth provider for consultation with a doctor or specialist.
- ▶ This equates to 6,682 patients (3.8% of Triple Zero (000) calls) being effectively managed in their own home without an ambulance. This is an increase of 2,401 patients compared to the historical period, and means almost 10,000 additional patients per year are being managed in their home due to the revised CRM.
- ▶ Referral to such alternative services and the provision of care advice at home allows emergency ambulances to be available to respond to high acuity patients, and also reduces demand on hospital Emergency Departments, positively impacting on the wider health system.

- ▶ The introduction of the revised CRM is estimated to have reduced attendances of patients to the Emergency Department by approximately 11,600 patients annually, an increase of 61% (annualised figure based on AV data for the CRM evaluation period compared to historical period). This is despite the growth in calls to Triple Zero (000) for ambulance and excludes patients advised to self-present to the Emergency Department or transported by a non-emergency ambulance.

Cases referred for emergency ambulance dispatch by Referral Service:

- ▶ In total, 3.1% of all Referral Service triages resulted in a Code 1 emergency ambulance dispatch, which is below modelled expectations (6%). Among these, almost half (48.8%) would have received a Code 2 response prior to implementation of the revised CRM.
- ▶ Importantly, the Referral Service provided an additional safety net for these cases, facilitating a higher priority ambulance response after more detailed questioning from an experienced paramedic or nurse to identify priority symptoms.
- ▶ The clinical profile (and hence risk) of patients referred for Code 1 dispatch by the Referral Service was similar for cases with an Event Type modified as part of the CRM and those with an Event Type not modified (Figure 9).
- ▶ A total of 27.9% of cases referred for Code 1 dispatch by the Referral Service were attended within 15 minutes in the CRM evaluation period, and this was higher than the 16.1% in the historical period (Table 2).
- ▶ When the call was immediately received by the Referral Service from ESTA (i.e. warm transferred), 31.6% of Referral Service Code 1 (REF01) cases were attended within 15 minutes.
- ▶ It is important to note that AV's response performance to cases referred for Code 1 dispatch by the Referral Service has improved after full implementation of the revised CRM.
- ▶ Time to dispatch (i.e. activation time) of state-wide warm transferred REF01 cases also improved in the CRM evaluation period when compared with the historical period (8:18 vs. 9:06 minutes).
- ▶ All telephone based triage systems will at times fail to identify patients that are potentially very ill as information may often be difficult to ascertain from some callers. Secondary triage improves the likelihood of identifying these patients.
- ▶ As such, the revised CRM may be optimised through ongoing monitoring and audit to determine the most appropriate resource to send to each Event Type. For example, the clinical profile of REF01 cases is presented in Figure 9, and suggests that less than 40% of all REF01 patients are potential high acuity. Similarly, the top 10 final paramedic assessments are provided in Table 3, with the most common assessment being pain. These results suggest that a lower response code may have been appropriate for many REF01 patients.
- ▶ A completed audit of the initial ESTA triage of cases referred for Code 1 dispatch by the Referral Service determined that approximately 9.0% should have received an emergency ambulance dispatch after the primary triage. It is therefore possible that the rate of Code 1 dispatch by the Referral Service could be reduced by 9.0% if all ESTA triages are compliant. AV is working with ESTA to drive improvements in triage accuracy.
- ▶ Importantly, for every Code 1 case identified by the AV Referral Service which received a response time longer than 15 minutes (the Code 1 KPI), there were an additional 3.9 cases (directly triaged to a Code 1 dispatch) which received a response within 15 minutes as a result of the revised CRM.



Table 2: Response time of cases referred for Code 1 dispatch by the Referral Service

	CRM	Historical
	12 Oct 16 - 12 Jan 17 (n=1,712)	12 Oct 15 - 12 Jan 16 (n=523)
Attended within 15 minutes	27.9%	16.1%
Median	19.2	23.0
90th percentile	34.8	42.6



Case Study 1: Secondary Triage Safety Net

“Sarah’s” Story

‘Sarah’, a 49 year old woman, has a history of high cholesterol, high blood pressure, and type 2 diabetes. One evening, Sarah was at home with her family and had a brief fainting episode. Her family called Triple Zero (000) and the ESTA call-taker triaged Sarah’s case to the AV Referral Service.

Upon secondary triage, the Referral Service Triage Practitioner noted that Sarah had experienced sudden onset of severe central chest pain with the pain radiating down her left arm. Sarah was also extremely sweaty, nauseous, and had slurred speech. Recognising the urgency of Sarah’s

condition, the Triage Practitioner upgraded the case to a time-critical (Code 1) ambulance response. Upon assessment, the crew noted that Sarah was having a heart attack, and transported her to hospital with lights and sirens for definitive care. Under AV’s revised CRM, the AV Referral Service acted as a safety net by identifying the urgency of Sarah’s condition and organising a higher priority ambulance response. Prior to implementation to AV’s revised CRM, Sarah would have received a Code 2 ambulance response, based on the information provided in the initial call.



Figure 9: Clinical profile of cases referred for Code 1 dispatch by the Referral Service

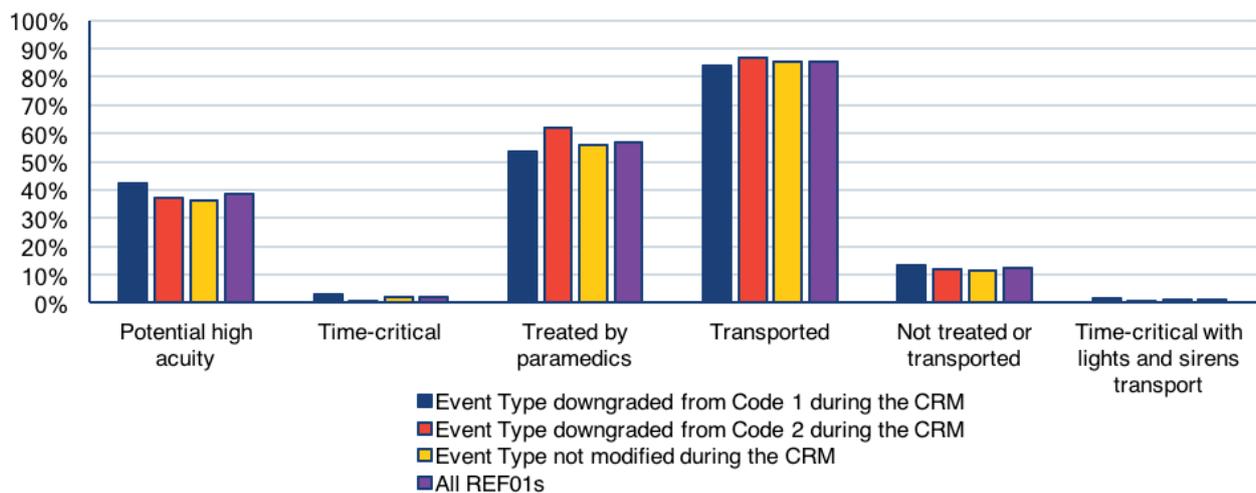


Table 3: Top 10 paramedic assessments of REF01 patients

	n	%
Pain (excluding chest pain)	227	16.6%
Stroke >6 hours	59	4.3%
Dizzy	50	3.7%
Chest pain	49	3.6%
Febrile	48	3.5%
Laceration	45	3.3%
Unknown problem	36	2.6%
No problem identified	35	2.6%
Headache	34	2.5%
Anxiety	32	2.3%



Case Study 2: Managed at home

“Kate’s” Story

‘Kate’, a 28 year old woman, had been feeling generally unwell for about one week. One evening at approximately 10pm, Kate experienced an onset of dizziness and called Triple Zero (000). Kate’s case was triaged by the ESTA call-taker to an Event Type which resulted in transfer to the AV Referral Service.

Upon secondary triage with the Referral Service Triage Practitioner, Kate reported lethargy, blocked ears and general weakness. Noting that Kate was unlikely to benefit from an emergency ambulance,

the Triage Practitioner arranged for a Locum doctor to visit and assess Kate. Prior to implementation of AV’s revised CRM, Kate would have received a Code 1 ambulance response. However under the revised CRM, Kate was able to be treated by a doctor in the comfort of her own home.

The locum doctor attended Kate’s home within 2 hours of the initial Triple Zero (000) call, and administered an antiemetic injection (standard practice for dizziness). He also provided Kate with a prescription for oral medications, and instructed her to visit her usual GP the following day.

Resource availability

A key aim of the revised CRM was to improve resource allocation and increase resource availability. Increased availability means that ambulances are available to respond to patients in a timely manner. As described above, the revised CRM decreased the number of cases to which an emergency ambulance was dispatched, and increased referrals to alternative health services and non-emergency services. In addition to this, routine dispatch of MICA to Code 1 Priority 1 cases was changed in order to reduce unnecessary MICA responses, and increase their availability to respond to the sickest patients.

As such, MICA resources are now only routinely dispatched to Priority 0 (life-threatening) cases, and are dispatched as back-up to other cases if specifically requested by an ALS crew. ALS paramedics are highly trained in Victoria, and historically cancelled >60% of MICA responses prior to MICA arrival at the scene. MICA do respond to Code 1 Priority 1 cases if they are the closest resource, however always receive ALS backup so that they may clear the case and become available to respond to the sickest patients. To understand the success of the revised CRM in increasing resource availability, two measures were used.

Activation time:

- ▶ Activation time describes the time between the Triple Zero (000) call being answered by ESTA and an emergency ambulance resource being dispatched to the case. A prolonged activation time may indicate a lack of available resources in the surrounding area, and is therefore a good measure of resource availability. Delayed dispatch translates to a longer ambulance response time.

The state-wide activation time of Code 1 cases improved from 1:56 minutes in the historical comparison period, to 1.50 minutes after full implementation of the revised CRM.

- ▶ Activation time for Code 1 cases dispatched by the Referral Service was prolonged (due to the secondary triage), particularly in cases where the Referral Service could not immediately accept the call and had to phone the caller back. However, the activation time of cases which were immediately accepted by the Referral Service improved after full implementation of the CRM.

MICA utilisation:

- ▶ To assess whether the revised CRM improved the availability of MICA resources, a measure of 'resource utilisation' was compared between the post-CRM period and September 2015 (i.e. one month prior to implementation of the revised CRM). Resource utilisation' is a measure of the 'hours worked' by a resource, divided by the 'planned hours'. In this instance, 'hours worked' represents the time interval between an ambulance being dispatched to and clearing a case. 'Planned hours' represents the hours included in the ambulance's allocated shift.

- ▶ According to this measure, MICA utilisation decreased substantially after full implementation of the revised CRM. State-wide, MICA utilisation decreased by 14.9 percentage points, from 34.8% prior to implementation of the CRM, to 19.9% after full implementation.

These results demonstrate that MICA resources are now more available to respond to the highest acuity patients when required.

Referral Service Impact

As a result of the revised CRM, demand on the Referral Service increased substantially. In order to accommodate the increased caseload managed by the Referral Service, staffing was increased significantly. Prior to the revised CRM, the Referral Service was staffed by 24 Full Time Equivalent Triage Practitioners and one Team Leader. Now, the Referral Service is staffed by 60 Full Time Equivalent Triage Practitioners, three Team Leaders, one Full Time Equivalent Care Planner, and five Full Time Equivalent mental health nurses.

A high proportion of calls being able to be accepted immediately by a Referral Service Triage Practitioner indicates Referral Service availability, and better response performance for those cases returned for emergency dispatch.

In total after full CRM implementation, 74.9% of calls transferred to the Referral Service by ESTA were immediately received (i.e. received via warm transfer). This was significantly higher than the proportion of calls warm transferred in the historical comparison period (59.7%). As such, Referral Service availability improved substantially after full CRM implementation.



Clinical outcomes

A key outcome of the revised CRM was to better align AV's allocated response with patient acuity and maintain AV's clinical KPIs. A number of measures can be used to assess the success of the revised CRM in achieving this objective.

Out-of-hospital cardiac arrest patients receiving a MICA response:

- ▶ To ensure that AV's highest acuity patients are receiving a MICA response, the proportion of OHCA patients who received a MICA response was compared before and after implementation of the revised CRM. OHCA is a time-critical and life-threatening condition in which a patient's heart stops beating. Cardiac arrest is considered the most serious of pre-hospital conditions.
- ▶ Among OHCA patients who received a resuscitation attempt by paramedics or first responders, 92.1% were attended by a MICA resource after full implementation of the revised CRM, compared with 87.7% in September 2015.
- ▶ These results further highlight the improved availability of MICA resources such that they are available to respond to the highest acuity patients.

Time-critical patients allocated a Code 1 response:

- ▶ 'Time-critical' patients are a cohort of patients for whom the clinical outcome is likely to be time-dependent. These patients were identified for this evaluation using a pre-defined data filter which searches for patients with the following clinical conditions: acute myocardial infarction (i.e. heart attack), cardiac arrest, suspected septicaemia, respiratory arrest, significant burns, and flail chest.
- ▶ Improved alignment between AV's response and patient acuity would be reflected through an increased proportion of time-critical patients receiving a high priority dispatch code.

- ▶ State-wide, 35.2% of the Priority 0 patient cohort were considered time-critical after implementation of the revised CRM, and this was higher than the 32.8% in the historical period (September 2015).
- ▶ Within the Code 1 cohort, 6.6% of patients were time-critical after CRM implementation, compared with 4.9% in the historical period.
- ▶ These results highlight that the revised CRM improved alignment between the resource dispatched by AV and the patient's clinical condition.

Code 1 patient characteristics:

- ▶ The acuity of the Code 1 patient cohort was also more appropriately aligned with a lights and sirens ambulance response.
- ▶ The proportion of Code 1 patients who were potential high acuity (i.e. potential to deteriorate) increased by more than 10 percentage points after CRM implementation when compared with the historical period (37.9 vs. 27.5%, $p < 0.001$).
- ▶ The proportion of patients who received treatment by paramedics increased (54.0 vs. 48.4%, $p < 0.001$), and the proportion of patients who were neither treated nor transported decreased (17.9 vs. 20.4%, $p < 0.001$).
- ▶ These results demonstrate that many lower acuity patients were effectively removed from the Code 1 cohort and received a response more appropriately aligned with their clinical needs.

Clinical KPIs:

- ▶ To ensure that the revised CRM had not negatively impacted on clinical outcomes, AV's clinical KPIs were compared before and after implementation of the changes (based on the 2015 and 2016 December quarters, Table 4).

Cardiac arrest survival:

- ▶ The proportion of OHCA patients who presented to AV in a shockable cardiac rhythm (i.e. able to be defibrillated) and who survived to hospital increased after full implementation of the revised CRM, from 53.5% in the historical period (Oct-Dec 2015), to 54.1%. Similarly, the proportion of patients who were discharged from hospital alive increased from 30.3% to 32.2%. This is the highest quarterly survival rate for patients in a shockable rhythm ever reported in Victoria.

Destination compliance for stroke patients:

- ▶ The proportion of suspected stroke patients transported to an appropriate facility within 60 minutes also increased after CRM implementation, from 87.6% in the historical period, to 92.1% after full implementation of the revised CRM. Whilst this is unlikely to have been significantly impacted by the revised CRM as it relates predominantly to paramedic assessment and triage decisions, it is important that this KPI was maintained.

Severe pain reduction:

- ▶ The proportion of severe pain patients (rating their pain as eight or more out of 10) who received clinical meaningful pain reduction (≥ 2 points) also increased after full CRM implementation, from 90.8% in the historical period to 91.3% during the evaluation period.



Case Study 3: Out-of-hospital cardiac arrest survivor

Senudin's Story

Senudin, a 56 year old grandfather, attends the gym at least five mornings per week. One day, moments after he had been on the treadmill, Senudin was found unconscious on the gym floor by bystanders. Upon noting that Senudin was not breathing, bystanders immediately dialled Triple Zero (000) and commenced cardiopulmonary resuscitation.

With resources available to be quickly mobilised, the first ALS crew arrived within five minutes of the Triple Zero (000) call. The crew delivered



two defibrillation shocks, and MICA paramedics arrived soon after. The MICA paramedics continued resuscitation efforts, delivering one more defibrillation which was successful in returning Senudin's pulse. The MICA paramedics inserted a breathing tube to assist with stabilising Senudin's condition. Senudin was transported to hospital where he received six coronary artery graft surgeries to improve blood flow to his heart. Less than two weeks later, Senudin was discharged home and reunited with his family, including his six-month old granddaughter.



Table 4: Clinical KPIs

	KPI target	CRM	Historical
		Oct-Dec 16	Oct-Dec 15
Cardiac arrest survival to hospital (VF/VF)*	45%	54.1%	53.5%
Cardiac arrest survival to hospital discharge (VF/VT)*	20%	32.2%	30.3%
Reduction in severe pain^	90%	91.3%	90.8%
Stroke patients transported to a stroke facility within 60 minutes**	80%	92.1%	87.6%

*Adult cardiac arrests (>14y), resuscitation initiated by Emergency Medical Services, excludes paramedic witnessed arrests. Based on 12-month rolling data. VF/VT, ventricular fibrillation/ventricular tachycardia (i.e. a shockable cardiac rhythm). ^Includes adult (>14y) ischaemic chest pain & traumatic pain patients with an initial pain score >7 with a reduction of ≥ 2 points (excludes intubated & Glasgow Coma Scale <9 patients). **Includes adult patients (>14y) whose final paramedic assessment was stroke and who were transported to a hospital with a stroke and thrombolysis service or telemedicine facilities. Excludes inter hospital transports.



Embedding The Revised Clinical Response Model

Quality and Safety

The quality and safety of the new CRM was subjected to rigorous assessment, as described in detail below.

Re-contact within 24 hours:

- ▶ Re-contact with the ambulance service within 24 hours of the Triple Zero (000) phone call can provide an indication of the appropriateness of the outcome of the initial call and/or the acceptance of the public with respect to the allocated resource. For example, patients referred to an alternative service by the Referral Service in their initial call may have been unsatisfied with this outcome, or experienced a clinical deterioration. Similarly, patients who were attended by an emergency ambulance but not transported to hospital may re-contact AV.
- ▶ The proportion of patients who were identified as re-contacting AV within 24 hours among patients who were either attended by an emergency ambulance but not transported to hospital, or referred to an alternative service/provided with self-care advice, was measured between the pre- and post-CRM periods.
- ▶ After full CRM implementation, 4.2% of patients were identified as re-contacting AV within 24 hours. However, this did not differ significantly when compared to the historical period (4.0%). This is lower than other reported rates (e.g. United Kingdom services reported 6.1% in January 2017).⁴
- ▶ As such, despite the increased proportion of patients who were referred away from an emergency ambulance as a result of the revised CRM, re-contact within 24 hours did not increase.

It is important to note that patients re-contact the ambulance service for many reasons, and it does not immediately mean that the initial response was not appropriate.

Non-emergency patient transport service requests for emergency ambulance assistance:

- ▶ Requests by non-emergency patient transport providers for emergency ambulance assistance are audited by AV to assess whether the patient was indeed unsuitable for a non-emergency resource. Given the increase in cases referred to non-emergency services as part of the revised CRM, it is important to understand whether such referrals are safe.
- ▶ A total of 1.0% of all non-emergency ambulance attendances involved a request for emergency ambulance assistance after full CRM implementation. This was lower than the historical period (1.2%).
- ▶ A similar proportion of these cases were validated as being unsuitable for referral to non-emergency after full implementation of the CRM when compared to the historical period (86.0% versus 84.2%).
- ▶ As such, despite the increased non-emergency service caseload after full implementation of the revised CRM, there was no significant increase in the proportion of cases that were unsuitable for a non-emergency resource, and the overall proportion remained very low (<1%).



Consumer feedback and complaints:

- ▶ Consumer feedback and complaints were examined to understand the acceptance of the CRM changes within the community.
- ▶ While the crude number of complaints increased after CRM implementation when compared with the historical comparison period (n=64), these complaints represented only 0.1% of all Referral Service triages. This was similar to the historical comparison period (n=43, 0.2%). Of these, seven were considered after investigation to be valid and steps have been taken to prevent recurrence.
- ▶ The outcome of all complaints to AV are communicated to the complainant in writing. The response letter details how AV intends to resolve the complaint.

Clinical significance of delayed response due to Referral Service triage:

- ▶ An expert panel of senior paramedics reviewed REF01 cases and determined the consequence to the patient's outcome with respect to how long the ambulance took to respond.
- ▶ In total, 3.1% of all Referral Service triages resulted in a Code 1 emergency ambulance dispatch after detailed questioning by the Referral Service call-taker. Of the 1,006 patients, 13 (1.3%) were considered, after expert panel review, to have to have a response greater than 15 minutes and a clinical condition which required prompt transfer to hospital for definitive care. After secondary triage, these 13 patients received a Code 1 response and the ambulance arrived on average within 25 minutes. Expert clinical review found there was no definite adverse impact for these patients. These patients included acute stroke (nine of the 13 cases), heart attack, neurological compromise, trauma and acute pulmonary oedema, and in the case of acute stroke and multiple trauma, should have been

identified during the initial ESTA triage. Not all of these patients would have received a response within 15 minutes prior to the revised CRM. AV is working with ESTA to improve the accurate identification of acute stroke and time-critical conditions at the point of primary triage to avoid referral of these cases to the AV Referral Service.

Given the low likelihood of significant consequences, the highest risk rating resulting from the matrix was 'medium' which requires ongoing monitoring but no immediate action. AV will continue to monitor and audit cases triaged by the Referral Service and referred for a Code 1 emergency ambulance response to drive continuous improvement.

It is important to establish the time of onset for strokes early in the triage process to prevent acute stroke patients being referred to secondary triage. Timely definitive care for suspected stroke patients is associated with improved patient outcomes for acute strokes. However, stroke patients are unlikely to benefit from therapy when the onset of stroke to therapy is more than six hours. Therefore acute strokes are time dependent, while other strokes, which are outside the current therapeutic treatment window, are not time dependent.

Primary triage has not changed as a part of the revised CRM and therefore the accuracy rate of primary triage has not changed. The secondary triage team has been almost trebled in size, expanding from 25 Full Time Equivalent (FTE) staff to 69 FTE staff to support the changes to the Dispatch Grid.

Adverse events:

- ▶ AV has a comprehensive clinical risk management system which has multiple pathways and methods to identify adverse events.
- ▶ During the evaluation period, no serious adverse events related to the revised CRM have been identified.

Embedding and optimising performance of the revised CRM

A number of optimisation activities are already underway at AV to embed and further improve the performance of the revised CRM, in particular the secondary triage process within the AV Referral Service. These include:

- ▶ Real-time coaching and support of Referral Service Triage Practitioners regarding dispatch processes, particularly with regard to patients referred for a Code 1 ambulance dispatch. The aim of the coaching is to improve early identification of the sickest patients and reduce the time to dispatch of an ambulance. For example:

The Medical Priority Dispatch System used in primary triage is not designed to discriminate levels of pain in patients. As a result, many of the patients who are referred back for a Code 1 response are patients whose severe pain has been detected by the Referral Service paramedic or nurse. This demonstrates the safety net provided by the Referral Service to facilitate a better response for these patients.

- ▶ There have also been a number of innovative initiatives trialled which are aimed at increasing the referral options available to patients and improving patient care. For example:

Piloting mental health nurses in the Referral Service; and

A trial of a telehealth provider that is able to arrange locum visits and provide consultations by telephone (including the provision of scripts and medical certificates).

- ▶ AV are continuing to work with ESTA to reduce the number of patients referred for secondary triage, who should have been sent an emergency ambulance at the point of ESTA triage. For example:

During the evaluation period, acute stroke patients accounted for nine of 13 of the cases which went to the Referral Service (1.3%) that were considered, after expert panel review, to have a response greater than 15 minutes and a clinical condition which required prompt transfer to hospital for definitive care. While not all of these patients would have received a response within 15 minutes prior to the revised CRM, it is essential to identify acute stroke early in primary triage. Timely definitive care for suspected stroke patients is associated with improved patient outcomes for acute strokes. As a result, ESTA are implementing a process whereby the onset of a suspected stroke is established earlier in the call and thus facilitating the immediate dispatch of an emergency ambulance to these patients.

It was also identified during implementation of the revised CRM that asking school staff to assist children who are injured in schools to self-present to the Emergency Department is not appropriate, when parents are unavailable. As a result, these cases are provided with a timely ambulance response.

- ▶ AV will continue the high level of audit and monitoring to ensure continuous improvement.
- ▶ AV has implemented a further 12 additional non-emergency transport services to increase resourcing for patients referred to this service by the Referral Service.



Conclusion

The revised Clinical Response Model, which was based on extensive clinical evidence and review, has been successfully implemented by Ambulance Victoria.

The fundamental aim of the revised Clinical Response Model is to provide a clinically-safe, evidence-based improvement to resource allocation in order get to the sickest patients faster to improve patient outcomes.

The new Clinical Response Model has reduced emergency demand and freed up more ambulances to be available to respond more quickly to seriously ill people than ever before. The changes to the Clinical Response Model have proved safe, with no serious adverse events identified.

The survival rate for our sickest and most time-critical patients – those in cardiac arrest – is the highest ever, with better availability of our MICA resources meaning even more of these patients are getting treatment from our specialist cardiac-trained intensive care paramedics.

Changes to the Ambulance Victoria Clinical Response Model were delivered safely through a rigorous and evidence-based approach, including clear and effective oversight and planning, risk identification and mitigation, stage implementation, and extensive monitoring and audit.

The proportion of Triple Zero (000) calls receiving a Code 1 emergency ambulance response decreased from 51.8% in the historical period, to 40.5% during the evaluation period of the revised Clinical Response Model. This aligns Ambulance Victoria

with international ambulance services in the United Kingdom and New Zealand, who have also introduced new models of triage and care.

The proportion of Triple Zero (000) calls which avoided an emergency ambulance dispatch increased from 9.6% in the historical period, to 16.5% during the Clinical Response Model evaluation period. This is significantly above Ambulance Victoria's Key Performance Indicator target of 10%. Annually, approximately 50,000 cases, which would have received an emergency ambulance prior to implementation of the revised Clinical Response Model, are now estimated to be referred to an alternative or non-emergency service, or provided with self-care advice, thus receiving a service more aligned with their clinical need. Furthermore, almost 10,000 additional patients per year are estimated to be managed in their home due to the revised Clinical Response Model, avoiding long waits in Emergency Departments.

The Referral Service also provided an additional safety net for some patients who would previously have received a Code 2 emergency ambulance response. Further questioning by clinically qualified Referral Service Triage Practitioners facilitated a higher priority ambulance response for these patients.

The revised Clinical Response Model improved expected Code 1 response time performance by 2.5 percentage points in the face of significant growth in demand and no significant change to paramedic resources. Importantly, this aligned with the improvement that had been predicted based on modelling of caseload distribution. In short, the revised Clinical Response Model delivered the performance gain that was expected.

Annually, this equates to an estimated 6,900 additional Code 1 cases that should now receive a response within 15 minutes that would not have been attended within this timeframe if the revised Clinical Response Model had not been implemented. Response times have also improved across Codes 2 and 3 as a result of non-emergency cases being referred to services more appropriate to their needs.

The revised Clinical Response Model increased the availability of MICA, allowing them to attend patients most in need of MICA care. Among out of hospital cardiac arrest patients who received a resuscitation attempt by paramedics or first responders, 92.1% were attended by a MICA resource after full implementation of the revised Clinical Response Model, compared with 87.7% historically. In addition, clinical outcomes after implementation of the revised Clinical Response Model were strong, with survival for cardiac arrest patients in a shockable cardiac rhythm reaching 32.2% for the December 2016 quarter (12-month rolling). This is the highest quarterly survival rate recorded by Ambulance Victoria.

Early access to definitive care for acute stroke patients has also improved. Stroke patients transported to a stroke unit within 60 minutes travel time from the scene improved from 87.6% in the December 2015 quarter to 92.1% in the December 2016 quarter. Further research will be undertaken into the specific patient outcomes for other time-critical patient categories once Ambulance Victoria has sufficient sample sizes from the period post-implementation of the new Clinical Response Model.

In summary, the revised Clinical Response Model improved resource allocation and availability, better aligned care to the level of patient acuity and need, improved response times to the sickest patients, and improved clinical outcomes.



Methodology

Time period

This evaluation uses data from September 2015 (one month prior to implementation of Stage 1) until three months after the full implementation of Stage 3 (12 January 2017).

The fully implemented revised CRM time period (12 October 2016-12 January 2017) is compared with the same time period in the year prior (12 October 2015 to 12 January 2016). The month of September 2015 is also included in relevant analyses to describe performance in the month prior to implementation of Stage 1.

State-wide results are reported, in addition to break downs by metropolitan and rural regions.

Data sources

Operational data, including Computer Aided Dispatch (CAD) data, were sourced from the AV Data Warehouse, as were data relating to Referral Service triage. Clinical data for this evaluation were sourced from the AV Clinical Data Warehouse which stores all clinical data as recorded within VACIS electronic patient care records (ePCRs). Consumer feedback and complaint data were sourced from the AV Clinical Risk Management System. Cases of OHCA were obtained from the Victorian Ambulance Cardiac Arrest Registry (VACAR) which collects data on every OHCA attended by AV.

Clinical data were used to identify potential high acuity and time-critical patients. Potential high acuity patients are identified by an electronic filter. This is a broad filter used to identify patients who have the potential to deteriorate and are likely to benefit from a timely response. Time critical patients are a subset of these patients, and include those who are highly likely to be time-dependent.

Limitations:

Referral Service distributions represent the final planned triage outcome recorded in the Referral

Service system. This may differ slightly from the actual response allocated, for example if the preferred resource was not available. However, it is expected that the true distribution is very similar to that presented in this report. Additionally, given the number of activities undertaken by AV to improve response performance during this time period, it is possible that other system factors may influence the presented results. However, these activities are accounted for in modelled performance predictions, which reduces bias inherent in historical comparisons.

Expert panel review

To understand the clinical significance of a delayed ambulance response due to Referral Service triage, an expert panel of senior paramedics was convened to examine the risk profile of patients who were triaged through Referral Service and subsequently received a Code 1 ambulance dispatch. The panel assessed:

- ▶ Patients who would have received a Code 1 response prior to the revised CRM and whose response time was greater than 15 minutes
- ▶ Patients who would have received a Code 2 response prior to the revised CRM and whose response time was greater than 30 minutes.

The expert panel reviewed these cases and determined the consequence to the patient's outcome with respect to how long the ambulance took to respond. This allowed the consequences to be ranked, and a risk matrix to be produced, using likelihood and consequence scores. This approach is similar to the approach used by AV when designing the revised CRM, which was endorsed by the AV Medical Advisory Committee. The approach aligns with both the Australian Standard on Risk Management (AS/NZ ISO 31000:2009) and the AV Enterprise Risk Management Framework.

Abbreviations

ALS	Advanced Life Support
AV	Ambulance Victoria
CAD	Computer Aided Dispatch
CECC	CareEnhance Call Centre
CRM	Clinical Response Model
ESTA	Emergency Services Telecommunications Authority
ePCR	Electronic Patient Care Record
KPI	Key Performance Indicator
MICA	Mobile Intensive Care Ambulance
MPDS	Medical Priority Dispatch System
OHCA	Out-of-Hospital Cardiac Arrest
VACAR	Victorian Ambulance Cardiac Arrest Registry



Definitions

Activation time	Measures the time between the call being answered by the ESTA call-taker and the time that an ambulance resource was dispatched to the incident.
Call-back by Referral Service	For cases where Referral Service is unable to immediately accept a transfer from ESTA, the Referral Service Triage Practitioner will 'call-back' the caller/patient.
Cases eligible for triage by the Referral Service	Cases assigned an MPDS Event Type by ESTA which is eligible to be transferred to the AV Referral Service, as defined in the AV dispatch grid.
Cases managed by the Referral Service	Cases successfully triaged by the Referral Service and referred to an alternative service, non-emergency transport service, given self-care advice or referred back to the emergency dispatcher. Excludes cases with an eligible MPDS Event Type, but which were not triaged by the Referral Service.
Dispatch Codes	
Code 1	Code 1 emergency incidents require a time-critical paramedic response and urgent hospital care, based on information available at time of the Triple Zero (000) call.
Priority 0	Priority 0 is a subset of Code 1 and indicates the most urgent events requiring a time-critical response. These usually involve patients with life-threatening conditions such as suspected cardiac arrest.
Priority 1	Priority 1 is a subset of Code 1 and indicates emergency, high priority incidents requiring a "lights and siren" response. Patients may have conditions such as chest pain or breathing difficulties.
Code 2	Code 2 emergency incidents are acute but not time-critical, based on the information at the time of the Triple Zero (000) call.
Code 3	Code 3 incidents are non-urgent based on the information at the time of the Triple Zero (000) call.
Emergency incident	An incident to which one or more ambulances are dispatched in response to a Triple Zero (000) call from a member of the public, or a medical request for transport requiring an emergency ambulance (due to patient acuity or transport timeframe).
ESTA	Responsible for primary triage of Triple Zero (000) calls.

Event Type	An MPDS code assigned by the ESTA call-taker which describes the primary complaint of the caller.
Potential high acuity patient	Potential high acuity patients include patients with: Signal 1 (lights and sirens) transport to hospital, cardiac arrest, acute coronary syndromes, acute pulmonary oedema, airway obstruction, anaphylaxis, major trauma, severe pain, respiratory arrest, stroke, haemorrhage, burns, altered/unconsciousness, or septicaemia. Management items relevant to these patient cohorts are used to identify these patients, in addition to paramedic diagnosis. These patients have the potential to deteriorate and are likely to benefit from a timely response.
Referral Service	AV's Referral Service conducts secondary triage on cases with low-acuity Event Types, as assigned by AV's dispatch grid. The outcome may be return of the call to an emergency dispatcher, or referral of the call to a non-emergency patient transport service or alternate service (e.g. locum doctor, nurse on call).
REF01, REF02 and REF03 responses	The Event Types assigned to a Code 1, Code 2 or Code 3 response, respectively for cases referred for ambulance dispatch by the AV Referral Service.
Response Time	The time from a Triple Zero (000) call being answered and registered by the ESTA call-taker, to the time the first AV resource arrives at the scene. All response times are based on data sourced from the CAD system.
Signal 1 transport	Transport to hospital with lights and sirens and/or pre-notification of hospital arrival.
Time-critical patient	Time-critical patients are a subset of potential high acuity patients, and include those with: acute myocardial infarction, cardiac arrest, suspected septicaemia, respiratory arrest, significant burns, and flail chest. Management items relevant to these patient cohorts are used to identify time-critical patients, in addition to paramedic diagnosis. The outcome of these patients is likely to be time-dependent.
Utilisation	Utilisation is equal to (worked hours) / (planned hours), where planned hours is based on a team's normal shift roster, and worked hours is the time interval between dispatch and clearing a case (known as unit case time). Utilisation can be thought of as the proportion of time a team is occupied with a case.
Warm transfer	The process of transferring a call directly from ESTA to the AV Referral Service, without the need for a Referral Service call-back.



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