

**BRIEF FOR EXPERT MICROBIOLOGIST
CLAIRE ROBERTS**

Introduction

1. Claire Roberts is one of 4 children who are the subject of a public inquiry being conducted by John O’Hara QC.
2. Claire was born on 10th January 1987. She was admitted to the Royal Belfast Hospital for Sick Children (“the Royal”) on 21st October 1996 with a history of malaise, vomiting and drowsiness and she died on 23rd October 1996. Her medical certificate recorded the cause of her death as Cerebral Oedema and Status Epilepticus. That certification was subsequently challenged after a television documentary into the deaths of Adam and 2 other children (Lucy Crawford and Raychel Ferguson).
3. The Inquest into Claire’s death was carried out nearly 10 years after her death by John Leckey on 4th May 2006. He engaged Dr. Robert Bingham (Consultant Paediatric Anaesthetist at Great Ormond Street) and Dr. Ian Maconochie (Consultant in Paediatric A&E Medicine at St Mary’s, London) as experts. The Inquest Verdict found the cause of Claire’s death to be Cerebral Oedema with Hyponatraemia as a contributory factor.
4. The other 3 children are :
 - (1) Adam Strain was born on 4th August 1991. He died on 28th November 1995 in the Royal following kidney transplant surgery. The Inquest into his death was conducted on 18th and 21st June 1996 by John Leckey the Coroner for Greater Belfast, who engaged as experts: (i) Dr. Edward Sumner Consultant Paediatric Anaesthetist at Great Ormond Street Hospital for Sick Children (“Great Ormond Street”); (ii) Dr. John Alexander Consultant Anaesthetist at Belfast City Hospital; and (iii) Professor Peter Berry of the Department of Paediatric Pathology in St. Michael’s Hospital, Bristol. The Inquest Verdict identified Cerebral Oedema as the cause of his death with Dilutional Hyponatraemia as a contributory factor.
 - (2) Raychel Ferguson was born on 4th February 1992. She was admitted to the Altnagelvin Area Hospital on 7th June 2001 with suspected appendicitis. An appendectomy was performed on 8th June 2001. She was transferred to the Royal on 9th June 2001 where brain stem tests were shown to be negative and she was pronounced dead on 10th June 2001. The Autopsy Report dated 11th June 2001 concluded that the cause of her death was Cerebral Oedema caused by Hyponatraemia.

The Inquest into Raychel's death was conducted on 5th February 2003 by John Leckey who once more engaged Dr. Edward Sumner as an expert. The Inquest Verdict found the cause of Raychel's death to be Cerebral Oedema with Acute Dilutional Hyponatraemia as a contributory factor. It also made findings that the Hyponatraemia was caused by a combination of inadequate electrolyte replacement following severe post-operative vomiting and water retention resulting from the secretion of anti-diuretic hormone (ADH).

- (3) Conor Mitchell was born on 12th October 1987 with cerebral palsy. He was admitted to A&E Craigavon Hospital on 8th May 2003 with signs of dehydration and for observation. He was transferred to the Royal on 9th May 2003 where brain stem tests were shown to be negative and he was pronounced dead on 12th May 2003.

The Inquest into Conor's death was conducted on 9th June 2004 by John Coroner who again engaged Dr. Edward Sumner as an expert. Despite the Inquest, the precise cause of Conor's death remains unclear.

The clinical diagnosis of Dr. Janice Bothwell (Paediatric Consultant) at the Royal was brainstem dysfunction with Cerebral Oedema related to viral illness, over-rehydration/inappropriate fluid management and status epilepticus causing hypoxia. Dr. Brian Herron from the Department of Neuropathy, Institute of Pathology, Belfast performed the autopsy. He was unsure what 'sparked off' the seizure activity and the extent to which it contributed to the swelling of Conor's brain but he considered that the major hypernatraemia occurred after brainstem death and therefore probably played no part in the cause of the brain swelling. He concluded that the ultimate cause of death was Cerebral Oedema. Dr. Edward Sumner commented in his Report of November 2003 that Conor died of the acute effects of cerebral swelling which caused coning and brainstem death but he remained uncertain why. He noted that the volume of intravenous fluids was not excessive and the type appropriate but queried the initial rate of administration. That query was raised in his correspondence shortly after the Inquest Verdict. In that correspondence Dr. Sumner described the fluid management regime as 'sub-optimal'.

The Inquest Verdict stated the cause of death to be Brainstem Failure with Cerebral Oedema, Hypoxia, Ischemia, Seizures and Infarction and Cerebral Palsy as contributing factors.

5. The impetus for this Inquiry was a UTV Live Insight documentary 'When Hospitals Kill' shown on 21st October 2004.¹ The documentary primarily focused on the death of a toddler called Lucy Crawford (who was subsequently

¹ See DVD of the programme with the accompanying Core Files

also found to have died in hospital in 2000 as a result of hyponatraemia) and what was presented as significant shortcomings of personnel at the Erne Hospital. In effect the programme alleged a cover-up and it criticized the hospital, the Trust and the Chief Medical Officer. The programme also referred to the deaths of Adam and Raychel in which hyponatraemia had similarly played a part. At that time no connection had been made with the deaths of Claire and Conor.

Original Terms of Reference

6. The Inquiry was established under the Health and Personal Social Services (Northern Ireland) Order 1972, by virtue of the powers conferred on the Department by Article 54 and Schedule 8 and it continues pursuant to the Inquiries Act 2005.
7. The original Terms of Reference for the Inquiry as published on 1st November 2004 by Angela Smith (then Minister with responsibility for the Department of Health, Social Services and Public Safety) were to:

To hold an Inquiry into the events surrounding and following the deaths of Adam Strain, Lucy Crawford and Raychel Ferguson, with particular reference to:

- i. The care and treatment of Adam Strain, Lucy Crawford and Raychel Ferguson, especially in relation to the management of fluid balance and the choice and administration of intravenous fluids in each case.
- ii. The actions of the statutory authorities, other organisations and responsible individuals concerned in the procedures, investigations and events which followed the deaths of Adam Strain, Lucy Crawford and Raychel Ferguson.
- iii. The communications with, and explanations given to, the respective families and others by the relevant authorities.

In addition, Mr O'Hara will:

- (a) Report by 1 June 2005 or such other date as may be agreed with the Department, on the areas specifically identified above and, at his discretion, examine and report on any other relevant matters which arise in connection with the Inquiry.
- (b) Make such recommendations to the Department of Health, Social Services and Public Safety as he considers necessary and appropriate.

(Emphasis added)

Changes

8. There have been a number of significant changes in the Inquiry since 2005. Firstly, the Crawford family wished to have Lucy excluded from the Inquiry's work and the Inquiry therefore received the following Revised Terms of Reference from the Minister:

EXPERTS

1. The care and treatment of Adam Strain and Raychel Ferguson, especially in relation to the management of fluid balance and the choice and administration of intravenous fluids in each case.
2. The actions of the statutory authorities, other organisations and responsible individuals concerned in the procedures, investigations and events which followed the deaths of Adam Strain and Raychel Ferguson.
3. The communications with and explanations given to the respective families and others by the relevant authorities.

In addition, Mr O'Hara will:

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 - (b) Make such recommendations to the Department of Health, Social services and Public Safety as he considers necessary and appropriate.
9. Secondly, Claire Roberts and Conor Mitchell were included into the Inquiry's work by the Chairman. That decision arose out of the Royal's belated acknowledgement that hyponatraemia played a part in Claire's death as well as the apparent fluid mismanagement in Conor's case so soon after the implementation of Guidelines on Hyponatraemia that stressed the importance of fluid management.
10. The effect of the Revised Terms of Reference was to exclude all explicit references to Lucy Crawford. The Chairman has interpreted them in the following way:

... the terms still permit and indeed require an investigation into the events which followed Lucy's death such as the failure to identify the correct cause of death and the alleged Sperrin Lakeland cover-up because they contributed, arguably, to the death of Raychel in Altnagelvin. This reflects the contention that had the circumstances of Lucy's death been identified correctly and had lessons been learned from the way in which fluids were administered to her, defective fluid management would not have occurred so soon afterwards (only 14 months later) in Altnagelvin, a hospital within the same Western Health and Social Services Board area.

11. Claire Roberts' case is being investigated in accordance with precisely the same terms as those of Adam Strain and Raychel Ferguson. The investigation of Conor will address more limited issues in view of the fact that hyponatraemia was not thought to be a cause of his death (if anything he developed hypernatraemia). Similarly the fluid mismanagement referred to by Dr. Sumner was not considered to have been a cause of his death. The Chairman has stated:

It is obviously a matter of concern if guidelines which have been introduced as a result of a previous death or deaths and which are aimed at avoiding similar events in the future, are not properly communicated to hospital staff and followed. It is relevant to the investigation to be conducted by the Inquiry whether and to what extent the guidelines had been disseminated and followed in the period since they were published. Another matter of interest is whether the fact that Connor was being treated on an adult ward rather than a

children's ward made any difference to the way in which it appears that the guidelines may not have been followed.

Accordingly, the Inquiry will investigate the way in which the guidelines had been circulated by the Department, the way in which they had been made known to hospital staff and the steps, if any, which had been taken to ensure that they were being followed. While this is an issue of general importance, it will be informed by an examination of the way in which the guidelines had been introduced and followed in Craigavon Area Hospital by May 2003.

Role of the Experts

12. The Role of the Experts to the Inquiry is set out in 'Protocol No.4: Experts', a copy of which is attached.² There are 4 categories of expert assistance:
- (i) Expert Advisors to assist the Inquiry in identifying, obtaining, interpreting the evaluating the evidence within their particular area of expertise, currently: (a) Paediatrician; (b) Paediatric Anaesthetist; (c) Nurse in Paediatric Intensive Care; and (d) National Health Service Hospital Management
 - (ii) Experts appointed to 'peer review' the work of the Expert Advisers, currently: (a) Internal Medicine/Nephrology; (b) Paediatric Anaesthetist; and (c) Paediatric Intensive and Critical Care Nursing
 - (iii) Experts on a case by case basis as Expert Witnesses
 - (iv) Experts to provide commissioned 'Background Papers'

Background to Claire

Initial admission to the Ulster (1987)

13. Claire Roberts was born on 10th January 1987. Claire was first admitted to hospital when on 23rd July 1987 she was admitted to The Ulster Hospital in Dundonald ("the Ulster Hospital"), aged 6 ½ months, because of seizures. Further episodes occurred during August 1987 resulting in treatment with the anticonvulsant, carbamazepine (Tegretol ®). Further convulsions occurred in September 1987, together with findings on examination of being floppy with possible abnormal posture and tone on the left side.

First referral to the Royal (1987)

14. Claire's presentation in September 1987 resulted in her being referred to the Royal on 3rd September 1987 under the care of Dr. Hicks³. A summary sent to her GP following discharge on 21st September 1987, described her as having

² See Tab 2 of the accompanying Core Files

³ Ref: 090-018-033, 034 Tab 3

'poor trunk control and poor ability to lift her head when prone' and described certain behaviours which were more typical of a much younger infant (e.g. 'no stabilising reflexes; could only roll from semi-prone; makes no effort to reach and take objects.'). Seizures were witnessed that were described as 'salaam attacks' (myoclonic epilepsy) although the contemporaneous handwritten notes also referred to tonic-clonic seizures and absences. Investigations, including brain CT scanning and electroencephalography, did not define any causative diagnosis for her epilepsy. She was prescribed the anticonvulsant sodium valproate (Epilim®) before discharge, while weaning her from her previously prescribed Tegretol⁴.

Ulster (1988 and 1996)

15. Dr. Gleadhill saw her at the Ulster Hospital on 9th February 1988, when he 'felt there was definitely some concern about her developmental delay.'
16. In May 1996 she was seen by Dr. Gaston, Consultant Community Paediatrician, in relation to behavioural problems. He concluded that she could be categorised as having 'attentional difficulties' and he noted in his letter to Claire's GP, the option of treating Claire with a stimulant medication, such as Ritalin®, Pemoline® or amphetamine⁵. Dr. Gaston saw Claire again on 1st August 1996 and a trial of Ritalin was discussed. He noted 'a very small risk of inducing seizures with Ritalin.' Claire was treated with Ritalin 10 mg daily until 2nd October 1996 when her parents reported 'dry mouth, viscous, pacing, ?agitated/unsettled 30 minutes after Ritalin.' Dr. Gaston noted his advice to 'hold meds' and 'restart on a weekend with just 5 mg. Mother to call 5 days later...'⁶. It is not known whether the Ritalin was restarted. There is no mention of it in her A&E admission notes⁷ or in the ward assessment⁸.

Second referral to the Royal (1996)

17. On 21st October 1996 Claire's GP referred her for admission to the Royal Belfast Hospital for Sick Children ("Royal"). He described Claire as a 9 year old girl with severe learning disability and past history of epilepsy who had been seizure-free for 3 years and had been weaned off anticonvulsant drugs 18 months previously. The referral also stated: 'No speech since coming home. Very lethargic at school today. Vomited x 3 - speech slurred. Speech slurred earlier'⁹. Claire was described as pale, not liking the light and with no neck stiffness. The GP considered her tone increased on the right side and suggested that Claire was post-seizure and had an underlying infection¹⁰.

⁴ Ref: 090-015-026, 027 Tab 4

⁵ Ref: 090-013-017, 018 Tab 5

⁶ Ref: 090-013-016, 017 Tab 6

⁷ Ref: 090-011-013, Tab 7

⁸ Ref: 090-022-050 Tab 8

⁹ Ref: 090-011-013 Tab 7

¹⁰ Ref: 090-011-013 Tab 7

18. Claire was admitted to the Royal later on 21st October 1996 exactly 4 months after the conclusion of the Inquest into Adam Strain's death of hyponatraemia at the Royal. The A&E note repeated parts of that history and noted non-bilious vomiting 'since this evening'. She was 'drowsy, tired, apyrexial' with no other abnormal signs except for increased left sided muscle tone and reflexes. At 2045 a decision was made to admit Claire to hospital under the care of Dr. Heather Steen¹¹.
19. The admission note (timed at 2000) refers to Claire as 'vomiting at 3 pm and every hour since' and to her having experienced a loose bowel motion 3 days previously. The admitting doctor, Dr. O'Hare, noted that Claire had severe learning difficulties but normally had meaningful speech and referred to the recent trial of Ritalin and its apparent side-effects¹². Dr O'Hare also noted that Claire 'sits-up and stares vacantly' and was ataxic. She was not responding to her parents' voice and only intermittently responding to a deep pain stimulus. She had cogwheel rigidity of her right arm and increased tone in all other limbs. Tendon reflexes were brisker on the right than the left and there was bilateral ankle clonus¹³.
20. The admission diagnoses were noted as: (1) Viral illness; (2) Encephalitis (but this was subsequently scored through)¹⁴.
21. Blood was taken for a full blood count, urea and electrolytes, bacteriological culture and viral studies. Treatment to be given was noted as 'IV fluids, IV diazepam if seizure activity'. She was to be reassessed after fluids¹⁵. An IV prescription chart was prepared, ordering 500 ml of 0.18% sodium chloride in 4% dextrose to be given at 64 ml/h (equivalent to 65 ml/kg/24 h)¹⁶. The nursing care plan referred to administering 'IV fluids as prescribed by doctor, according to hospital policy'¹⁷.
22. The nursing record includes a fluid balance chart, which shows that treatment was started at 2130 with 64 ml hourly of 5/N saline. By 0700, Claire had received 536 ml [just under 57 ml hourly]. During those 9½ hours, she was noted by Nurse McRandal to have had 1 'medium' and 5 'small' vomits¹⁸. The nursing notes of the night of 21st October and early morning on 22nd October 1996 describe those vomits as bile-stained; this was a change from the A&E note, where the vomits were described as 'non-bilious'¹⁹.

¹¹ Ref: 090-012-014 Tab 9

¹² Ref: 090-022-050 Tab 8

¹³ Ref: 090-022-051 Tab 8

¹⁴ Ref: 090-022-052 Tab 8

¹⁵ Ref: 090-022-052 Tab 8

¹⁶ Ref: 090-038-134 Tab 10

¹⁷ Ref: 090-043-146 Tab 11

¹⁸ Ref: 090-038-133 Tab 10

¹⁹ Ref: 090-040-140, 090-012-014 Tab 12

23. A medical note at midnight stated that she was 'slightly more responsive' and had no meningism. It was noted that she would be 'observed and reassessed a.m.' Directly beneath this note is a manuscript entry for the blood biochemistry results. These were:
- Sodium 132; Potassium 3.8; Urea 4.5; Glucose 6.6; Creatinine 36; Chloride 96;
Haemoglobin 10.4; Packed cell volume 31; White cell count 16.5; platelets 422,000
24. The laboratory reference range for sodium ('normal range') is given as 135-145²⁰. Next to the sodium result is the symbol ↓ and next to the white cell count is the symbol ↑²¹.
25. The nursing record at 0700 by Nurse McRandal states: 'Slept well. Much more alert and brighter this morning. One further bile stained vomit ... no oral fluids taken...'²². A nursing note timed at 0800 - 1400 states: 'Slept for periods during early morning - bright when awake; no vocalisation but arm [?] active. Late morning Claire became lethargic and "vacant". Parents concerned as usually Claire is very active. Seen by Dr. Sands - status epilepticus - non-fitting. Rectal diazepam given ...'²³
26. The first medical note on 22nd October 1996.10.96 referred to a ward round by Dr Sands (at the time, a registrar in paediatric cardiology) and stated: 'Admitted ? viral illness. Usually very active, has not spoken to parents as per normal. Wretching [sic]. No vomiting. Vagueness/Vacant appearance (apparent to parents). No seizure activity observed ...' The sodium of 132 and raised white count were restated. She was described as apyrexial, pale and showing little response compared to normal. Her pupils were 'sluggish to light.' The impression was of 'non-fitting status.' A different hand has added 'encephalitis/ encephalopathy.'²⁴
27. A plan was noted to give rectal diazepam (actually administered at 1230), to discuss her past medical history with Dr. Gaston and to consult Dr. Webb²⁵. Dr. Webb also attended Adam Strain when he was admitted to PICU after he failed to regain consciousness following his renal transplant surgery.²⁶
28. The fluid chart for 22nd October 1996²⁷ does not note the solution given. However, an undated prescription chart²⁸ also referred to 500 ml of 'No 18

²⁰ Ref: 090-031-100 Tab 13

²¹ Ref: 090-022-052 Tab 14

²² Ref: 090-040-140 Tab 15

²³ Ref: 090-040-141 Tab 16

²⁴ Ref: 090-022-052, 053 Tab 17

²⁵ Ref: 090-022-052, 053 Tab 17

²⁶ Ref: 058-035-139 - see his note in Adam's medical notes and records at 1930 on 27th November 1995 when he refers to "severe acute cerebral oedema" and the possibility of "unexplained fluid shifts". See also Ref: 058-035-142 and his note at 09.10 on 28th November 1995 recording that the criteria for brain stem death had been met - just below the entry for 0745: "electrolyte/fluid problem overnight" Tab 18

²⁷ Ref: 090-038-135 Tab 19

²⁸ Ref: 090-038-136 Tab 20

solution at 64 ml/hr'. A total of 562 ml was given over 8 h from 0800, i.e. 70 ml/h.

29. At 1530 Claire was reported as having a 5 minute 'strong seizer [sic]' at 1525. At 1630 her teeth tightened slightly²⁹. At 1600, Dr. Webb made a note. He saw Claire with her grandmother, noting a history of 'Vomiting and listless yesterday p.m. - followed by prolonged period of poor responsiveness.' He added that she had appeared to improve after rectal diazepam, given at 1230. She was afebrile and pale with no meningism. She opened her eyes to voice, was non-verbal, withdrew [limb] from painful stimulus and had (questionably) reduced movements on the right side. He found mildly increased tone in her arms and symmetrical brisk reflexes, sustained ankle clonus and upgoing plantar responses. Claire was sitting up with eyes open and looking vacant, not obeying commands. She did not have papilloedema³⁰. Dr Webb's impression was: 'I don't have a clear picture of prodrome + yesterday's episodes. Her motor findings today are probably long-standing but this needs to be checked with notes. The picture is of acute encephalopathy, most probably postictal in nature. I note (N) [normal] biochemistry profile'³¹.
30. Dr Webb suggested starting Claire on the anticonvulsant phenytoin intravenously: 18 mg/kg as a first dose, followed by 2.5 mg/kg 12 hourly. He asked for hourly neurological observations and a CT scan the following day 'if she doesn't wake up'³².
31. Although Dr. Webb's note is timed at 4pm, he states in his Deposition at the Inquest that he believed he saw Claire at about 1400. The SHO noted calculations of phenytoin dose at 1430 and ordered a dose of 18[mg] x 24 [h] which he or she wrongly calculated as 632 mg rather than 432 mg. The calculation of the continuing dose of 2.5 mg/kg 12 hourly is then stated as 60 mg 12 hourly³³.
32. Those doses were ordered on a prescription chart³⁴. The nursing notes record a stat dose of phenytoin given at 2.45pm³⁵, with a second dose at 11pm following blood sampling for phenytoin levels³⁶.
33. The next medical note (untimed) referred to Claire being seen by Dr. Webb and being 'still in status.' It went on to calculate a dose of the anticonvulsant/sedative midazolam to be given as a first dose of 0.5 mg/kg (12 mg) followed by 2 mcg/kg/minute, calculated as 2.88 mg/h. The nursing notes record 'stat IV

²⁹ Ref: 090-042-144 Tab 21

³⁰ Ref: 090-022-053, 054 Tab 22

³¹ Ref: 090-022-054 Tab 22

³² Ref: 090-022-054 Tab 22

³³ Ref: 090-022-054 Tab 22

³⁴ Ref: 090-026-075 Tab 23

³⁵ Ref: 090-026-075, 090-040-141 Tab 24

³⁶ Ref: 090-040-138, 090-038-135, 090-026-077 Tab 25

hypnovel (midazolam) at 3.25pm³⁷. No dosage was recorded against this entry. The continuing infusion of midazolam was ordered as 69 mg in 50 ml normal saline to be given at 2 ml/h, which is confirmed by the fluid charts as having been given from 1630³⁸. Also from 1600, No 18 solution was continued with 452 ml given over 7 h to 2300 [64 ml/h]³⁹.

34. At 1700, Dr Webb, having received information from Claire's mother about the onset of the illness, described Claire as 'largely unresponsive' with intermittent vomiting and chewing. He prescribed the antibiotic cefotaxime and the anti-viral drug acyclovir for 48 hours, although he noted that he did not think meningoencephalitis very likely. He noted that stool, urine, blood and a throat swab should be checked for evidence of enterovirus infection. He also suggested an additional anticonvulsant intravenous infusion: sodium valproate 20 mg/kg as an initial dose, followed by 10 mg/kg over 12 h⁴⁰. A nursing note at 1715 referred to Claire being given a stat dose of Epilim and added: 'Very unresponsive - only to pain. Remains pale. Occasional episode of teeth clenching ...'⁴¹
35. At 2100 a nurse reported that Claire had a 30 second episode of screaming and drawing up of her arms with her pulse rising to 165. A doctor was informed⁴².
36. At 2330, an SHO (possibly Dr Stewart) noted that a blood sample likely to have been taken when the doctor attended at 2100 - 2130, showed a sodium concentration of 121 mmol/L, potassium 3.3 mmol/L, urea 2.9 mmol/L and creatinine 33 µmol/L. The phenytoin level was 23.4 mg/L (reference range 10-20 mg/L). It was noted: 'Hyponatraemic - ? Fluid overdose with low sodium fluids. ? SIADH' and 'Imp[ression]. ? need fo↑ sodium content in fluids. Discussed with registrar - ↓ fluids to 2/3 of present value - 41 ml/h. Send urine for osmolality'⁴³.
37. In fact, between 2300 and 0200 Claire received 56 ml of No 18 solution (18.5 ml/h) and 7.6 ml of normal saline. Also between 2200 and 0100 Claire received 170 ml of other fluids, recorded as IV Acyclovir 60 (presumably 'ml') and Phenytoin 110 (? 'ml') recorded in the oral fluids columns. The exact nature of the fluids in which the Acyclovir and Phenytoin were dissolved is not stated⁴⁴.
38. A nursing note at 2130 referred to Claire receiving midazolam at 3 ml/h, completed by 2240. At 2300 she was given IV phenytoin over 1 hour. In addition, the fluid chart refers to two 'small mouthfuls' of vomit/aspirate

³⁷ Ref: 090-040-141 Tab 26

³⁸ Ref: 090-038-135, 136 Tab 27

³⁹ Ref: 090-038-135 Tab 27

⁴⁰ Ref: 090-022-055 Tab 8

⁴¹ Ref: 090-040-141, 090-142-144 Tab 28

⁴² Ref: 090-042-144 Tab 28

⁴³ Ref: 090-022-056 Tab 8

⁴⁴ Ref: 090-038-135 Tab 27

recorded at 2400 and 0100⁴⁵. It is unclear whether these were discussed with the doctors, as they are not referred to in the medical or nursing notes. As a result of instructions from 'a registrar', 20 mmol of potassium chloride was added to the No 18 solution and the rate reduced to 41 ml/h. At 0230 a nurse noted: 'Slight tremor of right hand noted lasting few seconds. Breathing became laboured and grunting. Respiratory rate 20 per minute. Oxygen saturations 97%. Claire stopped breathing. Dr contacted immediately. Oxygen and suction given. Registrar attempted to pass ET tube but unsuccessful - anaesthetist called and ET tube inserted. Transferred to intensive care at 3.25 am'⁴⁶.

39. The medical note states that Claire 'had been stable when suddenly she had a respiratory arrest and developed fixed dilated pupils.' The doctor who attended noted she was 'Cheyne-Stoking'. Oxygen was being administered by a face mask and 'bagging' with oxygen saturation in the 'high 90s' and a 'good volume pulse.' The doctor unsuccessfully attempted intubation. It was subsequently carried out by the on-call anaesthetist and Claire was then transferred to the ICU⁴⁷.
40. The neurological observation chart, started at 1300 on 22nd October 1996, shows that at 1300 she was noted as *opening her eyes to speech* and at 1430 as *opening eyes to pain*. Thereafter, hourly recordings until 0200 on 23.10.96 all stated there was *no eye opening*. 'Best verbal response' was noted as *none* from 1300 to 1800 and thereafter as *incomprehensible sounds*. Her 'best motor response' was noted as *obey commands* at 1300 and at 2000, *localise pain* between those times and *flexion to pain* thereafter⁴⁸.
41. Her Glasgow Coma Scale (GCS) score was given as 9 on first checking and thereafter was 6 - 7, except recorded as 8 at 2000. There was a rise in temperature from normal to between 37.5 C and 38 C from 1900 and of pulse rate from <90 at 1300 to 115 at 1800, thereafter remaining at 100-105. There was no significant change recorded in blood pressure⁴⁹.
42. Claire was admitted to ICU at 0315 on 23rd October 1996 and the first ICU note was made at 0400. It reiterated the history as given above and noted that 'Claire was 'now intubated and ventilated. Pupils fixed and dilated. Bilateral papilloedema [swelling of the optic discs visible using an ophthalmoscope and implying raised intracranial pressure] L>R. No response to painful stimuli ...' She was given mannitol to reduce the cerebral oedema and dopamine and a brain CT scan was requested. At that time, the serum sodium concentration was recorded at 121mmol/L, which was equivalent to the result recorded at 2330 on 22nd October 1996⁵⁰. It is not clear precisely when those bloods were taken or

⁴⁵ Ref: 090-038-135 Tab 27

⁴⁶ Ref: 090-040-138, 139 Tab 29

⁴⁷ Ref: 090-022-056 Tab 8

⁴⁸ Ref: 090-039-137 Tab 30

⁴⁹ Ref: 090-039-137 Tab 30

⁵⁰ Ref: 090-022-057 Tab 8

the laboratory results communicated but the phenytoin result states that it was received at 0420 and vetted at 0438⁵¹. The blood could therefore have been taken between 0315 and 0400.

43. Dr. Webb noted, at 0440, 'SIADH (syndrome of inappropriate antidiuretic hormone secretion) - hyponatraemia, hyposmolarity, cerebral oedema + coning following prolonged epileptic seizures. Pupils fixed and dilated following mannitol diuresis. No eye movements ...'⁵²
44. A first test for brain stem death was conducted by Drs. Webb and Steen at 0600⁵³. The CT scan was reported as showing 'severe diffuse hemispheric swelling with complete effacement of the basal cisterns. No focal abnormality identified'⁵⁴.
45. Dr. McKaigue, ICU Consultant, reiterated the history of her hospital admission in a note at 0710. This included the serum sodium, checked by Drs. Webb and Steen at the same time as brain stem tests [0600], and found on the ICU blood gas analyser, was 133 mmol/L (and pH 7.13, PO₂ 124.5 mm Hg and PCO₂ 79.2 mm Hg). A laboratory sample sent at the same time was reported as: sodium 129 mmol/L and osmolality 274 mOsmol/kg. Dr. McKaigue noted a plan to 'maintain circulatory support as Claire is a potential organ donor' and ordered a dopamine infusion to maintain blood pressure and a 'close check on serum sodium and osmolality and urine output. If serum sodium >150 mmol/L and osmolality >300 mOsmol/kg then commence desmopressin ...' He changed the IV infusion fluid to 0.9% saline and at 0810 or 0850 requested 2 hourly measurements of urea and electrolytes⁵⁵.
46. An untimed note, placed between that of Dr. McKaigue at 0810 or 0850 and that of Dr. Steen at 1825 referred to Claire becoming hypotensive (BP 70/?) 'with DI [diabetes insipidus], given HPPF 500 ml. Needs DDAVP to limit polyuria. Appears brain stem death informally. Sodium 129 (from 121).' In her witness statement to the Police Service of Northern Ireland ("PSNI"), Dr. Steen identifies the writer as Dr. Robert Taylor, Consultant Paediatric Anaesthetist in charge of the PICU on 23rd October 1996. Dr. Taylor was the Paediatric Anaesthetist in charge of Adam's anaesthesia and fluids for his kidney transplant at the Royal 26th November 1996.
47. Two untimed laboratory reports on 23rd October 1996 showed serum sodium concentrations as 139 mmol/L and 152 mmol/L respectively, with osmolality 274 and 313 mOsmol/kg. The latter blood sample was identified by Dr. Steen as having been taken in the afternoon⁵⁶.

⁵¹ Ref: 090-031-101 Tab 31

⁵² Ref: 090-022-057 Tab 8

⁵³ Ref: 090-045-148 Tab 32

⁵⁴ Ref: 090-022-058 Tab 8

⁵⁵ Ref: 090-022-059, 060 Tab 8

⁵⁶ Ref: 090-050-156 Tab 33

48. At 18.25 on 23rd October 1996 the brain stem death test protocol was repeated⁵⁷, and it was noted there was no spontaneous respiration while the PaCO₂ was 70 mm Hg. These findings were discussed with the parents who agreed that ventilation should be withdrawn; consent for limited post-mortem examination was given. Ventilation was discontinued at 1845. The Death Certificate issued for Claire gave the cause of death as cerebral oedema secondary to status epilepticus⁵⁸.
49. An untimed 'Relative Counselling Record' for 22nd October 1996 (query whether it should be 23rd October 1996) stated that parents were seen by Drs. Steen and Webb. Dr Steen [?] explained that Claire had trouble with her breathing and needed to have ventilatory support now. Following the CT scan she explained that 'Claire had swelling of the brain and could be (possible) brain dead.' Dr Webb [?] explained that Claire's brain had swollen and that the CT scan and brain stem tests showed Claire's brain had died. Only the ventilator was keeping her heart beating.' When they asked why her brain had swollen, they were told it was probably caused by a virus⁵⁹.
50. Dr Sands made a note on 11th November 1996 that he had spoken at length with Claire's parents, talking through the events before her death 'and also talked generally with them.' He noted that they were anxious to know the post mortem findings and he would 'pass this on to Dr. Steen ASAP'⁶⁰.

Post-mortem findings

51. Certain pathological investigations requested during her life were reported after Claire's death. These included a blood culture which was sterile, an unremarkable urine specimen, absence of blood antibody to mumps, measles, herpes simplex, herpes zoster, cytomegalovirus, adenovirus, Q Fever, PLG virus, Mycoplasma pneumoniae, and Influenza A & B. A cerebrospinal fluid sample [taken post-mortem] was bloodstained with protein 95 gm/L (normal 0.15 -0.45 gm/L), globulin present +++, red cells 300,000/ μ L and white cells 4000/ μ L - mostly lymphocytes. No organisms were cultured⁶¹.
52. An autopsy of the brain only was carried out on 24th October 1996 by Dr. Herron. The clinical summary referred to Claire's admission with vomiting after contact with a relative with diarrhoea and vomiting. It went on to refer to her increasing drowsiness, that 'she was felt to have subclinical seizures' and mentioned her anticonvulsant treatment and that her serum sodium concentration had decreased to 121. There was a query of inappropriate ADH

⁵⁷ Ref: 090-045-148 Tab 34

⁵⁸ Ref: 090-022-061, 091-012-077 Tab 35

⁵⁹ Ref: 090-028-088 Tab 36

⁶⁰ Ref: 090-022-061 Tab 37

⁶¹ Ref: 090-030-092 to 098 Tab 38

secretion. There is a statement that Claire had ‘iatrogenic epilepsy since 10 months’⁶².

53. Dr. Herron noted Claire’s brain weighed 1606 g. His evidence to the Coroner’s Inquest was that he would have expected it to be 1300 g. There was no cortical venous thrombosis or meningeal exudate. There was symmetrical brain swelling with effacement of gyri, confirmed on sectioning. He reported observing focal meningeal thickening over the cortex and a cellular reaction in the meninges and perivascular space. In the deep white matter there were focal collections of neurones arranged in a ‘rather haphazard manner.’ Dr. Herron also described focal collections of neuroblasts in the subependymal grey matter suggestive of a migration problem. There was focal haemorrhagic necrosis in the brain stem.
54. Dr. Herron’s diagnosis was cerebral oedema with neuronal migrational defect and a low grade subacute meningoencephalitis. He concluded that the reaction in meninges and cortex was suggestive of a viral aetiology although viral studies were ‘negative during life and on a post-mortem cerebrospinal fluid’. Dr. Herron could not rule out a metabolic cause.⁶³
55. On 5th March 1997, Dr. Steen wrote to Claire’s GP stating that the abnormal neuronal migration [as described by Dr Herron] would have accounted for her learning difficulties and that other changes ‘were in keeping with a viral encephalomyelitis meningitis.’ She added that she and Dr. Webb had discussed the findings with Claire’s parents and ‘we will be happy to see them if they want to discuss things further with ourselves.’⁶⁴
56. Dr. Webb wrote to Claire’s parents on 28th February 1997 (letter typed on 21st March 1997), offering condolences and summarising the post-mortem findings similarly. He added that the reaction in the meninges and cortex suggested a viral cause with which the history of diarrhoea and vomiting was in keeping.⁶⁵
57. A brief handwritten summary and a typed précis written by Dr. Mannam, an ICU SHO, dated 29th October 1996 records the principal diagnosis is recorded as Cerebral Oedema, other diagnoses are listed as Status Epilepticus and finally hyponatraemia. This summary dealt only with the events in ICU, not those preceding it.⁶⁶

⁶² Ref: 090-003-003 Tab 39

⁶³ Ref: 090-003-004, 005 Tab 39

⁶⁴ Ref: 090-002-002 Tab 40

⁶⁵ Ref: 090-001-001 Tab 41

⁶⁶ Ref: 090-006-008 Tab 42

Coroner's Inquest (2005)

58. That certification was subsequently challenged after her parents had seen the UTV Live Insight documentary 'When Hospitals Kill', which was shown on 21st October 2004. The documentary dealt with the death primarily of Lucy Crawford but also the deaths of Adam Strain and Raychel Ferguson.
59. On 7th December 2004, Dr Nicola Rooney, Consultant Clinical Psychologist, arranged a meeting with Claire's parents, herself, Dr Andrew Sands, Dr Heather Steen and Professor Ian Young, Professor of Medicine at Queen's University Belfast ('independent adviser').⁶⁷
60. Their initial questions were whether Claire's condition was misdiagnosed, what role did sodium and fluid management play in her case and what led to her sudden deterioration.⁶⁸
61. Professor Young stated that on arrival Claire's serum sodium concentration was 'slightly low at 132,' that she was given standard fluid intravenously which was 'the text book recommendation' and that approximately 24 hours later the sodium concentration was rechecked and that the result, 27 hours after arrival, was 121 mmol/L, which was very low. In response, the amount of fluid given was reduced. Professor Young considered that the fall in sodium concentration had contributed to Claire's death but could not say to what extent. He stated that lessons had been learned at the Royal and that the use of 5th normal saline was now banned. The Trust would now approach the Coroner for advice on the best course of action.
62. By letter, dated 16th December 2004, Mr AP Walby, associate medical director at the Royal, reported Claire's death to Mr. John Leckey, HM Coroner. He summarised Claire's admission in 1996 and the subsequent events, consequent upon the screening of the UTV programme. He noted that Professor Young 'has examined the notes and in his opinion there was an indication that hyponatraemia had played a part in Claire's death ...'⁶⁹
63. On the following day, Dr. Michael McBride, Medical Director, wrote to Claire's parents stating that the Trust's medical case review suggested that 'there may have been a care management problem in relation to hyponatraemia and that this may have significantly contributed to Claire's deterioration and death.'⁷⁰
64. The Inquest into Claire's death was carried out on 4th May 2006 by the Coroner who had engaged as experts Dr. Robert Bingham Consultant Paediatric

⁶⁷ Ref: 089-003-006 Tab 43

⁶⁸ Ref: 089-002-002 Tab 44

⁶⁹ Ref: 089-004-009 Tab 45

⁷⁰ Ref: 089-005-010 Tab 46

Anaesthetist at Great Ormond Street Hospital ("Great Ormond Street") and Dr. Ian Maconochie Consultant in Paediatric A&E Medicine at St Mary's, London ("St Mary's"). The Inquest Verdict found the cause of Claire's death to be Cerebral Oedema with Hyponatraemia as a contributory factor.

65. Dr Bingham considered the admission diagnosis was reasonable and acute encephalopathy (viral or ictal) a likely cause of the presenting illness. He did not consider the serum sodium concentration of 132 mmol/L a likely cause. He also considered it reasonable to give Claire intravenous fluids as she could not hydrate herself and noted that she was given the fluid used as standard in 1996 within the recommended volume for full maintenance fluid therapy. He believed there were, however, reasons why Claire might have required fluid restriction - namely low level of metabolism related to impaired consciousness (what is the evidence that you produce significantly less urine just because your conscious level is impaired, as long as a 'normal' fluid intake is maintained) and possible reduced urinary output due to secretion of ADH which often accompanies both encephalopathy and nausea and vomiting. He concluded that if the reported sodium concentration of 121 mmol/L was accurate, then it was the likely cause of her deterioration and death. He could not exclude the possibility of an inaccurate reading given the subsequent ICU measurements, in which case acute encephalopathy was involved or even central. He considered it possible that 'aggressive treatment at 2100 when her coma score reduced from 8 to 6, may have been effective'.
66. In his evidence at the Inquest, Dr. Bingham stated he agreed with Dr. Maconochie's formulation of cause of death and that he considered her neurological illness caused ADH secretion. Hyponatraemia was not her presenting problem.⁷¹
67. Dr. Maconochie considered the diagnosis of encephalitis/encephalopathy was made at an early stage and that of non-convulsive status epilepticus had a high probability given her past history of seizures. He regarded management of these diagnoses was appropriate and did not comment on hyponatraemia as it was addressed by Dr. Bingham. He considered Dr. Webb and other members of the team looking after Claire gave careful and informed advice. At the Inquest he gave his opinion as to cause of death as I(a) cerebral oedema; (b) encephalitis/encephalopathy and hyponatraemia and II status epilepticus.⁷²
68. He considered that the finding of a sodium concentration of 121 mmol/L should have led to an immediate repeat sample and clinical reassessment. Also a blood sample should have been taken the morning after her admission which may have shown a decrease in serum sodium concentration. Consideration would have had to be given to the cause. He considered her symptoms on

⁷¹ Ref: 091-006-021 Tab 47

⁷² Ref: 091-007-028 Tab 48

- 22.10.96 were consistent with a number of conditions including hyponatraemia but there was no hyponatraemia issue on presentation.⁷³
69. Dr. Sands informed the Inquest that he had seen Claire first on the morning of 22nd October 1996, requested notes to be faxed from the Ulster Hospital and went to speak to Dr. Webb to seek his opinion. He emphasised that he was very concerned regarding Claire's level of consciousness, and this concern prompted the urgent neurology referral. He recalled spending some time with Claire and her mother to get a clear history and idea of her normal behaviour and also believed he explained his concerns without causing alarm.⁷⁴
70. Dr Webb's statement to the Coroner listed the Glasgow Coma Score findings and gave as his interpretation that there had been a period of change between 1300 and 1500 on 22.10.96, which may have been related to administration of anticonvulsants, especially midazolam, or to the observed seizure at 1525. After 2000 there was a definite and sustained change.⁷⁵
71. He stated that when he first saw Claire he was uncertain whether there had been seizure activity on the day before admission but concluded, after speaking to Mrs Roberts, that there had been a definite right-sided seizure the previous day. His conclusion was that Claire was having subtle non-convulsive seizure activity provoked by a viral infection, so appeared 'encephalopathic.' He also raised other differential diagnostic possibilities. He commented that his note about her blood results as normal (when her serum sodium concentration was <135 mmol/L) was likely to be because he believed her sodium concentration was a product of her recent vomiting and diarrhoea and could not on its own have explained her current encephalopathy or seizures. He also believed he erroneously understood the result to have been from a sample taken that morning (rather than the night before) and his entry in the note was a memo to himself that it could not have explained her clinical state. He stated that he believed if he had understood the result to be from the previous evening he would have asked for an urgent repeat sample.⁷⁶
72. Dr Webb also stated that he was not sure Claire would have met the criteria for admission to ICU when he left the hospital on 22nd October 1996, as there was no problem with her airway or breathing and no supportive signs of raised intracranial pressure such as papilloedema, hypertension or bradycardia.⁷⁷
73. In his deposition, Professor Young noted that losses were not accurately recorded on Claire's fluid chart so that fluid balances could not be judged. He

⁷³ Ref: 091-007-028 Tab 48

⁷⁴ Ref: 091-009-055 to 057 Tab 49

⁷⁵ Ref: 091-008-049,050 Tab 50

⁷⁶ Ref: 091-008-050 to 052 Tab 50

⁷⁷ Ref: 091-008-053 Tab 50

judged the possibility of an inaccurate laboratory result for sodium as negligibly small, provided an appropriate sample was taken.⁷⁸

74. Dr. Steen, the consultant paediatrician under whose care Claire had been admitted, stated to the Inquest that the blood test result at 2330 on 22nd October 1996 should have led to a repeat test, reduction in fluid intake and a clinical reassessment. She recalled being told that Dr. Webb had taken over her management, that she was not contacted again until 0300 on 23.10.96 and that the Glasgow coma score at 2100 should have led to a discussion with a consultant.⁷⁹
75. The Coroner accepted Dr Steen's evidence that the sodium concentration of 121 mmol/L should have been repeated and have led to fluids being reduced and a clinical reassessment. However, by then it was unlikely that her condition was survivable even if prompt action had been taken.⁸⁰
76. The Inquest verdict gave as the cause of death 1(a) Cerebral Oedema due to (b) meningoencephalitis, hyponatraemia due to excess ADH production and Status Epilepticus.

PSNI Investigation (2008)

77. Following investigations into the deaths of initially Lucy Crawford and then Adam and Raychel, the PSNI decided to investigate Claire's death. The PSNI engaged a number of experts to assist with its investigations.
78. Dr Dewi Evans, consultant paediatrician at Singleton Hospital, Swansea provided a report at the request of the PSNI on 1st March 2008, having read the report of Dr. Harding (see below). Dr Evans stated that there was nothing in the medical notes to suggest Claire had suffered a seizure prior to admission. He further stated that: I suspect my primary diagnosis [on admission] would have been an encephalopathy secondary to an unknown viral infection.
79. He drew attention to the post-mortem cerebrospinal fluid examination and compared the findings with the three peripheral blood samples reported during her admission. In Claire's blood the ratio of white to red cells varied between 1:228 and 1:696. In the CSF it was 1:75. He pointed out that conventional teaching was that a CSF sample [contaminated accidentally by blood when inserting the needle] should contain a ratio of 1:500. Thus, there was an excess of white cells over what was to be expected (predominantly lymphocytes) which would be compatible with a diagnosis of viral meningoencephalitis.

⁷⁸ Ref: 091-010-063,064 Tab 51

⁷⁹ Ref: 091-011-067, 068 Tab 52

⁸⁰ Ref: 096-013-087 Tab 53

80. Dr Evans referred to the admission serum sodium concentration of 132 mmol/L with no clinical or biochemical evidence of dehydration. It is his opinion that in the context of her having an encephalopathy, 'one needs to consider seriously the possibility of her already experiencing the syndrome of inappropriate ADH secretion.' He did not disagree with the calculated volume of fluid prescribed. He attached to his report a copy of the 1997 *Advanced Paediatric Life Support Manual* which recommended the routine use of 1/5th normal saline but that his own practice had been to use 0.45% saline because of the risk of 'waterlogging.' Nonetheless, despite the recommendation for such routine use, he considers Claire's case merited a more concentrated solution because of the reasons expressed above.
81. He is also critical of the failure to measure urinary volume or its analysis for sodium concentration and osmolality and the failure to re-measure blood electrolytes the following morning. He considers the combination of urine and blood investigation would have allowed the medical staff to adjust her fluids carefully and accurately.
82. Dr Evans notes the first record of an observed seizure was at 1525 on 22nd October 1996. Given the disturbing GCS scores, he considers this event to have reflected raised intracranial pressure due to relatively early cerebral oedema, rather than primary epilepsy or non-convulsive status. This, he states, mandated CT scanning, the result of which would have led to treatment to control any such oedema.
83. Dr. Brian Harding, Consultant Neuropathologist at Great Ormond Street provided a report to PSNI on 22nd August 2007. He reported on numerous stained sections taken from Claire's cerebral hemispheres. He found no evidence of meningitis, encephalitis, haemorrhage or stroke. He found no evidence of malformation. He summarised his findings as:
- Brain swelling (macroscopic description)
Acute hypoxic damage to nerve cells (probably terminal)
No evidence of acquired or inherited disease
84. Dr. Harding noted the Inquest verdict on cause of death and stated that he considers meningoencephalitis excluded both by microbiology and post-mortem neuropathology. He found no neuropathological sequelae of status epilepticus, so concludes that hyponatraemia was the only causative factor positively identified as the reason for brain swelling.
85. Dr Rajat Gupta, paediatric neurologist provided a report to the PSNI in October 2008, having read the report of Dr Harding. He concluded that the cause of death was cerebral oedema, itself most likely caused by hyponatraemia.⁸¹

⁸¹ Ref: 097-011-026

86. Dr Gupta considers there was no clear evidence for the diagnosis of non-convulsive status epilepticus, although it was reasonable that it was considered as a possible diagnosis during Claire's admission. 'While possible it was unlikely and would have required EEG analysis for confirmation.' He commented that there was no definite improvement in Claire's condition following the use of anticonvulsants and that the (possible?) seizures seen during her admission may 'very well have been precipitated by hyponatraemia'. In support for his opinion he states that: (i) Dr Harding saw no pathological evidence of status epilepticus; (ii) Claire had not before had any episodes of non-convulsive status and (iii) Dr Harding saw no damage to the hippocampus as might be seen in children with chronic epilepsy.
87. Dr Gupta considered it reasonable that a diagnosis of meningoencephalitis was entertained although unlikely in the absence of fever and meningism.
88. He pointed out that Claire's GCS scores were between 6 and 7 from 1400 to 2000 on 22nd October 1996 (or 6-8 by Dr Webb's calculations). Dr. Gupta stated that as a GCS <8 is generally regarded as evidence of severe brain injury, serious consideration should have been given at that time to transferring her to ICU.
89. Susan Chapman, Nurse Consultant for acute and high dependency care at Great Ormond Street provided a report to the PSNI on 11th April 2008. She considered Nurse McRandal's initial assessment and care plan acceptable as was the overnight nursing assessment and the observation chart. Claire was placed on four hourly observations of temperature, pulse, respirations and blood pressure, which were described by Nurse McRandal as 'within normal limits'. However, Ms Chapman states that the pulse rate and blood pressure were elevated,⁸² and later suggests that 'there was an overall lack of recognition of the seriousness of Claire's clinical condition'.⁸³
90. Ms Chapman also considers the neurological observation chart, the intravenous therapy and fluid charts, drug chart and record of observed attacks to be completed to an acceptable standard. In particular, she notes that it was acceptable practice in 1996 not to calculate an accurate fluid balance by recording actual output, rather than an estimate of amount and frequency. We note that the nursing care plan requires nurses to 'record accurate fluid balance chart'.⁸⁴ As Claire wore a nappy at night ⁸⁵ and possibly during the day as well whilst she was drowsy and lethargic, it may have been possible to weigh the nappies to provide a more accurate assessment of urine output. On 22nd October 1996 it would appear that the nurses had collected a urine specimen; this was

⁸² Ref: 097-014-185 Tab 55

⁸³ Ref: 097-014-190 Tab 55

⁸⁴ Ref: 090-043-146 Tab 56

⁸⁵ Ref: 090-041-143 Tab 57

sent to the lab at 1100, ⁸⁶ but the urine volume was not recorded on the fluid chart.

91. Ms Chapman notes the absence of neurological observations from admission and considers this was related to the medical staff initially regarding the problem as 'viral' and subsequently not making it explicit that Claire's condition required regular neurological observation, until requested by Dr Webb.

Requirements

92. The most pressing matter is to receive your advice on certain aspects of Claire's care in the following context:
- (1) The Inquest in to Claire's death was held in 2006 and gave as cause of death, cerebral oedema due to meningoencephalitis, hyponatraemia due to excess ADH production and status epilepticus.
 - (2) A statement from Dr. Brian Harding to the PSNI described his examination of 32 H&E stained sections, 23 immunostained sections and 4 semi-thin slides of Claire's brain. His conclusion was brain swelling and acute hypoxic damage to nerve cells (probably terminal). He found no evidence of meningitis or encephalitis, which he considered excluded both by microbiologist and post mortem neuropathology, and that the evidence suggested brain swelling was the immediate cause of death and hyponatraemia was the only causative factor identified.
 - (3) In a report for the PSNI by Dr. Dewi Evans, pointed out the apparent disparity between the in vivo blood results and the post mortem Cerebral Spinal Fluid ("CSF") result. He suggested that could be taken as evidence in favour of there having been a viral meningoencephalitis.
93. Thus, there is a clear difference of opinion between the pathologists concerned, with Dr. Dewi Evan's hypothesis perhaps providing evidence in favour of Dr Herron's analysis rather than that of Dr .Harding.
94. The Inquiry's Expert Advisors have specifically identified the following issues:
- (i) The reliability of using CSF red blood count ("RBC")/ white blood count ("WBC") ratio as a guide to meningeal inflammation?
 - (ii) Whether the answer would be different when the CSF figure depends on a post mortem sample.

⁸⁶ Ref: 090-038-135

Tab 58

- (iii) The CSF report is not dated. Does the protein level (95g/l) allow for an inference that it must have been a post mortem sample?
 - (iv) Does the fact that Claire's total WBC fell from 16,520 on admission to between 5,540 and 9350 the following day assist in interpreting the nature of her illness?.
95. You will need to consider all the Claire documents so as to carry out a thorough review of the evidence and form an opinion on the issues. However, to assist you we have attached an index of 'key documents' together with a 'core bundle' identifying and providing the documents that would appear to be of especial significance.

Conclusion

96. It is of fundamental importance that the Inquiry receives a clear and fully reasoned opinion on these nursing issues.
97. Your assistance on the Inquiry's requirements should be provided in the form of a fully referenced Expert's Report.

APPENDIX

The main events surrounding Claire's admission to the Royal on 21st October 1996 and the care she received there until her death on 23rd October 1996 are summarised in the following table:

DATE	TIME	EVENT
20.10.1996		Claire had a loose motion following contact with her cousin on Saturday 19 th October 1996 who had a stomach upset ⁸⁷
21.10.1996		Claire attended school (Torbank Special School, Dundonald) during which time her teacher reported that she had vomited at school ⁸⁸
	15.00	Claire returns from school and continues to be unwell, vomiting on 2 or 3 occasions. She also has one loose bowel movement but no symptoms of diarrhoea ⁸⁹
	18.00	Claire's GP, Dr. Savage, who had been called for advice made a home visit to examine her ⁹⁰
	19.00	Claire referred to the Royal by her GP at Castlereagh Medical Centre, Belfast: <i>Very lethargic at school today. Vomited x3. speech slurred. On examination – pale. Pupils reacting, does not like light. No neck stiffness. Tone increased. Right side plantar reflex up-going, left side plantar reflex down-going. Ear nose and throat – nothing abnormal detected. Chest clear. Further fit? Or underlying infection?⁹¹</i>
	19.15	Claire was seen in the Accident & Emergency Department of the Royal and assessed by Nurse EA Jackson: <i>History of being off form and lethargy. Seizure? Apyrexia. Pale and drowsy. Temperature 36.9, Respiratory rate 24, Heart rate 96. Seen by medical registrar admit to Allen Ward⁹²</i>
	20.00	The history taken by the Medical Registrar (?): <i>On examination – drowsy, tired, no fever, no enlarged lymph nodes. Pupils equal and reactive to light. No neck stiffness. Ears normal. Heart sounds normal with no murmurs. Pharynx – unable to examine. Abdomen soft and non-tender, no masses and bowel sounds present. Lungs – air entry good, no added sounds. Plantar reflexes down-going right and left. No apparent limb weakness. Limb tone increased. Reflexes brisker on left than right. Plan – admit. Primary diagnosis – encephalitis?</i>

⁸⁷ Ref: 090-022-050 Tab 8

⁸⁸ Ref: 089-012-035 Tab 59

⁸⁹ Ref: 089-012-035 Tab 59

⁹⁰ Ref: 089-012-035 Tab 59

⁹¹ Ref: 091-008-039 Tab 50

⁹² Ref: 091-008-039 Tab 50

DATE	TIME	EVENT
	20.45	Claire is assessed by Dr. O'Hare the Paediatric SHO on call and admitted on to Allen Ward: ⁹³ The note made includes: <i>Pres, sit-up + stares vacantly ... Tone upper limb cogwheel rigidity ... Clonus ... not responding to parents voice/intermittently responding to deep pain ... Viral illness ... afebrile ... IV fluids⁹⁴ IV diazepam ? seizure. Activity Re-assess after fluids</i>
	21.45	Claire's weight on admission to Allen Ward is recorded as 24.1kg ⁹⁵
	12.00 Mid- night	Claire is re-assessed by Dr. O'Hare the Paediatric SHO: <i>Slightly more responsive - No meningism Observe and reassess am⁹⁶</i> Further entry from Dr. O'Hare showing: <i>Sodium 132 [falling]...</i>
22.10.1996		Dr. Sands' ward round. The note made includes: ⁹⁷ <i>Wretching. No vomiting Vagueness/vacant (apparent to parents) No seizure activity observed ... U&E - Na+ 132 Apresic on IV fluids Pale colour. Little response compared to normal Pupils sluggish to light ... Diag. Non fitting status ["encephalitis/ encephalopathy"]⁹⁸ Plan. Rectal Diazepam</i>
	13.07	Result of CAT scan of Claire's brain: "There is generalised cerebral swelling with effacement of the cortical sulci as well as basal cisterns and the third ventricle. No focal lesion has been identified" ⁹⁹
	14.30	Dr. Stein noted that Claire's levels should be checked ¹⁰⁰
		Claire was seen by Dr. Webb and it is noted that she is "Still in status" ¹⁰¹
	16.00	Examination by Dr. Webb and history taken. The note made includes: ¹⁰² <i>O/E Afebrile, no meningism. Pale Rousable - eye opening to voice. Non verbal, withdraws from painful</i>

⁹³ Ref: 090-022-050 and Ref: 090-022-051 Tab 8

⁹⁴ Ref: 090-022-052 Tab 8

⁹⁵ See Ref: 090-041-142. See also Ref: 090-021-049 and Ref: 091-008-040 Tabs 60, 61 and 57

⁹⁶ Ref: 090-022-052 and Ref: 091-008-042 Tabs 8 and 50

⁹⁷ Ref: 090-022-052 Tab 8

⁹⁸ The quoted comment is written in a different hand.

⁹⁹ Ref: 090-033-114 Tab 39

¹⁰⁰ Ref: 090-022-054 Tab 8

¹⁰¹ Ref: 090-022-055 Tab 8

¹⁰² Ref: 090-022-053 and Ref: 090-022-054 Tab 8

DATE	TIME	EVENT
		<p><i>stimulous. Reduced movements Rt. Side?</i> <i>... Mildly increased tone both arms</i> <i>Reflexes symmetrically brisk</i> <i>Clonus – sustained both ankles ...</i> <i>Sits up eyes open and looks vacantly</i> <i>Not obeying commands</i> <i>Imp. I don't have a clear picture of episode+ yesterdays episodes. Her motor findings today are probably long standing but this needs to be checked with notes. The picture is of acute encephalopathy most probably restricted in nature... Suggest ...</i> <i>(ii) Hrly obs</i> <i>(iii) CT tomorrow if she doesn't wake up</i></p>
	17.00	<p>Dr. Webb noted the results of his examination of Claire:¹⁰³</p> <p><i>... She continues to be largely unresponsive. She responds by flexing her ... arm to deep sup... pain + does have facial grimace</i></p>
	23.30	<p>Dr. Stewart examined Claire and noted the results of her blood sodium as 121.¹⁰⁴ He also queried and noted: "hyponatraemia", "fluid overload & low Na fluids" and "SAIDH":</p> <p><i>Imp -?Need for ↑ Na content in fluids</i> <i>-O/[?] Reg - ↓ to 2/3 of present value - 41mls/hr</i> <i>-send urine for osmolality</i></p>
23.10.1996	03.00	<p>Registrar called to see Claire and recorded that she had been stable but had suddenly developed respiratory arrest and fixed and dilated pupils.¹⁰⁵ The note records that she was 'cheyne stoking' and required oxygen via a face mask. It also records that an attempt at intubation was unsuccessful and an "anaesthetic colleague [Dr. Clarke?¹⁰⁶] came and intubated her orally with a 6.5 tube"</p> <p>Claire transferred to PICU</p>
	04.00	<p>Dr. Steen recorded Claire's recent history as:¹⁰⁷</p> <p><i>↓ level of consciousness</i> <i>[seen by] Dr. Webb ... acute encephalopathy ...</i> <i>... Na +121 ... Fluids restricted to 2/3rd maintenance</i> <i>Obs otherwise stable</i></p>
	04.40	<p>Dr. Webb examined Claire and recorded the following in her medical notes and records:¹⁰⁸</p> <ul style="list-style-type: none"> ▪ <i>S.I.A.DH – hyponatraemia, hypoosmolarity, cerebral oedema + coning following prolonged epileptic seizures</i>

¹⁰³ Ref: 090-022-055 ALL TAB 8

¹⁰⁴ Ref: 090-022-056

¹⁰⁵ Ref: 090-022-056

¹⁰⁶ See Ref: 090-022-058. See also Ref: 090-022-057 referring to: "Reg asked to see because of resp difficulties. Cheyne-Stoke breathing – intubated + transferred to ICU. At present intubated + ventilated ... pupils fixed + dilated. Bilateral papilloedema L > R. Plan – mannitol stat – dopamine infusion – urgent CT scan". Her blood sodium level was also recorded as "Na 121".

¹⁰⁷ Ref: 090-022-057

¹⁰⁸ Ref: 090-022-057

DATE	TIME	EVENT
		<ul style="list-style-type: none"> ▪ Pupils fixed and dilated following normal duresis ▪ No eye movements → For CT scan
	05.30	Claire had her CT brain scan, the results of which were recorded by Dr. Kennedy (radiology) ¹⁰⁹ as: <i>There is severe diffuse hemispheric swelling, with complete effacement of the basal cisterns. No focal abnormality is identified</i>
	06.00	Claire's brain stem death evaluation no.1. The results were recorded by Dr. Webb ¹¹⁰ and included: <i>CT Cerebral herniation ... Claire fulfils criteria for Brain stem death The evaluation should be repeated in 4-6 hrs</i>
	07.10	Dr. McKaigue examined Claire and recorded a full history in her notes, ¹¹¹ including: <i>Initially admitted to hospital with decreased level of consciousness with the clinical picture of acute encephalopathy. Status epilepticus subsequently developed ... Serum Na also noted to be low ↓ 121 presumably on basis of SIADH</i> <i>In PICU hyper ventilated and given manitol 0.5g/kg pupils fixed and dilated ... CT scan shows severe cerebral oedema. I set of brain stem tests performed by Dr. Webb/Dr. Steen. Serum Na also checked at same time (133 – blood gas analyser PICU) ... Plan: maintain circulatory support as Claire is a potential organ donor ... Dr. Webb/Dr. Steen have discussed Claire's clinical condition with her parents. They initially appear to be giving consent for organ ... I would be concerned that ... this picture [mottling] could be explained by pulmonary aspiration or early neurogenic pulmonary oedema. Any potential transplant centre should be alerted to the possibility of pulmonary aspiration. Lab. Sample at time of brain stem tests: Na 129</i>
		Dr. Taylor noted in Claire's medical notes and records that: "Needs DDAVP to limit polyuria. Appears B.S. Dead informally ... Na+ 129 (from 121)" ¹¹²
	18.25	Diagnosis of Brain death protocol completed. ¹¹³ Dr. Steen records in Claire's medical notes and records that: "Discussed ... parents – agree that ventilation should be withdrawn. Consent for limited pm given"
	18.45	Ventilation withdrawn from Claire after discussion with her parents ¹¹⁴
		Death Certificate issued – "cerebral oedema 2 to status epilepticus"

¹⁰⁹ Ref: 090-022-058

¹¹⁰ Ref: 090-022-058 ALL TAB 8

¹¹¹ Ref: 090-022-058

¹¹² Ref: 090-022-061

¹¹³ Ref: 090-022-061

¹¹⁴ Ref: 090-006-008 TAB 42