IN THE CORONERS COURT
OF VICTORIA
AT MELBOURNE

Court Reference: COR 2018 3542

FINDING INTO DEATH WITHOUT INQUEST

Form 38 Rule 63(2)
*Section 67 of the **Coroners Act 2008***

Findings of:	Coroner Jacqui Hawkins
Deceased:	Baby AA
Date of birth:	10 July 2018
Date of death:	21 July 2018
Cause of death:	I(a) Disseminated Herpes Simplex Virus (HSV 1)
Place of death:	Northern Hospital, 185 Cooper Street, Epping, Victoria, 3076

BACKGROUND

1. Baby AA was 11 days old when she died on 21 July 2018 at the Northern Hospital. She was the first child to parents Ms CT and Mr EA.

2. Baby AA's death was reported to the Coroner as it fell within the definition of a reportable death in the *Coroners Act 2008.*

THE PURPOSE OF A CORONIAL INVESTIGATION

3. The role of a coroner is to independently investigate reportable deaths to establish, if possible, identity, medical cause of death and with some exceptions, surrounding circumstances. Surrounding circumstances are limited to events which are sufficiently proximate and causally related to the death. The law is clear that coroners establish facts; they do not lay blame or determine criminal or civil liability.[1]

4. Due to the medical complexities associated with her death, this case was referred to the Coroners Prevention Unit for a comprehensive review and assessment of the medical and management of Baby AA.

5. All coronial findings must be made based on proof of relevant facts on the balance of probabilities.[2] The strength of evidence necessary to prove relevant facts varies according to the nature of the facts and the circumstances in which they are sought to be proved.[3]

6. In writing this Finding, I do not purport to summarise all the evidence but refer to it only in such detail as appears warranted by its forensic significance and the interests of narrative clarity.

IDENTITY OF THE DECEASED

7. Baby AA was identified by her mother, Ms CT on 21 July 2018. Identity was not in issue and required no further investigation.

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[1] In the coronial jurisdiction facts must be established on the balance of probabilities 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.

[2] *Re State Coroner; ex parte Minister for Health* (2009) 261 ALR 152.

[3] *Qantas Airways Limited v Gama* (2008) 167 FCR 537 at [139] per Branson J (noting that His Honour was referring to the correct approach to the standard of proof in a civil proceeding in the Federal Court with reference to section 140 of the *Evidence Act 1995* (Cth); *Neat Holdings Pty Ltd v Karajan Holdings Pty Ltd* (1992) 67 ALJR 170 at 170-171 per Mason CJ, Brennan, Deane and Gaudron JJ.

CIRCUMSTANCES IN WHICH THE DEATH OCCURRED

8. Ms CT had an uncomplicated pregnancy and went into spontaneous labour at 37 weeks gestation. Ms CT required a forceps-assisted delivery due to signs of foetal distress on the continuous tocographic (**CTG**) fetal heart rate monitoring.

9. Baby AA was born at the Northern Hospital on 10 July 2017. Her birth weight was 3,230grams. She had an Apgar score of six at one minute and nine at five minutes. Baby AA required continuous positive airway pressure (**CPAP**) via mask with supplemental oxygen at four minutes of life due to poor colour, although her respirations were regular. CPAP and oxygen were continued until 35 minutes of life, then weaned and ceased in response to Baby AA's improved condition.

10. Baby AA was admitted to the Special Care Nursery (**SCN**) and commenced on empirical intravenous (**IV**) antibiotics for risk of sepsis. These antibiotics were continued for 36 hours and then ceased as the blood tests were normal and Baby AA was clinically well. On 12 July 2018 she was discharged home with her parents.

11. On 14 July 2018, Baby AA was taken to the Emergency Department of the Northern Hospital for concerns about jaundice and lethargy. Baby AA's observations were in the normal range for her age. Baby AA had a physical examination which was normal, and a bilirubin level was well below the threshold for treatment. Baby AA was seen to drink a 40ml bottle of formula while in the Emergency Department. She was discharged home with advice to return if Ms CT and Mr EA had any further concerns.

12. A domiciliary midwife reviewed Ms CT and Baby AA in their home on 17 July 2018. The midwife referred Baby AA to the paediatric team at the Northern Hospital due to an 11.8 percent weight loss and poor feeding. The same day, Baby AA was admitted to the SCN. A nasogastric tube was inserted to facilitate feeds which resulted in improvement in her clinical condition. Initial blood tests looking for jaundice and sepsis were normal.

13. On 18 July 2018, Baby AA was lethargic, had a mild increase in her work of breathing, an elevated temperature and frequent self-resolving desaturations. A chest x-ray (**CXR**) showed signs of a chest infection. She was commenced on high flow oxygen therapy and intravenous antibiotics to cover for sepsis.

14. Over the next 48 hours Baby AA was closely monitored in the SCN. She had frequent medical reviews, was investigated for respiratory and cardiovascular causes of her symptoms.

These investigations were unremarkable except for an elevated white blood cell count which was consistent with infection.

15. Baby AA remained stable on high flow oxygen. She continued to have periods of desaturations, tachypnoea and fevers.

16. On 20 July 2018, Baby AA was not improving. Despite 36 hours of IV benzyl penicillin and gentamicin she continued to have a raised temperature, her inflammatory markers were trending upwards and she had a persistent oxygen requirement. Blood tests for sepsis were repeated and another intravenous antibiotic flucloxacillin was prescribed.

17. Dr Menon reviewed Baby AA at 9.10pm on 20 July 2018. On examination Baby AA had a palpable liver edge. Liver function tests were requested. Paediatric Registrar, Dr Brian Dunn reviewed Baby AA at 11pm and noted her liver enzymes were markedly elevated. Dr Dunn discussed Baby AA's condition with the on-call Neonatal Consultant, Dr Wie Ling Lean via phone.

18. Coagulation studies were collected at 11.40pm. At 2am on 21 July 2018, Dr Dunn received a phone call from the pathology laboratory staff stating they were not happy to issue the coagulation results as they were reading 'high' with an activated partial thrombin time (**APTT**) of 69. The laboratory staff advised that the sample was likely contaminated and should be repeated. Dr Dunn ordered a repeat sample which was collected at 3.55am.

19. Shortly after this the nursing staff requested an urgent review of Baby AA for hypothermia. Baby AA was warmed and oozing was noted from the IV cannulation site. Baby AA's fontanelle was noted to be soft. She had an increased oxygen requirement. Baby AA was moved to the high dependency area and another antibiotic, ceftriaxone was added. At 4.55am, Dr Dunn called the on-call consultant Dr Lean and requested she attend. Intramuscular vitamin K was administered with fresh frozen plasma (**FFP**) and cryoprecipitate was ordered pending the coagulation result. Dr Dunn called the laboratory and was advised the second set of coagulation bloods were markedly abnormal.

20. On repeat physical examination by Dr Dunn, Baby AA's fontanelle was observed to be tense which raised a suspicion of intercranial haemorrhage. Severe metabolic acidosis was identified by a capillary gas blood sample.

21. Dr Lean arrived at around 6am. Dr Dunn phoned the Paediatric Infant Perinatal Retrieval (**PIPER**) service and spoke to Consultant Neonatologist, Dr Leah Hickey for expert advice at

around 6.20am. Dr Hickey continued to advise via telephone, while a retrieval team was dispatched. Paediatric resident, Dr Raiti was called to arrange an urgent cranial ultrasound.

22. At 6.28am a code blue was called due to Baby AA's deteriorating respiratory function. Baby AA was intubated and received resuscitation according to standard neonatal resuscitation guidelines. PIPER arrived at around 7am. At 7.11am, Mr EA requested the resuscitation be stopped and Baby AA was pronounced deceased.

MEDICAL CAUSE OF DEATH

23. On 21 July 2018, Dr Sarah Parsons, Forensic Pathologist at the Victorian Institute of Forensic Medicine (**VIFM**) performed an autopsy on the body of Baby AA and reviewed the Form 83 Victoria Police Report of Death, medical deposition and the post mortem computed tomography (**CT**) scan.

24. At autopsy Baby AA had evidence of ischaemia and necrosis of the lungs, liver and adrenal glands along with viral inclusions in these areas. Herpes Simplex Virus (**HSV 1**) was cultured from all the sites taken for virology at autopsy including nasopharyngeal aspirate, myocardium, lungs and bowel.

25. HSV 1 is usually transmitted by oral to oral contact. It is a highly contagious infection. Mothers with HSV 1 genital infection can transmit the virus to the neonate during labour which can cause neonatal herpes, a rare but fatal condition. HSV is mainly transmitted by contact with HSV Type 1 found in cold sores, saliva and surfaces in or around the mouth and lips. Neonatal herpes is a potentially devastating complication which has a very high mortality.

26. Toxicological analysis on post mortem specimens detected paracetamol and flucloxacillin.

27. Dr Parsons provided an opinion that the medical cause of death was I a) *Disseminated Herpes Simplex Virus (HSV 1)* and was due to natural causes. I accept and adopt this as the cause of death.

Coroners Prevention Unit

28. Given the circumstances of Baby AA's death, I referred this case to the Coroners Prevention Unit (**CPU)** for a comprehensive review and assessment of her medical care and management.

29. The role of the CPU is to assist coroners investigating deaths, particularly deaths which occur in a healthcare setting. The CPU is staffed by healthcare professionals, including practising physicians and nurses, who are independent of the health professionals and institutions under

consideration. The CPU professionals draw on their medical, nursing and research experience to evaluate the clinical management and care provided in particular cases by reviewing the medical records, the autopsy report and any particular concerns which have been raised.

30. The CPU reviewed the Victoria Police Report of Death for the Coroner, the Medical Examiner's Report, E-medical deposition form, medical records from the Northern Hospital, maternal medical records and the letters of concern from Ms CT.

Neonatal Herpes Simplex Virus infection

31. The CPU advised neonatal HSV infection occurs in one out of every 3,200 to 10,000 live births. It causes significant morbidity and mortality and can leave survivors with permanent sequelae and disability.

32. Neonatal HSV can be acquired through three main means:

Intrauterine: this occurs when primary maternal HSV infection occurs during pregnancy or ascending HSV infection. This acquisition occurs rarely with an estimated incidence of 1 in 250,000 deliveries.

Perinatal: 85 percent of neonatal HSV is acquired perinatally when symptomatic or asymptomatic HSV infection is present in the maternal genital tract at the time of delivery. Other factors that can influence transmission include the type of maternal HSV (primary or recurrent), duration of rupture of membranes, mode of delivery and presence of maternal fever.

Postnatal: Postnatal acquisition of HSV accounts for 10 percent of neonatal HSV infections. This occurs when a caretaker with active HSV infection, has close contact with the newborn.

33. Neonatal HSV infection can generally present in three ways:

a) Skin, eye and mouth disease accounts for around 45 percent of presentations characterised by the development of vesicles on the skin, in the mouth or in the eyes. This typically presents during the first two weeks of life and can progress to disseminated or central nervous system (CNS) disease if untreated.

b) CNS disease accounts for about one third of presentations and is characterised by meningoencephalitis usually in the second or third week of life.

c) Disseminated HSV disease is characterised by a sepsis-like presentation. Symptoms can include lethargy, irritability, poor feeding, temperature instability and seizures, progressing to involve multiple organs.

34. Neonatal HSV infection is diagnosed by the isolation of the HSV viral DNA in surface cultures, swabs of skin lesions, cerebrospinal fluid (CSF), blood, plasma, and other specimens such as tracheal aspirates. The treatment of HSV is intravenous antiviral acyclovir therapy from the time the diagnosis of HSV is suspected. Supportive management of a critically ill neonate includes management of fluid and electrolytes, providing oxygen and breathing support, providing nutrition, controlling seizures, managing disseminated intravascular coagulation (DIC) and antimicrobial treatment for secondary bacterial infections.

35. The outcome of neonatal HSV depends upon the clinical presentation. The one-year mortality rate of treated disseminated disease is 29 percent and approximately 80 percent of survivors may have normal neurologic development. The mortality rate of untreated disseminated neonatal HSV exceeds 70 percent. The risk of mortality in disseminated HSV increases in infants with lethargy, severe hepatitis, acute liver failure, coma or near-coma at the time of presentation, DIC, prematurity and pneumonitis. The one-year mortality rate for treated HSV CNS disease is four percent and approximately 30 percent of survivors have normal neurological development.

36. The CPU provided advice in relation to the following issues:

Issue 1 - Baby AA's first admission after birth, the work up for sepsis was inadequate and antibiotics were not given for a full 48 hours

37. The CPU advised that routine investigation of a newborn baby with septic risk factors is to give 36-48 hours of empirical antibiotics. These antibiotics are ceased if the blood culture is negative, inflammatory blood markers are normal and the baby is clinically well.

38. Baby AA had only one risk factor for sepsis, which was low Apgar scores at birth. She remained clinically well over her admission with normal blood inflammatory markers and a negative blood culture.

39. The CPU considered Baby AA received standard appropriate care for her situation.

Issue 2 – In Baby AA's final admission:

(a) A viral cause of infection was not considered

(b) She was not adequately investigated, specifically, she should have had a

i. A lumbar puncture; and

ii. A cranial ultrasound; and

(c) She was not adequately diagnosed

40. The CPU advised that HSV can be difficult to diagnose when disseminated disease is present, as in Baby AA's case. Disseminated HSV disease is characterized by a sepsis-like presentation.

41. Bacterial sepsis is a more common cause of symptoms of lethargy, irritability, poor feeding and temperature instability in this age group. Baby AA had signs of pneumonia both clinically and on CXR and this can be either bacterial or viral.

42. Bacterial infections are managed with antibiotics as was done in the case of Baby AA. A viral infection was also considered and appropriately investigated with a respiratory virus test. This test does not include testing for HSV. The management would not be any different from what occurred if a respiratory virus was present.

43. According to the CPU, it is understandable that HSV was not considered as there was no indication of exposure to HSV perinatally or postnatally and Baby AA had no indication of CNS involvement until just before her death.

44. A lumbar puncture to sample CSF is indicated as part of a full septic screen, but especially if there are signs of meningitis. HSV is not routinely tested on CSF unless there is a clinical reason to suspect infection such as a history of HSV in family members or seizures in the infant.

45. A cranial ultrasound was ordered and would have been performed had Baby AA not arrested soon after.

46. The CPU considered that if a lumbar puncture and cranial ultrasound had been performed it would not have changed the outcome.

Issue 3 - Poor quality of care from hospital staff for Ms CT during labour and Baby AA during her hospital stays and poor communication from hospital staff

47. The CPU was unable to comment on issue three as it was not contributory to Baby AA's death.

48. The CPU concluded that the medical management in the case of Baby AA was appropriate and timely. The CPU have no concerns regarding the investigations and treatment given to Baby AA during her life.

49. The CPU did express some concerns regarding the delay in coagulation study results being reported to laboratory staff. However, it was considered that this was unlikely to have altered the outcome in this case but could create a potential risk for adverse outcomes in the future.

Further coronial investigation

50. As part of the coronial investigation, I requested two further statements from Mr Richard Laufer, Director of Legal and Information Services at Northern Health and Dr David Tran, Clinical Director of Paediatrics at Northern Health which related to the concerns of the delayed coagulation study results being reported by laboratory staff proximal to the death of Baby AA.

51. Since Baby AA's death the pathology provider at Northern Health has changed from Australian Clinical Labs to Northern Pathology Victoria (**NPV**). This occurred on 8 January 2019. Mr Laufer reported that current overnight staffing at NVP is the same as the Australian Clinical Labs staffing levels at 21 July 2018.

52. In his statement Dr Tran stated that Northern Health conducted a root cause analysis (**RCA**) into Baby AA's death. In addition to internal hospital staff, the RCA committee sought the opinion of two external experts, a neonatologist from Monash Medical Centre and a PIPER consultant.

53. The RCA identified two core issues:

    a) The abnormal liver function tests (**LFT**s) should have triggered a discussion with a tertiary centre for consideration of further treatment and possible transfer; and

    b) The inability to communicate meaningful coagulation results and the request for resampling, in an apparently stable infant, resulted in a delay in implementing an appropriate management plan.

54. The RCA recommendations were made to seek advice from the Victorian Neonatal Advisory Group on guidelines regarding escalation and transfer of care in the event of severe unexpectedly abnormal pathology, and to develop a clear escalation pathway for abnormal paediatric pathology that does not register a numeric value.

55. As a result of the RCA's recommendations the following improvements have been implemented at Northern Health:

    a) Advice from the Victorian Neonatal Advisory Group and PIPER regarding escalation and transfer of care in the event of unexpectedly severely abnormal pathology has been embedded in Northern Health's PIPER procedure.

    b) The Northern Health neonatal and paediatric unit escalation process was reviewed and amended.

c) In consultation with the new pathology provider, NPV, a policy has been implemented for escalation of critical abnormal results and what to do in the event of contaminated or unreliable results.

56. The Northern Health policy entitled '*Pathology – Critical Abnormal Results/Escalation*' outlines the procedure to be taken by pathology staff to notify clinicians of 'critically abnormal' results. Critically abnormal results for various tests are defined, however the policy states that there are no specific critical limits for coagulation tests in neonates and children up to 12 years of age, due to lack of age appropriate reference ranges. However, there are specific values given for coagulation results that should trigger escalation of care in the Northern Health PIPER policy.

57. Action to be taken in the event of contaminated or unreliable results is not addressed in the 'Pathology – Critical Abnormal Results/Escalation' policy. Mr Laufer stated that this policy was also in place on 21 July 2018, and since the RCA it "*has been amended slightly with no material changes*".

58. The only significant change to the policy, has been that pathology staff are now required to telephone abnormal results to clinicians as a first step, rather than paging them the results. In addition, NPV have a senior scientist and pathologist on call 24 hours a day, daily to assist with unclear results.

59. Northern Health advised that they met with Baby AA's parents following her death and they were arranging a further meeting to discuss the findings of the RCA at the time they wrote to the Coroners Court in October 2019.

60. Having considered the evidence I am satisfied that no further investigation is required.

FINDINGS

61. Pursuant to section 67(1) of the *Coroners Act 2008*, I make the following findings connected with the death:

(a) the identity of the deceased was Baby AA, born on 10 July 2018;

(b) Baby AA died on 21 July 2018 from 1(a) *Disseminated Herpes Simplex Virus (HSV 1)*;

(c) in the circumstances described above.

62. I find that disseminated HSV 1 is difficult to diagnosis and causes significant morbidity and mortality. I am satisfied Northern Health have conducted a thorough investigation into the events surrounding Baby AA's death and identified the relevant issues. The

recommendations made are appropriate, and it seems the majority of them have been implemented.

63. Having considered all of the circumstances, I am satisfied that the medical care and management provided to Baby AA by clinicians at Northern Hospital was appropriate, timely and reasonable in the circumstances

64. I wish to express my sincere condolences to Baby AA's family. I acknowledge the grief and devastation that you have endured as a result of the loss of your precious baby girl.

COMMENTS

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

66. It appears that the formal process for alerting clinicians of unexpected or abnormal results and what is to happen with contaminated or unreliable results has not been completely and clearly reflected in the Northern Hospital policies provided, particularly with respect to coagulation results in children aged 12 years and under. Consequently, I have made a recommendation consistent with this.

RECOMMENDATIONS

67. Pursuant to section 72(2) of the Coroners Act, I make the following recommendations connected with the death:

Recommendation One:

I recommend that the Northern Hospital consult with Victorian paediatric tertiary hospitals such as the Royal Children's Hospital and the Monash Children's Hospital in relation to the process of alerting clinicians of abnormal/unexpected coagulation results in children aged under 12 years, and what is to occur in the event of contaminated or unreliable results. This can then be compared to the Northern Hospital policy to ensure it is in line with standard practice in Victoria, and updates made if required.

68. Pursuant to section 73(1) of the Coroners Act, I order that this finding be published on the internet.

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

The family of Baby AA;

Northern Hospital;

Safer Care Victoria; and

Adjunct Professor Tanya Farrell, Chairman, Consultative Council on Obstetric and Paediatric Mortality and Morbidity

Signature:

JACQUI HAWKINS
Coroner
Date: 29 June 2020