IN THE CORONERS COURT
OF VICTORIA
AT MELBOURNE

COR 2024 001869

FINDING INTO DEATH WITHOUT INQUEST

Form 38 Rule 63(2)

*Section 67 of the **Coroners Act 2008***

Findings of:	Coroner Katherine Lorenz
Deceased:	Danielle Cadan
Date of birth:	6 June 1971
Date of death:	19 April 2023
Cause of death:	1(a) Methemoglobinemia in the context of lignocaine use
Place of death:	52 Maiden Street, Moama, New South Wales, 2731
Key words:	Methemoglobinemia, dental procedure, lignocaine, discharge advice

INTRODUCTION

1. Danielle Cadan was 51 years old when she died on 19 April 2023 at home in Moama, NSW, from *methemoglobinemia* following a tooth extraction with Echuca Regional Health (**ERH**) earlier in the day.

2. Methemoglobinemia is the increased presence of *methemoglobin* (**MetHb**) in the blood. MetHb is an altered state of the normal *haemoglobin* (**Hb**) molecule in the body's red blood cells which transports oxygen from the lungs to the rest of the body to support life. Hb is where oxygen binds to red blood cells, and MetHb cannot bind as well to oxygen as Hb. Therefore, as MetHb levels rise, less oxygen can be transported throughout the body. At sufficient levels of MetHb, the body essentially becomes deprived of oxygen which can lead to death.

3. There are many mechanisms by which Hb is altered to form MetHb. One mechanism is through *oxidative stress*. Oxidative stress is a phenomenon caused by an imbalance between production and accumulation of reactive oxygen species, or *free radicals*, and the antioxidants that detoxify these reactive products. This leads to cell and tissue damage.

4. Free radicals are normal by-products of energy production in the body. However, environmental stressors (such as UV radiation and heavy metals), medications, other drugs, and various disease processes can increase the level of free radicals. Depletion of antioxidants can also cause a relative increase in free radicals.

5. While the precise mechanisms are often unknown, methemoglobinemia caused by oxidative stress can be triggered by medications, other drugs, or from *sepsis*: a serious condition arising from the body's immune response to an infection. Any comorbidities that impair oxygen transport will predispose a person to methemoglobinemia. These include heart disease, anaemia, and lung disease. Smoking also increases oxidative stress.

6. Methemoglobinemia in this context is treatable if diagnosed. Treatment can range from observation only, supplemental oxygen, to administration of an antidote such as *methylene blue*. Methylene blue works by reacting with MetHb to change it back to Hb.

7. In Danielle's case, the methemoglobinemia was most likely caused by lignocaine, a drug commonly used in dental procedures as a local anaesthetic. However, other causes of methemoglobinemia were investigated and are outlined in this finding. Danielle had several risk factors for being more susceptible to oxidative stress such as smoking and obesity.

THE CORONIAL INVESTIGATION

8. Danielle's death was reported to the coroner in NSW as it fell within the definition of a reportable death in the *Coroners Act 2009* (NSW). Reportable deaths include deaths that are unexpected, unnatural, or occur in unusual circumstances.

9. During the investigation, it became clear that the cause of death was directly related to the dental procedure in Echuca. The Victorian legislation, the *Coroners Act 2008* (**the Act**), confers jurisdiction in this case as reportable deaths include cases where the cause of death occurs in Victoria irrespective of where a person dies or whether they live in Victoria.

10. While both jurisdictions can investigate the circumstances around Danielle's death, it is usual practice for only one jurisdiction to take carriage of any one matter. This is primarily to avoid unnecessary duplication of investigation. After discussion with the Coroners Court of New South Wales, I took carriage of this matter in April 2024 and all materials from NSW were transferred to the Coroners Court of Victoria.

11. 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.

12. Under the Act, coroners also have the important functions of helping to prevent deaths and promoting public health and safety and the administration of justice through the making of comments or recommendations in appropriate cases about any matter connected to the death under investigation.

13. This finding draws on the totality of the coronial investigation into the death of Danielle Cadan. Whilst I have reviewed all the material, I will only refer to that which is directly relevant to my findings or necessary for narrative clarity. In the coronial jurisdiction, facts must be established on the balance of probabilities.[1]

[1] 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.

MATTERS IN RELATION TO WHICH A FINDING MUST, IF POSSIBLE, BE MADE

Circumstances in which the death occurred

14. On 19 April 2023, Danielle presented to Echuca Regional Health for a dental appointment at 11.30am. The appointment was an emergency appointment for toothache. Danielle had many emergency dental appointments over the years and had many tooth extractions in similar circumstances. Danielle did not have any complications except for previous *dry socket*, a painful condition where the blood clot over the site of extraction prematurely dislodges or dissolves.

15. Danielle was seen by a final year dental student who was supervised by a dentist. On examination, tooth 13, the upper right canine, was found to be the source of Danielle's pain. Tooth 13 was documented as having *root caries* (tooth decay) with *irreversible pulpitis* (inflammation of the pulp, or inside of the tooth).

16. Two options were presented to Danielle. The first was to do nothing, which may have led to continued pain and infection. The second was extraction of the tooth, which carried the risk of acute pain and bleeding, dry socket, and damage to the adjacent tooth which was already compromised from existing decay. There was a high chance of the tooth fracturing during extraction owing to the extent of the tooth decay which may have required surgical intervention or referral elsewhere if the tooth could not be entirely retrieved.

17. Danielle agreed to the second option and provided verbal informed consent for immediate extraction.

18. The student commenced the extraction and remained supervised by the dentist. 2.2mL of lignocaine 2% with 1:80,000 adrenaline was used as a local anaesthetic by local infiltration with a needle. This is a standard medication and technique used in tooth extraction. Danielle had had this medication before with previous extractions.

19. The student sought assistance from the supervising dentist part way through the extraction as the tooth was heavily broken down. The supervising dentist completed the procedure and checked and irrigated for tooth fragments in the socket. The socket was sutured with resorbable sutures and Danielle was advised that this meant she did not need to return for suture removal.

20. The student dentist took additional steps to ensure that a blood clot was present and maintained as long as possible given Danielle's history of dry socket. The student dentist also explained that smoking can be a contributing factor to this complication and urged Danielle to cease smoking for at least four days.

21. Danielle was provided with a written copy of discharge advice with an emphasis on smoking cessation. It also included advice on maintain the blood clot, advice to avoid hot/hard foods, advice to be careful of accidental lip biting due until the local anaesthetic wears off, and advice to contact the clinical again if there were any concerns.

22. Danielle was well when she left the practice, and the procedure was uneventful overall.

23. When Danielle returned home that afternoon, she complained to her son, Kevin, that the extraction had not gone smoothly as the tooth broke into pieces as it was so rotted and needed to be taken out piece by piece.

24. Danielle also complained that she felt 'cold to the bone' and Kevin observed that she was shivering and cold. Danielle also said that she had never felt this way after any other tooth extraction and that it had really 'knocked her around' and that she wasn't feeling well.

25. Danielle rested for the remainder of the afternoon and was on the couch watching television with Kevin in the evening. Kevin went to bed at about 8.30pm, and Danielle remained on the couch watching television.

26. Later in the night, at about 3.15am, Kevin left the bedroom and saw Danielle lying on the ground in the hallway. Kevin called Triple Zero and commenced CPR under instruction from the call-taker while an ambulance was dispatched.

27. On arrival, paramedics from Ambulance Victoria took over resuscitative efforts. Unfortunately, Danielle was deceased and could not be revived.

28. Later in the afternoon of 20 April 2023, clinicians attempted to call Danielle as part of routine follow-up. Danielle's daughter answered the phone and advised that Danielle had passed away during the night. She advised that Danielle had not been feeling well following the dental treatment including that her heart had been racing. Danielle had felt better after resting and having a shower but still felt tired and needed to rest.

Identity of the deceased

29. On 20 April 2023, Danielle Cadan, born 6 June 1971, was visually identified at the scene by her son, Kevin Cadan, as certified by the Officer in Charge, Senior Constable Christopher Young.

30. Identity is not in dispute and requires no further investigation.

Medical cause of death

31. Forensic Pathologist Dr Bernard Ian l'Ons conducted an autopsy on 26 April 2023 and provided a written report of the findings.

32. The autopsy showed no external injuries and was unremarkable.

33. Toxicological analysis of post-mortem samples identified low levels of pregabalin, quetiapine, lignocaine, codeine, and metabolites of morphine. Further testing of the blood showed a methemoglobin saturation of 40%.

34. Dr l'Ons commented that the expected level of methemoglobin is 1%, and a level of 40% is well within potentially fatal levels. Dr l'Ons also noted that while the risk of methemoglobinemia increases with increased doses of medications such as lignocaine, methemoglobinemia can occur following normal therapeutic administration as well as in patients who had previously been exposed with no ill effects.

35. Lignocaine also has a direct toxicity related to the administered dose. Dr l'Ons calculated the maximum safe lignocaine dose as roughly 200mg which was well below the administered dose of 44mg.

36. Dr l'Ons noted two other potential causes of death as bacterial sepsis and anaphylaxis.

37. Dr l'Ons commented that bacterial sepsis following dental procedures is relatively rare. However, the reported difficulty of the dental procedure may have provided an increased likelihood of bacteria entering the blood. Blood cultures performed post-mortem detected multiple types of bacteria which was a finding of post-mortem contamination. Dr l'Ons commented that this neither excludes nor supports the diagnosis of bacterial sepsis.

38. The serum tryptase level, a marker for anaphylaxis, was elevated. However, Dr l'Ons commented that the clinical features were not consistent with anaphylaxis and this elevation could be from sepsis or from normal post-mortem changes.

39. Dr l'Ons provided an opinion that the medical cause of death was *1(a) Methemoglobinemia in the context of lignocaine use.*

40. I accept Dr l'Ons' opinion.

FURTHER INVESTIGATION

41. Methemoglobinemia is an unusual and rare condition. As such, Danielle's family spoke to Dr l'Ons to discuss the post-mortem examination report. During the discussion, Dr l'Ons explained that he could not definitively exclude that Danielle had developed sepsis and was concerned that antibiotic medication had not been prescribed as had been done with previous tooth extractions. Dr l'Ons also discussed his concern that the provided medical records did not adequately detail what was done (or not done) during the procedure.

42. In subsequent correspondence to the NSW coroner, Danielle's son outlined the family's concerns. The Cadan family believed that the care provided was inadequate and requested a thorough and appropriate investigation. The family also indicated that they were in the process of escalating their concerns to the Health Care Complain Commission (**HCCC**).

43. These concerns were communicated to ERH by the NSW coroner. In response, the Chief Medical Officer (**CMO**) at ERH indicated that a Root Cause Analysis (**RCA**) would be performed in this case. The CMO also wrote that the initial internal review of the death did not identify any obvious concerns in the care provided, nor was there a clear indication for prophylactic antibiotics.

44. The RCA was still in progress at the time I took carriage of the investigation. A report of the RCA findings and recommendations was subsequently provided to the Court in May 2024.

RCA findings

45. The purpose of the RCA was to investigate the possibility of any actions related to the dental procedure which may have contributed to the death, or if the methemoglobinemia could have been predicted. The RCA was performed by a panel made up of both ERH staff and an external member.

46. The panel acknowledged the reported findings of methemoglobinemia as the cause of death. The panel found no evidence or indication of this condition at the time of the procedure. There were no predictive factors which would indicate the development of the methemoglobinemia after the patient had left the clinic.

47. One of the learnings of the panel was that patients should be advised every time they have a drug, even if it is topical anaesthetic, to be aware that if they feel tired and lethargic more so than normal, they need to consult the Emergency Department.

48. The panel also suggested the following written information to be included in discharge paperwork following any dental treatment:

"*All medications can cause side effects, and the medications you have received today as part of your dental treatment are no different. While most may be mild and pass quickly, if you feel very tired, weak, dizzy and this is concerning for you, please present to the Emergency Department for review. These could be signs of nothing at all or something serious, so it's best to get checked out.*"

Possibility of sepsis and the role of antibiotic therapy

49. The RCA did not comment on the possible alternative cause of methemoglobinemia from sepsis nor any comment on consideration of antibiotic therapy and other concerns raised by the family and Dr l'Ons. I note the CMO's comment that there was no clear indication for prophylactic antibiotics.

50. I also note that the current therapeutic guidelines do not recommend routine antibiotic prophylaxis for tooth extractions and other dental procedures. However, the guidelines suggest for clinicians to consider the need for antibiotic treatment of acute odontogenic infection (dental infection).

51. A diagnosis of infection is not explicitly made in the medical records. However, the documented assessment of the tooth suggests that it was infected. Similarly, the diagnosis of irreversible pulpitis in and of itself usually indicates some degree of bacterial infection. Again, the guidelines state that antibiotic therapy is not required because dental treatment (in this case, removal of the tooth) removes the source of infection and any bacteria introduced into the blood stream from treatment resolves rapidly.

52. Antibiotics are only indicated if an infected tooth breaks during an extraction *and* there is a delay in removing residual root or bone fragments. While there was tooth fragmentation during the extraction, the area was sufficiently irrigated, and any residual root and fragments were removed at the time.

COMMENTS

Pursuant to section 67(3) of the Act, I make the following comments connected with the death.

53. I agree with Dr l'Ons' concern that the medical records provided by ERH lacked sufficient detail about the procedure. Entries were only date stamped and not time stamped, it is unclear who was involved in the procedure or even the author of each entry. The degree of difficulty and reported tooth fragmentation and breakage were also not sufficiently stated in the medical record.

54. I do not share the concern about lack of antibiotic prescribing as antibiotics are no longer routinely prescribed following dental procedures. At a population level, the risk of contributing to antimicrobial resistance if antibiotics are routinely prescribed outweighs the benefit of those same antibiotics preventing a very rare complication of a dental procedure. The current guidelines do not indicate that Danielle ought to have been prescribed antibiotics.

55. The prolonged nature of the procedure following tooth breakdown may have justified prescribing antibiotics, however, this is a case where reasonable clinical minds can differ. I am satisfied that both courses of action would have been appropriate and reasonable.

56. This does not mean that patients cannot become unwell from sepsis relating to dental treatment. Instead, and in lieu of antibiotic prescribing, patients should be appropriately educated and informed of the risks. This should include being provided with sufficient written advice on discharge about signs and symptoms to look out for and when to present for urgent medical review, such as in an emergency department.

57. Similarly, and as recognised by the RCA, drug reactions can still occur even in patients who have had the same medications previously and in normal therapeutic doses. The same education and written discharge advice would cover most, if not all, rare but serious adverse events such as drug reactions and sepsis.

58. It is not appropriate to rely on patients to recognise that they are unwell and need medical treatment. The onus should always be on clinicians to flag and explain when to return

following any medical or dental treatment. Had Danielle been provided such advice as suggested by the RCA, then her subsequent symptoms may have been recognised as requiring medical attention.

59. Nothing in medicine, nor in life, is completely free of risk. This case is a salient reminder that just because a complication is rare, it does not mean that it will never happen. Clinicians need to be prepared for the worst and provide sufficient safety netting to patients on discharge. The proposed written advice suggested by the RCA captures these considerations. This could be strengthened by adding to the first sentence so that it reads:

"*All medications can cause side effects, and the medications you have received today as part of your dental treatment are no different,* ***even if you've had them before***".

60. ERH were provided with a draft copy of my findings for the opportunity to comment further on any of the issues raised, including this suggested change. In response, ERH provided their written discharge advice titled *"Care Instructions After a Dental Procedure"* which incorporated this change and provides other information that strengthens post-discharge advice. ERH did not comment on anything else my draft finding.

FINDINGS AND CONCLUSION

61. Pursuant to section 67(1) of the Act I make the following findings:

    a) the identity of the deceased was Danielle Cadan, born 6 June 1971;

    b) the death occurred on 19 April 2023 at 52 Maiden Street, Moama, New South Wales, 2731, from *methemoglobinemia in the context of lignocaine use*; and

    c) the death occurred in the circumstances described above.

62. Having considered all the evidence, I am comfortably satisfied to the requisite standard that the methemoglobinemia was caused by administration of lignocaine despite being within a therapeutic dose.

63. I further find that the clinical care and treatment provided by Echuca Regional Health was reasonable and that antibiotics were not indicated in this case. I emphasise that Danielle's death was from an incredibly rare and unusual condition which could not have been predicted.

64. However, had Danielle been provided additional discharge advice, such as that suggested in the RCA or the updated written discharge document, then her death may have been prevented as she may have sought further medical advice when her symptoms began. This would equally apply if the cause of death had been from sepsis.

65. I am not prepared to say that the death was preventable because the precise hypothetical sequence of events that would have followed if Danielle had been provided the additional written discharge advice is too speculative to meaningfully consider. However, I reiterate that this would have been Danielle's best chance for survival.

I convey my sincere condolences to Danielle's family for their loss.

Pursuant to section 73(1A) of the Act, I order that this finding be published on the Coroners Cour of Victoria website in accordance with the rules.

I direct that a copy of this finding be provided to the following:
Kevin Cadan
Shantelle Cadan
Echuca Regional Health
Coroners Court of NSW

Signature:

Coroner Katherine Lorenz

Date : 12 August 2024

NOTE: Under section 83 of the ***Coroners Act 2008*** ('the Act'), a person with sufficient interest in an investigation may appeal to the Trial Division of the Supreme Court against the findings of a coroner in respect of a death after an investigation. An appeal must be made within 6 months after the day on which the determination is made, unless the Supreme Court grants leave to appeal out of time under section 86 of the Act.