CORONERS ACT, 2003

SOUTH  *AUSTRALIA*

FINDING OF INQUEST

An Inquest taken on behalf of our Sovereign Lady the Queen at Adelaide in the State of South Australia, on the 9th, 10th and 11th days of August 2011, the 5th and 6th days of October 2011 and the 26th day of March 2012, by the Coroner's Court of the said State, constituted of Anthony Ernest Schapel, Deputy State Coroner, into the death of Amber Jayne Sweetman.

The said Court finds that Amber Jayne Sweetman aged 10 years, late of 10 Elder Parade, Port Willunga, South Australia died at the Women's and Children's Hospital, 72 King William Road, North Adelaide, South Australia on the 18th day of February 2009 as a result of congenital hydrocephalus. The said Court finds that the circumstances of her death were as follows:

1. Preliminary Findings and Recommendations

1.1. These are the Court's findings in relation to an Inquest into the cause and circumstances of the death of Amber Jayne Sweetman, aged 10 years, who died at the Women's and Children's Hospital (WCH) on 18 February 2009.

1.2. At the conclusion of counsels' final addresses in this Inquest I delivered preliminary findings as well as two recommendations that were addressed to the Minister for Health. I indicated that I would deliver my unabridged findings and any further recommendations at a later date. I now deliver those further findings and recommendations.

1.3. The preliminary findings and recommendations that I initially delivered shall form part of these findings. Those preliminary findings were as follows:

> 'In this matter Amber Jayne Sweetman, who was aged 10, died at the Women's and Children's Hospital on 18 February 2009. The cause of death was congenital hydrocephalus. Amber's congenital condition was the result of a malformation of the brain that had been diagnosed and evaluated at or around the time of her birth and in early infancy.
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> A ventriculoperitoneal shunt was in due course placed in her brain in order to drain excess cerebrospinal fluid that in her condition would accumulate in her skull. The shunt would remain in place for her entire life.
>
> A shunt may become blocked. The consequent failure to drain the build up of cerebrospinal fluid may result in raised intracranial pressure. Raised intracranial pressure can be life threatening unless relieved.
>
> On 13 February 2009 Amber was conveyed by the South Australian Ambulance Service to the Flinders Medical Centre Emergency Department. She displayed certain symptomatology that I do not need to describe in detail in these preliminary findings, but which caused clinicians to order and perform a CT scan of Amber's brain in an attempt to definitively diagnose her presentation.
>
> The imagery from the CT scan was quickly made available. It became necessary to compare the condition of Amber's brain as revealed in the CT scan imagery obtained that evening with past radiological imagery. Scans of Amber's brain had been taken at times when she was well and, in particular, had been taken on 20 November and 22 November 2004 and again on 18 October 2007. These scans had been conducted at the Women's and Children's Hospital.
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> Although the computerised radiology reports relating to that earlier imagery were accessible at the Flinders Medical Centre on the evening Amber presented there in February 2009, the actual imagery of the previous scans from the past was not immediately available.
>
> The necessary comparison between the CT scan taken on the night of 13 February 2009 when Amber presented at the Flinders Medical Centre and the scans taken in the past when Amber was well could only be made by a comparison between the CT scan imagery taken that night and the previous reports. This was so because, as I say, immediate access could not be gained to the actual imagery from the Women's and Children's Hospital that had been taken in the past.
>
> In the event it is known that Amber did have a blocked shunt and raised intracranial pressure at the time and certainly soon after her presentation at the Flinders Medical Centre. However, the comparison made that night between the CT scan imagery of her head and the previous radiological reports did not immediately result in such a diagnosis. Approximately one hour later the actual imagery from the scan that had been conducted on 20 November 2004 became available through means that I will describe in my findings proper in due course.

When a comparison was made between the CT scan imagery of that night, that is to say 13 February 2009, and the earlier imagery from November 2004, it was readily apparent that there was a high degree of suspicion that Amber's shunt was blocked and that this accounted for her presentation. In effect, a positive diagnosis to explain her current presentation was made.

On the basis of that diagnosis, surgical measures were undertaken in an attempt to correct the underlying difficulty and Amber was transferred to the Women's and Children's Hospital, but she unfortunately died on 18 February 2009 in that hospital. The diagnosis of a blocked shunt had been significantly delayed by the unavailability of the actual scanned imagery from the past.

I have been informed during the course of this inquest that the Women's and Children's Hospital, where Amber's previous imagery had been housed, at the present time does not have a system whereby digitised CT imagery is made. If it did have that facility available, which I understand is available throughout other hospitals in the public system, it would mean that other hospitals in the public system could have immediate access by electronic means to that imagery, not merely to the written reports relating to that radiological imagery.

I am informed that steps are being taken to provide the Women's and Children's Hospital with the necessary means, firstly to implement digitisation of the taking of scans at the Women's and Children's Hospital and secondly, to implement a centralised digitised system of storage of imaging at Women's and Children's Hospital that would be available for access by other public hospitals.

I have been informed that the broader system described will be rolled out within the next 16 to 17 months of today's date. The digitisation of radiological imagery at the Women's and Children's Hospital is expected to occur sometime in 2012.

I understand that at the present time, past imagery that has been taken and stored at the Women's and Children's Hospital is not intended to be digitised except in relation to complex cases; Amber Sweetman's being an example of a complex case. The reason for this is that the imagery from the past is simply too voluminous to digitise in its entirety. However, it seems to the Court that digitisation of the most recent scan imagery in relation to a person would be worthy of consideration and be of benefit.

As things currently stand, public hospitals such as Flinders Medical Centre still do not have immediate access to Women's and Children's Hospital radiological imagery. In short, Flinders Medical Centre is in no better position to do that and have that access than they were and had in February of 2009. The same applies to other public hospitals to which patients like Amber Sweetman might be taken.

I recommend that the Minister for Health cause to be expedited the digitisation of radiological imagery at the Women's and Children's Hospital.

I also recommend that the Minister for Health cause to be expedited the implementation of the centralised digital system of storage of radiological imagery available for access by all public hospitals in South Australia.

I will publish my more detailed findings and recommendations on a date to be fixed.'

2. Cause of death

2.1. In the early hours of the morning of 14 February Amber Sweetman was transferred from the Flinders Medical Centre (the FMC) to the WCH where she died on 18 February 2009. Amber's clinical course over the period of 4 days is clear in the sense that her condition was due to the effects and complications of marked elevation of intracranial pressure that was the product of hydrocephalus. A document described as a SA Pathology Coroners Non-Autopsy Report[1] records the cause of death as congenital hydrocephalus. Professor Peter Reilly, who is the Clinical Professor of Neurosurgery at the School of Medical Sciences at the University of Adelaide and who was formerly head of the Neurosurgery Department of the Royal Adelaide Hospital (RAH), provided an independent overview of Amber Sweetman's clinical management. His report[2] was tendered in evidence. Professor Reilly also gave oral evidence in the course of the Inquest. In his report, Professor Reilly suggests that Amber experienced intractable brain swelling was likely to have been the result of hypoxic ischaemic[3] swelling due to prolonged intracranial pressure. But Professor Reilly did not disagree with the SA Pathology's opinion that the cause of death was in essence congenital hydrocephalus. Professor Reilly suggested that this condition was Amber's 'primary problem'[4].

2.2. I find that the cause of Amber Sweetman's death was congenital hydrocephalus.

3. Issues at Inquest

3.1. I have already identified in my preliminary findings one issue, and that relates to the inability of clinicians at FMC to readily access, by electronic means, CT scan imagery of Amber's brain that had been taken in the past. As will be seen, there were a number of other issues ventilated at the Inquest. These included whether, in any event, a diagnosis of raised intracranial pressure caused by a blocked shunt could have been made on the basis of Amber's clinical presentation in conjunction with an examination of the CT imagery that was taken upon her presentation to FMC, together with written reports of previous CT imagery but without recourse to the actual previous imagery itself. A related issue is whether such a working diagnosis could, and should, have been made at an earlier point in time such that it may have enabled

[1] Exhibit C15, Transcript, page 51
[2] Exhibit C10a
[3] Deprivation of oxygen due to impaired blood supply
[4] Transcript, page 369

relieving measures, such as an extra ventricular drain (EVD) or indeed a total revision of the shunt, to have been carried out. Although an EVD was ultimately administered at FMC that evening, its administration was delayed, arguably, by an unduly belated diagnosis of a blocked shunt. Ultimately, the question for consideration by the Court was whether an earlier diagnosis, and the administration of relieving measures to correct the pathology that had developed in Amber's head, may have prevented her death or may have improved her chances of survival.

4. Background

4.1. Much of Amber Sweetman's previous medical history and her condition in the period just prior to her presentation at FMC on 13 February 2009 was described in evidence by her father, Mr Richard Sweetman.

4.2. Mr Sweetman told me of the history of Amber's hydrocephalus and the insertion of the shunt. He also told me of Amber's development over the years. He told me of the fact that Amber had experienced seizures, her first having taken place in November 2001 when she was nearly 3 years old. On this occasion she had vomited and had been trembling. Amber had been taken to the FMC where a temperature related seizure had been diagnosed and a blocked shunt had been ruled out.

4.3. There was another occasion when Amber again had to be taken to FMC by ambulance after she had experienced a seizure at her day care centre. By then, according to Mr Sweetman, he had grown accustomed to Amber's seizures. He spoke of another occasion when FMC staff had ruled out a blocked shunt by checking the shunt reservoir.

4.4. Mr Sweetman also told me of occasional illnesses that Amber picked up that manifested themselves in loose bowel motions and lack of energy. She would recover from these bouts without the need for hospitalisation.

4.5. One morning in the days preceding Friday 13 February 2009, Mr Sweetman discovered that Amber had vomited copiously in bed. She was at first quite slow to move but seemed fresher after a bath. Mr Sweetman told the Court that he put that down to another of the stomach bugs that she experienced from time to time. Amber was not interested in eating anything, but sat quietly watching television. The following day, which he believes was the Thursday, he thought that Amber was

starting to improve as she was taking in a little bit more water. Although she was not eating very much, she again seemed content to watch television until the late afternoon when she experienced what he described as a '*fairly aggressive seizure which caused her muscles to actually tighten up*'[5]. Mr Sweetman believed that this was termed a 'tonic' seizure. He described the event as occurring over 10 or 15 seconds. Mr Sweetman likened the behaviour of Amber during the seizure as akin to the movements of a person afflicted with cerebral palsy where the muscles are very tight and the limbs twisted. Amber involuntarily wet herself during the course of this episode. This episode came after what Mr Sweetman believed was two full days of significant lethargy. Mr Sweetman told the Court that he had not seen Amber in this state before. I take it from that comment that this seizure had not resembled any other seizure Amber had experienced in the past. Mr Sweetman immediately called an ambulance. According to Mr Sweetman, by the time of the arrival of the ambulance Amber '*seemed quite okay*'[6], but it was decided that in any case she would be taken to FMC to be medically examined.

4.6. Mr Sweetman told the Court that in the ambulance on the way to the FMC Emergency Department, and in fact quite near the entrance to the hospital, he believed that Amber stopped breathing and became unresponsive. Amber was immediately taken to the Emergency Department where she was intubated.

4.7. According to the SA Ambulance Service record[7], on arrival at the Sweetman premises paramedics assessed Amber as having the maximum GCS score of 15 but was recorded as looking quite flat. She was described as initially chirpy in the ambulance but became 'sleepy ++' enroute. The paramedics recorded, presumably on the basis of what Mr Sweetman had told them, that the earlier seizure activity had lasted for approximately 10 seconds and had been followed by a period of delayed responsiveness and slurred speech. The report also contains a reference that at 5:45pm while enroute Amber experienced 'an absence seizure'. This resulted in the administration of oxygen, although according to the report she was still 'self ventilating' at that time. The SAAS report records that they arrived at the FMC at 5:50pm. On arrival at FMC she is recorded in the ambulance report as experiencing hypoventilation, that is to say a reduced effort at breathing. I am satisfied that Amber

[5] Transcript, page 27
[6] Transcript, page 28
[7] Contained within the FMC casenotes, Exhibit C3, Volume 2

had not actually ceased breathing by that time. She would, however, experience a total respiratory arrest in the FMC Emergency Department.

5. Amber Sweetman's presentation at FMC Emergency Department

5.1. The FMC Emergency Department progress notes record Amber's time of arrival as 5:56pm. Any inconsistency between that recorded time and the time of arrival recorded by SAAS is immaterial.

5.2. Amber was examined by Dr Adrian Foran who at the time with which this Inquest is concerned was an emergency junior registrar at FMC Emergency Department. On the day of Amber's presentation he was rostered to work in the paediatric area of the Department. Dr Foran gave evidence in the Inquest.

5.3. Dr Foran's evidence was based upon both his unaided recollection and upon detailed notes that he made at the time. The sequence of events in the Emergency Department are of some importance, particularly in regard to when within that sequence Amber experienced a respiratory arrest. Dr Foran's evidence in my view represents the most reliable account as to the order of events within that Department. Dr Foran recorded that Amber had been brought in by the ambulance service following a seizure at home and that she had experienced a further seizure enroute and was at that point assessed to be not out of the post-ictal phase of the seizure. The post-ictal phase of a seizure may involve drowsiness lasting from minutes to a couple of hours. He recorded a history, which one assumes he obtained from Mr Sweetman, to the effect that Amber had been unwell for a few days to a week, having been more unwell for the past 3 days with vomiting and loose stools that had then resolved. She had reported headache and had been lethargic with reduced oral intake. In his notes Dr Foran described the seizure that Amber had experienced during the afternoon as a possible 'complex partial' seizure that had lasted for less than 10 minutes, although from Mr Sweetman's own description of the episode, and from the description of the duration of the seizure as understood by the paramedics, Dr Foran's understanding of the seizure's duration must be considered doubtful. In any event, according to Dr Foran's recorded beliefs, the seizure had resolved itself and, upon the arrival of the ambulance, Amber had been responsive but was still in the post-ictal phase. Dr Foran recorded further information that Amber had become unresponsive 1 to 2 minutes prior to her arrival at the hospital and had a GCS of 3 on arrival. He recorded that she

was flat and pale and had small pupils that did not contract further with light and that the left eye deviated to the right. She had general increased tone but at that point was 'self ventilating'. However, Dr Foran noted that just after Amber arrived at the Emergency Department she stopped self ventilating, in other words she stopped breathing. She was then given IV midazolam, was intubated and ventilated. The midazolam appeared to have the effect of reducing her tone and correcting the eye deviation. She was given mannitol for suspected raised intracranial pressure. Neurosurgery at FMC and WCH were both informed of her presentation.

5.4. It will be observed that on this account of events Amber's respiratory arrest occurred just after her arrival at the Emergency Department and was not in response to any drug or medication that she may have been administered, such as midazolam. In fact, the need to intubate and ventilate Amber because of her respiratory arrest was one of the reasons that midazolam was given. The respiratory arrest therefore appears to have been part of her overall clinical presentation and the product of whatever pathology was at work. I find that to have been the case.

5.5. Within the Emergency Department progress notes Dr Foran recorded the 'provisional diagnosis' as '? ↑ ICP / Blocked VPS', meaning suspected raised intracranial pressure due to a blocked ventriculoperitoneal shunt. He had considered a number of differential diagnoses that he noted in the progress notes and which included focal neurology, complex seizure, raised intracranial pressure with a blocked shunt and meningitis from an infected shunt. The fact that Amber was very unwell, looking very flat with a history of hydrocephalus and a shunt, and had been vomiting, gave rise to an initial thought which he described as '*always the first thought*'[8] that there is trouble with the shunt, either by way of blockage or some other malfunction, or that there had been an infection of the tissues around the brain or of the brain itself. Dr Foran also considered whether her presentation could be from seizure activity within the brain. It was by reason of the fact that his initial thought was that she probably had a blockage of the shunt, or possibly an infection of the brain, that he thought that she had increased pressure in her brain. He said:

> 'That combined with a presentation of stopping breathing, arresting and one of her pupils being unreactive and one leaning inwards or being deviated inwards gives a picture of

[8] Transcript, page 55

potential increased pressure in the brain. So we're giving mannitol to try and reduce some of that pressure in the brain.' [9]

5.6. Dr Foran acknowledged that he was aware that one might check the shunt chamber lying under the skin as a means of possibly establishing a blockage, but Dr Foran did not perform that test. He said there were two main reasons, the first being that he was not trained to do this and he did not have the skills necessary to interpret the results meaningfully. The second reason was that Amber was critically unwell to the point where she had experienced a respiratory arrest and that the focus of his attention was on saving Amber's life and on administering the necessary intubation and ventilation in order to do that. It is impossible to say that Dr Foran's approach in this regard was anything other than reasonable.

5.7. According to Dr Foran, when he ultimately came to discuss Amber's presentation with the neurosurgical registrar, Dr Xenia Doorenbosch, he believed that her presentation was less likely to be due to a seizure and more likely to be the result of a blocked shunt or an infection of the brain. By that stage the CT imagery had been or was being conducted. Dr Foran told the Court that, as far as the CT images were concerned, his own view was that the CT result was significantly abnormal but was aware of the fact that Dr Doorenbosch would contact a neurosurgical consultant about the matter. Of concern to Dr Foran was the fact that the CT imagery displayed very large ventricles, which to him appeared to be obviously full of fluid and that given the patient's history of hydrocephalus and the presence of the shunt, one of the clinical concerns was that her respiratory arrest had been the result of raised intracranial pressure. However, Dr Foran emphasised that neurosurgery was not his speciality and he could not claim to know any more than a neurosurgical consultant. He indicated that he was content to have been led by the neurosurgical advice. As well, Dr Doorenbosch and the radiology registrar had told him verbally that they could not see any active evidence of coning from the CT imagery (compression of the brainstem as the result of raised intracranial pressure) and that they could not know whether the ventricles were any larger than they had been before, as they only had access to reports of previous imagery and not to the actual imagery itself. To my mind no criticism attaches to Dr Foran's management of Amber.

[9] Transcript, pages 60-61

6. Involvement of Neurosurgery

6.1. Dr Xenia Doorenbosch gave evidence during the Inquest. Dr Doorenbosch obtained her original medical qualification from the Adelaide University in 2003. Since obtaining her medical qualifications Dr Doorenbosch has worked in the field of neurosurgery, both during the course of her internship and as a resident medical officer at the RAH, and more latterly as a neurosurgical trainee. She has also worked as a medical practitioner in the Netherlands until February 2007. When Dr Doorenbosch returned to Australia, she took up a position as a resident medical officer at the RAH in the field of neurosurgery, among other disciplines. In February 2008 she moved to the WCH where she assumed the 'unaccredited neurosurgery registrar' position. Dr Doorenbosch explained that this involved work in the role of the neurosurgery registrar but not in an official capacity. Dr Doorenbosch explained that the fact that she was regarded as unaccredited did not have any impact on her capacity or qualification to perform certain neurosurgical procedures. She was under the supervision of two neurosurgical consultants, namely Dr Cindy Molloy and Dr Stephen Santoreneos. In February 2009 Dr Doorenbosch commenced work as the unaccredited neurosurgery registrar at FMC where she remained for 6 months. It was in this capacity that she came to be involved in the management of Amber Sweetman. Following this posting, Dr Doorenbosch returned to the WCH. In February 2010 Dr Doorenbosch began her formal neurosurgical training at the John Hunter Hospital in Newcastle, New South Wales. In February 2011 she took up a position as neurosurgery registrar at the RAH. Dr Doorenbosch gave evidence that she was familiar with interpreting radiological images of the brain. In addition, she told me that she had performed EVD procedures on numerous occasions prior to the occasion with which this Inquest is concerned. Dr Doorenbosch told the Court that she had personal experience in dealing with children who had shunts and, in particular had experience in dealing with shunt malfunctions. She described the practice in relation to shunts in children as the '*bread and butter really, of paediatric neurosurgery*'[10].

6.2. On the evening in question Dr Doorenbosch was driving home when she was telephoned and asked to return to FMC to examine Amber who at that time was at the Emergency Department. Dr Doorenbosch believed that she received the phone call from the Emergency Department registrar sometime between 6pm and 6:30pm,

[10] Transcript, page 210

probably around 6:30pm[11]. She was told that a child who had a shunt and who had experienced seizures was at the Emergency Department and that the suspicion was that the shunt was blocked. Dr Doorenbosch advised per telephone that an urgent CT of the child's brain was required. She then phoned Dr Santoreneos, the on-call consultant neurosurgeon at WCH, to tell him of the admission of the unwell child at FMC.

6.3. Dr Doorenbosch drove back to FMC and made her way to the CT Suite where Amber had been taken. Dr Doorenbosch was present when the CT was performed by the radiological registrar, Dr Benita Foreman. Dr Doorenbosch examined Amber who was intubated and ventilated and was paralysed for that purpose. She examined Amber's pupils and recorded in notes that she would make after the CT scan that they were 2mm in size bilaterally, the right pupil being reactive but the left pupil being unreactive. The CT examination took place between 7pm and approximately 7:13pm, although according to some information that was received during the Inquest that time may be out by 3 minutes, an immaterial discrepancy in any case. Dr Doorenbosch examined the CT imagery in conjunction with Dr Foreman. Dr Doorenbosch would also later consult with Dr Santoreneos.

6.4. Dr Doorenbosch's notes of two pages describe her observations of Amber as well as her presenting history. They also record what she believed had already taken place prior to her arrival at the hospital that evening. Although the document includes reference to Amber's intubation, it conspicuously says nothing about her respiratory arrest, the major feature of her presentation, nor of course when in the sequence of events it had transpired. Dr Doorenbosch's notes do make reference to the administration of midazolam and other medications including mannitol. Dr Doorenbosch noted the fact that Amber had a ventriculoperitoneal shunt in-situ and she also noted the specific brain malformation that she was said to have, namely Arnold Chiari Type II which is said to be difficult to distinguish from coning of the brain stem upon radiological examination. Dr Doorenbosch's notes also contain a description of her impression of the CT scan and the notes conclude as follows:

> 'A / Seizure 2° shunt malfunction + / - infection?' [12],

[11] Transcript, page 122
[12] Exhibit C3, Volume 2, page 17

meaning that her assessment was that there was a suspected seizure, secondary to shunt malfunction, with or without an infection. She noted her plan to discuss the matter with Dr Santoreneos with a view to retrieval to WCH where the CT scans could be compared to those taken of Amber at WCH in the past.

6.5. Dr Doorenbosch gave evidence at considerable length during the course of the Inquest. Much of her evidence concerned the accuracy or otherwise of her assessment of Amber, including her impressions from the CT scan. I will discuss Dr Doorenbosch's evidence presently.

7. Involvement of Radiology

7.1. Dr Foreman also gave evidence in the Inquest. Dr Foreman attained her original medical qualifications in 2004. As at 13 February 2009 she had completed one year of training as a radiology registrar at the RAH and had just commenced her second year of training at FMC. On the late afternoon in question Dr Marc Agzarian, a radiological consultant, was on-call and was available to Dr Foreman by telephone if needed. In the event, Dr Foreman would call Dr Agzarian and in due course he would come into the hospital himself to interpret the radiological images taken of Amber.

7.2. Dr Foreman's evidence was confined for the most part to her assessment of the CT imagery when compared to CT scan reports from the past. Dr Foreman did not have at her disposal any previous imagery, at least in the first instance. The comparison that was made in the first instance was with a report of a brain CT that had been conducted on 18 October 2007 in respect of a follow-up examination when Amber was clinically well. Dr Foreman told me that as far as she could recall, this was the first paediatric brain examination that she had undertaken by way of CT scan. Dr Foreman's impression of the CT scan was as follows:

> '… I looked through the images and realised that I wasn't able to - that I wasn't sure how I could say if there were acute changes on top of her base line scan.' [13]

Dr Foreman's uncertainty prompted her to telephone the on-call radiologist, Dr Agzarian. Dr Agzarian agreed to come into the hospital to assist and suggested to Dr Foreman that she attempt to retrieve any previous CT imagery that might be archived at FMC in respect of Amber Sweetman. There was no firm expectation that such imagery would be available or even be helpful but, in the event, by chance, the

[13] Transcript, page 445

archived material contained CT imagery from November 2004. As I understood the evidence this imagery had originally been obtained at WCH. However, the 2004 imagery, archived as it was, did not become available for some time that evening. In the meantime, the necessary comparisons had to be made with earlier written reports. I will come to the result of a comparison between the CT imagery taken on the night of 13 February 2009 with the November 2004 imagery in a moment. My assessment of Dr Foreman is that she did all that she could to clarify whether or not, with her experience and knowledge, there had been acute changes based upon, in the first instance, the assessment of the CT imagery from that night and also by way of comparison with the October 2007 report.

8. Events following the CT scan

8.1. Following the CT scan Amber was admitted to the FMC Intensive and Critical Care Unit (ICCU). The admission time is recorded as having been 7:25pm[14]. Dr Doorenbosch at some point telephoned Dr Santoreneos, as already indicated, and a plan was formed that Amber be retrieved to the WCH. Dr Santoreneos would later receive a second call from Dr Doorenbosch just before 9pm which prompted him to attend personally at FMC. I return to that event in a moment. Dr Agzarian, who had been called by Dr Foreman, in due course made his own way to the FMC. Dr Agzarian arrived at approximately 8:15pm to 8:30pm, by which time the archived radiology packet had arrived.

8.2. The WCH paediatric retrieval team arrived at approximately 8:35pm. At the time of Amber's admission to ICCU, Registered Nurse April Hawthorn[15] conducted a check of all of Amber's vital signs and noted that her pupils were considered to be within acceptable parameters. RN Hawthorn asserts in her affidavit that she was aware of the need to check Amber's vital signs regularly, including her pupils, and she did so at 5 minute intervals. In due course RN Hawthorn noticed that the pupils had changed and both had become dilated. RN Hawthorne asserts in her affidavit that this occurred quite suddenly. She explains that her routine is to double check her observations before recording them on the ICCU chart and it was in the 30 seconds to a minute between the initial check and the double check that Amber's pupils had both become dilated. The development was regarded as conclusive evidence of a

[14] Exhibit C3, page 14
[15] Exhibit C11

significant and dangerous raised intracranial pressure that required correction. This event is recorded as having taken place at 8:40pm[16]. Dr Doorenbosch attended at the ICCU and administered an EVD in that Unit. Her note suggests that this procedure commenced shortly after 8:45pm. This produced the emission from Amber's head of cerebrospinal fluid under high pressure. The emission ultimately ceased. Dr Santoreneos arrived at approximately 9:10pm to 9:20pm and at that point it was decided that Amber would be transferred from the ICCU to theatre where a second EVD was inserted in a different location. Further cerebrospinal fluid was extracted and in due course Amber's dilated pupils, seen as a sign of the raised intracranial pressure, reduced to normal size.

8.3. The radiological consultant, Dr Agzarian, told me in evidence that he had arrived at FMC sometime after 8pm and it was following his arrival that the CT imagery taken that night was compared to the archived imagery from 2004 and a conclusion was reached, quite independently of any clinical change that Amber would experience, that there were changes in Amber's brain consistent with raised intracranial pressure giving rise to high suspicion of shunt blockage. This information was immediately communicated to Dr Doorenbosch, the neurosurgery registrar, by phone. I am not certain of the sequence of events in relation to the imparting of this information. The clinical record suggests that the event that prompted the ultimate intervention by way of the administration of an EVD was the observation made that Amber's pupils had suddenly become dilated.

8.4. Amber was later that night retrieved to the WCH where it was confirmed that Amber had developed malignant intracranial hypertension with death as the final endpoint on 18 February 2009.

9. The independent expert evidence

9.1. Independent expert opinion that was adduced in the Inquest was to the effect that Amber Sweetman's clinical presentation as well as the CT imagery, compared as it was to previous reports, should have been sufficient to enable the clinicians to reach a conclusion or diagnosis that Amber was suffering from significant raised intracranial pressure, if not coning of the brain stem, that required immediate correction. In essence, the view is that any further delay in the administration of surgical

[16] This note, made retrospectively by Dr Doorenbosch, relates to the time at which she was called by the WCH retrieval registrar while she was seeing another patient

intervention, either by way of EVD or revision of the shunt, was unnecessary. The independent opinion that was adduced before the Court suggests that the EVD that was ultimately carried out was undertaken with undue delay and could have been administered earlier having regard to the information that was known about Amber at the time the CT scan images were evaluated by Dr Doorenbosch and Dr Foreman at or around 7:13pm.

9.2. In this regard I heard evidence from two sources. The first was Dr Janice Fletcher who is the Clinical Director for Genetics and Molecular Pathology at SA Pathology, is a Clinical Senior Lecturer in the Department of Paediatrics at the University of Adelaide and was formerly Executive Director, Medical, of the Children, Youth and Women's Health Service. Dr Fletcher pointed out that she is not an expert in neurology or neurosurgery, but is by training a metabolic paediatrician. The other expert witness was Professor Reilly to whom I have already referred.

9.3. As part of Dr Fletcher's role as Executive Director, Medical, of the Children, Youth and Women's Health Service, she served on the WCH Mortality Committee. Dr Fletcher provided a report[17] and gave oral evidence. Dr Fletcher explained that the Committee had occasion to review several paediatric cases where a diagnosis of raised intracranial pressure had been delayed. In her report Dr Fletcher expressed the view that with the clinical findings that Amber had demonstrated, including apnoea, and a diagnosis of a blocked shunt, Amber should have undergone surgery as soon as practicable. That opinion in some ways begs the question as to whether or not a diagnosis of a blocked shunt should have been the only diagnosis available at the time Amber first presented at the Emergency Department. I do not think anyone doubts that if a confident diagnosis of a blocked shunt had been made, an EVD would have been performed without delay. The question remains whether such a confident diagnosis should have been made on the basis of Amber's clinical presentation alone or on the basis of her presentation together with the CT imagery without recourse to previous imagery.

9.4. I think the salient feature of Dr Fletcher's evidence is that in her view it is unfortunate that so much diagnostic reliance is placed on imaging where clinical signs have been, and remain, the best indication of potential raised intracranial pressure.

[17] Exhibit C9a

9.5. The opinion of Professor Reilly, who is a neurosurgery specialist, to my mind ought to be given more weight. Professor Reilly provided a report to the Inquest[18] and gave oral evidence. In his report Professor Reilly suggests that the provisional diagnosis made upon admission of a blocked shunt was the correct diagnosis. He believed that the preceding history of drowsiness, headache and vomiting strongly indicated the likelihood of raised intracranial pressure due to shunt obstruction. He also suggested that the respiratory arrest that was apparently independent of a seizure or fit indicated a state of severe raised intracranial pressure and made shunt blockage highly likely and its correction a matter of urgency. However, in expressing this opinion both in his report and as repeated in evidence, I do not think Professor Reilly suggested that one would necessarily immediately act upon a suspected clinical diagnosis. He suggested that the seeking of the CT scan of the brain had been appropriate in order to confirm the diagnosis and as an aide to re-establishing ventricular drainage of the build-up of cerebrospinal fluid in the skull. I did not understand Professor Reilly to be critical of a failure to deliver surgical correction without proceeding to a CT scan beforehand. However, the nub of Professor Reilly's critique is that the CT examination by Drs Doorenbosch and Foreman, when compared against the previous reports, in particular that of 18 October 2007, should have led to the conclusion that the ventricles within the brain had become dilated and that Amber's shunt was blocked. In that event surgical correction should have taken place at the earliest opportunity. Professor Reilly was of the view that '*the necessary action is to relieve intracranial pressure as soon as* possible'[19]. In fact, Professor Reilly was of the view that the preferable surgical action would have been to revise the shunt rather than to administer an EVD[20]. The difficulty with that scenario however, in practical terms, was that this would have required the skills of a consultant neurosurgeon who may not have been immediately available. Professor Reilly, while expressing the view that the preferable action would have been to revise the shunt, did acknowledge that if the only mechanism available was for a registrar to administer an EVD, then that was the measure that probably ought to have been undertaken[21]. Either way, Professor Reilly's opinion was that remedial action should have taken place without undue delay following the CT scan. He calculates that the delay occasioned was something of the order of 1 hour and 45 minutes which I understood to be the time between 7pm,

[18] Exhibit C10a
[19] Transcript, page 361
[20] Transcript, page 362
[21] Transcript, pages 372-373

when the CT scan commenced, and 8:45pm when the EVD was inserted. I return to the question of the magnitude of the alleged delay below.

9.6. Central to Professor Reilly's opinion was his view that the CT scan taken on the evening of 13 February 2009, when examined in conjunction with the previous reports, ought to have been diagnostic of raised intracranial pressure caused by a blocked shunt. Professor Reilly in the main based his opinion upon the impression created by two specific CT slices[22] that in his view demonstrated acute changes in respect of the size of the lateral ventricles when examined against reports of previous imagery. In other words, Professor Reilly is saying that a comparison of the February 2009 imagery with the wording of reports relating to previous imagery should have revealed to the clinicians acute changes upon which a working conclusion as to raised intracranial pressure could and should have been drawn.

10. The response to the independent expert evidence

10.1. Professor Reilly's opinion was hotly disputed during the course of the Inquest. Dr Doorenbosch, who performed the CT comparison together with Dr Foreman, did not agree with that view at all. It will be remembered that by this time Dr Doorenbosch was the clinician responsible for Amber's management and it would have fallen to her to perform any surgical intervention by way of the administration of an EVD. She would not have been able to revise the shunt. There was a level of clinical uncertainty in her mind such as to cause her to hesitate before administering any surgical intervention.

10.2. In the event, I decided to call Dr Agzarian, the consultant radiologist at FMC to seek his view concerning the weight that could have been accorded to the CT imagery taken of Amber on 13 February as and when it was made available. Dr Agzarian prepared an affidavit[23] and gave oral evidence. Dr Agzarian currently holds the position of Head of Magnetic Resonance Imaging at FMC. He has been a consultant radiologist at FMC since February 2008. He obtained his original medical qualifications from FMC in 1997. He is a Fellow of the Royal Australian and New Zealand College of Radiologists. As alluded to earlier, Dr Agzarian had a direct involvement in Amber's management when the CT imagery from October 2004 was fortuitously made available out of archived FMC records. I regarded Dr Agzarian as

[22] Slices 29 and 30
[23] Exhibit C12

an expert in his field and as equally qualified to form an opinion as to the significance of the CT imagery taken that night as was Professor Reilly, although I am mindful of the fact that Dr Agzarian has a professional connection with FMC, had a supervisory role with respect to Dr Foreman and had a personal involvement in Amber Sweetman's case. Dr Agzarian's detailed affidavit deals with the question of what can be seen in the various images within the CT scan collection taken on 13 February 2009. His affidavit states as follows:

> 'However, when considering all of the slices collectively, I do not think it unreasonable for a practitioner to conclude, without access to previous images, that there is insufficient change between the 22 November 2004 and 18 October 2007 reports and the 2009 CT scan to come to a conclusive view that there was shunt blockage, warranting urgent surgical intervention. This is because the majority of the parts of the lateral ventricles are effaced on the 2009 CT scan. The only parts inconsistent with the 18 October 2007 report are slices 29 and 30. For the reasons outlined in this affidavit, reasonable minds may differ as to how these slices should be interpreted.' [24]

10.3. When Dr Agzarian gave evidence in the Inquest he reaffirmed that view. In the event, the interpretation turned on semantics and what meaning could be assigned to the word 'effaced' as used in the reports relating to Amber's previous imagery. The gravamen of Dr Agzarian's evidence is as follows:

> 'Q. On that basis do you say that it was - it should have been obvious to Dr Doorenbosch and Dr Foreman that there wasn't that inconsistency.
>
> A. No, I don't think it would be obvious, no. I think from part of our previous discussion it would be reasonable that someone could have looked at those areas of fluid that we have described on slices particularly 29 and 30 and said 'Well, that's part of the extra-axial fluid collection'. The rest of the lateral ventricles then are effaced other than the temporal horns, but we knew that the temporal horns weren't effaced on the previous study. So you could say 'Well, actually there is not much difference between the scan and the report'. So I think that the issue is not so much about - the issue really is I think there are two reasonable ways to look at and interpret what those fluid filled structures represented on the 2009 report. If you interpret them as they are the lateral ventricles, then you would come to the conclusion that there is a difference between the report of 2007 and the current scan. However, if you interpret that those areas of fluid are predominantly part of this extra-axial fluid collection in a brain that doesn't have the normal anatomical landmarks, then you would actually come to the complete opposite conclusion which is 'Well, that fits with the report from 2007'.
>
> Q. Is there a way to remove all ambiguity.
>
> A. The way to remove the ambiguity is to compare with the images of the 2007 scan.

[24] Exhibit C12, Paragraph 20

Q. I've put to you a number of things that Professor Riley (sic) has said in his evidence yesterday. Can I ask you to re-read para.20 of your affidavit, please.

A. Would you like me to read that out aloud?

Q. No, just to yourself.

A. I have.

Q. Having heard some of Professor Riley's (sic) views, do you remain of the view that it was not or you do not think it unreasonable for a practitioner to conclude without access to previous images that there was insufficient change between the 22 November 2004 and 18 October 2007 reports and the 2009 CT scan, to come to a conclusive view that there was shunt blockage.

A. I do.' [25]

Notwithstanding an element of possible bias towards other FMC practitioners involved in Amber's care, Dr Agzarian struck me as being a patently honest witness and I was convinced that he genuinely held the views concerning the CT imagery that he expressed both in his affidavit and his oral evidence.

10.4. Dr Agzarian acknowledged that in respect of Dr Doorenbosch who was a registrar of neurosurgery and Dr Foreman who was a registrar of radiology, that it was a '*difficult ask*'[26] for registrars to interpret a complex congenital brain abnormality with a shunt, but he emphasised that Dr Foreman had followed the appropriate procedure which was to look at the scan, recognise its complexity and then seek her consultant's opinion in a timely manner.

10.5. In her evidence before me, Dr Doorenbosch described her own state of mind after she had considered all of the information about Amber, including her clinical presentation and the CT scan. She said:

'A. I was certainly not completely reassured that her problem is not her shunt, but I do not have enough information to say that the reason why she's had - she's presented this way is because she had raised intracranial pressure from a shunt malfunction. Now of course bearing in mind that only less than 3% of children with hydrocephalus presents with a seizure because their shunt is blocked, so it's not a common - certainly not the common presentation. Knowing her history that she's been unwell for a few days as well, it's not just the one thing that says that a shunt is the problem, it's putting everything together and we didn't have enough information at the time to say that this is why she's become so unwell.

Q. Did you discount the possibility that the shunt may be blocked or malfunctioning.

[25] Transcript, pages 528-529
[26] Transcript, page 541

A. Absolutely not.

Q. Did you discount the possibility that Amber was suffering from raised intracranial pressure.

A. I don't think at the time it was - she could have intracranial pressure, but it's certainly not critical at that stage from the assessments that we've made - that I've made.' [27]

Dr Doorenbosch explained that when she used the term 'critical', she did not mean to imply that Amber's condition had not been critical, but that any raised intracranial pressure had not appeared critical at that time. She based this opinion on the fact that Amber's pupils were small bilaterally and also from her blood pressure and pulse parameters.

10.6. In any case, following her assessment of the CT scan, Dr Doorenbosch called Dr Santoreneos, the neurosurgical consultant at WCH, and she explained Amber's current situation to him. As she herself put it in evidence, the administration of an EVD is not something lightly undertaken[28]. In this regard, it has to be understood that regard must be had not only to the diagnostic scenario that presented itself to Dr Doorenbosch, but also to the consequences of that diagnostic scenario, namely the nature of the intervention that she would have been required to perform had she been persuaded in her own mind that Amber was suffering from raised intracranial pressure that required immediate surgical relief that was within her skill set. In essence, Dr Doorenbosch's position on this is that she was not on the evidence persuaded that the invasive step of performing an EVD was the appropriate thing to do because she was not sufficiently convinced of the diagnosis.

10.7. Dr Doorenbosch readily acknowledged that if she had seen the actual October 2007 imagery, as opposed to the report of that imagery, she would have regarded the comparison as diagnostic of a blocked shunt and she would have taken Amber straight to theatre and administered an EVD[29]. Dr Doorenbosch in fact suggested that the conclusion that there were acute changes exhibited by the 2009 imagery when compared to the 2007 imagery could have been identified instantly and that she could have performed an EVD in the Intensive Care Unit within 10 to 15 minutes of examining the imagery at about 7:13pm.

[27] Transcript, page 179
[28] Transcript, page 139
[29] Transcript, page 194

10.8. There is one matter relating to Dr Doorenbosch's management of Amber that is open to question. During cross-examination of Dr Doorenbosch at the Inquest, it became apparent that at the time of Amber's presentation in February 2009 Dr Doorenbosch had been unaware of Amber's respiratory arrest. She suggested that it had been her understanding that the midazolam had been given in response to a seizure or seizures and that Amber had positively responded to it. I am satisfied, as already indicated, that Amber Sweetman experienced her respiratory arrest shortly after her arrival at the Emergency Department and at a time prior to the administration of midazolam. As seen earlier, one of the reasons for the administration of midazolam was to effect intubation. That Dr Doorenbosch had not understood this to have been the case is evident from her handwritten notes, in particular the section in which she describes the presenting history which makes no mention at all of a respiratory arrest. This raises a question as to whether Dr Doorenbosch even knew at the time that Amber had experienced a respiratory arrest. She knew of course that Amber had been intubated and was ventilated, but this would not have necessarily signified in her mind that the reason for this was that Amber had suffered complete cessation of breathing. One would have thought that if Dr Doorenbosch had any understanding of this at the time, it would have featured prominently in her notes. Dr Doorenbosch herself conceded in cross-examination that the reason for not documenting any reference to a respiratory arrest was '*because I think it wasn't clear to me that she had arrested*'[30]. In addition, Dr Doorenbosch would, soon after the CT scan, speak to Dr Santoreneos about Amber. In Dr Santoreneos' description of Dr Doorenbosch's account of Amber's presentation, there was no mention of respiratory arrest included within it. I find on the balance of probabilities that Dr Doorenbosch had been unaware of the fact that Amber had stopped breathing in the Emergency Department. The respiratory arrest, which after all had been a life threatening event in and of itself, would seem to be an extraordinary thing for Dr Doorenbosch not to have known and therefore not to have taken into account in considering Amber's diagnosis.

10.9. As to the possible consequences of this omission, when asked by me as to whether her management would have been different if she had known that Amber had suffered a

[30] Transcript, page 234

respiratory arrest before she had been intubated, and before she had been given any midazolam, Dr Doorenbosch acknowledged that:

> '… certainly it would have increased my suspicion, I suppose my concern even more, but it wouldn't have been enough I don't think on discussion with Dr Santoreneos afterwards for us to say 'Let's put a drain in'. But again, like I said, I don't know what he would have thought at that time.' [31]

This was an acknowledgement that the respiratory arrest gave rise to a greater index of suspicion that Amber was suffering from intracranial pressure[32]. When Dr Doorenbosch was recalled to give further evidence at a later point in time during the Inquest, she on this occasion said that in her view a respiratory arrest could fit was not inconsistent with a diagnosis of a complex partial seizure that Dr Foran had suspected and noted. Professor Reilly was of the view that it was highly unlikely that a seizure in itself could result in a respiratory arrest and that in any event there did not appear to be any seizure activity at the time of the arrest, other than post-ictal. In the event, I do not need to resolve the debate other than by saying that having seen Dr Doorenbosch give evidence over an extended period of time, in my view her original concession that knowledge of the respiratory arrest certainly would have increased her suspicion and concern about intracranial pressure even more was well made.

10.10. To my mind it is unfortunate that Dr Doorenbosch did not understand that Amber had experienced a respiratory arrest. My impression of Dr Doorenbosch's evidence on the issue is that knowledge on her part that Amber had stopped breathing at one stage may have significantly heightened her suspicion of raised intracranial pressure from a blocked shunt and may have caused her to act sooner by way of surgical intervention in the form of EVD.

10.11. When Dr Santoreneos gave evidence he acknowledged that the account given to him by Dr Doorenbosch on the phone did not include reference to the respiratory arrest[33]. He was asked what in his view the significance of the respiratory arrest had been. He suggested that it is not common in a seizure to experience a respiratory arrest, although some reduction in respiratory rate in the ictal phase might be experienced.

[31] Transcript, page 232
[32] Transcript, page 232
[33] Transcript, page 259

He said, however, that after the ictal event of the seizure, the respiratory rate is likely to increase as the patient hyperventilates. He suggested:

> 'So a respiratory arrest perhaps will be more significant in terms of raised intracranial pressure.' [34]

Again, it is unfortunate that Dr Santoreneos was not informed of the fact that Amber had stopped breathing. It is now impossible to say whether he would have advocated any immediate surgical intervention had he known that fact.

11. Was Amber's death preventable?

11.1. The delay occasioned by the inability at about 7:13pm to radiologically compare like with like, that is to say the CT imagery taken that night with actual past imagery, was something of the order of 90 to 100 minutes. The question for evaluation is whether or not the delay was of clinical significance and whether Amber's death may have been prevented if, say, intervention by way of the administration of an EVD had occurred at an earlier point in time, namely shortly after the CT results of that night became available. Professor Reilly gave evidence about this question. In his report Professor Reilly states as follows:

> 'Had this CT scan been compared with any previous scan it would have confirmed that the ventricles had become dilated and that her shunt was blocked.
>
> There was a delay of 1 hr and 40 min from Dr Doorenbosch's assessment after the initial CT scan and Amber's further acute deterioration in the ICU when she developed fixed and dilated pupils. This is the period when urgent ventricular drainage might have been considered. Shortly afterwards (now 3 hours from admission) Dr Doorenbosch inserted an external ventricular drain tube and confirmed raised pressure. Despite relieving the intracranial pressure by this and a second external drain inserted later by Dr Santoreneos, Amber developed brain swelling which led to her death. The intractable brain swelling is likely to have been the result of hypoxic ischaemic swelling due to the prolonged raised intracranial pressure, the period of impaired respiration leading to respiratory arrest and the seizures. Inserting a ventricular drain before her final acute deterioration may have prevented this development.' [35]

Professor Reilly did add in his report that it could not be stated with certainty whether Amber's condition was fully reversible by the time of her arrival at FMC. He opines that the respiratory arrest, hypertension and small pupils at that point in time indicated a state of brain stem compression which may have been irreversible, or only reversible with severe neurological deficit. He does go on to say that it is possible

[34] Transcript, page 280
[35] Exhibit C10, page 6

that had the ventricles within the brain been drained earlier before Amber developed fixed and dilated pupils she may have survived without deficit.

11.2. There is one aspect of Professor Reilly's evidence about which I am not completely certain, and this relates to what he was advocating in terms of surgical intervention if an earlier diagnosis had been made. In his oral evidence before me, Professor Reilly suggested that the most appropriate surgical intervention in Amber's case would have been a complete revision of the shunt that would have required expertise at consultant neurosurgical level and not at the level of experience of Dr Doorenbosch, a trainee. Professor Reilly suggested that one might require an hour to arrange such surgery within an operating theatre as opposed to in an intensive care unit. On this basis, if this strategy had been considered the most appropriate if a diagnosis had been made immediately after the CT imagery was available, there would have been a delay of some magnitude in any event. It would possibly not have been of the same magnitude as that which ultimately transpired, but nevertheless there would have been some time lapse between diagnosis and surgical intervention. To my mind the preferred scenario ought to have been that if a diagnosis had been made at, say 7:13pm, then an EVD would have been the appropriate procedure. In this regard I accept Dr Doorenbosch's evidence that that is what she would have done if she had been in a position to have made a confident diagnosis.

11.3. It is difficult to determine what the possible outcome for Amber may have been if a diagnosis of raised intracranial pressure due to a blocked shunt, that required immediate surgical relief, had been made at or shortly after 7:13pm. It may be that her chances of survival without deficit would have been greater, but in my view there is no evidence upon which a positive finding can be made on the balance of probabilities that Amber would have survived.

12. Conclusions

12.1. When Amber Sweetman arrived by ambulance at the FMC Emergency Department she was experiencing raised intracranial pressure from a blocked shunt. Whether in fact she was coning through compression of the brain stem at that exact point in time is not as certain. However, her clinical presentation was reflective of raised intracranial pressure to a significant degree. In my opinion it has been established that her respiratory arrest was not the product of the administration of medication including midazolam. Nor was it the result of seizure activity, either ictal or post-

ictal. In my view the respiratory arrest was clearly the consequence of raised intracranial pressure due to a blocked shunt.

12.2. Clinicians at the Emergency Department properly considered the question as to whether or not Amber Sweetman was experiencing raised intracranial pressure from a blocked shunt. They also considered the possibility that her presentation was due to seizure activity. In my view the clinicians were correct to proceed to a CT scan of Amber's brain before coming to any positive diagnosis or before embarking upon any possible surgical intervention.

12.3. I find that Drs Doorenbosch and Foreman were genuinely unable to achieve a sufficient level of certainty about the significance of the CT findings. I acknowledge that Professor Reilly is of the opinion that a conclusion that Amber was experiencing raised intracranial pressure from a blocked shunt could have been drawn by comparing the imagery taken that night with the available previous reports. Dr Marc Agzarian, on the other hand, has expressed a differing view and that is that reasonable minds might differ as to how the CT scan taken that evening ought to have been interpreted. To my mind this is one of those cases where indeed reasonable minds may have differed. I am not critical of the lack of certainty experienced by Dr Doorenbosch and Dr Foreman in relation to the significance of the CT scan and Dr Doorenbosch's lack of certainty in relation to a diagnosis of raised intracranial pressure due to a blocked shunt. I am satisfied that in her own mind she did not have a sufficient degree of certainty that would have dictated a course of action that involved the administration of an immediate EVD.

12.4. It is unfortunate, however, that Dr Doorenbosch was not aware of the fact that Amber Sweetman had suffered a respiratory arrest in the Emergency Department. It is also unfortunate that this piece of information was not imparted to the neurosurgeon Dr Santoreneos. It cannot be known with certainty whether this piece of information would have made any difference to Dr Doorenbosch's assessment or diagnosis of Amber. All that one can say is that it was a highly relevant piece of information that should have been taken into account by Dr Doorenbosch.

12.5. In due course I find that the correct diagnosis was made, but only after a significant delay. The diagnosis was ultimately made upon the basis of a sudden dilation of Amber's pupils as observed by nursing staff in the ICCU at FMC. The measures subsequently undertaken to relieve the situation were reasonable, although it has to be

acknowledged that there is evidence to suggest that the original EVD administered by Dr Doorenbosch may not have been inserted in the ideal location.

12.6. The delay in diagnosis could have been avoided if by electronic means the previous CT imagery of Amber's brain taken in 2004 and 2007 at WCH was immediately made available. There is no doubt that had it been available, a diagnosis of raised intracranial pressure due to a blocked shunt would have been made at or around 7:13pm and that relieving measures in the form of an EVD would promptly have been administered.

12.7. However, it cannot be known with certainty whether Amber Sweetman's death could have been prevented if an earlier diagnosis had been made in respect to raised intracranial pressure due to a blocked shunt.

13. Recommendations

13.1. Pursuant to Section 25(2) of the Coroners Act 2003 I am empowered to make recommendations that in the opinion of the Court might prevent, or reduce the likelihood of, a recurrence of an event similar to the event that was the subject of the Inquest.

13.2. The two recommendations that I made when delivering my preliminary findings will be repeated.

13.3. The evidence adduced in this case suggested that, notwithstanding the availability of CT imagery in a diagnostic setting relating to blocked shunts in children, the clinical presentation is still crucial in terms of any diagnostic evaluation. There seems little doubt in this case that when Amber Sweetman presented at the FMC Emergency Department she was experiencing raised intracranial pressure from a blocked shunt and that her presentation and symptomatology reflected that. While proceeding to CT imagery is a necessary part of any diagnostic evaluation, what this case has demonstrated is that clinicians should not be wholly reliant upon such imagery and that they need to carefully consider the clinical presentation as well. Dr Fletcher emphasised this in her evidence. She produced in evidence a 'monograph' entitled 'Kids, Coma and Coning' that is designed to educate medical practitioners that while imaging is part of a diagnostic process, '**Clinical signs** have been, and remain, the best indication of a potentially crucial RICP *(raised intracranial pressure)* situation – whatever the cause.' (emphasis is part of the original text, but the italicised portion is

added) As this case demonstrates, views may well differ about the weight that might be given to clinical signs and symptoms, but it is sufficient to say that clinicians should have regard to the fact that the child will not always present with classic symptoms of brain stem compression such as the Cushing reflex where raised blood pressure is accompanied by a slow heart rate, or by fixed and dilated pupils. Clinicians should also bear in mind, as this case demonstrates, that children may deteriorate very quickly. I intend drawing this matter to the attention of the relevant authorities so that it in turn can be brought to the attention of the wider medical profession.

13.4. I make the following recommendations:

1) That the Minister for Health cause to be expedited the digitisation of radiological imagery at the Women's and Children's Hospital;

2) That the Minister for Health cause to be expedited the implementation of the centralised digital system of storage of radiological imagery available for access by all public hospitals in South Australia;

3) That these findings be drawn to the attention of the wider medical profession, including but not limited to general practitioners, emergency clinicians and paediatric, neurological, neurosurgical and radiological trainees. I direct this to the attention of the Minister of Health, the principal administrative officers of all South Australian medical schools and the South Australian Board of the Medical Board of Australia through the Australian Health Practitioner Regulation Agency.

Key Words: Hydrocephalus; Ventriculoperitoneal Shunt;

In witness whereof the said Coroner has hereunto set and subscribed his hand and Seal the 26th day of March, 2012.

Deputy State Coroner