IN THE CORONERS COURT
OF VICTORIA
AT MELBOURNE

Court Reference: COR 2016 5536

FINDING INTO DEATH WITH INQUEST

Form 37 Rule 60(1)
Section 67 of the Coroners Act 2008

Deceased:	**Apollo George PAPADOPOULOS**
Findings of:	Coroner Paresa Antoniadis SPANOS
Delivered on:	9 November 2018
Delivered at:	Coroners Court of Victoria, 65 Kavanagh Street, Southbank
Hearing date:	25-29 June 2018 and 24 August 2018
Counsel assisting the Coroner:	Leading Senior Constable Duncan McKENZIE of the Police Coronial Support Unit, instructed by Ms Amira Kafka, Coroner's Solicitor at the Coroners Court of Victoria
Representation:	Ms Naomi HODGSON of Counsel appeared on behalf of Ambulance Victoria, instructed by Ms Kate Mellier of Lander & Rogers Lawyers

Mr Peter ROZEN of Counsel and Mr Fatmir BADALI of Counsel appeared on behalf of the Emergency Services Telecommunications Authority, instructed by Ms Jess Bayly of K & L Gates

Mr James FORSAITH of Counsel appeared on behalf of the Bureau of Meteorology, instructed by Mr Evan Evagorou, Australian Government Solicitor

Mr Morgan McLAY of Counsel appeared on behalf of the Department of Health and Human Services, instructed by Ms Margaret Mann

Catchwords: Thunderstorm Asthma, asthma epidemic, respiratory distress, surge in '000' calls, delayed ambulance response, Emergency Services Telecommunications Authority (ESTA), Ambulance Victoria (AV), Inspector General for Emergency Management (IGEM), allergic asthma, rye grass pollen, hay fever, Bureau of Meteorology (BOM)

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GLOSSARY

AV	Ambulance Victoria
AV's ERP	AV's Emergency Response Plan
BOM	Bureau of Meteorology
CAD	Computer Aided Dispatch
The CHO's Report	Chief Health Officer's Report
CPR	Cardiopulmonary resuscitation
CSOPs	Communications Standard Operating Procedures
ED	Emergency Department
EMA	Emergency Management Act 2013 (Vic)
EMR	Emergency Medical Response
EMV	Emergency Management Victoria
EPA	Environmental Protection Authority
ERP	Emergency Response Plan
ESTA	The Emergency Services Telecommunications Authority
DHHS	Department of Health and Human Services
GP	General Practitioner
ICU	Intensive Care Unit
IAWG	Interagency Working Group
IGEM	Inspector General for Emergency Management
MICA	Mobile Intensive Care Ambulance
PMCT	Post-mortem computer assisted tomography scanning
RATeam	Rapid Assessment Team
RHEMS	Real-time Health Emergency Management System
SHERP	State Health Emergency Response
SDRs	Service delivery requirements

SOPs	Standard operating procedures
TA	Thunderstorm Asthma
VicSES	Victorian State Emergency Services
VIFM	Victorian Institute of Forensic Medicine
WFMT	Work Force Management Team

INTRODUCTION

1. Mr Apollo George Papadopoulos **(Mr Papadopoulos)** was a 35 year old man who lived in Epping[1] with his mother, Ms Emma Papadopoulos and worked as a steelworker in Campbellfield.[2]

2. Mr Papadopoulos died as a result of the Thunderstorm Asthma **(TA)** event which occurred in Melbourne on 21-22 November 2016.

3. Nine other Victorians are known to have died as a result of this event. They are:

   (a) Omar Moujalled, an 18 year old man who had just completed his Year 12 studies and died at the Greenvale Medical Clinic, Greenvale, on 21 November 2016;[3]

   (b) Hope Carnevali (Marsh), a twenty year old young woman who worked as a retail assistant and died at her home in Hoppers Crossing on 21 November 2016;[4]

   (c) Clarence Leo, a 37 year old married man who worked in security and died at a residential address in Keysborough on 22 November 2016;[5]

   (d) Ling Ling Ang, a 47 year old married woman who worked as an accounts manager and died at the Northern Hospital, Epping, on 25 November 2016;[6]

   (e) Thao Minh La, a 48 year old spray painter who died at Maroondah Hospital, Ringwood East, on 26 November 2016;[7]

   (f) Priyantha Nirmale Panjith Pieris, a 57 year old married man who worked as an electrical fitter and died at the Northern Hospital, Epping, on 29 November 2016;[8]

   (g) Hoi Sam Lau, a 49 year old married man who died at the Austin Hospital, Heidelberg, on 29 November 2016;[9]

   (h) Min Guo, a 29 year old married man who worked as a car salesman and died at Ballarat Base Hospital, Ballarat, on 9 December 2016;[10] and

[1] Inquest transcript **(transcript) page** 54.
[2] Statement of Emma Papadopoulos dated 8 February 2017 coronial brief pages 85-86.
[3] Coroners Court of Victoria reference 2016 5533.
[4] Coroners Court of Victoria reference 2016 5534.
[5] Coroners Court of Victoria reference 2016 5542.
[6] Coroners Court of Victoria reference 2016 5599.
[7] Coroners Court of Victoria reference 2016 5616.
[8] Coroners Court of Victoria reference 2016 5671.
[9] Coroners Court of Victoria reference 2016 5669.

(i) Le Hue Huynh, a 46 year old married woman who worked as a part-time seamstress and died at Sunshine Hospital, Sunshine, on 25 January 2017.[11]

4. At the outset, I wish to express my sincere condolences to the family members, friends and colleagues of each deceased lest their loss and grief be forgotten with the focus on the State's emergency response, the phenomenon of Thunderstorm Asthma and the coronial imperative to contribute to a reduction in the number of preventable deaths wherever possible.[12]

5. Apart from matters personal to each deceased such as their background, personal circumstances, their clinical management and care, and the medical cause of their deaths, a finding in identical terms to this one will be delivered in respect of each deceased.

THE THUNDERSTORM & THE IMPACT OF EMERGENCY SERVICES

6. On Monday, 21 November 2016, Melbourne's temperatures peaked at 35°C. High levels of pollen from the plains to the north and west of Melbourne and certain meteorological conditions, including a cool, stormy change, combined to produce what has been referred to as a TA event and, in some contexts, as a TA epidemic.

7. On Friday, 18 November 2016, the Bureau of Meteorology **(BOM)** weather forecast for 21 November 2016 was for high temperatures followed by a cool change with thunderstorms. The Emergency Services Telecommunications Authority **(ESTA)** forecast the potential for an increase in calls for assistance from the Victorian State Emergency Services **(VicSES)**. Such calls are usually taken by ESTA call-takers trained and dedicated to taking calls for police assistance **(police call-takers)**. ESTA accordingly arranged for additional police call-takers to be rostered to process the expected increased number of calls requesting VicSES assistance.[13]

8. However, as will be discussed below, the likelihood of a TA event was not appreciated at the time. Therefore, ESTA did not expect an increase in the number of calls requesting Ambulance Victoria **(AV)** attendance and did not revise the staffing roster for call-takers trained and dedicated to taking calls for ambulance assistance **(ambulance call-takers)**.[14] This was consistent with the state of knowledge of key stake holders, now parties in this

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[10] Coroners Court of Victoria reference 2016 5824.
[11] Coroners Court of Victoria reference 2017 0405.
[12] See the Preamble to the *Coroners Act 2008* (Vic) **(the Act)** and Purposes, specifically section 1(c).
[13] Exhibit D, statement of Michelle Smith dated 22 September 2017 coronial brief page 806.
[14] Transcript page 181. Ms Smith explained that the accuracy of the forecasting is dependent upon the information available to the ESTA's Workforce Management Team at the time. Transcript page 182.

inquest, that such a weather forecast did not suggest a potential impending health emergency.[15]

9. At about 2.00pm on 21 November 2016, the BOM issued a severe thunderstorm warning for damaging winds, heavy rainfall and hailstones. This warning did not include the Central district which encompasses the Ballarat, Geelong and Melbourne Metropolitan regions.[16] At about 4.00pm, the BOM extended its warning to other parts of Victoria, including Geelong and Melbourne.

10. The thunderstorm-induced gust front reached Geelong at 5.00pm and moved rapidly eastwards. Over the following hour and during the afternoon peak when many people were travelling home from work,[17] a cold front and associated thunderstorm swept across Melbourne from the west bringing with it wind gusts of over 80 kilometres per hour.

11. At about 5.15pm, ESTA received a further warning from BOM indicating that thunderstorms were detected on the radar and were expected to affect the west of Melbourne by 5.40pm and Melbourne suburbs by 6.10pm. The warning did not refer to air quality or the possibility of a TA event.

12. While the precise mechanism of a TA event is not clear, it is generally understood that the moisture from the storm breaks pollen particles into respirable-sized particles capable of being breathed deep into the lungs, resulting in breathing difficulties in a large number of people.

13. By 6.00pm, ESTA call-takers received an unprecedented surge of calls requesting ambulance assistance, particularly for people suffering shortness of breath or asthma-related symptoms.[18] It is important to appreciate that the cause of the surge of calls was unknown at the time it was occurring.[19]

14. The twelve hour period from 6.00pm on 21 November to 6.00am on 22 November 2016 saw the single greatest volume of calls for ambulance assistance received by ESTA in its history.

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[15] Coronial brief page 423.
[16] Exhibit D, statement of Michelle Smith dated 22 September 2017 coronial brief page 806. See also IGEM's Final Report at coronial brief page 423.
[17] Coronial brief page 423. The thunderstorm front comprised several small cells and although the storm front produced severe wind gusts, they swept through quickly. The BOM evidence provided to IGEM stated that there was nothing particularly remarkable about this storm.
[18] Exhibit D, statement of Michelle Smith dated 22 September 2017 coronial brief page 805.
[19] Ibid.

A total of 2,332 calls were received during this period, with demand peaking in the half hour period between 6.45pm and 7.15pm when 397 calls for ambulance assistance were received.[20]

15. Between 7.00pm and 7.15pm, the number of calls for ambulance assistance grew to almost 700% of the forecast call volumes. By 8.00pm, ESTA would have needed six times the forecasted ambulance call-takers to meet the demand. The number of received calls did not reduce to previously forecast or "normal" levels until after 6.00am on 22 November 2016.[21]

16. By about 6.30pm, the ambulance fleet in the West region had been depleted and dispatchers had no available ambulance units to dispatch to incoming calls. The number of "events" pending dispatch consequently increased. The events pending list grew so large that it was not able to fit into one Computer Aided Dispatch **(CAD)** screen. An ESTA employee with seven years' experience described this as the first time this had been seen.[22]

17. The peak in demand for ambulances occurred between 7.00pm and 7.15pm, when ESTA call-takers answered 201 emergency ambulance calls.[23] By 7.30pm, there were 140 Code 1 events awaiting dispatch. By 8.00pm, there were in excess of 150 ambulance events awaiting dispatch, almost 100 of which were Code 1 events.[24]

18. Senior ESTA and AV personnel communicated about how both agencies could best manage the increased demand on AV's resources. A number of strategies were subsequently put in place, including:

    (a) cancelling all dispatches for non-emergency ambulance events;

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[20] Exhibit D, statement of Michelle Smith dated 22 September 2017 coronial brief page 807. I am informed that the volume of requests for ambulance assistance received between 6.15pm and 8.15pm (1,329 calls) was comparable with the number of calls for ambulance assistance the ESTA would receive over a 12 hour period on a standard New Year's Eve. I also note that these figures represent the volume of calls for ambulance only, and that calls for police, fire and VicSES assistance continued unabated. Transcript page 243.

[21] Exhibit D, statement of Michelle Smith dated 22 September 2017 coronial brief page 807 and transcript page 187.

[22] Exhibit D, statement of Michelle Smith dated 22 September 2017 coronial brief page 814. This employee's experience included working during the Black Saturday Bushfires in February 2009.

[23] Coronial brief page 424. The longest call answer delay to '000' relating to a request for an ambulance occurred at 6.49pm, when it was reported that the caller waited four minutes and 36 seconds from when they dialled '000' until an ESTA call-taker answered. ESTA's ambulance call answer speed performance target time is to answer 90% of all calls recorded over a calendar month within five seconds. According to evidence provided at inquest ESTA regularly meets this target. Transcript page 354.

[24] Coronial brief page 424. Exhibit D, statement of Michelle Smith dated 22 September 2017 coronial brief pages 815-817. Transcript page 260. Ms Michelle Smith explained that a Priority 0 event means an imminent threat to life and a Priority 1 event means that urgent assistance is required. Both are 'Code 1 events' which means they are events requiring ambulance responding with lights and sirens. Transcript pages 242 and 275. Adjunct Associate Professor Michael Stephenson **(A/Prof Stephenson)** of AV explained that patients reporting an acute exacerbation of asthma are usually treating as a Priority 1. However if the patient's breathing is severely compromised, they will be treated as a Priority 0. Transcript page 276.

(b) arranging with the Metropolitan Fire Brigade [MFB] for fire units to attend some Priority 1 events as well as the Priority 0 events they would usually attend;[25]

(c) arranging with the Victoria Police for police units to attend appropriate events to conduct welfare checks where ESTA call-takers had been unable to re-establish contact with callers who had called earlier;[26] and

(d) AV directing that despite warnings being in place in relation to AV crews requiring welfare breaks (that in normal circumstances can only be interrupted for Priority 0 events) Priority 1 events could also be dispatched to such crews, as well as Priority 0 events.[27]

19. Nevertheless, the demand for Code 1 responses continued to outstrip available resources.[28] Despite AV requesting and receiving assistance from partner agencies, their capacity to respond to Priority 0 events within their 15 minute target timeframe was achieved in only 57% of cases.

20. Having noticed the increased number of calls requesting ambulance assistance, senior ESTA personnel recalled staff from breaks, instructed mentors to take over call management from trainees, and a number of the day-shift call-takers continued working into the evening to assist in meeting the demand.[29] Furthermore, team leaders assisted with call-taking and dispatch rather than undertaking their usual supervisory duties.

21. At about 6.18pm, an ESTA team leader sent the first of four text messages which was addressed to police call-takers requesting additional staff to return to work due to storm activity. The second text message was sent at 6.48pm, the third at 7.46pm and the fourth at 7.50pm and were addressed to ambulance call-takers.[30]

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[25] Ms Smith explained that the MFB provides an emergency medical response **(EMR)** service to Priority 0 events that occur within a defined geographical area. On 21 November 2016, following communications between the ESTA, AV and the MFB, it was agreed that fire appliances would also respond to Priority 1 events deemed appropriate by the AV duty clinician. Transcript page 195. After 8.00pm, the MFB were sent to eleven Priority 1 events as well as Priority 0 events. Transcript page 246.

[26] Exhibit D, statement of Michelle Smith dated 22 September 2017 coronial brief page 815.

[27] Transcript page 197.

[28] A/Prof Stephenson explained that the increased number of Priority 0 and Priority 1 cases (where Code 1 response is required) on 21 November 2016 was a gross distortion of what would be seen on a 'business as usual' evening/night. Transcript pages 276-277.

[29] Exhibit D, statement of Michelle Smith dated 22 September 2017 coronial brief pages 819-811. The shift changeover between the ESTA staff rostered for ambulance call-taking and dispatch occurs daily at 6.00pm and 6.00am, with staggering for some staff to account for part-time/casual working arrangements and forecast variations in call demand.

[30] Exhibit D, statement of Michelle Smith dated 22 September 2017 coronial brief page 812. It should be noted that ESTA call–takers are specifically trained in police, ambulance or fire call-taking or dispatch, with only some operators

22. All ESTA staff breaks were cancelled between 6.30pm and 9.00pm.[31]

23. ESTA dispatchers focussed on dispatching the events as they were presenting, based on the event determinant and priority that had been provided to them, rather than reviewing the relevant associated information, as was required when it was business as unusual.[32]

24. These measures, combined with the willingness of ESTA operators to come into or continue working after the end of their shifts, enabled ESTA to double the number of call-takers logged in to the system and able to process calls by 7.00pm.[33]

25. A commensurate peak in demand was experienced by Victorian hospitals. In particular, the Emergency Departments of Geelong and Melbourne-based public hospitals saw an increase of nearly 50% in anticipated presentations and these predominantly involved respiratory-related presentations.[34]

26. At about 8.10pm, the State Health Coordinator (DHHS) was notified that AV was experiencing a surge in demand. At that stage, neither the State Health Coordinator nor the State Health Commander (AV) knew about the cause of the surge.[35]

27. The State Health Coordinator approved the use of private hospital beds for public patients.[36]

28. Anecdotal evidence suggested that a large number of individuals attended community pharmacies due to lengthy waiting times for ambulances and took themselves to local emergency departments. Community pharmacies assisted with provision of medication and advice. Some remained open beyond their usual business hours and many redistributed salbutamol (Ventolin) to areas where it was needed.[37]

29. Key decision-makers on the evening of 21 November 2016 were the State Health and Medical Commander (DHHS), the State Health Coordinator (DHHS)[38] and the State Health Commander (AV). Management and decision-making between the DHHS and AV occurred

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being multi-skilled. Where available, multi-skilled call-takers were transferred from fire to ambulance incidents during the TA event.

[31] Exhibit D, statement of Michelle Smith dated 22 September 2017 coronial brief page 813.

[32] Transcript page 193.

[33] Exhibit D, statement of Michelle Smith dated 22 September 2017 coronial brief page 812. Transcript page 186.

[34] See discussion of the Chief Health Officer's report at paragraphs 123 and following below.

[35] Transcript pages 430-431.

[36] Transcript page 431.

[37] Coronial brief page 446. I note that salbutamol is marketed in Australia as Ventolin, among other brand names. Ms McMillan (DHHS) explained that early in the morning of 22 November 2016, city hospitals contacted her as the State Health Coordinator with concerns about their diminishing salbutamol supply. Ms McMillan contacted the Pharmacy Guild, who directed her to supplemental supplies, which were purchased and distributed accordingly. There are now formalised processes to permit such purchase at any time of day or night. Transcript pages 452-453.

[38] These two DHHS roles had been assigned to one person. Transcript page 377.

remotely, primarily through telecommunications and emails. Command and control arrangements for the TA event were formalised on the morning of 22 November 2016.[39] The Chief Health Officer was the Class 2 State Controller for TA event.[40]

30. At about 9.48am on 22 November 2016, the Emergency Management Commissioner requested a state coordination team meeting following advice that a number of deaths had been attributed to TA.[41]

31. It is in the context of the thunderstorm with its associated surge in demand for emergency ambulances and over-stretched hospital emergency departments that Mr Papadopoulos and the nine other Victorians suffered exacerbations of asthma, respiratory distress and the insults which subsequently led to their deaths in the hours, days and even weeks that followed.

THE PURPOSE OF A CORONIAL INVESTIGATION

32. The purpose of a coronial investigation of a reportable death[42] is to ascertain, if possible, the identity of the deceased person, the cause of death and the circumstances in which death occurred.[43] Mr Papadopoulos' death clearly fell within the definition of a reportable death in section 4 of the Act as his death occurred in Victoria and was unexpected.[44]

33. The cause of death refers to the *medical* cause of death, incorporating where possible the mode or mechanism of death. For coronial purposes, the circumstances in which death occurred refers to the context or background and surrounding circumstances, but is confined to those circumstances sufficiently proximate and causally relevant to the death, and not all the circumstances which might form part of a narrative culminating in death.[45]

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[39] Coronial brief pages 439-440.
[40] Coronial brief pages 456-457. Transcript page 379.
[41] Transcript pages 379 and 380-381 and coronial brief pages 456-457. The Emergency Management Commissioner has a legislative responsibility for coordination, consequence management and recovery coordination. The State Coordination Team supports State coordination and the function of the Emergency Management Commissioner.
[42] The term is exhaustively defined in section 4 of the Act. Apart from a jurisdictional nexus with the State of Victoria, a reportable death includes a death that appears to have been unexpected, unnatural or violent or to have resulted, directly or indirectly, from an accident or injury; and deaths that occur during or following a medical procedure where the death is or may be causally related to the medical procedure and a registered medical practitioner would not, immediately before the procedure, have reasonably expected the death (sections 4(2)(a) and (b) of the Act, respectively).
[43] Section 67(1) of the Act.
[44] Section 4 of the Act.
[45] This is the effect of the authorities, for example *Harmsworth v The State Coroner* [1989] VR 989; *Clancy v West* [1994] VSC (17 August 1994) per Harper J.

34. The broader purpose of any coronial investigation is to contribute to the reduction of the number of preventable deaths through the findings of the investigation and the making of recommendations by Coroners, generally referred to as the Coroner's prevention role.[46]

35. Coroners are empowered to report to the Attorney-General in relation to a death; to comment on any matter connected with the death that they have investigated, including matters of public health and safety and the administration of justice; and to make recommendations to any Minister or public statutory authority on any mater connected with the death, including public health and safety or the administration of justice.[47] These are effectively the vehicles by which the Coroner's prevention role can be advanced.[48]

36. It is important to stress that Coroners are not empowered to determine the civil or criminal liability arising from the circumstances in which a reportable death occurred, and are specifically prohibited from including in a finding or comment any statement that a person is, or may be, guilty of an offence.[49]

INVESTIGATION AND SOURCES OF EVIDENCE

37. This finding is based on the totality of the material the product of the coronial investigation of Mr Papadopoulos' death. That is, the initial coronial brief of evidence compiled by Senior Constable Noah Beasley, the combined TA cluster brief compiled by my assistant, Leading Senior Constable Duncan McKenzie, from the Police Coronial Support Unit, the statements, reports and testimony of those witnesses who testified at inquest and any documents tendered through them, and the final submissions of Counsel.

38. Particular mention should be made of the several prior inquiries undertaken by agencies impacted by the TA event, namely AV, ESTA, the Victorian Department of Health and Human Services **(DHHS)**, as well as the Inspector General for Emergency Management **(IGEM)**. These will be discussed in some detail below. Suffice for present purposes to say that, to a significant extent, the inquest involved an examination of the methodology and rigour of these prior inquiries. Such an examination is necessary in order to give effect to the

[46] The *prevention role* is now explicitly articulated in the Preamble and the purposes of the Act, compared with the *Coroners Act 1985* (Vic), where the role was generally accepted as implicit.
[47] See sections 72(1), 67(3) and 72(2) of the Act regarding reports, comments and recommendations respectively.
[48] See also sections 73(1) and 72(5) of the Act which requires publication of coronial inquest findings, comments and recommendations and responses respectively.
[49] Section 69(1) of the Act. However, a Coroner may include a statement relating to a notification to the Director of Public Prosecutions if they believe that an indictable offence may have been committed in connection with the death. See sections 69(2) and 49(1) of the Act.

exhortation to avoid unnecessary duplication of inquiries or investigations pursuant to section 7 of the Act.[50]

39. Furthermore, the existence of these prior inquiries or investigations expedited the coronial investigation of the death/s and facilitated a systemic approach, for example by obviating the need to obtain statements from each call-taker, each paramedic, each medical practitioner involved in the clinical management of the deceased before 21 November 2016 or in the aftermath of the TA event, and obviating the need to call each or any of them to give evidence at the inquest.

40. All of this material, together with the inquest transcript, will remain on the coronial Court file.[51] In writing this finding, I do not purport to summarise all of the material and evidence, but will refer to it only in such detail as is warranted by its forensic significance and in the interests of narrative clarity.

FINDINGS AS TO UNCONTENTIOUS MATTERS

41. There were no contentious issues surrounding Mr Papadopoulos' identity, nor about the date and place of his death. I accordingly find, as a matter of formality, that Apollo George Papadopoulos, born 30 May 1981, late of an Epping address, died at the Northern Hospital, 185 Cooper Street, Epping, 3076 on 21 November 2016.

MEDICAL CAUSE OF DEATH

42. On 23 November 2016, Dr Victoria Francis, a Forensic Pathologist practising at the Victorian Institute of Forensic Medicine **(VIFM)**, conducted an external examination of Mr Papadopoulos's body. Dr Francis provided a written report, dated 25 November 2016, which concluded that Mr Papadopoulos died from acute asthma.[52]

43. Dr Francis commented that the post-mortem CT scan **(PMCT)** showed a small left anterior pneumothorax with decompression lines and some cerebral oedema.[53] Dr Linda Iles, Head

[50] Entitled 'Avoiding unnecessary duplication' section 7 reads as *follows 'It is the intention of Parliament that a coroner should liaise with other investigative authorities, official bodies or statutory officers – (a) to avoid unnecessary duplication of inquiries and investigations; and (b) to expedite the investigation of deaths and fires.'* It follows that a Coroner should at least assess the methodology and rigour of the inquiries in order to ascertain if they are on all fours with a coronial investigation (which focuses on factors that caused or contributed to the death/s under investigation and/or prevention as that term is used in this jurisdiction) or at least, if they cover something of the same field.
[51] From the commencement of the Act on 1 November 2009, access to documents held by the Coroners Court of Victoria is governed by section 115 of the Act.
[52] Coronial brief page 68.
[53] Coronial brief page 68.

Forensic Pathologist at the VIFM, explained these findings are reflective of resuscitation attempts.[54]

44. Dr Francis opined that Mr Papadopoulos's death was due to natural causes.[55]

45. Toxicological analysis of post mortem[56] specimens taken from Mr Papadopoulos identified methylamphetamine and amphetamine[57] but there is no suggestion that these substances caused or contributed to his death.

46. Further specimen testing was completed, namely blood tests for allergen specific Immunoglobulin E **(IgE)** and Radioallergosorbent Test **(RAST)** (Cap Test). A Melbourne Health Shared Pathology Services report dated 9 May 2017 identified that the total IgE present in Mr Papadopoulos's specimen was 120kU/L.[58] The RAST identified a Rye Grass result of 46.5kUA/L, and an *Alternaria alternata* mould result of 7.57kAU/L.[59]

47. Dr Linda Iles, Head of Pathology at the VIFM, gave evidence at inquest about post-mortem examinations generally and about this testing specifically.[60] She explained that there are no particular asthma specific finding on PMCT. Lung hyper-inflation is suggestive of asthma but in the setting of prolonged resuscitation attempts, PMCT findings for asthma tend to be non-specific. Dr Iles testified that the utility of PMCT is in eliminating other potential causes of death. Having done so, in the setting of known asthmatic, a report that they were suffering from asthma immediately prior to death, are together fairly strongly diagnostic of an asthma related death.

48. Dr Iles testified about the difference between ante mortem and post-mortem specimens. The former are taken during life, generally from patients who were admitted to hospital and survived for some hours or days after the initial insult, while the latter are taken from those patients who did not make it to hospital or were only admitted briefly so that there was not the

[54] Transcript page 150.
[55] Coronial brief page 68.
[56] Transcript page 151. Prof Douglass indicated that it was her understanding that specimens were obtained from the majority of the deceased tested ante mortem, at the time of death, or shortly after. She commented that specimens obtained at those times would usually be accepted as being quite reliable. Transcript page 26.
[57] Coronial brief page 70.
[58] Coronial brief page 80. I note that the reference range is stated to be 0-120kU/L. Prof Douglass explained that the IgE varies in the normal population from 0 to 120 international units per litre. Normal level is considered as less than 120. It is very common for it to be elevated in those with allergic disease. Common levels expected in someone with hay fever or asthma is approximately 200-300kU/L and in the thousands for someone with eczema, inquest transcript, p 22. Prof Douglass noted that Mr Papadopoulos's results were elevated above the normal range. Prof Douglass' report 'Expert Report Asthma Cluster Deaths' dated 17 October 2017 page 26. Coronial brief page 907.
[59] Coronial brief, p 80. I note that there is a staged reference range, where (units measured in kUA/L) undetected is <0.35, 0.35-0.7 is low, 0.7-<3.5 is moderate, 3.5-<17.5 is high and 17.5 -<99 is very high. Professor Douglass explained that Mr Papadopoulos's rye grass sensitivity was very high, and that he was sensitised to *Alternaria* at a high level.
[60] Transcript page 144 and following.

time or exigency to take admission blood specimens. Furthermore, her evidence was that IgE is a relatively large molecule that is stable during the post-mortem period and thought to be a reliable indicator of IgE levels during life.[61]

49. In terms of the significance of IgE and RAST testing, Dr Iles testified that IgE levels tend to be elevated (relevantly) in atopic individuals, that is those who tend to be allergic and that RAST testing indicates sensitivity to a particular allergen. Otherwise she deferred to the evidence of Professor Jo Anne Douglass.[62]

50. Professor Jo Anne Douglass **(Prof Douglass)** is an immunologist and respiratory physician engaged by the Court to provide an independent expert opinion in relation to Mr Papadopoulos' death as well as the deaths of the other nine Victorians.[63] Prof Douglass provided a written report with several appendices and a copy of her curriculum vitae, all of which were included in the coronial brief, and was the first witness to give evidence at inquest.[64]

51. Prof Douglass explained that IgE is one class of five of the protein antibodies that are produced to defend the body against foreign infections and other things. IgE is the particular hallmark of allergic reactions and can be measured in total, as well as in relation to the component of IgE which is specifically directed to one allergen. About 46% of people will produce IgE to common environmental substances. In Victoria, these are most commonly house dust mites and rye grass pollen. According to Prof Douglass, IgE varies in the normal population from 0 to 120 international units per litre, reflected in the relevant testing reference range of 0-120kU/L. It is very common for IgE to be elevated in those with allergic disease. Common levels expected with hay fever or asthma are within the range of 200-300kU/L and in the thousands for someone with eczema.[65]

52. The test commonly used to detect the amount of IgE directed to a specific allergen is called a RAST (former name) or CAP (current name) test. The expected RAST or CAP result for an

[61] Transcript page 147. Dr Iles explained that it was not so much the stability of the IgE molecule that caused difficulties but the inability on occasions to obtain serum (the non-cellular part of blood) from which IgE is measured.
[62] Transcript page 146. Dr Iles' evidence was specific to the deaths under investigation but alluded to other causes for an elevated IgE in other contexts.
[63] Transcript pages 16-17. Prof Douglass lists the documents provided to her on which her expert report was based.
[64] Among her many credentials, Prof Douglass holds the degrees of Bachelor of Medicine, Bachelor of Surgery, a doctorate in medicine, is a Fellow of the Thoracic Society of Australia and New Zealand, is Head of the Department of Allergy and Clinical Immunology at the Royal Melbourne Hospital and is an Honorary Clinical Professor at the University of Melbourne. Prof Douglass' report commences at page 807 of the coronial brief, appendices pertaining to each deceased commence at page 882, a compilation table of common features at page 908 and her curriculum vitae at pages 909-929.
[65] Transcript page 21-22.

individual who is not allergic is zero or less than 0.35UA/L. At the other end of the spectrum, a level of 50UA/L is considered extremely high[66] with the caveat that the fact that a person has the specific antibody does not always mean that they will react.

53. According to Prof Douglass, a course of oral corticosteroid administered over three to six months has the potential to reduce both total IgE and specific RAST/CAP levels, as do massive blood transfusions in an acute setting. However, in relation to the circumstances of Mr Papadopoulos and the other deceased the subject of the inquest, Prof Douglass considered that the blood samples obtained and tested (whether ante mortem or post-mortem) would have provide a credible IgE and RAST/CAP levels despite the provision of acute treatment.[67]

54. Prof Douglass commented that Mr Papadopoulos's total IgE was just above the normal range, however his rye grass pollen results were very high (nearly half of which was attributable to rye grass pollen), meaning that he was strongly sensitised to rye grass, which corresponded with his previous springtime asthma presentations.[68]

55. Prof Douglass also commented on Mr Papadopoulos's sensitisation to *Alternaria* as being 'unusual', and said '…one wonders if that may have been a co-factor of the event'.[69]

56. Based on all the available evidence, I find that the medical cause of death of Mr Papadopoulos is acute asthma.

PRIOR CLINICAL MANAGEMENT OF MR PAPADOPOULOS

57. Mr Papadopoulos was diagnosed with asthma as a child. There are multiple reports of him presenting to his General Practitioner with active asthma in November 1993, 1994 and 2003 and October 1996 and 2004.[70] At this practice, Mr Papadopoulos presented 12 November 1992 and thereafter twice in that month for an asthma flare-up requiring an emergency presentation to the Austin Hospital, when he was treated with preventer medication.[71] It is notable that all of his attendances to his General Practitioner were for asthma and all but one of these occurred in the springtime.[72]

[66] The scale is not linear but logarithmic so that 50 is extremely high. Proportionality is important so that if IgE is quite low then even a RAST level of 3 or 4 may be significant. Transcript page 23.
[67] Transcript pages 24-25.
[68] Transcript page 46.
[69] Ibid.
[70] Transcript page 41.
[71] Prof Douglass' report 'Expert Report Asthma Cluster Deaths' dated 17 October 2017 coronial brief page 906.
[72] Ibid.

58. The Caulfield Medical Practice records (1987-2014) indicate that there was '*very thorough care with objective assessment of Mr Papadopoulos's asthma as a teenager'*, with annual reviews and regular preventer prescription. Following 2003, there are a few medical contacts with a single appointment for asthma in 2014.[73]

59. Mr Papadopoulos had been prescribed a preventer (Pulmicort) however it is notable that there were neither Medicare attendances nor recorded PBS items for prescriptions filled from 24 November 2014 until 21 November 2016.[74]

60. In 2003, Mr Papadopoulos' General Practitioner reported that he had hay fever, which he treated with over-the-counter antihistamine medication.[75] His mother reports that his hay fever was his main asthma trigger. [76] He used Salbutamol for his asthma,[77] which he carried with him and which he purchased from a local chemist.[78]

ACCESS TO MEDICAL ATTENTION ON 21 NOVEMBER 2016

61. On 21 November 2016, Mr Papadopoulos attended work as usual in the morning and was observed to be well. He worked outdoors and was exposed to the weather. His boss subsequently informed his mother that he was seen using his reliever medication on multiple occasions during the day.[79]

62. Mr Papadopoulos finished work at about 5.30pm and was driving home when began feeling unwell, calling into a friend's home in Epping. From there, he telephoned his mother at about 6.10pm, asking her to come to his friend's home as he was unwell. He declined an offer to call for an ambulance at this stage. It should be noted that his friend's home was located some four kilometres from the Northern Hospital. [80]

63. Mr Papadopoulos's mother arrived at about 6.20pm and found her son distressed, leaning against his car, objectively short of breath, blue in the face and unable to speak. She called 000 at 6.50pm and an ESTA call-taker answered the call at 6.53pm. An AV unit was dispatched at 6.54.48pm from a distance of about 25 kilometres. The first AV unit arrived at

[73] Transcript page 43.
[74] Transcript page 41. Prof Douglass explained the significance of this to be that he had not had a preventer medication for two years, suggesting that he was not regularly using preventer medication (preventers are only dispensed with a prescription). Transcript page 42.
[75] Transcript page 42.
[76] Transcript page 42.
[77] Transcript page 42.
[78] Prof Douglass' report 'Expert Report Asthma Cluster Deaths' dated 17 October 2017 coronial brief page 906.
[79] Statement of Emma Papadopoulos dated 8 February 2017 coronial brief page 86.
[80] Statement of Emma Papadopoulos dated 8 February 2017 coronial brief pages 86-87. Prof Douglass' report 'Expert Report Asthma Cluster Deaths' dated 17 October 2017 coronial brief page 906.

7.16.04pm.[81] After calling for an ambulance and prior to the ambulance's arrival, two ambulances with lights and sirens were observed by Ms Papadopoulos driving past, presumably *en route* to the Northern Hospital.[82]

64. Mr Papadopoulos collapsed just as the ambulance arrived at about 7.16pm. He was found to be pulseless and CPR commenced. A Mobile Intensive Care Ambulance was diverted from another Code 1 event and arrived at 7.24pm. Intubation was difficult due to inhaled vomitus. Ventilation was difficult and a pneumothorax was suspected. A drainage tube with a one-way valve was inserted to relieve this. Ventilation could only be achieved for short periods with periods of apnoea in between to permit trapped gas to escape.[83] High doses of intravenous adrenaline were given as per the AV resuscitation protocol.[84]

65. Mr Papadopoulos was taken to the Northern Hospital about 8.02pm, arriving at about 8.07pm. Mr Papadopoulos was in full cardiorespiratory arrest upon arrival and continuous automated CPR was in progress.[85] He had an endotracheal tube *in situ* and was receiving positive pressure ventilation manually *via* a standard bag valve mask device. It was determined that his arrival to the Emergency Department **(ED)** occurred 50 minutes after the onset of cardiac arrest.[86]

66. Advanced life support measures were continued in the ED for a further ten minutes, after which CPR attempts ceased on the basis of the attending clinicians' assessment of medical futility and a very high probability of severe, non-reversible hypoxic brain injury. Mr Papadopoulos was declared deceased at 8.16pm.[87]

THE FOCUS OF THE CORONIAL INVESTIGATION

67. At a mention hearing on 19 October 2017 and based on the investigation to date, I foreshadowed the scope of the inquest and indicated those matters that I did not propose to

[81] IGEM Investigation Report coronial brief page 647 and inquest transcript 24 August 2018 pages 36-37.
[82] Prof Douglass' report 'Expert Report Asthma Cluster Deaths' dated 17 October 2017 coronial brief page 906.
[83] Prof Douglass explained that there are two reasons why it can be hard to ventilate an asthmatic – either the airways are constricted/closed or the airways are open but there is gas trapped, meaning the lungs are at their maximum limited by the physical confines of the thorax (as the chest wall collapses during expiration, bronchoconstriction worsens); inquest transcript, p 45.
[84] Prof Douglass' report 'Expert Report Asthma Cluster Deaths' dated 17 October 2017 coronial brief page 906.
[85] Statement of Dr Alison Dwyer dated 12 April 2017 coronial brief page 83.
[86] Statement of Dr Alison Dwyer dated 12 April 2017 coronial brief page 83.
[87] Prof Douglass' report 'Expert Report Asthma Cluster Deaths' dated 17 October 2017 coronial brief page 906. Statement of Dr Alison Dwyer dated 12 April 2017 coronial brief pages 83-84.

further investigate.[88] In large part the latter was informed by section 7 of the Act and the inquiries or investigations that had been undertaken by other entities to date which were briefly canvassed at the mention hearing.

68. I informed the parties that it was my view that the identity and medical cause of death of each of the deceased were not contentious. Furthermore, that in the context of the surge in demand for emergency resources in the immediate aftermath of the TA event, I did not propose to investigate the adequacy of the clinical management and care provided to the deceased.[89] I indicated that it was apparent from the various investigations/reviews undertaken and Prof Douglass' expert report that there had been a lot of learnings since the TA event,[90] but that I intended to approach the BOM to identify a witness/meteorologist who could speak to the current understanding of the TA phenomenon from their perspective and to testify about the extent to which they could are able to contribute to a public warning system.[91]

69. At the mention hearing, Counsel representing the family of Ms Carnevali (Marsh) raised concerns about the adequacy of ESTA's response to the emergency telephone call placed by them, and in particular the repeated assertions by the ESTA call-taker that an ambulance was on its way when it was not. I assured the family that this issue had been identified in the various inquiries/investigation and had already been addressed.[92]

70. The scope and/or focus of the coronial investigation articulated at the mention hearing have not changed significantly since and were:[93]

    (a) appraisal of the rigour of the inquiries/investigation already undertaken;

    (b) what was known about the TA phenomenon prior to 21 November 2016 and by whom?; and

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[88] The parties legally represented at the mention hearing were (in no particular order) Eastern Health, Northern Health, ESTA, AV, the DHHS and the family of Ms Hope Carnevali (Marsh). Several other family members of other deceased were also in attendance but did not seek leave to formally participate in the mention hearing.

[89] Transcript of mention hearing dated 19 October 2017 page 10. (Reiterated at Inquest Transcript page 14.) I note that the family of Mr Priyantha Peiris had raised concerns about the clinical management and care provided to him at the Northern Hospital. Statement of Mrs Ann Peiris dated 15 February 2017, coronial brief pages 239-243.

[90] Transcript of mention hearing dated 19 October 2017 page 10.

[91] Transcript of mention hearing dated 19 October 2017 page 12.

[92] Transcript of mention hearing dated 19 October 2017 page 12. The court was subsequently informed that the family did not propose participating in the inquest. I note that Ms Voong expressed similar concerns at the directions hearing on 18 May 2017 at page 13, as did Mrs Peiris in her statement dated 15 February 2107 at pages 239-243 of the coronial brief.

[93] Transcript of mention hearing dated 19 October 2017 page 8 and inquest transcript page 14. Also reiterated at the directions hearing held on 18 May 2018, shortly before the commencement of the inquest – see transcript of the directions hearing at page 5. I note that the parties represented at the directions hearing on 18 May 2018 were the same parties represented at inquest – ESTA, AV, DHHS and BOM.

(c) what has been learnt since the events of 21 November 2016 and the days following in terms of:

(i) the optimal clinical management and care of people with asthma and/or hay fever generally and in anticipation of a TA event;

(ii) the ability to predict or forewarn the public of a similar event in the future and the form such warnings should take;

(iii) the preparedness of ESTA and AV in particular for another similar surge in demand for ambulance services; and

(iv) the preparedness of Victorian public hospitals for another similar surge in numbers presenting to emergency departments.

71. Most of the inquiries and investigations already undertaken by the parties are in the public domain and therefore readily accessible in their entirety. While I do not propose to detail the inquiries and investigations already undertaken by the parties in this finding, a brief outline of key findings and recommendations is included for completeness.

EMERGENCY SERVICES TELECOMMUNICATIONS AUTHORITY (ESTA)

72. Michelle Marie-Anne Smith **(Ms Smith)** is the Executive Manager of Operations at the Tally Ho State Emergency Communications Centre with oversight of the Ambulance Victoria portfolio. Ms Smith provided two statements and gave evidence at the inquest on the ESTA's behalf. Ms Smith explained that the IGEM has responsibility for oversight of the ESTA's non-financial performance and therefore, whenever there is a significant event, IGEM is required to investigate the ESTA's performance and the ESTA is required to cooperate with this investigation.[94]

73. Additionally, ESTA decided to conduct an independent post-incident review to investigate their response to the TA event on the night so as to identify any learnings they could take from the event [the ESTA review]. They engaged Price Waterhouse Coopers **(PWC)**, in particular for their data analytical capacity, to assist them to produce an accurate representation of what occurred on the night.[95] A copy of the ESTA review entitled

[94] Transcript pages 176-177.
[95] Transcript page 177.

'*Emergency Services Telecommunications Authority – Thunderstorm Asthma – Post Incident Review*"' and dated January 2017 is included in the coronial brief in its entirety.[96]

74. Amongst its key initial observations, the ESTA review identified a number of positives. They noted that experienced staff showed initiative to implement ad hoc process to reduce the impact of the surge; there was diligent inter-agency collaboration at ESTA with AV, MFB and Victoria Police; and a mature major event activity summary report including quality review of events, was prepared in real time.[97]

75. Key initial observations of a more negative nature were also made. These included:

    (a) insufficient resources available to respond to the surge;

    (b) escalation and notification processes were not followed and not performed in a timely way;

    (c) the draft critical incident response plan was found to be overly focused on event type rather than increase number of calls and therefore not formally invoked;

    (d) the absence of established data based triggers led to instinctive decision making which may create an over reliance on key individuals; and

    (e) the lack of a sentinel dashboard to provide early indication of a likely surge and triggers for activating a response.[98]

76. Not surprisingly, the ESTA review identified areas for improvements analogous to the deficiencies identified and prioritised those from highest to lower priority.[99] Among the areas for improvement considered of the highest priority were:

    (a) the development of strategies to increase workforce availability and flexibility for rapid response that addresses people, technology/facilities and process;

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[96] Coronial brief pages 826-868.
[97] Coronial brief page 829.
[98] Ibid. The Executive Summary at coronial brief page 828 includes the following – '*The response of ESTA staff was commendable – aided by practical decision making on the ground by experienced people and, fortuitously, by the vent commencing during a change in shift which meant that some additional staff were on site to respond to heightened call activity. Performance analysis has highlighted the criticality of being able to rapidly scale up the number of staff within the State Emergency Control Centres to handle the additional call volume and therefore the importance to ESTA of rapid access to its staff and additional resourcing to respond to events similar/greater in magnitude or more sustained in nature. A number of other observations led to recommendations to refresh/strengthen critical incident response planning, escalation procedures and dashboard reporting/early warning systems…*'
[99] Coronial brief pages 830, 856 and following.

(b) increased call-taking and dispatching skills/multi-skilling across higher demand channels and eliciting quicker response from surge workforce;

(c) implementing a real-time dashboard to support timely decision making within the State Emergency Control Centres; and

(d) developing triggers and procedures for activation during severe/extreme events (including recorded voice announcements, 'urgent disconnect' and the provision of ambulance estimated time of arrival information, subject to the approval of relevant stakeholders).[100]

77. Ms Smith was on duty at the Tally Ho State Emergency Communications Centre on 21 November 2016. Her evidence about ad hoc arrangements made as the enormity of the surge in calls for ambulances was becoming apparent is encapsulated above.[101] Ms Smith also gave evidence about the ESTA's role, its relationships with AV in particular and about changes made by the ESTA in the aftermath of the TA event aimed at improving the ESTA's performance in future.

78. ESTA was established on 1 July 2005 by the *Emergency Services Telecommunications Authority Act 2004* (Vic) **(the ESTA Act)** as a statutory authority providing State-wide around the clock emergency call-taking and dispatch services for police, fire, ambulance and the VicSES. In the 2017 financial year, the ESTA managed close to 2.6 million calls and dispatched emergency resources to over 2.1 million events.[102]

79. The ESTA call-takers receive calls for ambulance assistance from the public *via* Telstra's dedicated emergency '000' number. The ESTA delivers services to each of the emergency services in accordance with service specific administrative arrangements made pursuant to the ESTA Act. AV is required to provide the ESTA with its service delivery requirements **(SDRs)**, which comprise Communications Standard Operating Procedures **(CSOPs)** and other supporting documents.[103]

[100] Ibid. See also the evidence of Ms Smith and A/Prof Stephenson.
[101] See Introduction, especially at paragraphs 11 and following and transcript page 186 and following. This includes the calls serviced on 21-22 November 2016.
[102] Exhibit D, statement of Michelle Smith dated 22 September 2017 coronial brief page 803. Transcript pages 175 and following.
[103] Ibid.

80. Using these source documents, the ESTA develops its standard operating procedures **(SOPs)** which, effectively, operationalise the SDRs, providing clear and concise instructions to all ESTA staff operating the CAD system, in particular ambulance call-takers and dispatchers.[104]

81. Through their SDRs AV require the ESTA to employ a formal, structured question and answer methodology established by the International Academies of Emergency Medical Dispatch [the Academy]. Originally manual and entitled the Medical Priority Dispatch System, the software version of the protocol is currently known as ProQA. Based on a caller's main reported problem, the call-taker selects from one of 32 ProQA protocols which then prescribes a series of questions designed to elicit information relevant to the problem. Based on those answers, ProQA arrives at an event determinant (or event type), which the call-taker will input into the CAD system for dispatch. The event determinant is used to determine the priority to be given to dispatching an event in accordance with an AV sanctioned response grid. ProQA also provides call-takers with post-dispatch and, depending on the event, pre-arrival instructions to be relayed to the caller.[105]

82. As one indication of the impact of the surge, Ms Smith's testified that during the TA event, the ESTA was unable to meet its metropolitan call-answer speed and performance target of five seconds for most of the received calls. The longest call duration between the '000' call to Telstra and an ESTA call-taker answering the call was determined to be four minutes and 36 seconds. Ms Smith's evidence was that the cause of these delays was that every ambulance call-taker was already engaged in a live call and unavailable to answer new incoming calls.[106]

83. Ms Smith gave evidence about a number of aspects of existing ESTA/AV processes that were identified by the inquiries and investigations already undertaken as having a negative impact on ambulance call-taking during the TA event and represented potential areas for future improvement.

84. At the time of TA event, ProQA required call-takers to remain on the line when the call was coded Priority 1 and the patient was either not alert, unstable or worsening. In such circumstances the call-taker was to provide pre-arrival instructions and to monitor changes in

[104] Exhibit D, statement of Michelle Smith dated 22 September 2017 coronial brief page 804. Ms Smith explained that the SDRs are a statutory requirement under the ESTA Act. Transcript page 175.
[105] Exhibit D, statement of Michelle Smith dated 22 September 2017 coronial brief pages 804-805. Transcript pages 240-243.
[106] Transcript pages 247-248, 252.

the patient's state.[107] The impact of the surge of calls for ambulances on 21 November 2016 combined with the call duration associated with monitoring and reassessing a patient's condition meant that call-takers could not disengage from calls to take other incoming calls, even where the caller was comfortable monitoring the patient on the basis that they would call back if there was any change while waiting for an ambulance.

85. AV subsequently endorsed changes authorising call-takers to disconnect from Priority 1 events provided there was a second party with the patient and the patient was not unstable or worsening, in which case the call-taker is to stay on the line.[108] Regardless, call-takers are still required to provide all relevant pre-arrival instructions prior to disconnecting.[109]

86. To similar effect, ProQA had embedded "urgent disconnect" scripting which provides clear consistent scripting to provide to callers when disconnecting from calls to answer other calls during times of high workload. As at 21 November 2016, there was no approved policy to support the use of the urgent disconnect scripting[110] and, in any event, as envisaged in ProQA, it is only to be used in limited medical emergencies and unlikely to encompass calls made by or on behalf of any of the deceased the subject of this inquest.[111]

87. In February 2017, the ESTA advised the IGEM that it was working with AV to develop the triggers, workflows and script and governance require to employ urgent disconnect during a surge of calls.[112] As at the time of the inquest, Ms Smith gave evidence that AV had provided a direction around deploying urgent disconnect which was being incorporated into the ESTA's draft policy, and once formally endorsed, call-takers would be trained accordingly and urgent disconnect available as an option during future surges.[113]

88. Thought to allay callers' concerns, AV has mandated that the ESTA's ambulance call-takers use specific phrases during '000' calls and specific 'exit scripts' when they are ending a call.

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[107] Exhibit D, statement of Michelle Smith dated 22 September 2017 page 20. I am advised that the majority of events requesting ambulance assistance for shortness of breath with respiratory or asthma-related symptoms are Priority 1 events by default.
[108] Exhibit D, statement of Michelle Smith dated 22 September 2017 coronial brief page 823. As ESTA is Academy-accredited, it has to comply with academy standards unless there is a local policy in place endorsing otherwise, with sign off from the AV medical director.
[109] Exhibit D, statement of Michelle Smith dated 22 September 2017 coronial brief page 824.
[110] Ibid and transcript page 248. Ms Smith's evidence was that she and her AV counterpart Ms Carmen Petrotta considered the urgent disconnect policy, inter alia, and decided that they could not safely deploy the policy for reasons including absence of approval and lack of staff training.
[111] Relevantly, urgent disconnect should not be considered in the presence of priority symptoms (abnormal breathing, chest pain, decreased level of consciousness or serious haemorrhage) where the patient's condition could be life threatening, including …having an allergic reaction which is worsening or when the patient is unstable or not alert. Exhibit D, statement of Michelle Smith dated 22 September 2017 coronial brief page 824.
[112] Exhibit D, statement of Michelle Smith dated 22 September 2017 coronial brief page 825.
[113] Transcript pages 252-253.

According to Ms Smith, the phrases and exit scripts have developed organically over many years in response to feedback and testing in the live call-taking environment and, relevantly, call-takers have no discretion to deviate from the mandated exit script and are not permitted to provide callers with an estimated time of an ambulance's arrival. [114]

89. As at 21 November 2016, the mandated exit script for Priority 0 and Priority 1 calls was "the ambulance is on its way".[115] Ms Smith explained that in business as usual circumstances, this is accurate information as an ambulance would be either be dispatched immediately or would be about to be dispatched, or would be diverted from another event thus prioritising Priority 0 and Priority 1 events. However, during the TA event when the AV fleet was so significantly depleted, dispatch of ambulances to these high priority events had generally not occurred and would not occur for some time, rendering the exit script wholly inaccurate (and arguably misleading).[116]

90. In February 2017, in response to callers experiencing long waiting times during the TA event and reported community uncertainty about whether to wait for an ambulance or arrange their own transportation to hospital, AV approved a revision of its CSOPs in consultation with the ESTA. The resultant changes to exit scripts are summarised in the table below:[117]

	Script as at 21 November 2016	**Updated Scripts**
Surge	N/A	We are experiencing an extremely high demand for ambulance resources at present. If someone is available to provide medical help or you can seek alternative medical assistance, please do so. If you decide to seek alternative medical assistance, please call back to advise.[118]

[114] Exhibit D, statement of Michelle Smith dated 22 September 2017 coronial brief pages 820-821.
[115] Ibid.
[116] Ibid and transcript pages 207-210.
[117] Exhibit D, statement of Michelle Smith dated 22 September 2017 coronial brief page 822. Note that the prohibition on call-takers providing an estimated time of arrival of an ambulance continues. Transcript page 213.
[118] Ms Smith explained that this recorded announcement *when implemented* would be heard by a member of the public prior to the Telstra '000' operator answering a call. Transcript pages 204-205. She explained that the option of using a recorded voice announcement was considered around 9.30pm on 21 November 2016, but was not implemented as calls had already peaked and they did not want to discourage callers from remaining on the line, for example, to receive CPR instructions.

Priority 0	The ambulance is on its way.	Help is being arranged.
Priority 1	The ambulance is on its way.	Help is being arranged.[119]
Priority 2	I've sent the details to the dispatcher to organise the next available ambulance.	I've sent the details to the dispatcher to organise the next available ambulance.

91. The surge script is an innovation as there was no surge script in place on 21 November 2016. The script can only be deployed by the ESTA call-takers with AV authorisation, and when deployed, would be used for all '000' calls during a surge.[120] The hope is that the surge script and changes to the Priority 0 and Priority 1 exit scripts will better equip callers with information to enable them to make independent decisions about their health emergency during periods of surge or high demand for emergency services. [121]

92. Another proposed change to ProQA relates to the instructions call-takers give to callers about CPR pending ambulance arrival. In the usual course of administering CPR for cardiac or respiratory arrest, instructions are to administer compressions before ventilations. However, pursuant to the Academy's guidelines and protocol, CPR instructions for patients with a history of asthma in cardiac arrest provided that ventilations should precede the commencement of compressions.[122] According to Ms Smith's evidence, although this remains the position under the current Version 12.2 of ProQA, the Academy has advised that Version 13 will provide for modified CPR instructions such that the call-taker is to instruct to provide compressions first for patients with a history of asthma in cardiac arrest if a medical decision to that effect has been made.[123]

[119] Ms Smith explained that the 'help' could be from an MFB unit where the event was within an **EMR** Zone or a community ambulance officer, and not necessarily an ambulance in the first instance, so the script did not specify the type of help. Transcript pages 248-250.
[120] Transcript pages 212-213. As at the date of the inquest, Ms Smith advised that the surge script had not been used.
[121] Exhibit D, statement of Michelle Smith dated 22 September 2017 coronial brief page 822. Ms Smith also explained that the changes are anticipated to reduce the likelihood of callers placing further calls seeking estimated time of ambulance arrivals during periods of high demand, thereby freeing up further call-taking capacity.
[122] Exhibit D, statement of Michelle Smith dated 22 September 2017 coronial brief page 825. As at September 2017, Version 13 was anticipated to be deployed in 2018. In the meantime, the ESTA has tabled a request to AV to consider endorsing this (anticipated) change to CPR instructions.
[123] Exhibit D, statement of Michelle Smith dated 22 September 2017 coronial brief page 825.

93. As at 21 November 2016, the ESTA had a Critical Incident Response Plan **(CIRP)** which enabled the ESTA to escalate its functions in response to a critical incident.[124] The CIRP was developed in late 2009 in response to the Black Saturday Bushfires of February 2009,[125] aligns with the State Emergency Management Plan, the State Health Emergency Response Plan and AV's Emergency Response Plan and aims to ensure that adequate planning and coordination occurs to reduce the impact of demand surges on the ESTA's service provision. Reflective of its genesis, the ESTA's CIRP was designed with fire and/or weather-related incidents in mind such that a severe fire or storm could trigger the CIRP. The expectation was that these would lead to an increased demand on police, fire and VicSES resources.[126]

94. The CIRP did not envisage a health-related emergency, even if weather-related as was the TA event.[127] On 21 November 2016, the CIRP was not formally activated. It should be acknowledged, however, that the ESTA staff focused on escalation and meeting surge demands and undertook a number of steps consistent with the CIRP.[128]

95. Following the ESTA review and the IGEM review, the ESTA committed to review its CIRP to ensure that events requiring CIRP activation are clearly defined and that activation occurs at agreed time points. Also, the ESTA has also incorporated a health sub-plan into its CIRP. According to Ms Smith, the most significant change is that activation of the CIRP is no longer confined to fire and weather events but extends to natural disasters, siege situations and any event that impacts service delivery, even if the underlying cause of the event is unknown during the surge.[129]

96. Moreover, the CIRP under its current iteration can be triggered either externally or internally by those on the ground.[130] Ms Smith testified that it was likely that the primary trigger for the CIRP activation would still be email notification or contact from an external agency advising of an event likely to impact emergency services, for example the BOM advising of a forecast weather event, or the DHHS advising of a health-related outbreak. However, the CIRP can

[124] Transcript page 199.
[125] Exhibit D, statement of Michelle Smith dated 22 September 2017 coronial brief page 817. ESTA's CIRP was updated in 2014 and 2016.
[126] Transcript page 199.
[127] Transcript page 199.
[128] Transcript pages 199-200, 247. Ms Smith testified that although internal and external notifications that now occur with CIRP activation did not occur as prescribed during the TA event, '*…otherwise all the actions that would have been required out of the CIRP around staffing levels and everything else were enacted on the night*'.
[129] Exhibit D, statement of Michelle Smith dated 22 September 2017 coronial brief page 819. Transcript page 200.
[130] Transcript pages 219-220.

also be activated internally by the ESTA staff where a surge event becomes apparent to the ESTA staff through a spike in '000' calls or calls of a particular type.[131]

97. Ms Smith testified about a number of the ESTA's processes relevant to staffing levels that had been improved following the TA event, largely but not entirely software-related. First, ESTA updated its 'Whispir' text messaging templates, in particular the messages sent to staff requesting they work overtime (or report urgently for work) so that they are better informed about the reasons underlying the request, presumably in the hope that they will be more responsive in exigent circumstances such as another TA event.[132]

98. A second 'Whispir' application, developed since the TA event, is 'One Click', a red button with pre-formatted staged messages for notification to designated internal and external stakeholders of surge events. Once pressed, the application instantly notifies what is unfolding via Whispir's text messaging and email service, ensuring prompt notification of external stakeholders.[133]

99. Previously, the ESTA's staffing levels were determined by the Work Force Management Team **(WFMT)** applying its experience generally, any particular demands relevant to the period in question (for example New Year's Eve and the AFL Grand Final are generally busy times for '000' call takers) and applying an overlay to address anticipated demand arising from weather forecasts (previously anticipated to increase demand for police and VicSES resources). Since the TA event, the potential for increased demand for ambulances has been recognised.

100. Currently, the DHHS is responsible for notifying the ESTA of a forecast TA event.[134] When the ESTA receives a high alert for TA from the DHHS, the WFMT uses this information to apply an overlay[135] to the calls predicted to be received during the high alert period, and takes

[131] Exhibit D, statement of Michelle Smith dated 22 September 2017 coronial brief page 818 and transcript page 200. Ms Smith noted that the CIRP was activated in January and February 2017 in response to the Bourke Street and Essendon Airport incidents, respectively, with alerts being sent to various emergency services organisations. Transcript page 202.
[132] Exhibit D, statement of Michelle Smith dated 22 September 2017 coronial brief page 819.
[133] Exhibit D, statement of Michelle Smith dated 22 September 2017 coronial brief page 820. Ms Smith explained that external stakeholders include the IGEM, Emergency Management Victoria [EMV] and DHHS. Transcript page 203. A/Prof Stephenson from AV described the 'One Click' application as '*very important*' in providing an '*early warning system in essence that there's an increase in demand*' regardless of cause, to facilitate appropriate response. Transcript page 309.
[134] Transcript page 200.
[135] Ms Smith explained that an 'overlay' functions to re-forecast expected emergency services call volumes. Transcript page 221.

steps to increase staffing levels accordingly, in anticipation of increased demand.[136] The WFMT can also recommend that the CIRP be activated in the absence of a specific alert from an external agency.[137]

101. The ESTA also uses a variety of software tools to monitor real-time information relating to events of a particular type, call activity levels and resource demands, enabling the ESTA to validate alert information received from the DHHS and the BOM. For example, regional Situational Awareness Dashboards provide real-time and interactive information regarding pending[138] and active events and AV unit availability. The dashboards are displayed on large screens throughout the communication centres and enable the ESTA to quickly identify a surge in demand and respond accordingly.[139]

102. The ESTA has also developed greater capacity to develop systemic intelligence. For example, the ESTA now monitors pollen levels, as informed by external agencies, recording this information against the impact it has on the demand for ambulances. This enables the ESTA to identify when an event-type cluster is arising in a particular geographical area.[140]

AMBULANCE VICTORIA (AV)

103. Ambulance Victoria's Chief Executive Officer also commissioned an internal review of AV's TA related activities. The review entitled '*The Ambulance Victoria Debrief and Review Final Report Thunderstorm Asthma – November 2016*' is dated 28 August 2017 **(the AV review)**[141] was undertaken by AV's Emergency Management Unit with oversight from former Victorian Police Deputy Commission, Mr Timothy Cartwright, and a copy is included in the coronial brief.[142]

104. The AV review identified a number of positive steps taken during the TA event which increased its capacity, by moving quickly from managing a routine increase in demand, to an extreme demand surge over a wide geographical area. This included recalling operational staff and requesting additional resources from AV's six contracted non-emergency patient

[136] Ms Smith explained that forecasters in the WFMT look at the number of forecasted calls together with the average handling time and service target levels and compute the number of staff required. Transcript page 187.
[137] Exhibit E, supplementary statement of Michelle Smith dated 22 June 2018 pages 2-4. According to Ms Smith, in practice, with the TA forecasting tools developed since the TA event, if a TA event was forecast, a CIRP could be activated and increased staffing would be arranged in advance of the event. Transcript pages 221-223.
[138] A/Prof Stephenson explained that AV 'pending' events refer to cases where an ambulance cannot be dispatched at that time due to resource unavailability. Transcript page 259.
[139] Exhibit E, supplementary statement of Michelle Smith dated 22 June 2018 pages 5-9.
[140] Exhibit D, statement of Michelle Smith dated 22 September 2017 coronial brief page 820. Transcript page 247.
[141] Coronial brief pages 748-801.
[142] Statement of Mr Justin Dunlop dated 7 September 2017 coronial brief page 746.

transport providers, mobilising key partner organisations such as the MFB to provide first responder support, Victoria Police to conduct welfare checks, and the Field Emergency Medical Officer program to provide in field responders and assistance at hospitals.[143]

105. The key recommendations emanating from the AV review are that AV:

(a) approach the DHHS as the control agency for public health to develop an early warning/predictive system for TA and other public health emergencies;

(b) utilise its Emergency Response Plan **(ERP)** for demand surge of '000' calls;

(c) develop a public messaging plan to inform the community when AV is experiencing high demand; and

(d) approach Emergency Management Victoria **(EMV)** regarding use of Emergency Alert and the State Emergency Warning System by AV for demand surge where they are not the control agency.

106. Briefly, and without doing justice to the detail of the AV review, 34 recommendations were made in support of the key recommendations, all aimed at improving AV's capability to identify and respond to similar surges in demand in the future. As at 1 September 2017, AV had already commenced work on all 34 recommendations, with 17 already implemented and a further 15 planned to be implemented by 1 October 2017.[144]

107. Adjunct Associate Professor Michael Stephenson **(A/Prof Stephenson)**[145] is AV's Executive Director of Emergency Operations and gave evidence at inquest, including speaking to the statement provided by his colleague Mr Justin Michael Dunlop, AV's Acting Director, Emergency Management at the time he made a statement for the coronial brief.[146]

108. Prior to the night of 21 November 2016 and speaking on behalf of AV, A/Prof Stephenson testified that he had not heard of TA, nor had he heard anyone else in AV use the term. In the aftermath, he first heard the term used during a phone call and then an internet search took him to some published literature and a newspaper article about an occasion in 2010 thought to

[143] Executive Summary to the AV review at coronial brief page 751.
[144] Statement of Mr Justin Dunlop dated 7 September 2017 coronial brief page 747. As at that date, recommendations 5 and 26 were outstanding. The former related to post-incident reporting and was expected to be implemented by 1 October 2018 and the latter relating to AV's use of a smartphone application to mobilise registered community responders was scheduled to be implemented by 31 January 2018.
[145] Transcript page 256. A/Prof Stephenson is an Associate Professor at Monash University in two departments – Epidemiology/Preventative Medicine and Community Health/Paramedicine.
[146] Transcript page 257. Statement of Mr Justin Michael Dunlop dated 7 September 2017 coronial brief page 745.

be a TA event. Subsequent discussion in AV about that 2010 incident suggested a 'sustained spike in workload but not to the point that the service was overwhelmed'.[147]

109. According to A/Prof Stephenson, at a broader level, the coincidence of weather changing and ambulance paramedics noting an increase in respiratory cases was not unknown and indeed somewhat normalised. Anecdotally, paramedics would say that it happens but never before to the extent that it was overwhelming in terms of the service AV provide.[148]

110. As regards AV's progress with the recommendations made by the AV review, A/Prof Stephenson testified that as at July 2018, all but three of the recommendations had been implemented. One of the outstanding recommendations relates to post-incident reporting and has no bearing on AV's response to future TA events. The other two outstanding recommendations relate to a public messaging plan to inform the community when AV is experiencing a high demand and the development of a public messaging plan to inform the community of relevant health related emergencies.[149]

111. According to A/Prof Stephenson, as the DHHS is the controlling or lead agency for health-related emergencies, there is a legal impediment to AV acting unilaterally in this space and AV have an arrangement for the DHHS to send out community messages on their behalf. As at the date of the inquest, AV had an in-principle agreement with the Commissioner of Emergency Management that AV will have the authority to directly remit their own messaging in the future. In the interim, in the event of another TA event or surge in demand of a different (or even unknown) aetiology, A/Prof Stephenson was '*entirely satisfied*' that those warnings would go out as envisaged by AV.[150]

112. AV has a range of government and internal key performance indicators and targets that the IGEM considered in its Final Report. A number of these relate to timeliness of the AV response. A/Prof Stephenson conceded that AV resources were overwhelmed during the TA event, despite positive ad hoc steps taken during the TA event to bolster resourcing. By any measure, but particularly on the basis of sheer demand, the number of cases pending and the relatively high acuity of cases, AV was unable to meet its targets for the delivery emergency ambulance assistance.[151]

[147] Transcript pages 257-259.
[148] Transcript page 258.
[149] See Recommendation 26 of the AV review at coronial brief page 798 and transcript pages 267 and following.
[150] Transcript page 267-268.
[151] Coronial brief page 461 and transcript pages 383-394.

113. With respect to AV's performance target of the number of ambulances that arrive at Code 1 events within 15 minutes, the Victorian target is 85%. During the five weeks prior to the TA event, AV was 5% below the performance target on average. On 21 November 2016, AV attended only 57.1% of Code 1 cases within their 15 minute target, due to unprecedented demand. This improved to 70.6% on 22 November 2016.[152]

114. A/Prof Stephenson explained that AV's Emergency Response Plan **(ERP)** is the governing mandate dictating AV's response to incidents in terms of escalation, response and recovery and provides staff with checklists relevant to their roles to ensure that their roles are performed at the expected standard.[153] As at 21 November 2016, neither the ERP nor any of its sub-plans addressed TA events. However, AV had a draft policy in their communications centres dealing with abnormal workload levels. That draft policy, which is very similar to the TA sub-plan developed subsequently, was activated by AV during the TA event.[154]

115. As of August 2017, AV now have a dedicated TA sub-plan to the ERP.[155] The sub-plan describes how and from whom AV receives TA warnings and what AV does as a result of receiving such warnings. As at the time of the inquest, AV receive TA warnings from the DHHS by way of a risk forecast from the Chief Health Officer (or their delegate) two days before a potential TA event. These warnings rate the risk of TA as low, moderate or high and AV response in in accordance with the level of forecast risk. Low risk warnings tend to be a 'heads up' and translate to a 'business as usual' response on the part of AV; moderate risk and high risk warnings trigger specific responses on the part of AV, including escalating by communicating with all internal and external stakeholders so that they are aware of the potential for a TA event and starting preparations such as resourcing the roster, ensuring that fleet and equipment is available, and may also involve a regional health commander's teleconference to assist in coordinating the response.[156]

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[152] Coronial brief page 462 and transcript page 394.
[153] Transcript pages 277-278. A/Prof Stephenson explained that sub-plans are addenda to the ERP formed through the evolution of the ERP because they become known events that AV may be called upon to manage. Sub-plans can refer to other relevant sub-plans, such as the operational logistics sub-plan which provides for vehicle and equipment availability and maintenance or the roster sub-plan which provides for staff resourcing. Transcript pages 295-296.
[154] Transcript page 265. A/Prof Stephenson explained that the ERP is a longstanding arrangement, commencing some time in about the 1980s. Transcript page 277.
[155] Transcript pages 278 and 292 and Exhibit H.
[156] Transcript pages 293-295. A/Professor Stephenson explained that Metropolitan Melbourne has about half of the ambulances in the State, with the others remaining in rural Victoria. As rural regions have less capacity to respond to a large event, their escalation triggers have a lower threshold. He also explained that an example of escalating AV resources could be engaging contracted providers located in Metropolitan Melbourne who normally assist in non-emergency transport of low acuity patients to be activated for code 1 (lights and sirens) cases and transport critically-ill patients to hospital. All those employed by the contracted providers have undertaken recognised registered qualifications, are trained in resuscitation and can usefully be deployed in a surge situation. Transcript pages 301-304.

116. A/Prof Stephenson testified about an AV conducted drill in November 2017, aimed at exercising the ERP and some sub-plans and stated that the results provided '*quite a degree of comfort*' that AV would be able to deploy a significant number of ambulances on the road in a very short period (40 within one hour).[157]

117. Another improvement improvised during the TA event and formalised since by an exchange of letters between AV and MFB involves the deployment of MFB EMR to attend Priority 1 events during a surge as first responders, as well as Priority 0 events attended during 'business as usual' times. The now formalised arrangements mean a more seamless deployment and incorporation of the MFB (and the CFA) into AV's escalation and communication plans for surge events.[158]

118. Although AV had draft plans at the time of the TA event relating to recalling staff, A/Prof Stephenson described the SMS alert system used during high-demand periods as '*not being as functional as they would have liked*'. AV have since changed their staff communication system and use 'Whispir' (as do the ESTA) which he felt was a '*much more failsafe, seamless system which has been tested*'. In addition to the change in software, staff are also now told why they are being recalled, the nature of the emergency and the corresponding ERP/sub-plan being escalated.

119. Other improvements in communications are also underway within AV. These include the rollout of digital radio across metropolitan and rural regions to promote interoperability within their systems, as well as across various emergency services organisations. AV now also has four running radio channels (an increase from three available to them during the TA event) and critical incident channels to address radio congestion.[159]

120. During a surge event, AV has other avenues available to free up ambulance and paramedic resources. One avenue is the AV referral service which can function to hold off lower acuity patients who might otherwise require an ambulance transfer to hospital.[160] Also, under the AV roster sub-plan, AV managers are assigned to hospitals experiencing high demand and

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He also explained that AV do not receive forecasts directly from the BOM but from the DHHS. Transcript page 314. There are a number of sub-plans that overlap and outline AV's response to surge events in a variety of ways either prior to or during an event. These sub-plans refer to AV resources (fleet, equipment, and staff) and formal arrangements with other agencies.

[157] Transcript pages 305-307. A/Prof Stephenson stated that their goal, which matched what they were able to achieve during the drill, was to have about 40 more ambulances on the road within the first hour of an event. This compares favourably with AV's ability to mobilise an extra 48 ambulances (involving 79 paramedics) during the TA event, albeit not within one hour. Transcript page 318.

[158] Transcript pages 315-316.

[159] Transcript page 319.

[160] Transcript page 320.

feed intelligence between hospitals and AV to improve efficiencies, decrease 'ramping' and free up paramedics as soon as possible.[161]

121. A/Prof Stephenson gave evidence that as at 21 November 2016, there was no agreed process in place about the use of a surge script. He conceded by the time consideration was given to the use of a surge script on an ad hoc basis on the night, it was probably too late, as by then cases requiring a Code 1 lights and sirens response had been cleared from the CAD cases pending list.[162]

122. According to A/Prof Stephenson, the impetus behind AV's new surge script was that AV had heard '*loud and clear from the community that they were unhappy about being told that an ambulance was on the way when this was not necessarily so and many complained that they would have made their own arrangements to get to hospital if they knew an ambulance was not coming*'.[163] He noted in this respect that the TA event marked the first time that the community had collectively communicated an expectation that AV would inform them of a surge in demand and its effect on AV resources.[164] Although the effectiveness of the surge script was as yet untested, A/Prof Stephenson was confident that, had it been used during the TA event, some people would have made alternative arrangement or at least had that option.[165]

123. When challenged at inquest about whether the surge script, the new Priority 0 and Priority 1 exit scripts and the prohibition on the ESTA call-takers giving an estimated time of arrival, enabled callers to make an informed decision to arrange alternative transportation to hospital, A/Prof Stephenson explained that the dispatch of an ambulance to a particular event and its arrival time were unknown to the ESTA call-taker at the time that the call is ending and, in any event, remained subject to diversion to a higher priority event during a surge event and even during normal business. A/Prof Stephenson expressed the view that this reflects good ambulance practice.[166] As regards the adequacy of the new exit script 'help is being arranged', he said '*I'm not sure that there are any perfect words, that's the problem*'.[167]

124. It is appropriate to note that A/Prof Stephenson took the opportunity of testifying at the inquest to convey his sympathies to the family members of the deceased and to say how

[161] Transcript page 321.
[162] Transcript page 323.
[163] Transcript page 280.
[164] Transcript pages 280-281. AV was responsible for the development of the surge script, which was circulated internally and broadly approved.
[165] Transcript pages 281-282.
[166] Transcript pages 282-284 and 313-314.
[167] Transcript page 333.

confronting the TA event was both professionally and personally. He referred to the '*humanity*' of paramedics and gave examples of some of the extraordinary actions taken by them on the night.[168] His conclusion about this aspect of his evidence is worth quoting verbatim:

> *I've said it publicly, I think I'm right, I don't think I've seen so many lives saved on any given night…and yet again, I've not seen any organisation so together and so connected and so purposeful in what they did…so, it was an extraordinary event and…in many ways, it's still um knowing that we couldn't do what we wanted to do, a very confronting event.*[169]

DEPARTMENT OF HEALTH AND HUMAN SERVICE (DHHS)

125. The DHHS published the Chief Health Officer's Report dated 27 April 2017 entitled '*The November 2016 Victorian epidemic thunderstorm asthma event: an assessment of the health impacts*' **(the CHO's report)** which is a publically available document that was also included, for convenience and completeness, in the coronial brief.[170] The CHO's report is an invaluable aid to the understanding of the TA event, both in terms of the environmental and meteorological conditions associated with TA, and the broad health impacts and associated demands placed on emergency responders and the health system.[171]

126. Key findings of the CHO's report pertaining to AV are that on 21 November 2016 there were 1,626 more calls to the ESTA requesting an emergency ambulance than forecast, an increase of 73% and that in the six hours from 6.00pm, 814 ambulance cases were generated, 643 of these for Code 1 events.[172]

127. In terms of the impact on Victorian public hospital emergency departments, there were 12,723 presentations on 21 and 22 November 2016, being 3,867 or 44 % more than expected, based on the three-year average. Whereas the impact was even greater on public hospital emergency departments (**EDs**) in Melbourne and Geelong with 9,909 presentations over the

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[168] The AV review contains some personal accounts of the night from paramedics. Coronial brief pages 799-801.
[169] Transcript page 264.
[170] Coronial brief pages 321-400. See also https://www2health.vic.gov.au/emergencies/thunderstorm-asthma-event. Note that the report refers to the eight deaths known to be associated with the TA event at the time of the CHO's report which was in any event confined to the period 21-30 November 2016. The deaths of Mr Min Guo and Ms Le Hue Huynh occurred outside this period and their identities had not been publicly disclosed as at the date of the report.
[171] As to the purpose of the CHO's report see page 2 of the Executive Summary (page 328 of the coronial brief) – '*The purpose of this report is to provide the Victorian community, health service providers, policymakers and government and non-government organisation with a record of the health impacts from this previously unimagined event. It has created a new benchmark for emergency and health service delivery that requires planning and preparations, as these infrequent but recurrent events are now known to be capable of generating an impact of such magnitude*.'
[172] Ibid.

two days, being 3,643 or 58% more than expected, based on the three-year average, resulting in a 672% increase in respiratory-related presentations in the thirty hours from 6.00pm on 21 November 2016, 3,365 more presentations than expected based on the three-year average.[173]

128. Asthma-related hospital admissions also increased commensurately and, reflecting the acuity of those patients requiring admission, thirty more patients were admitted to intensive care units in the Melbourne and Geelong public hospitals in the thirty hours commencing 6.00pm on 21 November 2016, than expected based on the three-year average.[174]

129. Two witnesses gave evidence at inquest on behalf of the DHHS, Ms Alison Jayne McMillan, Deputy Director of Strategy and Policy, and one of the State Health Coordinators[175] and Dr Danny Csutoros, a Senior Medical Advisor in the Health Protection Branch, specifically the Environmental Health Unit and a General Practitioner working in primary care.[176]

130. The DHHS, via the Chief Health Officer, is the control agency for a health emergency, including a TA event. As such, the DHHS is responsible for sending out associated warnings, a responsibility shared with Emergency Management Victoria.[177]

131. The IGEM Final Report found that communication between the DHHS and public hospitals was not effective on the evening of 21 November 2016. Rather, communication was described as *ad hoc*, inconsistent across the various health services impacted and not timely, preventing a shared understanding on the part of the DHHS and senior hospital staff of the surge in patients requiring urgent medical attention and limiting their ability to plan and respond accordingly.[178]

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[173] The CHO's report Executive Summary page 3 at coronial brief page 329.
[174] Ibid. The thirty admissions to an ICU amounted to a 3,000% increase than expected based on the three-year average. It follows that statistically somewhere between 0 and 1 admission was expected.
[175] Ms McMillan's statement dated 30 May 2018 is at coronial brief pages 985-992 and outlines actions taken by the DHHS following the TA event and progress made in relation to those IGEM review recommendations directed to the DHHS.
[176] Dr Csutoros described himself as a public health specialist and is a Fellow of the Australian College of Public Health Physicians. Dr Csutoros' statement dated 31 May 2018 is at coronial brief pages 993-1002 and sets out the DHHS' and the Health Protections Branch's response to what he describes as the Epidemic Thunderstorm Asthma Event or ETSA. Predominantly this involved getting safely through the remainder of the pollen season; understanding the phenomenon; scoping, co-developing and implementing a new forecasting system; developing and implementing an ETSA preparedness and response plan; and developing and delivering a community awareness and health promotion and education program about ETSA. Coronial brief page 993.
[177] Transcript page 268.
[178] Coronial brief page 444 and transcript pages 386-388. The DHHS typically gathered information by contacting hospital Chief Executive Officers rather than their emergency controllers, communicating with individual hospitals rather than using methods capable of communicating with multiple hospitals simultaneously. Health services suggested that if a similar event occur in the future, the DHHS should activate its formal incident management arrangements as soon as possible to communicate information as it comes to hand through agreed channels.

132. Since the TA event, the DHHS has undertaken work to address the relevant IGEM Final Report recommendations, work that falls under four key strategic areas:

(a) revision of the State Health Emergency Response **(SHERP)** arrangements;

(b) real-time monitoring of demand for hospital emergency department services;

(c) epidemic TA forecasting and monitoring systems; and

(d) community and health professional engagement and education program.[179]

133. Extensive work has been undertaken by the DHHS following the TA event to address the recommendations, including:

(a) revision of the SHERP and its release to stakeholders in October 2017;[180]

(b) establishment of a single point of contact for each hospital with a requirement that the hospital is required to maintain a 24/7 mobile number, email address and contingency landline;[181]

(c) development of a private hospital protocol to increase community access to medical treatment, permitting public patients to be treated at private hospital emergency departments during an emergency;[182]

(d) development of the Community Pharmacies Liaison Protocol in conjunction with the Pharmacy Guild of Victoria to enable efficient distribution of important information and warnings through pharmacies;

(e) development of the Primary Health Liaison Officer Protocol for coordination of information between the DHHS and key primary and community health stakeholders;

(f) development of an emergency department checklist to facilitate self-assessment of preparedness for epidemic TA events;

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[179] Statement of Ms Mc Millan dated 30 May 2018 coronial brief page 986.

[180] This also involved the introduction of the State Health Emergency Management Coordinator function to provide executive oversight and administrative leadership in health emergency responses. Statement of Ms McMillan dated 30 May 2018 coronial brief page 989. SHERP4 also marked the first time that the Public Health Control Plan and the SHERP were merged into one plan. Of note, SHERP4 can be escalated to address any emergency that has an impact on the community's health and wellbeing, irrespective of the cause. Transcript page 445.

[181] Ms McMillan explained that this process takes about 15 minutes to reach every Victorian public hospital, at the instruction of the State Health Coordinator. Transcript page 438.

[182] I note that Ms McMillan was able to approve such an arrangement during the TA event even without a formal protocol in place. Transcript pages 431-432.

(g) implementation of the Real-time Health Emergency Management System **(RHEMS)** which provides the DHHS with ongoing real-time monitoring of the number of people presenting to emergency departments within a three minute window. This provides the DDHS with proactive early notification of potential health emergencies by notifying the DHHS through automated email and SMS alerts when a surge in demand occurs. By March 2018, all 38 Victorian public hospitals were added to the RHEMS system;[183]

(h) development and implementation of a Code Brown[184] guideline to health services to remind hospitals of their responsibility to notify the DHHS when a Code Brown is activated;

(i) expansion of the Victorian pollen monitoring system through the inclusion of five new monitoring sites, operational from October 2017;[185]

(j) implementation of the enhanced epidemic TA forecasting system from 1 October 2017, enabling the DHHS to provide advice to health and emergency services and the community about the possibility of any epidemic TA events during the pollen season;

(k) the development and implementation of an epidemic TA public health campaign, launched 1 September 2017 for the duration of the 2017 pollen season, which included publication of new and updated Better Health Channel and Health Vic web sites' resources, including videos, posters, fact sheets and social media and radio advertising. The campaign highlighted the importance of community members knowing, understanding and managing their risk in relation to TA for those with: hay fever and therefore possibly undiagnosed asthma; a past history of asthma who are not actively managing their condition; and severe asthma.[186] Part of the rationale for DHHS' public health campaign was that to reduce the number of people requiring

[183] Ms McMillan explained that within the RHEMS technology there is facility for the DHHS to search for keywords relevant to particular conditions, to assist in identifying emerging surges in particular syndromes. Transcript, page 456.
[184] A Code Brown denotes that a hospital is experiencing a significant external demand on its services. The concept involves activating a number of agreed steps to quickly free up capacity, to recall staff and open additional beds. Transcript pages 432-433. Although this process was in place at the time of the TA event, it was not fully utilised by hospitals.
[185] Dr Csutoros explained that there are now eight pollen traps which monitor pollen on a 24/7 basis, are checked daily and stored at universities. They are accurate for a range of about 30-50km form the monitoring site. I note that there are nine BOM weather districts across Victoria. Transcript pages 567-568.
[186] This campaign involved community pharmacies, general practitioners and other organisations such as the Asthma Australia. Transcript page 450. I note that in December 2016, DHHS also ran ten advertised and well-attended community information sessions about what had occurred during the TA event, what the DHHS knew about TA and was still learning and what the DHHS were doing in relation to TA. Transcript pages 459 and 464.

assistance during future TA events and thereby reducing the pressures of surge experienced in hospital emergency departments;[187]

(l) the development and implementation of a health professional education program, including four new online TA training modules and face-to-face training sessions held across Victoria;

(m) updating existing asthma-related online training modules for schools and early childhood facilities, sports and recreation groups and workplaces; and

(n) evaluation of the DHHS TA program.[188]

134. At inquest, Ms McMillan testified that the Vic Emergency website[189] and mobile telephones can be used to provide either state-wide warnings or community advice and warnings specific to a particular geographical area.[190] Like the other agencies (the ESTA and AV specifically), the DHHS have also formalised their processes for recalling staff during a TA event or other emergency.[191] These and other initiatives were tested in ten DHHS facilitated mass casualty simulations within Victorian public hospitals and involving AV.[192]

135. Ms McMillan's evidence gave a sense of what the DHHS' approach to TA events now looks like in practical terms. All days in the pollen season (1 October – 31 December) are considered days of potential risk for epidemic TA. During the pollen season, the DHHS will prepare a daily risk forecast for TA for that day and the ensuing three coming days throughout Victoria. The risk for TA will be assessed by reference to a risk matrix developed since the TA event as either low, moderate or high risk.[193] The response to the risk assessment will vary according to the level of risk. On a day assessed as high risk for a TA event, the DHHS activate their State Emergency Management Centre, which is co-located with AV. Designated DHHS staff will then actively monitor systems in real-time to ascertain if in fact Victoria is experiencing a TA related impact.[194]

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[187] Transcript page 465.
[188] Statement of Ms Mc Millan dated 30 May 2018. Ms McMillan's evidence at inquest was that at the time of the inquest, the evaluation program was underway and that the DHHS' considers the epidemic TA program to be a three-year program. Transcript page 479.
[189] https://emergency.vic.gov.au/prepare/#understanding-warnings, accessed 26 October 2018.
[190] Ms McMillan further explained that mobile SMSs can be sent to people within a specified geographical area even if they have not downloaded the mobile telephone application. Transcript pages 438-440.
[191] Transcript page 454.
[192] Coronial brief page 988 and transcript pages 477-478.
[193] Exhibit H and transcript pages 313-314. All hospitals receive the same high-risk forecast to allow for relevant planning and preparation. Transcript page 467.
[194] Transcript page 467.

136. While the initiatives described by Ms McMillan arose in the aftermath of the TA event and there was a clear imperative to understand that particular phenomenon and its health impacts, Ms McMillan explained the broader focus saying that '…*our modern approach now is that the cause is not necessarily what we should concentrate on, despite the amount of work we've done importantly for epidemic Thunderstorm Asthma. Our planning and processes now should be able to accommodate any cause for a surge in demand irrespective of its cause*.'[195]

137. Dr Csutoros testified about the pressing need in the aftermath of the TA event to improve the State's readiness for any other TA event during the remainder of the 2016 pollen season and, in furtherance of that aim, the need to better understand the phenomenon of TA. He gave evidence about a number of DHHS initiatives, in which other parties such as ESTA, AV and BOM were also involved.

138. An Interagency Working Group **(IAWG)** was rapidly convened in the days following 21 November 2016. The IAWG included representatives from the DHHS, the BOM, pollen experts from the University of Melbourne and Deakin University and the Environmental Protection Authority **(EPA)**. An epidemic TA Preparedness and Response Plan was developed and a Rapid Assessment Team **(RATeam)** was formed to assess daily pollen levels, meteorological forecasts and air quality data in order to provide expert advice to the DHHS's Chief Health Officer during the remainder of the grass pollen season.[196]

139. The National Thunderstorm Asthma Epidemic Symposium was held on 22 March 2017. Participants included the ESTA and various experts.[197]

140. Another important initiative was the DHHS commissioning of a detailed literature review relating to TA which was undertaken by Queensland University of Technology and was published in May 2017.[198]

141. At inquest, Dr Csutoros agreed that current thinking based on the preponderance of evidence was that rye grass is an important variable or precondition to a TA event. However, he

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[195] Transcript page 448.
[196] Statement of Dr Danny Csutoros dated 31 May 2018 coronial brief page 994. The RATeam was formed within days of the TA event and comprised representatives from the DHHS, the BOM, Associate Professor Ed Newbigin (University of Melbourne), Associate Professor Cenk Suphioglu (Deakin University) and the EPA. Transcript page 484.
[197] Ibid.
[198] Statement of Dr Danny Csutoros dated 31 May 2018 coronial brief page 994. Entitled '*Literature review on thunderstorm asthma and its implications for public health*.' The review is available at https://www2.health.vic.gov.au/about/publications/researchandreports/thunderstorm-asthma-literature-review-may-2107.

referred to a number of other unknowns and potential variables contributing to a TA event and cautioned that we need to keep a very open mind.[199]

142. Consequently, the current Victorian TA Surveillance Program, which includes eight pollen traps, is not solely focused on counting pollen, but is counting other particles such as *Alternaria* (mould). Dr Csutoros indicated that to his knowledge, expert/botanists at the University of Melbourne had turned their mind to whether *Alternaria* was present in the air on 21 November 2016, and to his knowledge, the research, which was still underway at the time of the inquest, was inconclusive. Dr Csutoros indicated that while *Alternaria* did not appear to be an important broader environmental factor, it had not been excluded as being causal in a small group of people.[200]

143. Dr Csutoros gave evidence that the phenomenon of TA is a complicated story that sits in the context of the prevalence of asthma and hay fever within the Victorian population which in turn gives some sense of the potential scale of future TA events. He noted that asthma, which is best regarded as a chronic disease rather than an episodic one, affects 10% of the Victorian population, translating to 600,000 people in Victoria (and 2.5million people in Australia). Three quarters of the cohort of asthma sufferers also suffer from hay fever. Hay fever affects one in five or six people in Victoria, translating to one million people.[201]

144. As regards the developing forecasting system for TA events, Dr Csutoros expressed the view that the system is relatively new, largely untested, should form only one part of the response to a TA event, only one aspect of the response and should not be solely relied upon to manage the risk of a future TA event.[202] He noted the inherent risk with any system that produces some false positive, that of desensitising the public by over-warning about TA events, or the development of 'warning fatigue' and indicated that the DHHS is mindful of this challenge.[203]

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[199] Transcript pages 501-502. ' *…we've got to keep a very open mind as to what else…could be there…could it be fungus, could it be spherics, like could it be electric charge, could the Rye grass be more allergenic now than it was before, is it simply more Rye grass…more allergen, is it that the weather is actually stronger? So there are elements of climate change that come into this. Is this now something…that's going to happen more commonly because we're in a different weather pattern?...it may be that the environmental factors were the predominant thing…We don't know if…there are more susceptible people because people are using just Ventolin rather than their steroids or that there's…the impact of migration…I don't think we have a full explanation as to why it is so big.*'

[200] Transcript pages 509-511. Dr Csutoros noted that it is not known whether *Alternaria* travels with Rye grass pollen.

[201] Transcript page 486.

[202] Statement of Dr Danny Csutoros dated 31 May 2018 coronial brief page 996.

[203] Transcript page 565-566. Dr Tupper from the BOM testified that the forecasting decision matrix does produce some false positives. Transcript page 617.

INSPECTOR GENERAL FOR EMERGENCY MANAGEMENT (IGEM)

145. On 9 December 2016, the Victorian Government requested that the IGEM review the emergency responses to the TA event. [204] The purpose of the review was to identify opportunities to learn from the TA event, to improve future preparedness of public health emergency planning, response arrangements and performance.[205]

146. The IGEM's involvement in review and investigation of the TA event resulted in three separate reports, as follows:

(a) '*Review of response to the thunderstorm asthma event of 21-22 November 2016 – Final Report'*, published April 2017 and publicly available and referred to in this finding as the **IGEM Final Report**;[206]

(b) '*The management of call-taking and dispatch for eight deceased patients during the thunderstorm asthma event of 21-22 November 2016 Investigation Report'*, finalised in July 2017 and referred to in this finding as the **IGEM Investigation Report**. This report remains confidential and is not publicly available;[207] and

(c) '*Progress Report – Implementation of recommendations from the Review of response to the thunderstorm asthma event of 21-22 November 2016* (**IGEM Progress Report**)', finalised May 2018, published 20 July 2018 and now publicly available.[208]

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[204] Statement of Mr Christopher Petty dated 15 June 2018 coronial brief page 1005.
[205] Transcript page 347.
[206] IGEM provided the Court with a copy of the IGEM Final Report pursuant to section 72(1)(c) of the *Emergency Management Act 2013* (Vic) **(EMA)**, in consideration of the public interest and having regard to the Coroner's function. That report is available at https://www.igem.vic.gov.au/reports-and-publications/igem-reports/review-of-response-to-the-thunderstorm-asthma-event-of-21-0.
[207] The IGEM Investigation Report was provided to the Minister. The IGEM also provided me with the report in-confidence due to the patient related confidential information contained within it. Submissions were heard on 29 June 2018 in relation to the status of this document. Counsel acting on behalf of the IGEM indicated that it was the IGEM's position that once the document had been given to the Coroner pursuant to section 72(1)(c) of the EMA, how it was distributed or used in the inquest was at my discretion. The IGEM had commenced an investigation in November 2016 pursuant to section 64(1)(f) of the EMA. On 9 December 2016, the Minister for Ambulance Services and Minister for Emergency Services requested a review pursuant to section 64(1)(c) of the EMA and the work done prior to this request was absorbed into the latter request. IGEM's position is that Investigation Report was therefore subject to the confidentiality provision in section 72 of the EMA and the IGEM requested that if I were to release the Investigation Report or any part of it, that I ensure redaction of any personal/confidential information prior to its release. I acceded to this request. See discussion at transcript pages 519 and following.
[208] On 22 May 2017, the Victorian government requested IGEM to monitor the implementation of these 16 recommendations and to provide a report to the Minister of Emergency Services and the Minister for Health and Ambulance Services. Transcript pages 396-397. IGEM provided me with an embargoed copy of this report in April 2018, prior to receiving the Minister's approval for publication. The Progress Report is now available at https://www.igem.vic.gov.au/reports-and-publications/thunderstorm-asthma-review-implementation. I indicated at the commencement of the inquest that in the absence of ministerial approval for release of the progress report to interested parties, I intended to rely on Mr Petty's statement and *viva voce* evidence in relation to the Progress Report's Executive

147. Mr Christopher Petty, IGEM Senior Officer, Performance Monitoring, was involved in the compilation of these reports and was authorised by the IGEM to give evidence on his behalf at the inquest.[209]

148. The IGEM Final Report examined the emergency response of the entire sector, and made 25 findings and 16 recommendations.[210] In April 2017, the Victorian government indicated its in principle acceptance of all 16 recommendations. On 22 September 2017, the government endorsed a detailed response to the IGEM Final Report which set out the activities addressing the 16 recommendations.[211]

149. The IGEM Investigation Report examined ESTA's performance of call-taking and dispatching services for specific cases where IGEM was aware that they involved a deceased patient. The purpose of this report was to identify any causal factors that either delayed dispatch or response of ambulance crews or affected the level of care and advice given to callers while waiting for ambulances to arrive. IGEM sought to identify root causes and make recommendations where appropriate in the interest of continuous improvement.[212] They did so by predominantly relying on an analysis of evidence provided by the ESTA and AV to make 27 findings and 11 recommendations.[213]

150. The IGEM Investigation Report identified a number of performance issues relevant to ESTA. Findings (or issues) found across a number of cases included:

    (a) call answer speed performance;[214]

    (b) recognition of ineffective breathing;[215]

Summary, on the understanding that the Minister (which one) had no objection to that information being before the court. Transcript pages 4-5.

[209] Statement of Mr Christopher Petty dated 15 June 2018 coronial brief page 1004. The IGEM is a statutory assurance entity established under the EMA with the objectives of providing assurance to the government and community in respect of Victorian emergency management arrangements and fostering continuous improvement of Victorian emergency management. Under the EMA, the IGEM undertakes system wide reviews, prepares advice and reports at the request of the Minister for Emergency Services (**the Minister**), investigates and monitors the ESTA's service provision, make recommendations to the Minister and determines, in consultation with the ESTA, standards for the ESTA's performance of emergency telecommunications.

[210] Coronial brief pages 415-418 and transcript page 300.

[211] Transcript page 396. This response was published on the DHHS and EMV websites.

[212] Transcript page 399. I note that these were causal factors for the purpose of the IGEM investigation.

[213] Statement of Mr Christopher Petty dated 15 June 2018 coronial brief page 1006. I note that this was an extremely thorough report that examined over 500 items of evidence, in addition to more than 600 items that were examined in preparing the IGEM Review – Final Report. Transcript, page 399. Mr Petty indicated that the IGEM had in August 2018 reviewed progress in relation to these 11 recommendations, that nine are complete and three are in progress. Inquest transcript 24 August 2018 pages 47-48.

[214] Transcript page 400.

(c) advice to callers about a surge in demand and estimated arrival times;

(d) *no nearby unit* dispatch workflow;[216]

(e) recognition of unstable and not alert patients; and

(f) pre-arrival instructions – ventilations first (instead of compressions for CPR).[217]

151. The IGEM Investigation report also noted that six of the deceased were located outside of the EMR zone[218] and identified issues around the availability of defibrillators, the recording of relevant information in the CAD system and the confirmation of and recording of callers' telephone numbers.[219]

152. The recommendations made in both reports were aimed at improving future preparedness and response arrangements for rapid-onset health emergencies.[220]

153. On 22 May 2017, the Minister for Emergency Services requested that the IGEM monitor the implementation of the 16 recommendations it made in its Review – Final Report, resulting in the IGEM Progress Report.[221] Overall, that report found significant improvements to the arrangements, systems, communications and capacity to prepare and respond to future rapid-onset Victorian emergencies, beyond TA events. Furthermore, the IGEM Progress Report found that 11 recommendations had been completed, eight led by the DHHS, and that four recommendations were progressing satisfactorily. One recommendation is considered closed, with no further planned activity.[222] IGEM is continuing to monitor progress in the

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[215] I note that in the case of Ms Hope Carnevali (Marsh) (COR 2016 5534), the IGEM identified that although the ESTA call-taker adhered to the correct process, the event type assigned to Ms Carnevali was changed from a Priority 0 to a Priority 1 based on Ms Carnevali experiencing ineffective breathing *in the context of having a history of asthma*. Mr Petty explained that although the International Academies of Emergency Dispatch (responsible for the product overseeing the medical priority dispatch call taking system) recommend priorities and responses, it is up to the local agency (AV) to assign the priorities Inquest transcript 28 August 2018 pages 22-26. Coronial brief page 592.

[216] Mr Petty explained that this is an issue specific to the dispatch of ambulance, in situations where there is no ambulance available for dispatch, the ESTA's workflow is that dispatchers will alert an AV Communication staff member or Duty Manager. It is then their job to appraise the ESTA dispatcher of which AV resource to send. Inquest transcript 24 August 2018 pages 10-11.

[217] Coronial brief page 533 and transcript pages 403-404.

[218] The EMR zone relates to a geographical zone whereby arrangements are in place so that the MFB or CFA can attend Priority zero matters. Transcript page 404. Exhibit R. At the time of 21 November 2016, the CFA had indicated that there were going to roll out EMR to more stations within the per-urban fringe. I am informed that they are still rolling out such a service and will continue to do so, with the current plan to be completed by 30 June 2019. Inquest transcript 28 August 2018 page 18 and coronial brief page 684.

[219] Coronial brief page 534 and transcript pages 405-406. Mr Petty explained that while the findings were directly leading to issues or delays from the IGEM's perspective for the purposes of their investigations, the observations are potentially issues, but did not specifically contribute to any patient problems.

[220] Statement of Mr Christopher Petty dated 15 June 2018 coronial brief page 1009.

[221] Statement of Mr Christopher Petty dated 15 June 2018 coronial brief page 1007.

[222] Transcript pages 397-398.

implementation of the recommendations made in both the IGEM Final Report and the Investigation Report.[223]

PROFESSOR JO DOUGLASS' EXPERT EVIDENCE & OVERVIEW

154. In addition to the appraisal of clinical management and care provided to each deceased, as an experienced respiratory physician and immunologist and an active clinician and researcher, Prof Douglass was an invaluable expert witness able to inform the coronial investigation about knowledge of the phenomenon of TA prior to 21 November 2016, and learnings since, especially in terms of the optimal clinical management of asthmatics and/or hay fever sufferers and identifying those groups or individuals at greatest risk. Except where otherwise indicated, the evidentiary source for this section of the finding is the evidence of Prof Douglass.

155. Worldwide, deaths from TA have only been described on one previous occasion in a report from the United Kingdom in 2002 involving a single fatality.[224]

156. There was also a prior reported TA event in Wagga Wagga, New South Wales, in October 1997, but one not associated with any fatalities.[225] Coincidentally, a local asthma study was underway in Wagga Wagga at the time, and local clinicians were able to contemporaneously capture information relating to patients and controls when the TA event occurred. The study showed that of the 183 people who presented to hospital during the TA event, 95% reported hay fever, 96% were found to be sensitised to ryegrass pollen, and only 27% were taking inhaled corticosteroids. Moreover, 56% of the control group were taking inhaled corticosteroids, was considered fair evidence that inhaled corticosteroids could be protective against TA.[226] As a result, the Murrumbidgee district health service established a TA warning system, which distributes hospital and community warnings during the pollen season.[227]

157. Consistent with other evidence heard at the inquest, Prof Douglass noted an earlier TA event experienced in Melbourne in November 2010 when she happened to be on duty at the Alfred Hospital. Although this was a busy night in EDs across Melbourne, it was not on the scale

[223] Statement of Mr Christopher Petty dated 15 June 2018 coronial brief pages 1007 and 1009.
[224] Transcript pages 20-21.
[225] Transcript page 121.
[226] Transcript pages 104-105. Exhibit B, "Thunderstorm-associated asthma in an inland town in south=eastern Australia. Who is at risk?" Girgis, Marks, Downs and Ors. European Respiratory Journal 2000 at pages 3-8.
[227] Transcript page 135.

associated with the TA event of 21 November 2016 and she was not aware of any associated fatalities.[228]

158. In terms of awareness of the phenomenon of TA prior to the impact of the event on 21 November 2016, Prof Douglass expressed the view that while she expected that respiratory physicians would have been aware of the phenomenon, she did not believe that specialist or generalist primary care physicians, pharmacists, emergency physicians or health administrators or planners were likely to have been aware of the dangers that TA posed.[229]

159. While studies going back to 1984 described clinical experiments indicating a severe asthmatic reaction to the inhalation of pollen particles and the consensus view that it is certain weather events that will replicate that result, the precise mechanism is not entirely clear and it is not clear which particular storms during pollen season will lead to a TA event. Certainly, not every thunderstorm during pollen season will lead to a TA event. It is noteworthy in this regard that, while there are on average four to six thunderstorms in or around November to December each year in Melbourne, recent history suggests there a TA event occurs only once every two to five years. Little is known about the specific meteorological, biological and aerobiological variables that predispose or combine to bring about a TA event.[230]

160. Nevertheless, there appears to be some predictability in the Melbourne TA season with TA events having been observed to occur mostly in the second half of November (although there were two events in 1984 and 1987 that occurred in the first half of November) and to occur approximately six weeks after preceding rains which create a spike in pollen counts.[231]

161. Arising from the prevailing weather patterns, there is the suggestion of a potential early warning system for TA, as opposed to a predictor as such. As Melbourne's weather generally comes from the west, tracking west or south-westerly through Victoria and Geelong before reaching Melbourne, a surge in demand for ambulance or a spike in ED presentations in the west, if recognised and communicated in a timely way to other hospitals or the relevant health authorities '*would have perhaps predicated what would have happened in the rest of the State*

[228] Ms Smith on behalf of ESTA confirmed that the ESTA received 1108 calls for ambulance services over a 12 hour period from 9.00am to 9.00pm on 25 November 2010 and there were no consequential impacts on the ESTA's service. See transcript pages 259 and coronial brief page 425.
[229] Transcript pages 105, 123-124.
[230] Transcript pages 120-121 and 133.
[231] Transcript page 137.

and then opportunities to intervene both in warning people…to manage themselves inside…[and for] hospitals to become prepared'.[232]

162. In order to understand the significance of those features of commonality shared by the cohort of deceased, there is a need to understand something of the asthma disease process and its recommended (or optimal) clinical management. Asthma is fundamentally a disease of narrowing of the lung's airways due to either airway swelling (which has an inflammatory component) or to airway narrowing secondary to intrinsic compression or constriction of muscles located in the airway wall.[233]

163. Reliever medications (beta-2 agonist) which relax those muscles but do not relieve inflammation are nevertheless useful as a cornerstone of treatment for patients with mild asthma who experience minimal airway inflammation.[234] Reliever medication are far less potent in moderate or severe asthma and there is a concern about their overuse as they can render patients more prone to severe attacks. The use of reliever medication more than twice weekly (except in exercise-induced asthma) indicates the need for preventer medication.[235]

164. Preventer treatments contain an anti-inflammatory component (a modified corticosteroid) and when inhaled actually supress the airway inflammation associated with asthma. Preventers are one of the few effective treatments for moderate (?) and severe asthma and are highly recommended as a preventative strategy for all but the mildest forms of asthma. Most currently prescribed preventers are a combination of inhaled corticosteroid and long-acting bronchodilators which relax the airway and are generally designed to be used regularly.[236] Systemic corticosteroid medication would likely be protective for a severe episode of asthma.

165. There is an issue of patient non-compliance with preventer medication, possibly due to patients feeling it is intuitively unreasonable to keep using a drug when they feel well and to concerns about the long-term use of inhaled corticosteroids. Prof Douglass advised that the

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[232] Transcript page 138-9. Prof Douglass agreed that even an hour or two can make a difference to a hospital to be better prepared to respond to such a TA event. Moreover, she expressed her understanding that the updrafts of pollen are actually minutes of really high exposure over a very short period of time, and in that case it is a matter of staying inside and out of that updraft. That is something that might be usefully employed in community warnings.

[233] Transcript page 99.

[234] For something like 40 years in Australia, salbutamol (available as Ventolin) is available over-the-counter. Prof Douglass noted that Australia is unique in this respect. In most countries, a prescription is required, thereby requiring some medical monitoring. Transcript pages 42-43.

[235] Transcript page 100. Prof Douglass explained that spacers assist in delivering more of the inhaled medication into the lungs. It is considered that using the puffer alone delivers less than 20% of the dose to the lungs. Also, the use of a puffer alone requires co-ordination and can be difficult when a patient is short of breath. A spacer creates a reservoir of medication and improves medication delivery to the lungs. Transcript page 101. See also transcript pages 48-49 where Prof Douglass discusses the relative merits of Formoterol and Salmeterol which is in Seretide.

[236] Transcript pages 98-99.

evidence indicates that the routine use of preventers at the prescribed dose is very safe and certainly safer than risking an asthma exacerbation. She suggested that there was scope for further patient education, improved health literacy and marketing to improve patient outcomes in this regard, especially for those with moderate to severe asthma.[237]

166. Unopposed, frequent reliever use appears to increase air hyper-responsiveness to non-specific stimuli.[238] In a TA event, this means that those asthmatics who do not have the use of a preventer or inhaled corticosteroid are at a greater risk of significant bronchoconstriction in a TA event if they are frequently relying solely on salbutamol (Ventolin).[239]

167. There is a distinction that needs to be made between those patients who suffer from severe asthma and those who experience a severe asthma response.[240] A patient with severe asthma is one who fails to obtain control of their asthma or who suffers from exacerbations despite maximum doses of inhaled combination preventer therapy. On the other hand, the cohort of deceased suffered a very profound severe asthma attack.[241] Prof Douglass gave anecdotal evidence from the TA event that patients known to have severe asthma who she and her colleagues might have predicted would be vulnerable in a TA event apparently did not experience difficulties on 21 November 2016.[242]

168. Also available over the counter and therefore accessible without monitoring by any medical practitioner are antihistamine medications, inhaled nasal corticosteroids and topical eye medications for the treatment of the symptoms of seasonal allergic rhinitis or "hay fever", as it is commonly known. This places pharmacists in a position to educate their customers and to influence their choices. Relevantly, although oral antihistamines appear more popular, studies provide evidence that topical nasal corticosteroids are more effective in head to head studies compared to oral antihistamines and are also associated with reduced asthma exacerbation rates (and so may be protective of hay fever sufferers in a TA event).[243]

169. Asthma management plans are recommended for and should do two things. They need to help a person recognise when they are sicker, when to call for help, when they are more significantly unwell and need to call for emergency assistance, and what treatment to institute

[237] Transcript page 99.
[238] Transcript pages 124-125. Prof Douglass explained that airway hyper-responsiveness is (defined in a strict clinical sense) a response to agonists that cause airway muscle constriction that is greater than what you find in people who don't have asthma, and it can be measured, classically by using methacholine (or mannitol or hypertonic saline).
[239] Transcript pages 125-126.
[240] Transcript page 128.
[241] Transcript pages 128-129.
[242] Transcript page 129.
[243] Transcript page 88.

at both of those times.[244] Prof Douglass said that if one has hours available in a situation of worsening asthma, then oral corticosteroid medication can be lifesaving. If people had been better informed about their asthma and better able to recognise earlier symptoms of deterioration, they might have had more time to respond accordingly. It follows, that where appropriate, family members and carers should also be familiar with asthma management plans and able to enact them.[245]

170. Prof Douglass commented that it was not apparent form the available material whether any of the deceased were aware of the utility of high dose reliever medication or resorted to the 'four by four by four' asthma first aid paradigm recommended by Asthma Australia.[246]

    (a) take one puff into a spacer device;

    (b) take four breaths from the spacer;

    (c) repeat until fours puffs have been taken;

    (d) wait four minutes and if there has been no improvement, give four more separate reliever puffs; and

    (e) if there is still no improvement, call '000'.[247]

171. Prof Douglass was hopeful that with the benefit of people having good asthma plans, which included simple strategies such as staying indoors, shutting windows and taking their preventer medications on days/times when there is a forecasted risk of TA, that it would be less likely that they would require the assistance of AV or hospitals in a TA event.

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173. Having appraised the clinical management and care provided to each of the ten deceased, Prof Douglass was able to inform the inquest about features they had in common that might assist in the identification of patients most at risk in a TA event and/or might suggest protective

[244] Transcript page 85.
[245] Ibid.
[246] Ibid and https://www.asthmaaustralia.org.au/act/home.
[247] https://www.asthmaaustralia.org.au/act/about-asthma/asthma-emergency accessed 5 September. Professor Douglass explained that very high doses of reliever medications are used in hospitals and are considered quite safe in an acute or emergency setting. Transcript pages 85-86.

factors. As a general observation, the demographic features of the deceased were that they were relatively young, resided in the northern and western suburbs of Melbourne,[248] with a disproportionately high representation of males[249] and of people from Asian backgrounds, many of whom had immigrated to Australia relatively recently.[250]

174. All ten of the cohort of deceased were known to suffer from asthma. Another standout feature of the cohort was that they suffered from hay fever and/or, historically, experienced seasonal exacerbations of asthma. Investigations post-mortem indicate they were all sensitised or even highly sensitised or allergic to ryegrass pollen and, in general, their use of preventer medications to control their known asthma symptoms was sub-optimal. Four out of ten of the deceased appear to have been prescribed oral corticosteroid medication, indicating that this was treatment for a flare up of severe asthma.[251]

175. There was evidence of an asthma action and asthma emergency plans in respect of only three of the ten deceased, a proportion consistent with community levels whereby only about 30% of asthmatics have asthma management plans. Prof Douglass noted that epidemiological studies demonstrate that asthma management plans facilitate improved control of asthma symptoms and protect from adverse outcomes, including death. Prof Douglass bemoaned 'banging on' about asthma management plans for 30 years and finding they continue to be under-utilised, despite strong recommendations for their use.[252] In any event, it is unclear how many of the deceased in fact followed their asthma management plans (or asthma emergency plans) during the TA event.[253]

176. Other features of optimal clinical management generally conspicuously absent were the objective measurement of lung function. Prof Douglass noted that there appeared to be very few lung function tests[254] or peak flow measurements documented for the cohort of

[248] Transcript pages 80-81. Prof Douglass explained that this distribution may indicate the direction of the storm from the west, or other sociodemographic factors that need to be identified.
[249] Professor Douglass notes that seven out of the 10 deceased were male, which was consistent with the hospital presentation demographic. She noted that the prevalence of asthma in general is predominantly middle-aged women. See transcript page 83 for a discussion of a Lancet Planetary Health article that looked at 1,400 presentations, 44% of which were women. Exhibit A. This article entitled '*The Melbourne epidemic thunderstorm asthma event 2016: an investigation of environmental triggers, effect on health services, and patient risk factors.*' Thien, Beggs, Csutoros and Others e255-e263 is a succinct and accessible summary of the TA event.
[250] Ibid. Prof Douglass spoke of a hypothesis that, as a group, people who immigrate to Australia from Asia are well known to develop quite severe hay fever, after some three to four years for reasons that are not yet well understood. The same group was also over-represented in emergency department presentations during the TA event.
[251] Transcript page 102 and table at coronial brief page 908.
[252] Transcript page 87.
[253] Transcript page 85.
[254] Prof Douglass explained that this assessment is a gold standard for asthma treatment and measures a person's maximum expiration. Where there is an impairment noted in this measurement that improves following treatment with a beta-2-agonist (for example salbutamol) there is support for a diagnosis of asthma. Transcript pages 89-90.

deceased.[255] She gave evidence that studies have also demonstrated that lung function testing provides an objective measure of the severity of asthma and is associated with protection against adverse outcomes for asthmatics.[256]

177. Prof Douglass gave evidence that there was an argument to be made for particular targeting prevention strategies at those Melbournians with hay fever[257] as the evidence would suggest that 'seasonal asthma' is not well dealt with nor recognised in current asthma treatment guidelines, either in Australia or globally. She therefore suggested that the use of asthma preventer medication in episodic fashion in individuals who suffer hay fever or seasonal exacerbation of their asthma, is something that should be strongly considered.[258]

178. As regards possible triggers for TA, Prof Douglass noted that the testing of post-mortem samples indicated that three of the cohort of deceased were sensitised to *Alternaria* mould, know to trigger asthma but usually in the autumn months. It may be significant that the three deceased were among the first four to die on the night.[259] According to Prof Douglass, sensitisation to *Alternaria* is unusual in individuals who have lived in Melbourne most of their lives and is more common in those who have spent time in arid, inland Australia. The presence of mould sensitisation is an indicator for severe asthma, referred to as severe asthma with fungal sensitisation or SAFS.[260]

179. Prof Douglass stated that while it is currently unknown whether *Alternaria* was present in the air on 21 November 2016, it was her understanding that air sample slides from pollen monitoring activities have been preserved. She suggested that the presence and extent of moulds in the air on 21 November 2016 is an active research question which could potentially elucidate the mechanisms of TA, or at least on those operating on 21 November 2016.[261] Prof

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[255] Prof Douglass explained that this merely involves getting the patient to perform an expiration/puff into a peak flow device a number of times, to gauge their maximum measurement. There is a predicated normal range, according to a patient's age and size. Transcript page 90.

[256] Transcript pages 90 and 94. Prof Douglass mentioned the lack of lung function testing, including peak flow measurement particularly with reference to Mr Min Guo (COR 2016 5824). If this measurement had been taken and, hypothetically, had been low, it arguably would have been factored into the decision to discharge him. Professor Douglass explained that it is a good way to assess asthma severity and better than a stethoscope as patients can otherwise present deceptively - they can 'sit there with poor lung function and you just don't know'.

[257] Hay fever is also known as seasonal allergic rhinitis.

[258] Transcript pages 87-88.

[259] Mr Leo, Ms Carnevali (Marsh) and Mr Papadopoulos, most highly sensitised of all. Coronial brief page 908.

[260] Prof Douglass' report dated 17 October 2017 coronial brief page 888 and transcript pages 53-54 where her evidence was '*[t]his is quite remarkable [be]cause you wouldn't – in clinical practice it's quite uncommon to see so many people sensitised – it's an unusual event to see three…out of 10 is certainly higher than – well, far higher than community expectations for a Melbourne dwelling cohort'*. The most common mould allergy in Melbourne is to *Cladosporium herbarium,* which was also tested for, and is a domestic mould commonly found in bathrooms. Transcript page 40.

[261] Transcript at pages 39, 94-96. I note that this was the first time I was informed of this situation. Professor Douglass indicated that she believed the slides were kept at the University of Melbourne's Department of Botany, with a suggested contact of Associate Professor Ed Newbigin. The Court subsequently corresponded with Melbourne and

Douglass thought that mould may be an important or additional co-factor in TA, in addition to pollen. She referred to the relatively recent discovery of pathways by which mould can indirectly stimulate airway inflammation and the notion of a 'two-hit' phenomenon which might account for the severity of the reaction in so many individuals on 21 November 2016.[262]

180. Another aspect of the circumstances that is common among the cohort of deceased is that that were either outdoors or by a window and therefore exposed to the air when the thunderstorm struck. Prof Douglass' evidence was that consistent with this fact and experience from previous TA events, remaining indoors was considered '*somewhat protective*'. Her suggestion was that remaining indoors with windows shut during future TA events could be a simple future preventative strategy on high pollen days with predicted thunderstorms. For similar reasons, advice to turn off evaporative cooling or other mechanisms which draw in air from outside might be usefully researched in future. [263]

181. Speaking of all ten individuals whose deaths were the subject of the inquest, Prof Douglass characterised their underlying diagnoses as severe allergic asthma with an allergen-induced exacerbation which led to respiratory arrest and their demise.[264] She noted that the average time from complaint or flare up to respiratory arrest was very short, as little as 15 minutes in some cases, rendering any emergency response very time critical. It therefore behoves clinicians to be aware of the warning signs of severe asthma and of unstable asthma in the hours that may precede a severe attack and to treat the patient accordingly.[265] Prof Douglass noted that an out of hospital respiratory arrest from asthma is something from which very few, if any, people would survive. Moreover, even though in a hospital setting, survival is not assured, getting people to hospital remains a major ambition of treatment.[266]

182. Drawing on the common features of the cohort of deceased, Prof Douglass opined that the risk factors for fatal TA are pre-existing asthma, hay fever, and severe sensitisation to ryegrass pollen. Beyond these, more needs to be known about the precise risk factors in order to target patient populations and therapies accordingly.[267]

Deakin Universities, and corresponded further with Professor Douglas and Dr Iles in relation to *Alternaria*. A copy of these correspondences were distributed to the legal representatives of Interested Parties and tendered in evidence (Exhibit Q).

[262] Transcript pages 126-127.
[263] Transcript pages 82-83, 131.
[264] Transcript page 84.
[265] Ibid.
[266] Transcript page 87.
[267] Transcript page 103.

183. As regards the observation that many people who had never had asthma previously reported experiencing asthma symptoms following the 21 November 2016 TA event, Prof Douglass suggested that it was possible that there was an under appreciation of symptoms in these people previously, that is that they may have indeed suffered from asthma but never been formally diagnosed.[268]

184. Also under appreciated is the link between hay fever, asthma and consequently TA. Prof Douglass referred in evidence to the old mantra 'hay fever never kills anyone' that may need to be re-visited as a result of the TA event. Lessons learned in the aftermath of 21 November 2016 include a need to reconsider the clinical management of hay fever sufferers, among medical as well as community allied health professionals, who are often the first point of contact for people with allergic disease.[269]

BUREAU OF METEOROLOGY (BOM)

185. The BOM is Australia's national weather, climate and water agency, operating pursuant to the *Meteorological Act 1995* (Cth) and the *Water Act 2007* (Cth). The BOM provides regular forecasts, warnings, monitoring and advice across Australia,[270] including issuing TA forecasts to the DHHS for dissemination.[271]

186. The BOM was generally aware of TA as a health issue associated with previous weather events. Prior to the 21 November 2016 TA event in Melbourne, the only Australian TA warning system operated in NSW, where the BOM provides NSW Health with thunderstorm advice in support of this service.[272]

187. In the lead up to spring 2016, Victoria's temperatures had been generally close to average. Spring 2016 was Victoria's 10th wettest spring on record, with western areas received above average rainfalls.[273]

188. During the week before 21 November 2016, the weather transitioned from a cool, moderate to strong south-westerly wind flow, to warmer conditions by 17 November as a high pressure system moved eastwards across Victoria. A mainly dry trough with an associated weak wind change moved across the State on 18 November, bringing cooler south-westerly winds to the south. Maximum temperatures in the north reached the low 30's. A high pressure system

[268] Transcript pages 112-113.
[269] Transcript pages 122-123.
[270] Statement of Dr Andrew Tupper dated 7 May 2018 coronial brief page 974.
[271] Statement of Dr Andrew Tupper dated 7 May 2018 coronial brief page 982.
[272] Ibid.
[273] Ibid.

moved across Victoria on 19 November, resulting in lights winds, no rainfall, and temperatures in the low to mid 20's in the south and high 20s to low 30s in the north. Northerly winds developed on 20 November, with maximum temperatures generally in the high 20s to mid-30s throughout Victoria. Thunderstorm and shower activity developed during the afternoon, but no significant rainfall was recorded.[274]

189. On 21 November, Victoria experienced its first hot day since the previous summer as a fresh and gusty northerly wind flow developed ahead of an approaching cold front. Temperatures generally reached the mid to high-30s. A cool change entered the southwest during the early afternoon, bringing a west to south-westerly wind shift. Storms also developed across western and central Victoria during the afternoon, particularly near the change. Damaging wind gusts (greater than 90kph) were recorded with the storms in the west. A north-south line of storms developed ahead of a mid-afternoon change to Melbourne's west.[275]

190. The wind gusts associated with individual thunderstorms developed into a gust front (the boundary between theses wind gusts and the surrounding air) along a north-south line to the east of the thunderstorms.[276] The thunderstorms dissipated in the western suburbs of Melbourne, however the gust front progressed eastwards through greater Melbourne between 5.00pm and 6.30pm. Relative humidity was approximately 40% in the late morning, dropping to 20-30% by the mid-afternoon. These conditions persisted with the passage of the gust front.[277]

191. The passage of the gust front was spatially and temporally coincident with the onset of the TA event. A thunderstorm gust front is an example of a 'convergence line' (a line of converging air masses).[278] The gust front generally acts as an atmospheric 'broom' in concentrating loose particulates swept up from the ground (e.g. dust and pollen). The gust front persisted and tracked in a coherent fashion across all of Melbourne.[279]

[274] Statement of Dr Andrew Tupper dated 7 May 2018 coronial brief pages 976-977.
[275] Statement of Dr Andrew Tupper dated 7 May 2018 coronial brief pages 977-978.
[276] Dr Tupper explained that the strong and geographically large and continuous gust front is a very powerful mechanism, which can occur very close to a thunderstorm/convergence line (a few kilometres) or can travel hundreds of kilometres ahead. Also, when a thunderstorm dissipates. That is, the gust front can be physically separate from the storms that generated it, the gust front continues. Transcript pages 615 and 625-626.
[277] Statement of Dr Andrew Tupper dated 7 May 2018, coronial brief, page 978.
[278] Dr Tupper explained that a recent study that looked at 12 of the highest Melbourne asthma presentation days strongly suggested that visible convergence lines may be important in concentrating pollen, and that on four of the 12 days, there was no associated thunderstorm. Exhibit P, transcript pages 613-614.
[279] Statement of Dr Andrew Tupper dated 7 May 2018 coronial brief page 978 and transcript page 592.

192. The combination of a warm to hot day with a late afternoon line of thunderstorms (a squall line)[280] is a relatively common Melbourne occurrence, particularly in November. BOM State Manager, Victorian Office, Dr Andrew Tupper,[281] noted that Melbourne's maximum temperature on 21 November 2016 was not considered exceptionally hot. He stated that meteorological circumstances alone are insufficient to explain the gravity of the TA event, noting that the physical mechanisms of the interaction of pollen with the weather are not well known.

193. Dr Tupper advised that two theories exist:

    (a) allergenic pollen fragments inhaled by people during the passage of the gust front could have been blown along near the ground and concentrated in the gust front; and/or

    (b) pollen grains are lifted in the developing thunderstorms where they rupture secondary to 'osmotic shock' in the presence of moisture, then returned to the surface by the storm circulation where they concentrate in the gust front.[282]

194. Dr Tupper stated that the mechanism by which larger pollen particles fracture is "an important…unresolved problem".[283]

195. In March 2018, the BOM hosted a workshop that evaluated the results of the 2017 TA forecasting efforts, and made recommendations for improvement in 2018 and beyond, including noting the importance of:

    (a) routine monitoring of pollen concentrations;

    (b) moving towards automated pollen monitoring;[284]

    (c) developing a software platform and online portal for analysing pollen data; and

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[280] Transcript pages 589-590. Dr Tupper explained that thunderstorm cells that form a squall line create a self-sustaining system where the strength of the gust front is maintained or even increases over time, depending on the development of the storms. On 21 November 2016, there was a single essentially coherent line from north to south covering all of Melbourne and Geelong, which had the effect of running a very large broom along the landscape, creating a collection of small object in that [g]ust front.

[281] Transcript, page 582.

[282] Statement of Dr Andrew Tupper dated 7 May 2018 coronial brief page 980. Dr Tupper explained that the two theories are not necessarily mutually exclusive. Transcript page 605.

[283] Transcript page 606.

[284] Dr Tupper explained that currently, pollen monitoring is quite a labour-intensive process. He also explained that pollen monitoring is done on a daily basis, and as illustrated by the TA event, understanding what is occurring in terms of pollen as a gust front comes through could better improve TA understanding. Transcript page 623.

(d) gaining a better understanding of the weather and pollen conditions responsible for epidemic TA events.[285]

196. Dr Tupper stated that in his experience, warning systems for emerging hazards such as TA take decades to fully mature from a global perspective, particularly as the science develops. As such, the response to TA is in its early stages. The science is not well understood, and evaluation of the effectiveness of the TA forecast system is ongoing.[286] Despite the forecast system being in its relative infancy, international engagement and national information-sharing is already occurring.[287]

197. Dr Tupper stated that in his experience, warning systems for emerging hazards such as TA take decades to fully mature from a global perspective, particularly as the science develops. As such, the response to TA is in its early stages. The science is not well understood, and evaluation of the effectiveness of the TA forecast system is ongoing.[288] Despite the forecast system being in its relative infancy, international engagement and national information-sharing is already occurring.[289]

FINDINGS/CONCLUSIONS

198. The standard of proof for coronial findings of fact is the civil standard of proof on the balance of probabilities, with the *Briginshaw* gloss or explications.[290]

199. Adverse findings or comments against individuals or institutions are not to be made with the benefit of hindsight, but only on the basis of what was known or should reasonably have been known or done at the time, and only where the evidence supports a finding that they departed materially from the standards of their profession, and in so doing, caused or contributed to the death under investigation.

200. Having applied the applicable standard of proof to the available evidence, I find that:

(a) Mr Papadopoulos died as a result of the thunderstorm asthma event occurring in Melbourne on 21-22 November 2016.

[285] Statement of Dr Andrew Tupper dated 7 May 2018 coronial brief page 983.
[286] Statement of Dr Andrew Tupper dated 7 May 2018 coronial brief page 984.
[287] Transcript page 584.
[288] Statement of Dr Andrew Tupper dated 7 May 2018 coronial brief page 984.
[289] Transcript page 584.
[290] *Briginshaw v Briginshaw* (1938) 60 CLR 336 at 362-363; '*The seriousness of an allegation made, the inherent unlikelihood of an occurrence of a given description, or the gravity of the consequences flowing from a particular finding are considerations which must affect the answer to the question whether the issues had been proved to the reasonable satisfaction of the tribunal. In such matters "reasonable satisfaction" should not be produced by inexact proofs, indefinite testimony, or indirect inferences…'.*

(b) Mr Papadopoulos was known to suffer from asthma and hay fever, which appeared to act as a trigged for his asthma. His allergy status does not appear to have been investigated during life.

(c) Mr Papadopoulos became acutely unwell at about 6.10pm on 21 November 2016. His mother telephoned '000' at 6.50pm and the first Ambulance Victoria unit arrived to assist him at 7.16.04pm.

(d) Mr Papadopoulos collapsed as the paramedic arrived. Despite life-saving measures including CPR, intubation and (difficult) ventilation and transportation to the Northern Hospital Emergency Department, where advanced life support measures were continued, Mr Papadopoulos was pronounced deceased at 8.16pm on 21 November 2016.

(e) Post-mortem investigations established that Mr Papadopoulos had a very high sensitivity to rye grass pollen, a common allergen in the Melbourne area, as well as a sensitivity to *Alternaria* mould, the significance of which remains unclear in relation to TA.

(f) The weight of evidence supports a finding that any delay in dispatch and attendance of an ambulance was not inordinate in all the circumstances and is unlikely to have materially altered the outcome for Mr Papadopoulos.

(g) While Thunderstorm Asthma was a known phenomenon, described in the literature since the 1980s, and recognised by meteorologists, some public health researchers and respiratory physicians, prior to 21 November 2016, the potential for epidemic health impacts was not appreciated by first line emergency responders and the public health system.

(h) The scale of the Thunderstorm Asthma event experienced in Melbourne on 21-22 November 2016, and to a lesser extent the rest of Victoria, can be fairly described as unprecedented globally, both in terms of the demands placed on first line emergency responders and the public health system, and the nature and extent of health impacts on individuals.

(i) That said, it is important to acknowledge the enormous efforts made by those working at the coal face on the evening of 21 November 2016 and into the next day – the ESTA call-takers, dispatchers and managers, AV clinicians, paramedics and

managers, the MFB members providing first responder assistance and Victoria Police members who assisted on an as needs basis, and the public health system, all of whom went above and beyond to deliver emergency services to the public in extremely challenging circumstances.

(j) In keeping with the reasonable expectations of the Victorian community of its public institutions and entities, the ESTA, AV and the DHHS have engaged in appropriate professional reflection and reviewed their performance in response to the Thunderstorm Asthma event, as well as cooperating with the IGEM review and assisting this coronial investigation.

(k) Significant effort has gone into these reviews and significant learnings were derived. More importantly, improvement have been made across the ESTA, AV and the DHHS which should see Victoria better prepared for any future Thunderstorm Asthma events and for any future surge in demand for emergency services, irrespective of the cause, or even where the cause of the surge is unknown.

COMMENTS

Pursuant to section 67(3) of the ***Coroners Act 2008***, I make the following comments on matters connected with the deaths I have investigated, including matters relating to public health and safety or the administration of justice:

1. I do not propose to make any recommendations, as so many have been made, and few stones left unturned. However, I think it is appropriate to document those areas where the available evidence supports the need for further or ongoing work, and where there is potential for further improvements in public health and safety.

2. Although the specific meteorological, biological and aerobiological factors that combine to create a Thunderstorm Asthma event are not fully known and/or understood, the available evidence supports a finding that further research into these will improve our understanding of the phenomenon, our ability to predict which particular weather event has the potential to produce Thunderstorm Asthma and to issue more accurate forecasts and more meaningful public warnings.[291] Similarly, further verification and development of the currently described 'immature' Thunderstorm Asthma forecasting system is vital in providing the Victorian community with accurate and meaningful Thunderstorm Asthma warnings.

[291] Transcript t page 120.

3. Public awareness campaigns undertaken by the DHHS, asthma action plans that have been promulgated in Victoria, and publicity around the link between hay fever and Thunderstorm Asthma with the aim of escalating preventative therapy for those at increased risk, are all presumed to have contributed to increased general preparedness to deal with a future Thunderstorm Asthma event. While the efficacy of these strategies has yet to be tested, it makes sense that they be continued into the future in the interests of further improving the community's health literacy and alleviating the impact of any future surge in demand for emergency services due to Thunderstorm Asthma.[292]

4. Similarly, there is scope for further medical, allied health and general community education encouraging hay fever sufferers to submit to allergy testing in order to better understand their susceptibility to Thunderstorm Asthma, to inform clinical management of their hay fever and to provide a specific management plan in anticipation of seasonal exacerbations or Thunderstorm Asthma.

5. The circumstances in which the cohort of deceased suffered an exacerbation of their asthma to which they ultimately succumbed, provides a sound basis for recommending that when a Thunderstorm Asthma warning is issued, those at risk remain indoors, with the windows and doors shut, and any evaporative cooling or other systems which draw in air from outside turned off, and/or travel to or from work later, in an effort to minimise their risk of potentially fatal exposure to the elements.[293]

6. AV and the ESTA have been responsive to feedback and introduced the new surge script informing '000' callers that they are experiencing high demand and that they should consider alternative means of accessing medical attention/treatment. In a similar vein, they have changed the exit scripts for Priority 1 and Priority 0 calls from '*The ambulance is on its way*' to '*Help is being arranged*' which is likely to be more accurate at times of high demand for ambulance services. I accept the changes have been made in a genuine effort to be more informative and that the new scripts provide more accurate (and some additional) information.

7. However, it is not apparent that a caller hearing the new scripts is in any better position to make an informed choice about whether to wait for an ambulance or to engage in self-help. What such a caller needs is information specific to their situation, effectively an estimated time of arrival of the ambulance. As I understand it, our emergency response system is not

[292] Transcript pages 122-123.
[293] Transcript page 139.

presently configured to provide such information. I am confident that AV and the ESTA are well aware of this issue and I certainly do not intend to minimise its complexity. Rather, I consider it appropriate to highlight this as an extant issue going forward.[294]

PUBLICATION OF FINDING

This finding is to be published on the Internet in accordance with the rules of the Court pursuant to section 73(1) of the Act.

DISTRIBUTION OF FINDING

I direct that a copy of this finding be provided to the following:

Ms Emma Papadopoulos, Senior Next of Kin.

Ms Jackie Petrov, Legal Coordinator, The Northern Hospital

Ms Jess Bayley, K&L Gates, on behalf of the Emergency Services Telecommunications Authority

Ms Margaret Mann on behalf of the Department of Health and Human Services

Ms Kate Mellier, Lander and Rogers Lawyers, on behalf of Ambulance Victoria

Mr Evan Evagorou, Australian Government Solicitor's Office, on behalf of the Bureau of Meteorology

Mr Tony Pearce, Inspector-General for Emergency Management

Minister for Emergency Services

Minister for Ambulance Services

Minister for Health

Safer Care Victoria

Australasian Society of Clinical Immunology and Allergy

Royal Australasian College of Physicians

Royal Australian College of General Practitioners

[294] Transcript pages 215-18.

Professor Jo Anne Douglass

Australasian College for Emergency Medicine

College of Emergency Nursing Australasia

Pharmacy Guild

Asthma Australia

National Asthma Council

Senior Constable Noah Robert Beasley, Coroner's Investigator, Victoria Police.

Signature:

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PARESA ANTONIADIS SPANOS

CORONER

Date: 9 November 2018

Cc:

Ms Ruth Bergman, Manager, Health & Medical Investigations, Coroners Prevention Unit

Leading Senior Constable Duncan McKenzie, Police Coronial Support Unit

Ms Amira Kafka, Coroner's Solicitor, Coroners Court of Victoria