IN THE CORONERS COURT
OF VICTORIA
AT MELBOURNE

Court Reference: COR 2015 0048

FINDING INTO DEATH WITHOUT INQUEST

Form 38 Rule 60(2)
Section 67 of the Coroners Act 2008

Findings of:	Caitlin English, Coroner
Deceased:	Mrs Z
Date of birth:	7 February 1944
Date of death:	3 January 2015
Cause of death:	I(a) Tiger snake envenomation
Place of death:	Royal Melbourne Hospital 300 Grattan Street, Parkville, Victoria

Table of Contents

I, CAITLIN ENGLISH, Coroner having investigated the death of Mrs Z

without holding an inquest:

find that the identity of the deceased was Mrs Z

born on 7 February 1944

and the death occurred on 3 January 2015

at Royal Melbourne Hospital, 300 Grattan Street Parkville

from:

I(a) Tiger snake envenomation

Pursuant to section 67(1) of the **Coroners Act 2008**, there is a public interest to be served in making findings with respect to **the following circumstances**:

1. Mrs Z was 70 years of age at the time of her death. She resided at 308 Minns Road Melton, Victoria with her de facto partner, Mr Z.
2. On the early morning of 3 January 2015, whilst sleeping in bed, Mrs Z was bitten three times on the big left toe by a tiger snake.
3. She died after being unable to be revived in the Intensive Care Unit at the Royal Melbourne hospital on the evening of 3 January 2015.

The purpose of a coronial investigation

4. Mrs Z's death was reported to the Coroner as it appeared to be unexpected, unnatural or the result of an accident, and so fell within the definition of a reportable death in section 4 of the *Coroners Act 2008.*
5. The role of a coroner is to independently investigate reportable deaths to establish, if possible, identity, medical cause of death and surrounding circumstances. Surrounding circumstances are limited to events which are sufficiently proximate and causally related to the death. The purpose of a coronial investigation is to establish the facts, not to cast blame or determine criminal or civil liability.
6. The coronial brief includes statements obtained from Mr Z, an Ambulance Victoria paramedic and the coroner's investigator. I also have Mrs Z's medical records from Royal Melbourne Hospital.

7. As part of the investigation I requested the Coroners Prevention Unit to review Mrs Z's medical care. Following that review I obtained expert opinions from snakebite experts, Dr Julian White, Associate Professor Mark Little and Professor Geoff Isbister.

8. I investigated the medical management of Mrs Z's snake bite and considered the current debate surrounding the guidelines for administering antivenom.

9. I have also had regard to a letter received from Mr Z dated 2 February 2015, a letter and list of questions dated 13 July 2015 from CZ, on behalf of Mr Z and a letter dated 27 January 2017 from Mr Z. I have taken into account the questions raised in correspondence in this Finding.

10. I have based this Finding on the evidence contained in the coronial brief. In the coronial jurisdiction facts must be established on the balance of probabilities.[1]

11. I take into account section 8 of the *Coroners Act 2008*, particularly section 8(e) and the public interest in protecting the personal information of Mrs Z's family, and have redacted her and her family's identities for distributing this Finding and publishing it on the Internet.

IDENTITY

12. On 3 January 2015, Mr Z visually identified his de facto wife, Mrs Z, born 7 February 1944. Identity is not in dispute and requires no further investigation.

Background

13. Mrs Z had lived at the same address in Melton for 28 years and was engaged in home duties. Mr Z worked as a Field Officer for Corrections Victoria.

14. The couple lived in the garage which had been converted into a dwelling. The rest of the premises was used as a storage facility, located in a rural area on a property of 100 acres.

15. Mrs Z had a medical history of multiple sclerosis.

CIRCUMSTANCES IN WHICH THE DEATH OCCURRED

Snakebite incident

16. On 3 January 2015, Mrs Z went to bed around 11.00pm. Mr Z went to bed at about 11.20pm and stated they spoke together in bed for approximately 10 minutes. Mr Z reported dozing off into a broken sleep as it was an extremely hot night.

---

[1] This is subject to the principles enunciated in *Briginshaw v Briginshaw* (1938) 60 CLR 336. The effect of this and similar authorities is that coroners should not make adverse findings against, or comments about, individuals unless the evidence provides a comfortable level of satisfaction as to those matters taking into account the consequences of such findings or comments.

17. At approximately 12.30am Mr Z reported hearing something fall in another room or outside, and Mrs Z querying it. He then dozed off to sleep again and felt Mrs Z pulling up the sheet, which he described as very unusual for her. In retrospect, Mr Z believes this is when she was bitten by the tiger snake.

18. Mr Z stated he awoke about 1.00am to the sound of Mrs Z gurgling and appearing limp. He discovered a live snake in the bedroom doorway next to Mrs Z's side of the bed. He killed the snake and called an ambulance at 1.13am.

19. On arrival of the ambulance at 1.37am, the crew noted Mrs Z was awake with Glasgow Coma Scale (GCS) 14, and appeared to have 3 bite marks at the base of her left big toe.

20. Mrs Z had vomited and lost control of her bowels. She was placed in a wheelchair by ambulance officers.

21. On observing what appeared to be 3 double fang bites on the big toe of Mrs Z's left foot, the officers placed thick padding over the bites and then wrapped her whole leg in an immobilising bandage from toe to thigh.

22. Mrs Z appeared lethargic and sweaty and complained of a headache. Once in the back of the ambulance at 1.47am metoclopramide was administered intravenously to treat her nausea and vomiting, as well as oxygen.

23. The ambulance departed at 1.51am and transported her to the Royal Melbourne Hospital. She arrived at 2.18am. Laboratory tests on arrival showed venom induced consumptive coagulopathy and a bite site strongly positive for tiger snake venom. She had cranial nerve dysfunction indicating developing neurotoxicity.

Clinical management

24. At 3.30am, following consultation with the on-call toxicologist,[2] Mrs Z received two vials of CSL tiger snake antivenom.

25. On arrival in ICU at about 5.00am, Mrs Z's blood pressure was normal at 166/70mmHg and GCS 15. Blood tests at 6.40am showed unresolved coagulopathy. From about 7.15am, Mrs Z became hypotensive and poorly responsive to treatment, including intravenous fluid loading. At about 9.30am she developed right side abdominal pain and tenderness; intra-abdominal bleeding was suspected and blood product replacement was arranged. Six units of fresh frozen

[2] Statement by Dr Susan Winter, Royal Melbourne Hospital, dated 15 February 2016.

plasma was administered to address the coagulopathy and facilitate the insertion of a central venous line.

26. In view of her severe deterioration, further antivenom was given in the form of one vial of CSL tiger snake antivenom at 1000hrs. She deteriorated further, with decreased consciousness and worsening coagulopathy. At about 2.50pm she was intubated and at about 3.00pm suffered a cardiac arrest. Despite vigorous resuscitation, she died at 6.15pm.

CAUSE OF DEATH

27. Forensic Pathologist Dr Malcolm Dodd conducted an internal examination at the Victorian Institute of Forensic Medicine (VIFM) and formulated the cause of death as: '*I(a) Tiger snake envenomation*'. There was evidence of bleeding into many tissues with significant haemorrhage into the abdomen. Of note, tiger snake venom levels of 697ng/mL were measured, a level comparable to that found in envenomed low body weight animals, implying a very high venom load in this case.

SNAKEBITE MANAGEMENT

Coroners Prevention Unit

28. In an unusual coincidence, two months prior to Mrs Z's death, another death from tiger snake bite had been reported to the Coroners Court.[3] Following this death, correspondence sent to the Coroners Court of Victoria (CCOV) alerted me to differences in opinion within the clinical community about snakebite medical management.

29. In letters to the court dated 13 July 2015 and 27 January 2017, Mr Z raised a number of concerns regarding Mrs Z's medical management. His concerns included: the Ambulance Victoria and Royal Melbourne Hospital Protocol for treating snakebites, the time of diagnosis and time swabs were taken, the times and amount of antivenom and other fluids or medications administered, and the cause of Mrs Z's extremely swollen face and neck.[4]

30. In a further letter Mr Z also queried the time line of events recorded in the notes by AV and RMH. He also referred to an article written by Associate Professor Chris MacIsaac '*Lessons from practice: haemorrhagic death despite antivenom following tiger snake envenomation*' for which he provided his consent. He listed a number of factual concerns, which I have sought to clarify in this Finding.

---

[3] See the Finding without Inquest into the death of Shane Tatti (COR 2014 5696).
[4] Mr Z's letter to Coroners Court of Victoria, dated 13 July 2015, sent on his behalf by CZ.

31. I requested the Coroners Prevention Unit[5] (CPU) and the Health and Medical Investigation Team[6] (HMIT) to review Mrs Z's medical management and the appropriateness of the current guidelines for the treatment of snakebites.

Published snakebite management guidelines

32. Most snakebites will not result in envenoming and do not require antivenom,[7] however, if there is evidence of envenoming,[8] antivenom must be administered as soon as possible. Venomous snakebites in Victoria are from brown or tiger snakes.

33. Once a decision has been made to administer antivenom of a particular type, the Victorian clinical guideline for snakebite management is the applicable guideline used in Hospital Emergency Departments. The 2013 Guidelines distinguish between clinical pathways for envenomation and suspected snake bite and, among other things, include instructions to seek advice from a clinical toxicologist at the Poisons Information Centre.

34. In 2013 a 'clinical focus' was published in the Medical Journal of Australia containing a summary of research, 'Snakebite in Australia: a practical approach to diagnosis and treatment'[9] by Professor Geoff Isbister (an emergency physician and toxicologist) and his research group from the Australian Snakebite Project (ASP). With respect to the amount of antivenom to be administered, it stated:

    '*One vial of the relevant antivenom is sufficient to bind all circulating venom. However, recovery may be delayed as many clinical and laboratory effects of venom are not immediately reversible.*'[10]

35. The section headed 'Antivenom treatment' states one vial of antivenom is all that is needed for children and adults for all snake types. '*The use of more than one vial or repeated doses is no longer recommended.*'[11]

---

[5] The Coroners Prevention Unit (CPU) is a specialist service created to strengthen their prevention role and provide them with assistance on issues pertaining to public health and safety.

[6] The Health and Medical Investigation Team (HMIT) is part of the Coroners Prevention Unit, which assists in the investigation and development of recommendations surrounding deaths occurring during the provision of healthcare. HMIT also assists in identifying factors that may help improve patient safety and risk management.

[7] Isbister G, Brown S, Page C et al. 'Snakebite in Australia: a practical approach to treatment'. *Medical Journal of Australia* 2013; 199 (11): 763-768.

[8] Envenoming includes venom-induced consumption coagulapathy, sudden neuro toxicity thrombotic microangiopathy and renal impairment.

[9] Isbister G, Brown S, Page C et al. 'Snakebite in Australia: a practical approach to treatment'. *Medical Journal of Australia* 2013; 199 (11): 763-768.

[10] Ibid.

[11] Ibid.

36. The article in the Medical Journal of Australia[12] suggests it is recommended practice regarding diagnosis and treatment of snakebite, although the 2013 Victorian clinical guidelines for management of snake bite in emergency departments do not specifically adopt that wording.

Debate regarding the guidelines

37. In separate correspondence sent to the Coroners Court, Professor Julian White, Head of Toxinology at Adelaide Women's and Children's Hospital[13] and Mr Peter Mirtschin,[14] an independent researcher at private company Venom Science Pty Ltd expressed, their particular interest in the circumstances of the earlier snake bite death.

38. Professor White referred to different opinions in Australian emergency medicine and toxicology circles concerning the recommendation that one ampoule of antivenom be administered. Mr Mirtschin raised a number of issues involved in treatment of snakebite for the extremely difficult cases of high venom yield and that he would have recommended 6+ vials of tiger snake antivenom, '*as an ideal start.*' He wanted to comment on recommendations for the future management of such cases.

39. Professor White stated that there are circumstances in which multiple ampoules should be administered. He noted that the antivenom producer CSL (now Seqirus)[15] recommends two ampoules of tiger snake antivenom as the initial dose and that in two reported series of Australian snakebite cases (23 cases in Western Australia over 16 years including one death, and a national series of 56 cases with no deaths) patients received more than one ampoule of tiger snake antivenom on average, with four ampoules in the WA series, and two ampoules in the national series.

Expert reports

40. In Mrs Z's case, there was clinical and post-mortem evidence of very significant envenoming and she received two vials of tiger snake antivenom.

41. Death from snakebite in Australia should be rare, particularly with early access to specific antivenom therapy. As noted above, two Australian studies reported one death in 23 cases (Western Australia) and 56 cases with no fatalities (national data).

---

[12] The AMJ is sent to all members of the Australian Medical Association.
[13] Emails dated 20 November 2014 and 4 December 2015.
[14] Letter dated 29 December 2104.
[15] 2013: A Clinician's Guide to Australian Venomous Bites And Stings

42. Two deaths from snakebite in the space of two months in the one State is highly unusual.

43. In view of the divergence of opinion regarding antivenom administration, I decided to obtain expert reports as recommended by CPU.

44. Associate Professor Mark Little and Professor Julian White were asked to provide expert opinions on the two deaths, noting any areas of similarity and common issues between the two. Professor Isbister, whose research supports the administration of one ampoule of antivenom, was asked to respond to the two expert opinions.

- *Associate Professor Mark Little*

45. In respect of Mrs Z's medical management Associate Professor Little concluded:

'*I have no concerns about the standard of care provided to Mrs Z, as this was consistent with national guidelines for the management of snakebite in Australia...She received 2 units of tiger snake antivenom within 2.5 hours of the bite, assuming Mrs Z was bitten when husband awoke.*

The role of early clotting factor replacement still remains controversial, with some limited evidence of its benefit. There are risks associated with its use...

Notwithstanding that, in Mrs Z's case we do not know if early FFP (Fresh frozen plasma) would have reversed her coagulopathy, although it was more likely to than not if we go on the evidence from the randomised controlled trial, as long as it was not administered within six hours of the snakebite.

I believe further review of all evidence for the use of FFP in the reversal of coagulopathy due to snake bite VICC (incoagulable blood) is required, and it is likely that new recommendations suggesting earlier usage are recommended. '[16]

- *Professor Julian White*

46. Professor White stated:

'*...there appear to be no grounds for doubting the diagnosis of snakebite by a tiger snake resulting in severe envenoming. The initial history and presentation indicated envenoming was likely present and the initial blood test results, from 02.55, about 3 hours post-bite, confirmed envenoming was the most likely diagnosis and that urgent administration of antivenom was warranted. Whether antivenom could have been given earlier, immediately*

[16] Report by Associate Professor Mark Little dated 9 January 2016.

after arrival at RMH, is difficult to answer, but I think the course of action is supportable and reasonable. Similarly, an initial dose of 2 vials of CSL Tiger Snake Antivenom can be considered reasonable, in the circumstances.'[17]

47. With respect to the additional ampoule of antivenom administered, Professor White stated:

'*The effect, if any, of not giving a follow up dose of antivenom early and only a single vial later cannot be certainly determined. There were reasonable grounds to administer further antivenom, in my opinion, particularly since active and life threatening bleeding was suspected and blood product replacement therapy planned, but I hesitate to suggest not giving further antivenom early, or giving a single vial later, contributed to the fatal outcome.*' [18]

- *Professor Geoffrey Isbister*

48. Responding to the expert opinions of Professor White and Associate Professor Little, Professor Isbister agreed with Associate Professor Little that Mrs Z's medical management was reasonable.

49. Professor Isbister stated that analysis of Australian Snakebite Project data has shown that one vial is sufficient in the vast majority of cases and potentially all cases. He also stated that it is important to continue to carefully monitor the effect of lower dose antivenom and that there are current studies underway.

50. Professor Isbister noted that two vials were administered in the case of Mrs Z and there was no venom detected in her post anti-venom blood samples.

51. Professor Isbister explained that larger antivenom doses carry a risk of allergic reactions in one in five patients and severe or life-threatening anaphylaxis in three out of 100 cases. There is also a cost issue, with antivenom costing between $200 and $2000 per vial; it would be very expensive to stock all Australian Hospitals with sufficient doses to urgently treat snake bite, and the cost would be unnecessary when the data supports one vial.

52. By way of background, Professor Isbister explained that in the 1980's and 1990s the recommended dose of antivenom was increased because of what he described as a flawed belief that antivenom could reverse an irreversible process. In the early 2000's the ASP provided evidence to disprove the concept that antivenom could reverse the coagulation disturbance that occurs in envenoming.

---

[17] Report by Professor Julian White dated 5 February 2016 p 14.
[18] Report by Professor Julian White dated 5 February 2016 p 5.

53. He stated:

'We certainly need to consider that we may need to give larger doses where we think there is more severe envenoming. Unfortunately, we are currently unable to determine in which cases there is a massive venom load. I would support Associate Professor Mark Little's opinion that we need to keep researching this and we need to record cases such as this and modify guidelines when there is sufficient evidence.'[19]

54. Professor Isbister stated:

'It is clear from the venom measurements (in Mrs Z's case) that no venom was detectable after the 2 vials of antivenom was given. As stated previously the actual venom quantity is likely to be overestimated, but venom was never detected again. This simply demonstrates that 2 vials was sufficient in this case, and not that one vial was not sufficient.'[20]

55. He concluded: *'...[this] death is similar to many deaths over the last 10 years from brown and tiger snakes, with coagulopathy resulting in major haemorrhage. The case provides no support to the guidelines affecting the management because the patient was given 2 vials of tiger snake, contrary to the guidelines. Although the larger dose did not result in any untoward outcome it also provides no support for the fact that a dose of one vial would have been any different.'*[21]

Referral of expert reports to Department of Health & Human Services

56. The expert statements reflect an ongoing debate regarding the amount of antivenom that should be administered to treat snakebite, particularly in cases where there is evidence of high envenomation. [22]

57. In view of the divergence in opinion it was apparent the debate needed resolution so that clinicians treating and advising on snakebite management had access to evidence-based research and advice.

58. In order to facilitate this, I sent by cover of letter dated 20 September 2016, the three expert reports to the Department of Health and Human Services (DHHS).[23]

---

[19] Report by Professor Geoffrey Isbister dated 18 May 2016 p 20.
[20] Ibid.
[21] Ibid p 27.
[22] Although there was also dispute amongst the experts as to how to establish this.
[23] Formerly the Department of Health.

59. I advised DHHS that whilst investigating two deaths from snakebite, I was provided with conflicting evidence from experts regarding the appropriateness of the recommended practice in the MJA, namely that a single dose of antivenom should be administered to treat snakebite.

60. I asked DHHS to consider the three reports with a view to ascertaining whether the 2013 guideline for the management of snake bite in emergency departments in Victoria should be reviewed.

61. DHHS agreed to review the Guidelines. The response from Safer Care Victoria dated 30 June 2017 indicated that the 2013 'Management of snake bite in emergency departments in Victoria' clinical pathway had been revised by an expert panel and endorsed by the Emergency Care Clinical Network Steering Committee.

62. The updated 2017 Guidelines are largely the same as the 2013 Guidelines. They emphasise the importance of early discussions with a clinical toxicologist at the Poisons Information Centre.

63. The 2017 Guidelines refer to the ECCN convening an expert reference group of clinical toxicologists and experts in management of snakebite to update the 2013 Snakebite Clinical Pathway. I note the expert reference group includes Professor Geoff Isbister.

64. With respect to the amount of antivenom to be administered the Snakebite Clinical Pathway acute management implies one vial is to be administered as it refers to diluting in 100-500 ml of isotonic saline and administering over 15-30 minutes.

65. The 2013 and 2017 Guidelines both note that in case of envenomation *and* delay in contacting a clinical toxicologist, to administer one vial of tiger snake antivenom and one vial of brown snake antivenom.

Ambulance Victoria

66. Mr Z queried whether guidelines were in place for the treatment of snakebites by ambulance staff.

67. Colin Grant, Manager of Professional Standards with Ambulance Victoria (AV) provided advice that AV uses a Clinical Work Instruction (dated 3 February 2012) relating to bite management and the application of pressure immobilising bandaging.

68. AV also issued a Clinical Bulletin in 2012 and produced a learning package for paramedics regarding snake bite management in 2012.

69. Mr Grant stated:

'In short, the occurrence of a snakebite cannot always be initially determined by paramedics. All suspected snake bite patients need to be triaged as a medical emergency and transported to hospital ASAP. The paramedics should do as little as possible to the wound other than apply a pressure immobilisation bandage, to allow for traces of venom to be swabbed with a hospital's venom detection kits. If the patient has already had some first aid applied prior to AV attendance, the existing bandage is to be left in place (unless distal circulation has been severely compromised.'[24]

Review by Royal Melbourne Hospital

70. As part of the coronial investigation, Royal Melbourne Hospital was asked if it conducted a case review following Mrs Z's death. RMH stated:

'Given the likely cause of death in Mrs Z was internal haemorrhage associated with venom induced coagulopathy (VICC), the management of VICC was extensively discussed at our case review meeting. It was acknowledged that the management she received was consistent with expert opinion on the management of VICC, but this opinion is based on very limited evidence.

The administration of FFP (Fresh Frozen Plasma) within four hours of the administration of anti-venom has been associated with the restoration of clotting in many snakebite patients.' [25]

Conclusion

71. I find the medical response to Mrs Z's snake bite was appropriate and timely.

72. I accept the expert opinions that the standard of medical care provided was reasonable and consistent with the national guidelines for the management of snakebite in Australia. In this case two vials of antivenom were administered between 2.5 hours and under 4 hours after her bite, which the experts agreed to be within a reasonable time frame. There is no evidence a further antivenom vial at that point would have altered the outcome.

73. Pre-mortem blood samples were sent to the Australian Venom Research Institute which revealed that venom was not detected following the administration of the Tiger snake anti-venom. This result supports the fact Mrs Z received an appropriate dose of anti-venom in the Emergency Department.

[24] Correspondence from Colin Grant, Ambulance Victoria, dated 4 December 2017.
[25] Statement of Dr Susan Winter, Royal Melbourne Hospital, dated 15 February 2016.

74. Despite receiving appropriate antivenom, Mrs Z's blood remained incoagulable and she died as a result of a life threatening bleed.

Comments pursuant to section 67(3) Coroners Act 2008

75. Deaths from snakebite in Australia are rare and two Victorian deaths in close succession are a cause for particular concern. In the course of my investigation I was provided with conflicting evidence from experts regarding the appropriateness of suggested recommended practice regarding diagnosis and treatment of snakebite in Australia.

76. Because of this I sent the expert reports obtained during the investigation to the DHHS and was advised of their intention to review the 2013 'Management of snake bite in emergency departments in Victoria clinical guidelines.'

77. When provided with the reviewed and updated 2017 Guidelines by DHHS there was no acknowledgement of the divergence of views in the clinical community as outlined in the expert reports, or how or, indeed if, they had been reconciled. I note there is no reference in the 2017 Guidelines to the number of ampoules of antivenom to be administered. I note the emphasis in the Guidelines is to contact a clinical toxicologist at the Poison Information Centre for advice, which will presumably include the type and number of ampoules of antivenom to be administered.

78. There is no suggestion or acknowledgement there could be circumstances, such as severe envenoming, when more than one ampoule of antivenom be administered.

79. I conclude by noting Associate Professor Mark Little's comment that '*...in treating an envenomed patient we need to successfully treat the 'outlier' case, not the 'median' case. Whilst it is likely that for many patients envenomed by a snake in Australia, one ampoule may be enough, this case would suggest a higher initial dose (possibly two ampoules) might be required, for tiger snake envenomings.*'

80. Unfortunately, the coronial investigation has not resolved this issue and I have made recommendations in the Finding into death without Inquest into the death of Shane Tatti (COR 2014 5696).

81. I support the suggestion by Associate Professor Mark Little that the clinical details of this case and Mr Tatti's be published in the medical literature (subject to family consent) so that clinicians are aware of the details surrounding these deaths.

Recommendation pursuant to section 72(2) Coroners Act 2008

1. I recommend that the Australasian College for Emergency Medicine (ACEM) circulate this Finding to ACEM fellows to highlight the evidence, guidelines and potential issues in the management of snake bite.

I express my sincere condolences to Mrs Z's family for their tragic loss.

Pursuant to section 73 (1A) Coroners Act 2008 I direct this Finding be published on the Internet.

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

Mr Z
Dr Damian Turner, Royal Melbourne Hospital
Dr Malcolm Mohr, Melbourne Health
Mr Colin Grant, Manager Professional Standards, Ambulance Victoria
Dr Simon Judkins, President, Australasian College for Emergency Medicine
Professor Julian White, Women & Children's Hospital, Adelaide, SA
Professor Geoff Isbister, University of Newcastle, NSW
Associate Professor Mark Little, Cairns Hospital, QLD
Mr Peter Mirtschin, Venom Science Pty Ltd

Signature:

CAITLIN ENGLISH
CORONER
Date: 5 October 2018