Witness Statement Ref. No. 156/1

NAME OF CHILD: Claire Roberts

Name: Seamus McKaigue

Title: Dr

Present position and institution:

Consultant Paediatric Anaesthetist, Belfast Health and Social Care Trust

Previous position and institution:
[As at the time of the child's death]

Consultant Paediatric Anaesthetist, The Royal Group of Hospitals and Dental Hospital Health and Social Services Trust

Membership of Advisory Panels and Committees:
[Identify by date and title all of those between January 1995- November 2011]

None

Previous Statements, Depositions and Reports:
[Identify by date and title all those made in relation to the child's death]

OFFICIAL USE:
List of previous statements, depositions and reports attached:

Ref:	Date:	

IMPORTANT INSTRUCTIONS FOR ANSWERING:

Please attach additional sheets if more space is required. Please identify clearly any document to which you refer or rely upon for your answer. If the document has an Inquiry reference number, e.g. Ref: 049-001-001 which is 'Chart No.1 Old Notes', then please provide that number.

If the document does not have an Inquiry reference number, then please provide a copy of the document attached to your statement.

(1) State the date when you were first appointed as a Consultant Paediatric Anaesthetist by the Royal Group of Hospitals (Royal) and describe your experience as a Consultant Paediatric Anaesthetist in the Royal Belfast Hospital for Sick Children (RBHSC) and any other hospital in which you worked prior to 21st October 1996.

1st August 1995

RBHSC was the only hospital I worked in as a Consultant Paediatric Anaesthetist prior to 21st October 1996

There was a mixture of elective and emergency theatre cases. Patients were drawn from all the major specialities except neurosurgery and cardiac surgery and ranged in age from preterm babies to children aged up to 13. In the Paediatric Intensive Care Unit (PICU), there were patients from all specialties and ages ranging from preterm babies to children aged up to 13. Emergency resuscitation of patients. Participated in an On-Call rota for nights and weekends.

(2) Describe your work commitments to the Royal from the date of your appointment as a Consultant Paediatric Anaesthetist including the department/s and locations in which you worked and the periods of time in each department/location, and particularly over the period 21st October 1996 to 23rd October 1996.

I have always worked at least a full-time contract.

Initially on appointment:

5 sessions in Theatre per week on average RBHSC

2 sessions in PICU per week on average RBHSC

2 sessions allowed per week to cover On-Call RBHSC

1 session allowed for pre and post operative visits to see patients RBHSC

1 session allowed for audit/administration/teaching RBHSC

Each session was a nominal 3.5 hours. This was a Full-Time 11/11 contract.

Sessions were worked flexibly to ensure optimum cover when colleagues were on leave.

In 2004 the fine detail of contracts changed as a result of national negotiations between the government and the medical profession, but my work patterns did not change. My casemix remained the same.

21st October 1996

09:00 – 13:00 I cannot recall if I was in hospital

On duty Theatre 14:00 – 18:10

22nd October 1996

09:00 – 18:00 I may have been on duty in PICU but I cannot be certain

18:00 – 09:00 (23rd October) On-Call for Theatres and PICU, Home until called in

23rd October 1996

03:45 – 04:00 arrival in RBHSC and therefore on duty until approximately 08:00 – 09:00

Locations:

Possibly Allen Ward see (5)

Possibly transfer from Allen Ward to PICU see (5)

PICU see (5)

Possibly ambulance on return journey from PICU to CT scanner

Following handover to Dr Taylor in PICU at approximately 08:00 – 09:00, I do not have a clear recollection of where I was and what I was doing. The Theatre Log Book does not record me as having administered any anaesthetics. I was in the hospital at some stage of the afternoon/early evening, when I became aware that there was a plan to perform the second set of brain stem tests on Claire that evening. I cannot remember who approached me but the issue which needed to be resolved was, the tests would be performed if there was an anaesthetist available to disconnect Claire from the ventilator, should the second set of tests fulfil the requirements for brainstem death. I agreed to do this as I had knowledge of Claire's clinical condition. I disconnected Claire from the ventilator at 18:45 following completion of the brain stem tests by Dr Steen and Dr Webb.

(3) **State the times at which you were on duty between 21st October 1996 to 23rd October 1996 and in particular:-**

See (3), (5)

(a) **Whether you were present in the hospital or**

See (3), (5)

(b) **Whether you were on call during that period**

See (3), (5)

(c) **What contact you had with Claire and her family during that period including where and when that contact occurred**

Contact with Claire see (5)

I had no contact with Claire's family

(4) **Describe what you considered to be your role in relation to and responsibilities towards Claire and her family over the period from her attending A&E in RBHSC on 21st October 1996 until 23rd October 1996 when ventilatory support was withdrawn, and in particular:**

Role in relation to Claire - one of a team of doctors who provided care to her

Role in relation to parents – None

Responsibilities in relation to Claire:

To use my skills as a paediatric anaesthetist to provide additional treatment to her while she was a patient in the PICU, during transfer to and from PICU for CT scan of head either performed by Dr Clarke or myself, resuscitation in Allen Ward either performed by Dr Clarke or myself.

Responsibilities in relation to Claire's parents – None for the brief period of time I was on duty.

(a) **From Claire's attendance at A&E at RBHSC until her arrival in Allen Ward**

(b) **While Claire was in Allen Ward until her admission to PICU**

(c) **From admission to PICU until her death**

(a) no role/responsibility

(b) as an anaesthetist my role was to help in the resuscitation with responsibility for airway management which would have included oversight of Dr Clarke SpR in Anaesthetics. Also ensuring safe transfer of Clair to the PICU. I cannot be absolutely certain that I was present in Allen Ward and/or that I was present with Claire during her transfer from Allen Ward to PICU

(c)PICU

Role: one of a team of doctors who provided care to her

Responsibility:

Securing the airway

Placing Claire on a ventilator

Ensuring appropriate monitoring and advice on interpretation of vital signs: Heart rate, BloodPressure, adequacy of ventilation, urine output

Prescribing drugs to support the circulation including blood pressure, when necessary

Making/directing changes to ventilation when necessary

Establishing suitable vascular access

Prescribing iv maintenance fluids in accordance to her needs

Liaising with other members of the clinical team in the management of her care

Transfer by ambulance from RBHSC to CT scanner and back again

Performing a handover to my consultant anaesthetic colleague Dr Taylor when my period of duty had finished

(5) **Describe in detail your actions in the care, management and treatment of Claire between her attendance at A&E at RBHSC on 21st October 1996 and 23rd October 1996 when ventilatory support was withdrawn, and in particular:**

(a) **State the reasons for those actions.**

(b) **Specify which actions were carried out on the express instruction of other clinicians, identifying each clinician and describing the respective instructions given and identify where they are recorded in her notes.**

(c) **State whether you sought advice or consulted with any other clinicians prior to taking any of those actions, and if so:**

(i) Identify the clinician(s) from whom you sought advice or with whom you consulted and state when you sought advice or consulted them

(ii) Explain the nature of the advice you sought/the issues on which you consulted

(iii) Explain the advice that was given by the clinician(s)

(iv) If you did not seek any such advice or consultation, explain why not.

Immediately following receipt of a telephone call at home I drove into hospital. I cannot recall detail of the telephone conversation namely to say that a patient had sustained a respiratory arrest on Allen Ward.

(a) I drove into hospital because if the patient survived they would require admission to the PICU for ventilation and I was the Consultant Anaesthetist On-Call for PICU
(b) I do not recall who made the telephone call or all the precise detail contained therein.
(c) I did not seek advice or consult with any other clinicians prior to driving into hospital.
(i) Not applicable
(ii) Not applicable
(iii) Not applicable
(iv) This was an emergency and if advice or consultation proved to be necessary it could be done at a later time

I believe I went straight to Allen Ward when I arrived in hospital but I cannot be absolutely sure of this. I do not have any recollection of what I did in Allen Ward. I do not have any recollection of being present during the transfer of Claire from Allen Ward to the PICU

(a) If I did go straight to Allen Ward it would have been to assist with resuscitation.
(b) I do not recall being expressly instructed by another clinician to go to Allen Ward
(c) I did not seek advice or consult with any other clinician prior to going to Allen Ward
(i) Not applicable
(ii) Not applicable
(iii) Not applicable
(iv) I was responding to a medical emergency, advice or consultation could be done at a later time

In PICU:

I believe I changed the oral endotracheal tube to a nasal endotracheal tube. If I did not change the endotracheal tube then Dr Clarke must have done it with myself in attendance as his supervising consultant.
(a) A nasal endotracheal tube can be secured better to the patient and therefore less likely to become displaced or fall out.
(b) No other clinician would have expressly instructed the above
(c) I did not seek advice or consult with any other clinician
(i) Not applicable
(ii) Not applicable
(iii) Not applicable
(iv) There was no need to seek advice or consult

Mannitol 0.5 g/kg was administered.

(a) Mannitol acts as an osmotic diuretic by pulling extravascular water from the tissues back into the vascular compartment (ie blood vessels) and the water is then excreted from the body by the kidneys. In cerebral oedema there is excess water in the brain tissues and the aim was to remove some of this water from the brain in order to make the brain smaller and thereby reduce the pressure inside the skull.

(b) I cannot recall who issued the instruction and/or prescribed this drug. It could have been myself.

(c) I cannot recall, I may have consulted with Dr Steen and/or Dr Webb

(i) see (c)

(ii) see (c)

(iii) see (c)

(iv) If I issued the instruction and/or prescribed the drug it would have been on the merits as described in (a)

A peripheral infusion of dopamine was commenced to support the blood pressure. BP was approximately 95 mmHg systolic.

(a)Dopamine is normally administered via a central line, but in an emergency it can be administered via a peripheral line to support the blood pressure

(b) I cannot recall who issued the instruction and/or prescribed this drug. It could have been myself.

(c) I cannot recall, I may have consulted with Dr Steen and/or Dr Webb

(i) see (c)

(ii) see (c)

(iii) see (c)

(iv) If I issued the instruction and/or prescribed the drug it would have been on the merits as described in (a)

An arterial line was inserted into the dorsalis pedis artery on the Right foot. If I did not insert the arterial line then I would have been in attendance while Dr Clarke did it.

(a) To monitor blood pressure and to facilitate blood sampling.

(b) No other clinician would have expressly instructed the above

(c) I did not seek advice or consult with any other clinician

(i) Not applicable

(ii) Not applicable

(iii) Not applicable

(iv) There was no need to seek advice or consult

A 5 Fr 8cm triple lumen central line was inserted into the Right internal jugular vein.

(a) A central line is the preferred access route for infusion of drugs to support the circulation (eg dopamine). The line was secured by stitching to the skin of the neck. It is more secure and therefore less likely to fall out compared to a peripheral line. A central line delivers all medication into a large vein. Inotropes like dopamine and high concentration potassium solutions can cause tissue necrosis should the peripheral iv cannula through which they are running, become displaced from the superficial vein into the surrounding tissue. This disrupts the administration of the drug as well and in the case of inotropes can cause cardiovascular instability.

(b) No other clinician would have expressly instructed the above

(c) I did not seek advice or consult with any other clinician

(i) Not applicable

(ii) Not applicable

(iii) Not applicable

(iv) There was no need to seek advice or consult

I believe I accompanied Claire (but I cannot be certain of this) along with Dr Clarke Anaesthetic SpR and a nurse, in an ambulance from RBHSC to RVH where a CT scan of her head was performed and then back by ambulance to PICU. I cannot be certain Dr Clarke was present for this episode and likewise if there was a nurse present.

(a) There was no CT scanner in RBHSC. Claire was intubated and ventilated in PICU prior to commencing her journey by ambulance and this treatment would need to have been continued at all times, including while the scan itself was being performed. Should a problem develop with the endotracheal tube, for example should the tube become dislodged, or a problem develop with ventilation, then an anaesthetist would need to be immediately available to deal with these matters. For the above reasons, I can say that at least one anaesthetist would have been continuously present with Claire for the duration of the transfer.

(b) The CT scan of the head was ordered by Dr Steen.

(c) Not applicable

(i) Not applicable
(ii) Not applicable
(iii) Not applicable
(iv) Not applicable

I discussed Claire's condition with Dr Steen. I believe Dr Webb was also present but I cannot be certain. I do not recall who else was present. I do not recall what time this conversation took place, but I believe it was most likely after Claire had returned to PICU following her CT scan. By this stage it was clear to me that Claire's prognosis was extremely grave and she would most likely die. I was then endeavouring to find out would Claire's cause of death fit the criteria for a death certificate to be issued or would the Coroner have to be informed? Dr Steen gave a summary of Claire's current clinical condition. I cannot recall exactly but I believe that Dr Steen was aware that hyponatraemia could accompany meningoencephalitis and that she further commented that the treatment of hyponatraemia in such circumstances was managed by fluid restriction. The other comment I remember her making, I don't have the exact words, but it was to the effect that Claire's parents had gone through enough and that she wanted to be able to get Claire home to them. At some point I brought up the issue of Claire being a potential organ donor with Dr Steen and or Dr Webb.

(a) It is important to know when a patient dies, to consider whether the Coroner needs to be informed.
(b) There were no express instructions given to me

(c) I did not seek advice or consult with any other clinician prior to initiating the above conversation
(i) Not applicable
(ii) Not applicable
(iii) Not applicable
(iv) This would be a routine question to ask

I made a retrospective note in Claire's chart covering my involvement in her care 090-022-058, 059,060

(a) To document my input to her clinical management

(b) There were no express instructions from other clinicians to be documented in my note.

(c) My note in the chart was based on what treatment I had personally provided to Claire along with information which I had obtained from her chart and from other members of healthcare staff who were looking after her.

(i) Dr Clarke, Dr Steen, Dr Webb, Dr Kennedy (Radiologist), one or more nurses whom I cannot identify

(ii) as detailed above
(iii) as detailed above
(iv)Not applicable

I outlined a management plan 090-022-059 and 060

(a) To brief nursing and medical staff.

(b) There were no express instructions from other clinicians to be documented in my note.

(c) I did not seek advice or consult with any other clinician
(i) Not applicable
(ii) Not applicable
(iii) Not applicable
(iv) It was my responsibility as the Consultant Anaesthetist

I handed over to Dr Taylor approximately between 08:00 and 09:00

I believe I recounted Claire's reason for admission to PICU namely that she had been a patient on the ward under the care of Dr Steen and Dr Webb, being treated for encephalopathy. She was being treated for meningoencephalitis. Subsequently she developed status epilepticus and required treatment with phenytoin, valproate and a midazolam infusion. She was noted to have hyponatraemia with a sodium of 121, the previous evening. In response to this the iv fluids (No 18 solution) were restricted to 2/3 maintenance rate. Suddenly without warning she developed a respiratory arrest a few hours later. She was intubated on the ward and transferred to PICU where she was noted to be unresponsive with fixed dilated pupils. She required dopamine to maintain blood pressure. A CT scan of her head showed cerebral oedema. One set of brain stem tests had been conducted by Dr Steen and Dr Webb and there were no reflexes. I also believe that I informed Dr Taylor of my earlier conversation with Dr Steen. I also believe I would have said that Claire should be managed as a potential organ donor.

(a) To brief him on Claire

(b) There were no express instructions given to me

(c) I did not seek advice or consult with any other clinician prior to initiating the above conversation
(i) Not applicable
(ii) Not applicable
(iii) Not applicable
(iv)This was normal practice

I disconnected Claire from the ventilator at 18:45

I was in the hospital at some stage of the afternoon/early evening, when I became aware that there was a plan to perform the second set of brain stem tests on Claire that evening. I cannot remember who approached me but the issue which needed to be resolved was, the tests would be performed if there was an anaesthetist available to disconnect Claire from the ventilator, should the second set of tests fulfil the requirements for brainstem death. I agreed to do this as I had knowledge of Claire's clinical condition. After inspecting the findings of the brain stem death tests Ref: 090-045-148 which had been performed by Dr

Steen and Dr Webb and making note of Dr Steen's record in the chart Ref: 090-022-061, I disconnected Claire from the ventilator at 18:45.

(a)Claire was clinically brain stem dead

(b) There were no express instructions given to me

(c) I did not seek advice but I may have consulted with Dr Steen and /or Dr Webb around the time I disconnected Claire from the ventilator.

(i) I may have consulted with Dr Steen and/or Dr Webb, I cannot recall the time
(ii) I was not seeking advice, I cannot recall detail of what I may or may not have consulted with them about
(iii) I cannot recall if advice was given or not
(iv)Not applicable

(6) In regard to Claire's medical notes and records, identify precisely the entries that you made or which were made on your direction and state below:

090-022-058, 090-022-059, 090-022-060, 090-022-061

(a) **When each of the identified entries was made**

090-022-058 at 07:10 on 23rd October 1996

090-022-059 at 07:10 on 23rd October 1996

090-022-060 at 07:10 and 08:00 on 23rd October 1996

090-022-061 at 18:45 on 23rd October 1996 (note the year recorded on the actual entry is wrong)

(b) **The source of the information recorded in the entry**

090-022-058 Handover from Dr Clarke, Dr Steen,

090-022-059 Dr Steen, Dr Webb, Dr McKaigue

090-022-060 Dr McKaigue with the exception of the text below which was provided by a nurse whom I cannot recall.

'Dr Webb/Dr Steen have discussed Claire's clinical condition with her parents. They initially appear to be giving consent for organ donation but Dr Webb will speak again to both parents at approx 10:00'

(7) State whether a PICU fluid balance and IV prescription sheet was completed in respect of Claire Roberts on 23rd October 1996.

(a) **If so, identify and furnish a copy of it. If you are unable to do so, explain why.**

(b) **If this PICU document was not completed on 23rd October 1996 explain why.**

I have no recollection of personally completing a PICU fluid balance and IV prescription sheet. I would expect that the fluid balance sheet and IV prescription sheet would have been completed usually by the resident on-call paediatrician for PICU.

(a) I am unable to identify and furnish a copy of it because it is not in the patient notes

(b) I have made the assumption that it was completed on 23rd October 1996

(8) **Identify the consultant whom you believed to be responsible for Claire and her management, care and treatment between her admission on 21st October 1996 and her death on 23rd October 1996, and explain the basis for this belief.**

I believe there were 4 consultants responsible for management, treatment and care.

Claire was admitted into hospital under the care of Dr Steen Consultant Paediatrician (Ref: 090-014-020; 090-022-057).

Dr Webb Consultant Paediatric Neurologist provided neurology advice (Ref: 090-022-053).

Dr McKaigue Consultant Paediatric Anaesthetist provided Intensive Care support (Ref: 090-022-058)

Dr Taylor Consultant Paediatric Anaesthetist provided Intensive Care support (Ref: 090-022-061)

(a) **In particular, identify the consultant who was responsible for the care and management of Claire immediately prior to her admission to PICU and explain the reasons for your answer.**

Dr Steen. This is the consultant paediatrician who I believe was on-call on the night of 22/10/96 / 23/10/96 (Ref:090-022-057).

(9) **State at what time you were first contacted in relation to Claire on 23rd October 1996, by whom, for what reason you were contacted, what you were told about Claire at that time and what you did as a result of that contact.**

(a) **Describe any advice or instructions which you gave in relation to Claire when you were first contacted.**

(b) **State at what time and where you first attended Claire on 23rd October 1996. In particular, state whether you were present in PICU when Claire was transferred there from Allen Ward.**

I was first contacted about Claire by telephone at home at approximately 03:30. I cannot recall detail of the telephone conversation namely to say that a patient had sustained a respiratory arrest on Allen Ward. I do not remember who I spoke to on the telephone. I would have been contacted to assist with resuscitation and if necessary carry on further treatment in the PICU. Following the telephone call I immediately drove into the hospital.

(a) I cannot recall what if any advice or instructions I gave
(b) Based on the above I believe I would have arrived in the hospital at approximately 03:45 – 04:00. I believe I went straight to Allen Ward when I arrived in hospital but I cannot be absolutely sure of this. I do not have any recollection of what I did in Allen Ward. I do not have any recollection of being present during the transfer of Claire from Allen Ward to the PICU. I was present in PICU either at the time Claire would have arrived or else a few minutes shortly after she arrived.

(10) State whether you were on duty/call in PICU when Claire was transferred from Allen Ward to PICU on 23rd October 1996.

I was on call when Claire was transferred from Allen Ward to PICU, but I cannot say with certainty what location I was in. My understanding of 'on duty' is that an individual is physically present in the hospital. Therefore based on my previous evidence in questions 5 & 9, I cannot say with absolute certainty if I was physically on duty in the hospital when Claire arrived in PICU.

(a) **Identify all nurses and other clinicians by name and position who were involved in this transfer.**

I have no recollection of the transfer. All I can say is that Dr Clarke (SpR Anaesthetics) and or myself would have accompanied Claire from Allen Ward to PICU.

(b) **Describe the nature of your involvement and the involvement of the other clinicians and nurses in that transfer to PICU.**

Although I cannot recollect details of the transfer Claire would have been intubated and would have been hand-ventilated by an anaesthetist during the transfer from Allen Ward to PICU. Should a problem develop with the endotracheal tube, for example should the tube become dislodged, or a problem develop with ventilation, then an anaesthetist would need to be immediately available to deal with these matters. The anaesthetist also monitors the vital signs of the patient and would be prepared to administer resuscitation should the need arise. If I was present this would have been my involvement. Dr Clarke if he was present would also have had a similar role. I do not recall if a nurse or any other clinician was present. It would be normal for a nurse to accompany a child like Claire, to be of assistance as required and also to hand over to the next nurse.

(c) **Identify the consultant/s and any other clinicians who accompanied Claire when she was transferred from Allen Ward to PICU.**

See (b)

(d) **Identify any nurses who accompanied Claire when she was transferred from Allen Ward to PICU.**

See (b)

(e) **Identify the consultant or other clinician in PICU to whom Claire's care was transferred on admission to PICU on 23rd October 1996.**

When Claire was admitted to the PICU, if I had previously made a contribution to her care which I believe I did, then it became my responsibility to continue making a contribution to her care. If I had not previously been involved in her care, then on admission to PICU, it became my responsibility to make a contribution to her care. Therefore on admission to PICU, Dr Steen and Dr Webb continued to provide ongoing care to Claire in addition to my contribution. I cannot identify the resident on-call paediatrician in PICU.

(f) **Identify the designated PICU nurse and any other PICU nurse/runner to whom Claire's care was transferred on admission to PICU on 23rd October 1996.**

I cannot identify the nurse(s)

(g) **State at what time Claire's handover to PICU clinicians took place on 23rd October 1996 and identify who was present during that handover.**

I have no recollection of the handover of Claire in PICU. I believe that Claire's handover in PICU took place over a period of time and was a process rather than an event, when Dr Steen and Dr Webb were both present. I believe that Dr Clarke would also have been present, but I cannot be sure about this. I cannot be certain if the resident on-call paediatrician was present for all of the handover or if there were any other doctors present.

(h) **Identify who carried out the handover to the PICU clinician(s) on Claire's arrival in PICU on 23rd October 1996, and state what information was given to the PICU clinician(s), or if you do not recall specifically, what information was likely to have been given during that handover, about:**

I have no recollection of the handover. At some stage Dr Clarke, I cannot be sure of when this occurred, handed over to me an account of the care he provided to Claire in Allen Ward. There also may have been other doctors who handed over information to me about Claire but I cannot be sure of this.

(i) Claire

I believe Dr Steen handed over information and while I cannot specifically remember the episode, it would likely have covered her history of being a child with learning difficulties, presenting to hospital with a decreased level of consciousness.

(ii) The reason for Claire' s transfer to PICU

I had already acquired this knowledge namely a respiratory arrest. Dr Steen and and/or Dr Webb would probably have mentioned this.

(iii) Claire's diagnoses since her admission to RBHSC and on transfer to PICU

I cannot recall, but a viral illness would likely be mentioned as well as, seizures and meningoencephalitis

(iv) The cause of Claire's respiratory arrest and fixed and dilated pupils

I cannot recall, but coning of the brainstem due to cerebral oedema would likely be mentioned.

(v) Claire's serum sodium concentration since her admission and in particular, the serum sodium concentration of 121mmol/L recorded at 23.30 in Claire's medical notes on 22nd October 1996 (Ref: 090-022-056), and the cause of these sodium concentration levels

I cannot recall, but a sodium concentration of 121mmol/l would likely have been given. The cause for this result would likely have been given as SIADH.

(vi) The cause of Claire's cerebral oedema

I cannot recall, there may have been more than one cause. It is likely that some or all of the following would have been mentioned: hyponatraemia, meningoencephalitis and seizures.

(vii) The likelihood that Claire had SIADH and the possible causes

I cannot recall, but it is likely that it was mentioned that Claire had SIADH due to meningoencephalitis and/or seizures

(viii) Claire's fluid input and output since her admission

I cannot recall

(ix) Claire's presentation, attacks and central nervous observations since her admission

I cannot recall, but it is likely that her presentation, seizures and central nervous observations would have been a part of the handover.

(i) State at what time Claire's handover to PICU nurses took place on 23rd October 1996 and identify who was present during that handover.

I have no knowledge on these matters.

(j) Identify who carried out the handover to the PICU nurse(s) on Claire's arrival in PICU on 23rd October 1996, and state what information was given to the PICU nurse(s), or if you do not recall specifically what information was likely/normally given during that handover, about:

I have no knowledge of the handover

(i) Claire

(ii) the reason for Claire' s transfer to PICU

(iii) **Claire's diagnoses since her admission to RBHSC and on transfer to PICU**

(iv) **the cause of Claire's respiratory arrest and fixed and dilated pupils**

(v) **Claire's serum sodium concentration since her admission, and in particular, the serum sodium concentration of 121mmol/L recorded at 23.30 in Claire's medical notes on 22nd October 1996 (Ref: 090-022-056), and the cause of these sodium concentration levels**

(vi) **the cause of Claire's cerebral oedema**

(vii) **the likelihood that Claire had SIADH and the possible causes**

(viii) **Claire's fluid input and output since her admission**

(ix) **Claire's presentation, attacks and central nervous observations since her admission**

(11) **Identify the clinician who 'handed over' Claire's management, treatment and care to you, the time at which that happened and where it is recorded in her notes.**

Dr Clarke Anaesthetic SpR who was called to assist in the resuscitation of Claire, would have 'handed over' his management, treatment and care of Claire to me, when I first met up with him, I believe this was in Allen Ward, but I cannot be sure of this, it could have been in the PICU. I was his supervising Consultant Anaesthetist that night and would have taken over any responsibilities he had, once I had met him and/or Claire. The time this happened I cannot be certain, but I believe it would have been approximately around 03:45 – 04:00. My reference to this is contained in Ref: 090-022-058. No other clinician 'handed over' their management, treatment and care of Claire to me.

(a) **State what information you were given by that clinician about Claire's condition, care and treatment and plan of care.**

Dr Clarke told me that he took over airway management of Claire from staff on the ward who had been hand-bagging Claire following a respiratory arrest. I cannot recall if he commented any further about her condition. He passed an oral endotracheal tube and continued ventilation. He observed vomitus in the oropharynx at the time of intubation – liquid material, no solid material. Following intubation he sucked out the trachea and a small amount of watery material was aspirated. I believe he did not comment on Claire's care or plan of care, but I cannot be sure about this.

(b) **Identify any protocol, guidance or practice relating to such a 'handover'.**

I am not aware of any protocol, guidance or practice relating to such a 'handover'

(12) *"22.10.96 05.30 CT [computerised tomography]Scan...*

There is severe diffuse hemispheric swelling, with complete effacement of the basal cisterns. No focal abnormality is identified...." **(Ref: 090-022-058)**

"CAT [Computerised Axial Tomography] Scan of Brain 23-OCT-96 13:07

There is generalised cerebral swelling with effacement of the cortical sulci as well as the basal cisterns and the third ventricle. No focal lesion has been identified." **(Ref: 090-033-114)**

(a) **State at what time the first CT/CAT scan of Claire was carried out.**

Shortly (ie a few minutes) before 05:30 on 23/10/96

(b) **Identify the report arising from that CT/CAT scan. If that report is shown at Ref: 090-033-114, explain why the report records the scan as occurring at 13.07.**

Ref: 090-022-058

(c) **State whether a second CT/CAT scan was carried out on 23rd October 1996, and if so, explain the reasons why and state at what time that happened.**

I have no knowledge of a second CT/CAT scan being carried out on Claire on 23rd October 1996.

(d) **Identify the report arising from that later scan.**

I have no knowledge of a second CT/CAT scan being carried out on Claire on 23rd October 1996.

(13) *"23/10/96 07.10 ... 9 yr old girl admitted to PICU from Allen Ward. Suffered a respiratory arrest. Was initially bagged and intubation performed by Dr. Clarke (SPR) Anaes on the ward. At the time of the intubation vomiting was noted in oropharynx - liquid material. No solid material. Folturim intubation, trachea was sucked out and a small amount of watery material was aspirated. Oral ET tube then changed to normal ET tube in PICU."* **(Ref: 090-022-058 and 059)**

To clarify the above I wrote 'vomitus' and not 'vomiting'; I wrote 'following' and not 'Folturim'; I wrote 'nasal' and not 'normal'.

(a) **On Claire's admission to PICU, identify any person, other than Dr. Steen, Dr. Webb and/or the Consultant she was under immediately prior to her transfer to PICU, who briefed you on Claire, her treatment, care and management, and state when you were given this information and where it is recorded in her notes.**

Dr Clarke

I cannot be sure it may have been on Allen Ward or PICU

Reference to the discussion is made in the notes at 090-022-058 and 059

I have no recollection of any other person

(b) **State from whom you received the information regarding Claire's intubation, including what you discussed, and where and when you discussed same.**

See (a)

(c) **Identify the person/s who contacted Dr. Steen at approximately 03.00 on 23rd October 1996, their position, and the reasons why they contacted Dr. Steen in relation to Claire.**

I have no knowledge of this

(14) ***"Initially admitted to hospital with decreased level of consciousness with the clinical picture of acute encephalopathy. Status epilepticus subsequently developed requiring phenytoin, valproate and midazolam."*** **(Ref: 090-022-059)**

(a) **Identify the source(s) of this information.**

During the handover (10) (h) (i) and with reference to one or more of the following:

Dr Steen makes reference to a decreased level of consciousness Ref: 090-022-057

Dr Steen makes reference to 'S B Dr Webb diagnosis acute encephalopathy ? aetiology' Ref: 090-022-057

I cannot identify the author but reference is made to Claire being 'drowsy' 090-022-050

In the ward round clinical note, reference is made to 'Little response compared to normal' 090-022-053

In Dr Webb's note reference is made to 'The picture is of acute encephalopathy' 090-022-054

Phenytoin Ref: 090-022-054

Valproate Ref: 090-022-055

Midazolam Ref: 090-022 -055

(b) **In particular, identify the source of the information that *"[s]tatus epilepticus subsequently developed"* and state the date and time at which you understood that *"[s]tatus epilepticus subsequently developed".***

I cannot remember the source, I can only state that my understanding that Claire had subsequently developed status epilepticus, was based on my recollection of the handover at the time, see 10 (h) (ix) and also with reference to one or more of the following:

I cannot identify the author but reference is made to'? Seizure activity' Ref: 090-022-052

In the ward round clinical note, reference is made to 'non-fitting status' Ref: 090-022-053

I cannot identify the author but reference is made to 'S/B Dr Webb Still in status' Ref: 090-022-055

Dr Webb in his note makes reference to 'prolonged epileptic seizures' Ref: 090-022-057

I came to understand that 'status epilepticus subsequently developed' on 22nd October, with the time of onset approximately around the time of the first ward round and Dr Webb first seeing Claire.

(15) ***"serum Na also noted to be low ↓121 presumably on basis of SIADH."*** **(Ref: 090-022-059)**

(a) **Identify the printed laboratory biochemistry reports for each of the serum sodium concentration results of 121 mmol/L recorded in Claire's medical notes (Ref: 090-022-056, 090-022-057), and furnish a copy of it. If the laboratory reports are missing, explain the reasons why.**

I cannot identify the said printed reports. I cannot furnish copies of them. I have no explanation to offer why they are missing.

(b) **Describe any information you were given that Claire's low serum sodium concentration was caused by SIADH, identify who gave it to you, when that happened and state where it is recorded in her notes.**

I cannot recall an individual telling me.

(c) **Explain the basis for your diagnosis of SIADH, what you believed triggered the SIADH and explain the reasons why.**

I did not make the diagnosis of SIADH

(d) **Explain the reasons why you presumed that Claire's *"serum Na also noted to be low ↓ 121 ... on basis of SIADH".***

Dr Webb made reference to SIADH in his note Ref: 090-022-057

(e) **Explain what, other than SIADH, could have caused Claire's *"serum Na ... to be low ↓ 121"* at 23.30 on 22nd October 1996 and in the early hours of 23rd October 1996, and state whether you considered these alternatives. If so, state when and what was the outcome of your consideration. If you did not consider them, explain why not.**

An increase in water intake or loss of sodium. I believe I did consider these. Claire did not receive large amounts of No 18 solution. Vomiting was documented as being present, but was difficult to interpret the amount. When writing my note at 07:10 Ref: 090-022-058 I believed that SIADH had caused the low sodium.

(f) **Explain your knowledge of hyponatraemia including dilutional hyponatraemia as at 23rd October 1996.**

Hyponatraemia is a serum sodium level less than 135 mmol/l

Dilutional hyponatraemia will occur when there is an increase in water or a decrease in sodium

Dilutional hyponatraemia can be caused by SIADH and can also occur during or after some surgical procedures on the prostate gland see (35) (b)

SIADH is one of the non-metastatic effects of carcinoma

(g) **Describe your knowledge at that time of Claire's fluid management between her admission on 21st October 1996 and her admission to PICU on 23rd October 1996, and state whether you considered Claire's fluid management for that period in:**

Claire was receiving iv No18 solution for maintenance fluid

(i) assessing her condition

No

(ii) reaching your diagnosis of SIADH and

I did not make the diagnosis of SIADH

(iii) managing Claire's fluids in PICU

No I did not consider Claire's previous fluid management in deciding my fluid management. In PICU I made the decisions on fluid management based on my understanding of the pathophysiological processes affecting Claire's brain and the electrolyte results.

If so, explain how and what effect that had on Claire's care. If not, explain why not.

Claire was admitted to PICU following a respiratory arrest. There was hyponatraemia. Treatment for cerebral oedema was instituted by administering mannitol 0.5 g/kg. Mannitol acts as an osmotic diuretic by pulling extravascular water from the tissues back into the vascular compartment (ie blood vessels) and the water is then excreted from the body by the kidneys. In cerebral oedema there is excess water in the brain tissues and the aim was to remove some of this water from the brain in order to make the brain smaller and thereby reduce the pressure inside the skull. As a consequence of this osmotic diuresis the serum sodium will increase. By 06:00 the serum sodium was 133 mmol/l (blood gas analyser) at the time the first set of brain stem death tests were done Ref: 090-022-059. I was also taking into account the possibility that neurogenic diabetes insipidus could occur, secondary to the cerebral oedema which could further increase the serum sodium. I made indirect reference to this in my comment on management should serum sodium increase to greater than 150 mmol/l Ref: 090-022-060. On receipt of the lab sample serum sodium of 129 mmol/l result, I gave instructions for maintenance iv fluids to change to 0.9% saline at 08:00 Ref: 090-022-060 to allow for the possibility that the serum sodium may not increase just as much as I had thought initially.

(16) ***"In PICU hyperventilated and given mannitol 0.5g/kg. pupils fixed and dilated. BP ~ 95 systolic. Peripheral dopamine infusion commenced. arterial line R dorsalis pedis and R int. jug triple 5/8"*** **(Ref: 090-022-059)**

(a) **State the cause of Claire's *"pupils [being] fixed and dilated"* and explain the reasons for your answer.**

Raised intracranial pressure caused by cerebral oedema. The rise in intracranial pressure is transmitted to the 3rd cranial nerve inside the skull. Shining a light into the eye will normally cause the pupil to constrict if the 3rd cranial nerve is working. If the 3rd cranial nerve is not working the pupil will naturally tend to dilate and will not constrict in response to light.

(b) **Explain the significance of Claire's *"pupils [being] fixed and dilated"*.**

To stop the 3rd cranial nerve from working, the increase in intracranial pressure must be significant and the implication is that other parts of the brain will be damaged due to a similar mechanism.

(17) ***"[T]hen transferred for CT scan. Transfer uneventful."*** **(Ref: 090-022-059)**

(a) **State where the CT scan was carried out and how Claire was transferred to the venue for the CT scan.**

The CT scan was carried out in the Royal Victoria Hospital. Claire was transferred by ambulance.

(18) ***"CT scan shows severe cerebral oedema. 1 set of brain stem tests performed by Dr Webb / Dr Steen. serum Na also checked at same time. (133 - blood gas analyser PICU. No resp. effort with ABGS: pH 7.13 pO_2 124.5 pCO_2 79.2.***

Plan: maintain circulatory support as Claire is a potential organ donor -dopamine infusion to maintain SBP - 100mmHg - close check on serum Na and serum osmolality and urine output. If serum Na>150 and osmolality > 300 then commence desmopressin -will need conc. K infusion ...

Lab sample at time of brain stem tests..." **(Ref: 090-022-059, 090-022-060)**

(a) **State the time at which a blood sample was also sent to the laboratory for analysis of Claire's serum sodium concentration and osmolality.**

I have no knowledge of this

(b) **State how accurate you regarded the blood gas analyser serum sodium result of 133 mmol/L to be**

(i) generally and

good

(ii) compared to laboratory analysis,

my answer to (i) is based on a comparison with laboratory analysis

and explain why.

I have no specialist technical knowledge on these matters

(c) **Describe the action taken to maintain a *"close check on serum Na and serum osmolality and urine output"*, and state how often Claire's serum sodium concentration was being checked at that time.**

I cannot describe the action taken.

At 08:00 on 23rd October I asked for serum sodium (U + E) to be checked every 2 hours Ref: 090-022-060

(d) **Explain:**

(i) the cause of *"pCO2 79.2."*

Claire not breathing

(ii) the significance of *"pCO2 79.2"*

As part of the protocol for brain stem death testing the pCO2 must rise above 50 mmHg

(iii) the normal range of *"pCO2"* for a 9 year old girl.

35 - 45 mmHg

(e) **Explain:**

(i) the cause of *"pH 7.13"*

Respiratory acidosis due to an increase in pCO2

(ii) the significance of *"pH 7.13"*

The patient is acidotic and is therefore a stimulus to breathe.

(iii) the normal range of *"pH 7.13"* for a 9 year old girl.

pH 7.35 – 7.45

(19) ***"Maintainence [sic] fluids with Dextrose 4%/Saline 0.18%."*** **(Ref: 090-022-060)**

(a) **Explain your choice of *"Dextrose 4%/Saline 0.18%"* as *"Maintainence [sic] fluids"* at this time.**

I wanted to limit the increase in serum sodium. See (15) (g) (iii)

(20) ***"ventilate to pCO2 35"*** **(Ref: 090-022-060)**

(a) **Explain the purpose of and the reason for planning to *"ventilate to pCO2 35".***

An increase in pCO2 will increase cerebral blood flow. An increase in cerebral blood flow will increase cerebral blood volume. An increase in cerebral blood volume will increase intracranial pressure. An increase in intracranial pressure will decrease cerebral perfusion pressure. A decrease in cerebral perfusion pressure will increase brain ischaemia and make the underlying injury worse.

Maintaining the pCO2 within a normal range will optimise cerebral blood flow.

(b) **State whether elective ventilation of Claire to keep the partial pressure of carbon dioxide to a reduced level could and ought to have been considered on 22nd October 1996 or in the early hours of 23rd October 1996. If so, explain the reasons why and state when this ought to have been considered and by whom. If not, explain why not.**

There was no knowledge that Claire had life-threatening cerebral oedema for this to be considered. However if there had been knowledge of life threatening cerebral oedema, elective ventilation of Claire to keep the partial pressure of carbon dioxide to a reduced level, could and ought to have been considered earlier. See (a).

(21) *"Dr Webb/Dr Steen have discussed Claire's clinical condition with her parents. They initially appear to be giving consent for organ donation but Dr Webb will speak again to both parents at ~10.00."* **(Ref: 090-022-060)**

(a) **State the basis for your knowledge that *"Dr Webb/Dr Steen have discussed Claire's condition with her parents."***

I cannot recall details but I believe a nurse told me that Dr Webb and Dr Steen had discussed Claire's condition with her parents

(b) **State what was discussed with Claire's parents regarding Claire's condition.**

I have no knowledge of what was discussed

(c) **State if you were present at the discussion with Claire's parents. If you were not present, identify who told you what was discussed.**

I was not present at the discussion with Claire's parents. I cannot recall any discussion about what was discussed with Claire's parents.

(d) **Explain if organ donation is appropriate in cases where the cause of death is not certain.**

Yes. The death is referred to the Coroner because the cause of death is not certain. The Coroner would be advised that the family have expressed a wish that the deceased's organs be donated for transplantation. The Coroner may or may not at his discretion ultimately allow some or all of the organs to be donated.

(22) *"check CXR shows central line and ET tube are in good position. There is some mottling of both [illegible] regions more so on the R side. There has been a deterioration in ABGs pO2 76 on FiO2 0.6. I would be concerned that ...this picture could be explained by pulmonary aspiration or early*

neurogenic pulmonary oedema. Any potential transplant centre should be alerted to possibility of pulmonary aspiration." (Ref: 090-022-060)

With respect to the above the illegible word is 'hilar'

(a) **State whether a chest x-ray "*CXR*" was taken of Claire, and if so, state at what time and location.**

I cannot recall what time the CXR was taken, but I note that there is a time given on the x-ray report of 07:15. I believe the x-ray was taken in PICU.

(b) **State whether the report at Ref: 090-033-115 is the report of a chest x-ray of Claire, and if so, explain the findings of that report.**

The report at Ref: 090-033-115 is the report of 2 chest x-rays of Claire which are being compared.

'Patchy consolidation' is a descriptive term used to communicate that the normal air filled spaces of the lung now contain more solid material than normal. In Claire's case this could be due to infection, which being an inflammatory response is associated with the presence of increased water and cellular material where it should not normally be. Another possible reason is that soiling of the lung has occurred with the liquid material that was noted to be present in the oropharynx at the time of intubation on Allen Ward. Ref: 090-022-058. The two possibilities are not mutally exclusive.

'Mid and upper zones' The lung can be divided into 3 zones from the top downwards: upper, mid and lower zones.

'ETT' is an abbreviation for endotracheal tube

'tip at the thoracic inlet' identifies what part of the trachea the end of the endotracheal tube is at

'an iv line is present with the tip in the SVC' an intravenous line is present with the end of the catheter in the superior vena cava. This report confirms the position of '[R] int jug triple 5/8' Ref: 090-022-059 and refers to insertion of a 5Fr gauge (width), 8 cm in length, triple lumen (3 channels) central line into the Right internal jugular vein.

(23) *"Serum Na also checked at same time. (133 – blood gas analyser PICU. [...]*

Lab sample at time of brain stem tests

Na 129 K3.6 Cl 94 Urea 3.7

Glucose 7.2 Osmolality 274 (Ref: 090-022-059 and 060)

(a) **Identify the printed laboratory biochemistry report recording the serum sodium result of 129 and/or furnish a copy of it. If this laboratory report is missing, explain why.**

I cannot identify the said printed report. I cannot furnish a copy of it. I have no explanation to offer why it is missing.

(b) **Explain the reasons for the difference between the laboratory Na result of 129mmol/L and the blood gas machine result of 133mmol/L.**

The differences I believe are not significant.

(24) *"0800 check 2hrly U+Es. Change maintainence fluids to 0.91 saline"* (Ref: 090-022-060)

To clarify the above '0.9l' should read '0.9%'

(a) **Explain your choice of *"0.91 saline"* as *"maintainence [sic] fluids"* at 08:00.**

On receipt of the lab sample serum sodium of 129 mmol/l result, I gave instructions for maintenance iv fluids to change to 0.9% saline at 08:00 Ref: 090-022-060 to allow for the possibility that the serum sodium may not increase just as much as I had thought initially. See 15 (g) (iii)

(b) **State the nature and time of the changes to Claire's IV infusion fluid during her time in PICU on 23rd October 1996 and the reasons for each of those changes.**

The iv fluid prescription sheet is not in the notes See (7).

(25) **In relation to the laboratory biochemistry results at Ref: 090-031-100, state:**

(a) **At what time the blood sample was taken from Claire on 23rd October 1996 which gave rise to this result.**

I do not know

(b) **At what time was this biochemistry result received in PICU on 23rd October 1996.**

I have no knowledge of this

(c) **Identify in Claire's medical notes where this result is recorded, and if it is not recorded, state the reasons why.**

I have not been able to identify where the result is recorded in Claire's medical notes. I have no explanation for this.

(26) **In relation to the laboratory biochemistry results at Ref: 090-031-102, state:**

(a) **At what time the blood sample was taken from Claire on 23rd October 1996 which gave rise to this result.**

I do not know

(b) **At what time was this biochemistry result received in PICU on 24th October 1996.**

I have no knowledge of this

(c) **Identify in Claire's medical notes where this result is recorded, and if it is not recorded, state the reasons why.**

I have not been able to identify where the result is recorded in Claire's medical notes. I have no explanation for this.

(27) Describe all communication you had with the consultant responsible for Claire following her admission to PICU, including the time of each communication, the means by which communication was made, the nature of each communication and whether any advice or direction was given by that consultant in relation to Claire's treatment and care, and if so the nature of that advice or direction.

There was more than one consultant responsible for Claire.

(a) *Dr Steen*

(10) (g), (10) (h), (5), Ref: 090-022-057, 090-022-058, 090-022-059, 090-022-060, 090-022-061, 090-045-148

(b) *Dr Webb*

(10) (g), (10) (h), (5), 090-022-057, 090-022-058, 090-022-059, 090-022-060, 090-045-148

(c) *Dr Taylor*

(5), 090-022-058, 090-022-059, 090-022-060

(28) State what communication you had with Dr. Heather Steen in relation to Claire from 03.00 on 23rd October 1996 onwards including:

(a) **The date and time each communication was made, and the means by which communication was made e.g. in writing, telephone, in person etc.**

(i) *Handover in person 23rd October 1996, (10) (g), (10) (h), (5)*

(ii) *Handover in writing 23rd October 1996 Ref: 090-022-057*

(iii) *Review of Claire's clinical condition in person 23rd October 1996, (5)*

(iv) *Retrospective note in writing 23rd October 1996 Ref: 090-022-058, 059,060*

(v) *Disconnection from ventilator in person 23rd October 1996, (5)*

(vi) *Disconnection from ventilator in writing 23rd October 1996, 090-022-061, 090-045-148*

(vii) *I cannot recall detail or date or time but there was one verbal communication following Claire's death. Dr Steen commented on the neuropathology report*

(viii) *I believe Dr Steen presented Claire's death at the Audit meeting in RBHSC (44) (a)*

(ix) *I cannot recall any other communications*

(b) **Identify who initiated each communication and the reason for each communication being made**

(i) *I believe Dr Steen. Handover*

(ii) *Dr Steen. To communicate her thoughts and document a management plan*

(iii) *As part of a review of Claire's clinical condition I initiated the communication to find out if there was an intention to refer case to Coroner or if a death certificate could be issued. Also to highlight that Claire may be a potential organ donor.*

(iv) *Dr McKaigue. My input into her clinical management and to outline a management plan.*

(v) *I cannot recall.*

(vi) *Dr Steen. Document clinical findings and management plan*

(vii) *Dr Steen. Update with new information*

(viii) *Dr Steen. Present case at Audit meeting*

(c) **State what information you gave Dr. Heather Steen about Claire during each communication**

(i) *I cannot recall*

(ii) *None*

(iii) *Result of CT scan of head. Claire is a potential organ donor*

(iv) *See (28) (a) (iv)*

(v) *I cannot recall*

(vi) *None*

(vii) *I cannot recall*

(viii) *I cannot recall*

(d) **State what advice or instructions Dr. Heather Steen gave you in relation to Claire on each occasion and what the plan of care was for Claire following each communication**

(i) *See (5)*

(ii) *See (28) (a) (ii)*

(iii) *See Ref: 090-022-060*

(iv) *None*

(v) *I cannot recall*

(vi) *Ref: 090-022-061*

(vii) *I cannot recall*

(viii) *I cannot recall*

Identify any document where each communication is recorded and produce a copy thereof

Each document I have referred to is on the Inquiry website

(e) **If no communication was made, explain why not**

(29) State what communication you had with Dr. David Webb in relation to Claire between 21st October 1996 and her death including:

(a) **The date and time each communication was made, and the means by which communication was made e.g. in writing, telephone, in person etc.**

(i) *Handover in person 23rd October 1996, (10) (g), (10) (h), (5)*

(ii) *Handover in writing 23rd October 1996 090-022-057*

(iii) *Review of Claire's clinical condition in person 23rd October 1996 (5)*

(iv) *Brain stem death testing 23rd October 1996 Ref: 090-022-058*

(v) *Retrospective note in writing 23rd October 1996 Ref: 090-022-058, 059,060*

(vi) *Disconnection from ventilator in person 23rd October 1996, (5)*

(vii) *Disconnection from ventilator in writing 23rd October 1996 Ref: 090-045-148*

(viii) *I cannot recall any other communications.*

(b) **Identify who initiated each communication and the reason for each communication being made**

(i) *I believe Dr Webb. Handover*

(ii) *Dr Webb. To communicate his thoughts and document a management plan.*

(iii) *As part of a review of Claire's clinical condition I initiated the communication to find out if there was an intention to refer case to Coroner or if a death certificate could be issued. Also to highlight that Claire may be a potential organ donor.*

(iv) *Dr Webb. Document clinical findings and management plan*

(v) *Dr McKaigue. My input into her clinical management and to outline a management plan.*

(vi) *I cannot recall.*

(vii) *Dr Webb. Document clinical findings.*

(c) **State what information you gave Dr. David Webb about Claire during each communication**

(i) *I cannot recall*

(ii) *None*

(iii) *Result of CT scan of head. Claire is a potential organ donor*

(iv) *None*

(v) *See (29) (a) (v)*

(vi) *I cannot recall*

(vii) *None*

(d) **State what advice or instructions Dr. David Webb gave you in relation to Claire on each occasion and what the plan of care was for Claire following each communication**

(i) See (5)

(ii) See (29) (a) (ii)

(iii) *I cannot recall*

(iv) *See (29) (a) (iv)*

(v) *None*

(vi) *I cannot recall*

(vii) *See (29) (a) (vii)*

(e) **Identify any document where each communication is recorded and produce a copy thereof**

Each document I have referred to is on the Inquiry website

(f) **If no communication was made, explain why not**

(30) **Describe your communication with Claire's parents and family and in particular:**

I did not have any communication with Claire's parents and family

(a) **State what information you communicated to Claire's parents and family, and what information they gave to you.**

(b) **Identify to whom you gave this information**

(c) **State when and where you told them this information.**

(d) **Identify where the information you communicated/received was recorded or noted.**

(e) **State whether you recorded Claire's parents'/family's understanding of this information and their concerns, and if so, identify the documents containing that record. If you did not record this, explain why not.**

(f) **State if you discussed Claire's condition at any time with her parents. If so, state when, who was present, and what was discussed, where this is noted, and if it was not noted, explain why it was not noted.**

I did not discuss Claire's condition at any time with her parents

(g) **State whether you informed Claire's parents/family of the diagnosis, its implications and the treatment needed, and if so, state when you provided this information, to whom and where this communication is recorded. If you did not provide this information, explain why not. If any such communication is not recorded, explain why not.**

I did not inform Claire's parents/family of the diagnosis, its implications and the treatment needed.

I did not discuss these matters with Claire's parents/family because Dr Steen and Dr Webb had done so. Ref: 090-022-060. Dr Steen and Dr Webb as Claire's paediatricians were best placed to discuss these matters in view of their knowledge, training and experience.

(31) Describe your perception of the seriousness or otherwise of Claire's condition during your care of her, and the reasons for this.

When Dr Clarke handed over his care of Claire to me see [Question 11], it was my perception that Claire was gravely ill and would most likely die. She had suffered a respiratory arrest, her pupils were fixed and dilated, and subsequently a CT scan of the head showed cerebral oedema. Brain stem tests then demonstrated an absence of brain stem reflexes.

(32) Explain whether you believe that consideration should have been given to admitting Claire to PICU earlier and explain the reasons for your answer. If so, state when should this have been considered and by whom.

I cannot answer this question. My decision making would have had to be informed by personally examining her on the ward and take into account how well or unwell she might have appeared to me. This is a subjective component to her assessment, but one which I regard as very important and was not available to me. Medical and nursing staff had no serious concerns about her condition, until there was a sudden deterioration. On this basis any opinion which I might espouse would be based on a significant degree of speculation.

(33) Prior to 23rd October 1996:

(a) State your knowledge and awareness of the case of Adam Strain, his Inquest and the issues arising from in it

I had a narrative account in my mind of the Adam Strain case. Adam was a child who underwent a renal transplant. His native kidneys were in situ and he had poplyuric renal failure, which resulted in him producing a large volume of dilute urine. At the end of surgery he was noted to be not breathing and to have fixed dilated pupils. He had hyponatraemia. A CT scan of his head showed cerebral oedema. During anaesthesia and surgery he had a large volume of iv No 18 solution to replace a fluid deficit in addition to other fluids which contained more sodium than No18 solution. No18 solution contains small amounts of sodium. Adam died shortly after his surgery, his cause of death being due to cerebral oedema. Dr Taylor was the Consultant Anaesthetist for the case and he outlined the clinical scenario. On a number of occasions he discussed issues which had been raised about the anaesthetic, with both Dr Crean and myself. I also believe I discussed the same issues separately with Dr Crean. Arising out of these discussions, as a group of Consultant Paediatric Anaesthetists we came to the conclusion that it would not be advisable to give iv No18 solution at a rate faster than normal maintenance rates ie it should not be administered as a bolus to replace a fluid deficit, because of a risk of the patient developing hyponatraemia.

Dr Gaston a Consultant Anaesthetist who was our Clinical Director asked the three of us to review a statement which was being prepared by the Trust to submit to the Coroner during the Adam Strain Inquest, with the aim of taking steps to prevent similar cases occurring again. We agreed a statement which was then submitted to the Coroner. Ref: 060-014-025, 059-008-024,025. This statement applied to all children undergoing major paediatric surgery.

I had no other knowledge of the Adam Strain Inquest or issues which arose out of it.

(b) **State the source of your knowledge and awareness and when you acquired it**

The sources were Dr Taylor and Dr Crean. I remember Dr Taylor telling me shortly after the operation had finished, that Adam did not breathe at the end of the anaesthetic, that he had fixed dilated pupils and I believe that he also said Adam was due to get a CT scan of his head, but I cannot be absolutely certain of this. He may well have told me other information then, but I cannot recall it. I do not recall the times when other discussions occurred between Dr Taylor, Dr Crean and myself.

(c) **Describe how that knowledge and awareness affected your care and treatment of Claire**

Both Claire and Adam died from cerebral oedema. Hyponatraemia was present in both cases. Both children received iv No18 solution. These were the similarities between the cases. The differences were Adam received a large volume of iv No18 solution over a relatively short period of time which I believe contributed to the development of hyponatraemia. Rapid onset of hyponatraemia is a risk factor for cerebral oedema. A major difference was that Adam did not have SIADH. In Claire's case there were underlying naturally occurring disease processes affecting her brain (i) meningoencephalitis (ii) status epilepticus and (iii) SIADH. IV No18 solution was administered to Claire at normal maintenance rates, which was standard practice in paediatrics. The syndrome of SIADH and resultant development of hyponatraemia appeared to be well recognized by paediatricians. When it occurred with Claire I believe that a standard treatment to manage the hyponatraemia was instituted namely restriction of fluids to 2/3 maintenance rates. With this analysis and in the context that I was providing care and treatment to Claire in my role as an anaesthetist in the presence of paediatricians, who by virtue of their knowledge, training and experience in managing meningoencephalitis, status epilepticus and SIADH , which I did not have, I took their opinion in these matters. The additional care and treatment which I provided to Claire was in my role as an anaesthetist as previously detailed.

(34) Since 23rd October 1996:

(a) **State your knowledge and awareness of the case of Adam Strain, his Inquest and the issues arising from it**

Adam was a child who underwent a renal transplant. His native kidneys were in situ and he had polyuric renal failure, which resulted in him producing a large volume of dilute urine. At the end of surgery he was noted to be not breathing and to have fixed dilated pupils. He had hyponatraemia. A CT scan of his head showed cerebral oedema. During anaesthesia and surgery he had a large volume of iv No 18 solution to replace a fluid deficit in addition to other fluids which contained more sodium than No18 solution. No18 solution contains small amounts of sodium. Adam died shortly after his surgery. The verdict at his Inquest put the cause of death as being due to cerebral oedema due to dilutional hyponatraemia and impaired cerebral perfusion.

I believe there were issues around the accuracy of sodium results when analysed by the blood gas machine in PICU

(b) **State the source of your knowledge and awareness and when you acquired**

I acquired it from speaking with Dr Taylor and Dr Crean and reading the Coroner's verdict on the Inquiry website. I cannot recall specific times.

(c) **Describe how that knowledge and awareness affected your work**

I do not administer iv fluids to children which contain a sodium level of less than 131 mmol/l, at faster than normal maintenance rates. If I had to replace a fluid deficit in a child, I would use an iv fluid which contained a sodium level of 131 mmol/l or greater. I teach this to my anaesthetic and paediatric trainees.

(35) **Describe in detail the education and training you received in fluid management (in particular hyponatraemia) and record keeping through the following, providing dates and names of the institutions/bodies:**

(a) **Undergraduate level**

The Queen's University of Belfast. I cannot recall details. I have no record of dates and names

(b) **Postgraduate level**

Medical Protection Society and GMC for record keeping

The importance of keeping good contemporaneous notes.

Anaesthetics training for hyponatraemia.

Adult male patients undergoing transurethral resection of the prostate gland (TURP) are at risk due to acute water overload and resultant dilutional hyponatraemia, occurring in the setting of large volumes of glycine irrigation fluid combined with a large raw prostate bed, which may facilitate excessive absorption of the irrigation fluid. 0.9% saline cannot be used because of current leakage from the resectoscope. Patients were managed by administering diuretics and they may also have been given hypertonic saline (Reference 1).

I have no record of dates

(c) **Hospital induction programmes**

I cannot recall details. I have no record of dates or names

(d) **Continuous professional development**

Keeping up to date on the subject of hyponatraemia as a requirement for my appraisal

(36) **Prior to 21st October 1996, describe in detail your experience of dealing with children with hyponatraemia, including:**

(a) **the estimated total number of such cases, together with the dates and where they took place**

I cannot recall any experiences of dealing with children with hyponatraemia

(b) **the number of the children who were aged less than 10 years old**

See (a)

(c) **the nature of your involvement**

See (a)

(d) **the outcome for the children**

See (a)

(37) **Since 21st October 1996, describe in detail your experience of dealing with children with hyponatraemia, including:**

I have had dealings with Claire Roberts and Lucy Crawford. I have treated other children with hyponatraemia on a relatively frequent basis. I do not have individual details. I treated these children by increasing the amount of sodium in their intravenous fluids. I would have fluid restricted some of these children. On some occasions I have prescribed 2.7% Saline at 2ml/kg/h (Reference 2) until the serum sodium reached a level in the low 130's. I believe that children of any age and presenting from any specialty may develop hyponatraemia during the course of a large number of illness episodes.

(a) **the estimated total number of such cases, together with the dates and where they took place**

I do not have this detail.

(b) **the number of the children who were aged less than 10 years old**

I do not have this detail.

(c) **the nature of your involvement**

I believe that I gained most of my experience through my work in PICU.

(d) **the outcome for the children**

I believe that most of the children had a good outcome with respect to their hyponatraemia, but I cannot be sure of this in the absence of having details. It is possible that patients did not have a good outcome for another reason.

(38) **Identify any 'Protocols' and/or 'Guidelines' which governed Claire's care and treatment.**

I cannot identify any

(39) **State whether you were aware of any discussions involving the Trust, clinical or managerial staff relating to Claire's death and her inquest and the lessons that could be learned and/or action that should be taken as a result of her death.**

No

(a) **If so, state when those discussions took place, who participated in them and what the outcome was.**

(b) **State, in particular, the extent to which you were involved in any such discussions and/or action.**

(c) **If you were not involved in either discussions or action, explain why not.**

I have no explanation to offer

(40) State whether there is any record of learning from Claire's death through events (e.g. case conferences, grand rounds, post-graduate clinical meetings, audits, nurse education meetings, etc.) from 23rd October 1996 onwards. If so, please furnish copies of relevant documents. If not, explain why not.

I have no knowledge of any record of learning

(41) State whether Claire's death was considered / discussed in any continuing medical education meetings (e.g. Neuroscience Grand Rounds, Neuropathology (Autopsy and Biopsy Review) Department meetings, seminars, Journal Club, topic and casenote reviews, Paediatric Grand Rounds, etc.).

I have no knowledge if any of the above were considered or discussed.

(a) **If so, provide details thereof, including when, where and why this was considered / discussed, by whom, the nature of the consideration / discussion, and what was done as a result thereof, and furnish copies of all documents including notes, minutes, correspondence or memoranda relating thereto.**

(b) **If Claire's death was not considered / discussed, explain why not.**

I cannot explain

(42) State whether you were required to (i) formally report Claire's death and the circumstances thereof and/or (ii) explain what happened to Claire to a senior manager or clinician within the Trust. If so, state:

No. I was not required to (i) formally report Claire's death and the circumstances thereof and/or (ii) explain what happened to Claire to a senior manager or clinician within the Trust.

(a) **To whom and when you reported / explained this**

(b) **The nature of the report / explanation**

(c) **The outcome thereof**

(d) **Any document relevant thereto**

If you did not report / explain this, explain why not.

(43) Describe the procedure for medical and clinical audit at RBHSC in October 1996 and identify any relevant documents.

There were monthly multiprofessional audit meetings in RBHSC which I attended. I also on occasions attended instead of the audit meeting in RBHSC, the anaesthetic audit meeting which was scheduled at the same time. The audit meeting in RBHSC was used to present cases of patients who had died. Audits and educational teaching presentations were also part of the program.

I cannot identify any relevant documents

(a) **Describe what you did in terms of a 'medical and /or clinical audit' of Claire's case, and provide any relevant documents. If there was no medical or clinical audit, explain why not.**

I did not perform a medical or clinical audit of Claire's case

I have no explanation

(b) **State whether your actions relating to a medical and/or clinical audit of Claire's case would differ in 2011 and if so, state how. If not, explain why not.**

My actions would differ and would be taken in a multiprofessional setting. I would ensure that all present were aware of the dangers of hyponatraemia occuring in children of any age and presenting from any specialty during the course of a large number of illness episodes. I would ensure that everybody involved understood the importance of being familiar with the latest Trust Policy (Reference 3) and that all staff looking after sick children had easy access in the clinical area, to the wall-chart summary of parenteral fluid therapy guidance (Reference 2). Increase the general awareness of the syndrome of SIADH within the setting of paediatrics, among anaesthetists.

(44) Describe the procedure for discussions of deaths amongst medical personnel (e.g. 'death meetings' / 'morbidity and mortality meetings') at RBHSC in October 1996 and identify any relevant documents.

A mortality meeting was an integral part of the multiprofessional monthly audit meetings in RBHSC. The case would be presented by a consultant who was involved in the care of the patient, had an understanding of the management and who could answer questions.

(a) **Describe whether you participated in any such meetings in Claire's case, and if so, state when and provide any relevant documents.**

I believe that I was present at the audit meeting when Claire's case was presented. I believe that Dr Steen presented the case. I cannot recall the date of the meeting. I have no documents to provide.

(b) **In particular, state whether you attended the mortality/morbidity meetings on or about 8th November 1996 in relation to Claire, and if so, state what was discussed and furnish minutes thereof.**

I attended an audit meeting on 8th November 1996. I believe I presented a case. I do not have any details of this case. I have no recollection of what was discussed.

(45) **Provide any further points and comments that you wish to make, together with any documents, in relation to:**

(a) **The care and treatment of Claire from her attendance on 21st October 1996 to her death on 23rd October 1996**

(b) **Record keeping**

(c) **Communications with Claire's family about her condition, diagnosis, and care and treatment**

(d) **Lessons learned from Claire's death and how that has affected your practice**

(e) **Current Protocols and procedures**

(f) **Any other relevant matter**

Reference 1: A synopsis of anaesthesia 9th Edition 1982 pages 363 – 364 RS Atkinson, GB Rushman, J Alfred Lee

Reference 2: Parenteral fluid therapy for children and young persons (aged over 4 weeks and under 16 years). Initial management guideline

Reference 3: Policy for the administration of intravenous fluids to children aged from 1 month until the 16th birthday: reducing the risk of hyponatraemia

THIS STATEMENT IS TRUE TO THE BEST OF MY KNOWLEDGE AND BELIEF

Signed: J McVeigh **Dated:** 30/1/12

normal saline infusions avoided. Treatment includes potassium replacement and, if necessary, assisted respiration. These electrolyte changes do not occur with transplantation into an ileal loop.

Tumour embolus causing collapse and cardiac arrest is an occasional complication of operations for carcinoma of the kidney.

(*See also* Lahiri S. K. and Boys S. B. *Br. J. Anaesth.* 1973, **45**, 1162.)

Suprapubic[38] and Retropubic Prostatectomy. Relaxation is required and considerable haemorrhage may occur. *Extradural analgesia* using 7–20 ml of 1·5 per cent lignocaine, with or without light general anaesthesia, gives good results, especially if emphysema and bronchospasm are also present. *Intradural spinal analgesia* to T.10, obtained by 1·4–1·6 ml of hyperbaric cinchocaine, prilocaine or lignocaine, provides relaxation and reduces haemorrhage. The blood pressure should ideally either be lowered during and for at least 4 hours after operation or be kept normal throughout, depending upon the fitness of the patient and the preferences of the surgeon. The blood pressure can, in these cases, be maintained by intravenous infusion and suitable drugs, e.g. ephedrine or methoxamine, should this be thought necessary.

Many workers prefer for prostatectomy a *general anaesthetic*, e.g. halothane and oxygen, thiopentone with gas–oxygen with or without an analgesic or volatile supplement. Relaxation can be produced or increased by a suitable muscle relaxant and IPPV will often be beneficial through a tracheal tube. Blood should be available for transfusion to replace the measured amount lost. To reduce the incidence of clot retention intravenous mannitol 10 per cent, 1 litre in 4 hours, has been found to be superior to frusemide.[39]

HYPOTENSIVE ANAESTHESIA gives good results in experienced hands, with a low morbidity and mortality. The blood pressure is reduced by intra- or extradural block, or hypotensive agents. Halothane and oxygen can also be employed to produce wound ischaemia. *See also* Chapter 17.

THE INNERVATION OF THE URINARY BLADDER. The bladder, lower ends of the ureters and the prostate are supplied by filaments of the inferior hypogastric plexus. This is formed from: (1) The sympathetic T.11 to L.2 roots; (2) The parasympathetic—S.2, S.3 and S.4.

Transurethral Prostatectomy. If *general anaesthesia* is used the explosion hazard must be remembered. Halothane and oxygen or thiopentone-nitrous-oxide–oxygen and an analgesic supplement with or without a relaxant are suitable. Low intradural spinal block is very satisfactory. Lumbar or sacral extradural block may also be used. The simple technique of nitrous oxide, oxygen and halothane, omitting relaxants, i.v. drips, intubation and IPPV gives good results.[41] Other investigators support the use of IPPV.[42]

Glycine 1·5 per cent at an optimal pressure of 70 cm water, used for irrigation, may result in excretion of large amounts of oxalate and glycolate which may be dangerous if the urinary flow-rate is allowed to drop during the

first 10 days or so after operation. Postoperative hyponatraemia must be sought for and treated.[40] Ordinary water may be absorbed into the vascular system and result in: (1) Haemolysis with subsequent renal damage; (2) Water intoxication which results when a greatly increased volume of water enters the circulation. It causes a dilutional hyponatraemia which may lead to prolonged action of non-depolarizing relaxants, cerebral or pulmonary oedema, raised blood pressure, acute left ventricular failure, cardiac arrest,[43] nausea, vomiting, headache, and possibly convulsions and coma. Intravenous sodium chloride 5 per cent solution and a loop diuretic[43] may be helpful in treatment. Normal saline, used for irrigation, partly dissipates the electric current of the diathermy. Cold irrigating solutions may cause hypothermia.[223]

Oozing during this operation may be increased by anything raising the central venous pressure, e.g. straining, vascular over-load with irrigating fluid, over-transfusion; by pressor drugs and by prolonged operation time. If the blood pressure can be maintained at a steady 80 mm Hg, oozing is minimized.

During prostatectomy some surgeons use 40 g of urea in 1000 ml of dextrose solution, mannitol or frusemide to promote diuresis and prevent clot retention. Mannitol and blood should not be used in the same drip system.

Prostatic Biopsy. This may be performed under general anaesthesia, local analgesia or sedation with diazepam and a narcotic analgesic.[44]

Cystoscopy. The first electrically illuminated cystoscope was introduced in 1876.[45] If a *general anaesthetic* is used for cystoscopy, the anaesthetist must provide: (1) Complete loss of sensation; (2) Relaxation of bladder sphincters and abdominal wall; (3) Quiet breathing through a patent airway; (4) Freedom from hazard of explosion. In the authors' opinion, this anaesthetic procedure can be difficult to accomplish smoothly, e.g. in emphysematous old men with bronchitis. It should never be undertaken lightly and may require tracheal intubation. Even in experienced hands, anaesthesia for cystoscopy is often inelegantly given. Halothane and oxygen with or without nitrous oxide is an excellent choice, while an i.v. narcotic analgesic may be a useful addition.

Topical analgesia is fairly satisfactory, e.g. lignocaine 1 or 2 per cent jelly, but should not be used after recent instrumentation or in the presence of bleeding from the urethra (*see* Chapter 33). Cases with gross cystitis are often unsuitable for local analgesia as the distension of the bladder with irrigating fluid causes painful spasm. Women will frequently tolerate this examination without general anaesthesia if simple sedatives are given, e.g. diazepam.

Extradural sacral block is very satisfactory as is low intradural spinal analgesia.

PARENTERAL FLUID THERAPY for CHILDREN & YOUNG PERSONS
(AGED OVER 4 WEEKS & UNDER 16 YEARS)
Initial management guideline

DHSSPS Department of Health, Social Services and Public Safety www.dhsspsni.gov.uk

Sept 2007
Amended February 2010

Monitoring & observations essential

ALL CHILDREN

Admission Weight. U&E *(unless child is well & for elective surgery)*

12 Hourly – Assess In / Output, plasma glucose

Daily – Clinical reassessment. U&E (more often if abnormal; 4-6 hourly if Na^+ < 130 mmol/L).

ILL CHILDREN

May need:

Hourly - HR, RR, BP, GCS. Fluid In/ Output (urine osmolarity if volume cannot be assessed)

2-4 hourly – glucose, U&E, +/- blood gas.

Daily – weight if possible

Each shift

Handover and review of fluid management plan.

If plasma Na^+ < 130 mmol/L or > 160 mmol/L or plasma Na^+ changes > 5 mmol/L in 24 hours ask for senior advice

Is shock present? — YES →

ADMINISTER RAPID FLUID BOLUS
Give 20 ml/kg sodium chloride 0.9% IV or Intraosseous
[10 ml/kg if history of haemorrhage or in diabetic ketoacidosis]
Reassess. Repeat bolus if needed. Call for senior help.
(Up to 60 ml/kg may be needed. Use blood after 40 ml/kg if patient has haemorrhaged)

NO ↓

Can child be managed with oral fluids? — YES →

PRESCRIBE ORAL REHYDRATION SOLUTION

DKA / burns: initiate departmental protocol. Renal / cardiac / hepatic - get senior advice.

Is there a fluid deficit? — YES →

ESTIMATE DEFICIT
FLUID DEFICIT = (% dehydration x kg x 10) as mls of:
sodium chloride 0.9%
The volume of fluid to be prescribed is: fluid deficit MINUS volume of any fluid bolus received
Prescribe this residual volume of deficit separately from the maintenance prescription.
Give over 24 hours (but over 48 hours if Na^+ < 135 or > 145 mmol/L)
ONGOING LOSSES: calculate at least 4 hourly. Replace with an equal volume of:
sodium chloride 0.9% (with or without pre-added potassium)
Be prepared to change fluid type and volume according to clinical reassessment, electrolyte losses and test results

NO ↓

Prescribe Maintenance fluids →

PRESCRIBE INITIAL IV MAINTENANCE FLUID AND TIME FOR REASSESSMENT

Patients particularly at risk of hyponatraemic complications:
peri-operative patients; patients with head injuries; gastric losses; CNS infection; severe sepsis; hypotension; intravascular volume depletion; bronchiolitis; gastroenteritis with dehydration; abnormal plasma sodium, particularly if less than 138 mmol/L but also when greater than 160 mmol/L; salt wasting syndromes.

Fluid choices: glucose containing fluid normally required if under 1 year old and may also be required by older children

sodium chloride 0.9% (with/ without pre-added glucose 5%)
or
Hartmann's Solution
or
Solution Corporately Approved at Trust Level

Other Patients:
sodium chloride 0.45% with pre-added glucose 2.5% or 5%

All Patients:
Alter fluid rate according to clinical assessment. Change electrolyte and glucose content of infusion fluid according to test results.
COMMENCE ORAL FLUIDS & DISCONTINUE IV FLUIDS AS SOON AS POSSIBLE

CALCULATION OF 100% MAINTENANCE RATE

(a) for first 10 kg:	100 ml/kg/ day	≡ 4ml/kg/hr
(b) for second 10 kg:	50 ml/kg/ day	≡ 2ml/kg/hr
(c) for each kg over 20 kg:	20 ml/kg/ day	≡ 1ml/kg/hr

[For 100% daily maintenance add together (a) + (b) + (c)]

MAXIMUM: in females 80 mls per hour; in males 100mls per hour.
If the risk of Hyponatraemia is high consider initially reducing maintenance volume to two thirds of maintenance.

Hypokalaemia (< 3.5 mmol/L): Check for initial deficit. Maintenance up to 40 mmol/L IV potassium usually needed after 24 hrs using pre-prepared potassium infusions as far as possible. Consult Trust Policy on IV strong potassium.
Oral intake and Medications: volumes of intake, medications & drug infusions must be considered in the fluid prescription.
Hypoglycaemia (< 3 mmol/L). **Medical Emergency: give 5 ml/kg bolus of glucose 10%.** Review maintenance fluid, consult with senior and recheck level after 15-30 mins. **INTRA-OPERATIVE PATIENTS:** consider monitoring plasma glucose.
Symptomatic Hyponatraemia: check U&E if patient develops nausea, vomiting, headache, irritability, altered level of consciousness, seizures or apnoea. **This is a Medical Emergency and must be corrected.**
Commence infusion of sodium chloride 2.7% at 2 ml/kg/hour initially and get senior advice immediately.

Standards and Guidelines Committee

Policy for the administration of intravenous fluids to children aged from 1 month until the 16th birthday: reducing the risk of hyponatraemia.

Summary	This policy outlines the BHSCT approach for administration of intravenous fluids to children aged from 1 month until the 16th birthday with particular reference to reducing the risk of hyponatraemia. It maps the advice issued in March 2007 from the National Patient Safety Agency (NPSA) and September 2007 from the Northern Ireland Regional Paediatric Fluid Therapy Working Group on how to reduce the risks associated with administering intravenous infusions to children. This is fundamentally a document aimed at prevention of hyponatraemia and not treatment.
Purpose	To improve the safe use of intravenous fluid in children and reduce the risk of hyponatraemia.
Operational date	March 2008
Review date	March 2010
Version Number	V4
Supersedes previous	V3
Director Responsible	Medical Director
Lead Author	Dr. Peter Crean
Lead Author, Position	Consultant Paediatric Anaesthetist, RBHSC.
Additional Author(s)	Dr H Steen, Associate Medical Director.
Department / Service Group	Social Services, Family and Child Care
Contact details	Dr Peter Crean Paediatric Intensive Care Unit Royal Belfast Hospital for Sick Children [redacted]

Reference Number	
Supercedes	N/A

Date	Version	Author	Comments
25 August 2009	V 3.1	[redacted]	Draft version 3
14 September 2009	V 3.2	[redacted]	Minor RMcL amendments
16 September 2009	V 3.3	[redacted]	8.3.4; Appendix 6 changes Final Draft for RQIA
17 September 2009	V 3.4	[redacted]	4.1; 8.4 - DKA Fluid chart change
17 September 2009	V 3.5	[redacted]	Appendix 4 changes
February 2010	V 3.6	[redacted]	Trigger list

Policy Record

		Date	Version
Author (s)	Approval	27/03/2008	1.2
Director Responsible - [redacted]	Approval	27/03/2008	1.2

Approval Process – Trust Policies

Policy Committee	Approval		
Executive Team	Authorise		
Chief Executive	Sign Off		

Approval Process – Clinical Standards and Guidelines

Standards and Guidelines Committee	Approval		1.2
Policy Committee	Approval		
Executive Team	Authorise		
Appropriate Director	Sign Off		

Summary

Reference No: SG001/08

Title:
Policy for the administration of intravenous fluids to children aged from 1 month until the 16th birthday: reducing the risk of hyponatraemia.

Purpose:
To improve the safe use of intravenous fluid in children and reduce the risk of hyponatraemia.

Objectives:
This Policy sets out recommended practice for everyone who looks after children receiving intravenous fluids. It is based on regional and national guidance, ongoing clinical audit, published literature and is also aimed at specifically reducing the risk of hyponatraemia.

It should be considered alongside the guidance from the National Patient Safety Agency Patient Safety Alert 22[1], and the Regional Paediatric Fluid Therapy Group wallchart[2].

Policy Statement(s):
1. The Paediatric Parenteral Fluid Therapy wallchart[2] forms the basis of BHSCT guidance on fluid prescription in paediatric patients aged from 1 month until the 16th birthday.
2. Sodium chloride 0.18% with glucose 4% will be withdrawn from general use in all BHSCT ward areas that treat children and the availability of these fluids will be restricted to critical care areas and other specialist wards such as renal, liver and cardiac units.
3. This policy and wallchart will be disseminated throughout the BHSCT.
4. Information about the availability of infusion fluids throughput the BHSCT will be attached to the Paediatric Fluid Guideline wall chart[2].
5. A new fluid prescription/ balance chart will be developed for the prescription of fluids for all children treated in the BHSCT.
6. All staff involved in prescribing, administering and monitoring IV fluids to such children will be made aware of this policy and the Paediatric Parenteral Fluid Therapy wallchart[2] through the BHSCT intranet and Service Group dissemination.
7. The BHSCT will implement the following governance measures – incident reporting using a set of reporting 'triggers' and formal auditing.

Chief Executive/ Director *(delete as appropriate)*	**Author**
Date:	**Date:**

Contents Page:

Full Description

Reference No: SG001/08

1. ***Policy for the administration of intravenous fluids to children aged from 1 month until the 16th birthday: reducing the risk of hyponatraemia.***

2. **Introduction:**

The development of fluid-induced hyponatraemia in the previously well child undergoing elective surgery or with mild illness may not be well recognised by clinicians.[1]

Since 2000, there have been four child deaths following neurological injury from hospital-acquired hyponatraemia reported in the UK.[1] International literature cites more than 50 cases of serious injury or child death from the same cause, and associated with the administration of hypotonic infusions.[1]

In March 2007 the National Patient Safety Agency (NPSA), with Alert 22, issued advice on how to reduce the risks associated with administering infusions to children[1].

In April 2007, with DHSSPSNI circulars[3,4], NHS organisations in Northern Ireland were tasked to produce and disseminate local clinical guidelines for the fluid management of paediatric patients based on the suggested NPSA guidelines template. The Northern Ireland Regional Paediatric Fluid Therapy Working Group produced an intravenous fluid clinical guideline in accordance with NPSA guidance[1]. This was disseminated to each HSC Trust for local implementation and monitoring.

In February 2009 the Regulation and Quality Improvement Authority (RQIA) published an independent review "*Reducing the risk of hyponatraemia when administering intravenous infusions to children*" which dealt with the implementation of recommended actions outlined within the NPSA Alert 22 and dissemination of the clinical guidelines / wall chart throughout HSC Trusts and independent hospitals. (see appendix 7.)

This document, using both the NPSA guidance and the RQIA recommendations, outlines the BHSCT policy for administration of intravenous fluids to children aged from 1 month until the 16th birthday with particular reference to reducing the risk of hyponatraemia; it is fundamentally a document aimed at prevention of hyponatraemia and not treatment.

3. **Purpose:**

To improve the safe use of intravenous fluid in children and reduce the risk of hyponatraemia.

4. **The scope:**

4.1 Applicable to all children more than 1 month and until their 16th birthday throughout the Belfast Health and Social Services Trust (BHSCT).

It is relevant for all general inpatient areas that treat patients from this age range (even if it is only occasionally) and includes the post-operative scenario, emergency departments, day case departments and the ambulance service.

This policy (and attendant fluid prescription chart) is not intended to apply to paediatric

and neonatal intensive care units, specialist areas such as renal, liver and cardiac units where it is used to replace ongoing losses of hypotonic fluids, or those suffering from burns or diabetic keto-acidosis (DKA) where hypotonic solutions may have specialist indications.

Children receiving long term Total Parenteral Nutrition (TPN) are not covered by the conditions of this policy.

4.2 Young people

As a child progresses through the teenage years there is a transitional stage of physical development i.e. adolescence, as that child progresses through towards adulthood. They will be referred to as 'young people' and many are cared for in adult wards by staff who generally treat adults.

The DHSSPSNI indicates that this paediatric fluid therapy guidance relates to all children from 1 month until their 16th birthday, regardless of the ward setting, except in the ICU and specialist areas mentioned above.

5. Objectives:

This policy sets out recommended practice for everyone who looks after children receiving intravenous fluids. It is based on regional and national guidance, ongoing clinical audit, the published literature and is also aimed at specifically reducing the risk of hyponatraemia.

It should be considered alongside the guidance from the National Patient Safety Agency Patient Safety Alert 22[1], and the Regional Paediatric Fluid Therapy Group wallchart[2] and the RQIA recommendations[5].

6. Roles and Responsibilities:

All professionals caring for children must:-

- be familiar with the signs of hyponatraemia.
- be familiar with its emergency management.
- ensure that they have received adequate training in intravenous fluids appropriate to their role.
- if they exclusively care for young people in an adult ward, know where to obtain expert paediatric should it be needed. (Appendix 5).
- be familiar with the guidance on intravenous fluids for children outlined by the Regional Paediatric Fluid Therapy Group wallchart[2].

7. The definition and background of the policy:

A child, for the purposes of this policy, is defined as being aged from 1 month up to their 16th birthday.

Hyponatraemia is an abnormally low concentration of sodium (Na) in serum. The normal range is generally agreed to be 135 – 145 mmol/L.

Hyponatraemia is defined as a plasma Na of less than 135 mmol/L. It represents an excess of water in relation to sodium in extracellular fluid and is described as severe or significant if below 130 mmol/L.

Significant acute hyponatraemia is defined as a decrease in plasma sodium from normal to less than 130 mmol/L in less than 48 hours.

Symptoms are likely with serum Na <125 mmol/L or if the serum Na has fallen rapidly; greater than 5 mmol/L decline in 24 hours.

The main causes of hyponatraemia in children are:

- Administration of hypotonic fluids, intravenous or enteral (e.g. excessively dilute formula or sodium chloride 0.18% and glucose 4% (No 18 solution))
- Conditions with impaired free water excretion and high anti-diuretic hormone levels
  - Meningitis, encephalitis, pneumonia, bronchiolitis, sepsis
  - Surgery, pain, nausea and vomiting
- Gastrointestinal fluid losses

Less common but important causes are:

- Adrenal insufficiency (Congenital Adrenal Hyperplasia, Addison's Disease)
- Defect in renal tubular absorption, including obstructive uropathy
- Psychogenic polydipsia

The main symptoms of hyponatraemia relate to its central nervous system effects; cerebral oedema, seizures and death. Warning signs may be non-specific and include nausea, malaise and headache.

All children are potentially at risk, even those not considered to be obviously 'sick'. The complications of hyponatraemia often occur because of the inappropriate management of intravenous fluids but they can also occur with inappropriately managed oral fluid regimes. Vigilance is required for all children receiving fluids.

Children particularly at risk are those who are postoperative, have gastrointestinal fluid losses or who have bronchiolitis, CNS injuries or burns. These risk factors also apply to young people.

8. Policy / Guideline description:

The NPSA recommended in Alert 22 the following actions:-

1. **Remove 'No. 18 solution'** from general areas that treat children and restrict availability to specialist areas except in critical care and specialist wards such as renal, liver and cardiac units.
2. Produce and disseminate **clinical guidelines** for the fluid management of paediatric patients.
3. Provide adequate **training** and supervision for all staff involved in the prescribing, administering and monitoring of intravenous infusions for children.
4. Review and improve the design of existing intravenous fluid prescriptions and **fluid balance charts** for children.
5. Promote reporting of hospital acquired hyponatraemia **incidents** via local risk management reporting systems. Implement an **audit** programme to ensure adherence to the above.

The 16 RQIA recommendations (appendix 7) map to the above NPSA recommendations:-

NPSA	RQIA
1	1, 2
2	3, (4), 5, 7
3	6, 7, 8, 9, 10
4	11
5	12, 13, 14,
6	15, 16

The specific actions that the BHSCT will institute in order to limit the production of hospital acquired hyponatraemia are detailed below and are mapped to the RQIA recommendations.

8.1.1 *NPSA 1 RQIA 1* *Remove 'No. 18 Solution'*
Sodium chloride 0.18% with glucose 4% has been withdrawn from general use in all BHSCT ward areas that treat children and the availability of these fluids is restricted to critical care areas and other specialist wards such as renal, liver and cardiac units. A table showing areas permitted to stock or order 'No.18 solution' is given in Appendix 6.

8.1.2 *NPSA 1 RQIA 2* Any area that is still permitted to stock 'No. 18 solution will arrange for the provision of additional labelling or separate storage.

8.1.3 *NPSA 2 RQIA 5* Information about the availability of infusion fluids throughput the BHSCT (Appendix 4) will be attached to the Paediatric Fluid Guideline wall chart[2].

8.1.4 The BHSCT's list of sanctioned standard maintenance fluids is given in Appendix 4.

Where a senior clinician(s) considers that a "special" maintenance infusion fluid is required, then this alternative choice for fluid maintenance must be endorsed by the Chief Executive of the Trust with clear documentation of the reasons for that endorsement.

8.2 *NPSA 2 RQIA 3,5,7* *Clinical Guideline*
The Paediatric Parenteral Fluid Therapy wallchart[2] forms the basis of BHSCT guidance on fluid prescription in paediatric patients within the previously defined age range. This policy and wall chart will be disseminated and displayed throughout the BHSCT; to all wards that accommodate children aged from one month until their 16th Birthday including Emergency Departments, Adult Wards, Theatre and Intensive Care Units.

This will replace any previous wallchart including the 2002 wallchart issued by CMO entitled "Any Child Receiving Prescribed Fluids is at Risk of Hyponatraemia". All previous versions of the chart should be removed.

8.2.1 *NPSA 2 RQIA 7* The BHSCT will develop policy and guidelines on the general principles of intravenous therapy for adults and children.

Until then, this policy will form the basis of guidance on fluid therapy in children within the BHSCT and, as for all BHSCT policies, it will be reviewed and implemented throughout the organisation.

8.2.3 *NPSA 2 RQIA 3* All medical and nursing staff should base their intravenous fluid practice for children, young people (and indeed adults) on the following best practice model of:-

- administer appropriate therapy for shock such as fluid boluses
- measure/estimate and correct any fluid deficit
- prescribe a fluid maintenance fluid regime.

Treatment of these elements of the overall fluid status is outlined in the Paediatric Parenteral Fluid Therapy wallchart[2].

The fundamental layout selected for this guideline complements a structured approach to patient clinical assessment. A sequence of questions is offered that prompts the clinician to

- assess for the presence of shock and guides treatment, if required;
- further assessment of whether there is also a deficit to be considered and then
- calculation and prescribing for maintenance requirements is also included.

8.2.4 This policy, centred on children, has many features that indicate good practice for young people and adults. An intravenous fluid therapy practice based on using

- an individual patient's weight in kilograms
- fluid administration based on a millilitres/hour prescription

is commended rather than blanket prescriptions based only on fluid volume.

8.2.5 Baseline Assessment

Good practice guidelines on monitoring body weight, electrolytes/urea and fluid balance should be followed. Again, these recommendations apply to adults as well as children.

An essential preliminary to these assessments is to accurately measure the body weight in kilograms or failing this, to make an estimate. This must be cross-referenced with the child's age to minimize the risk of error.

In the emergency situation an estimation of the child's weight should be made and an accurate weight obtained as soon as practically possible.

Baseline measurement of electrolytes and urea should be made unless the child is healthy and scheduled for elective surgery when it may be considered unnecessary.

8.2.6 Shock therapy

Shocked or collapsed children must immediately receive fluid boluses as outlined on the Regional Paediatric Fluid Therapy Group wallchart[2].

Good practice would indicate that the response to fluid therapy is closely observed and if there is no response by the time 40 mls/kg has been administered, senior medical advice and help is required.

Note that special treatment is needed for children with diabetic coma and trauma and the need to obtain senior advice and help is highlighted.

8.2.7 Fluid Deficit management

Calculation of the overall fluid deficit and the prescription of deficit replacement should only be undertaken by a doctor experienced in caring for dehydrated patients. The recommended fluid is sodium chloride 0.9% and it must be prescribed separately. The rate at which it is given is determined by the degree of dehydration and a relevant electrolyte sample.

For those caring for young people in a general adult ward, and who may not have such experience, they should ensure that they can avail themselves of advice from the sources as detailed in Appendix 5.

8.2.8 For advice regarding the estimation of the percentage of dehydration which is required for the fluid deficit calculation, the table in Appendix 2 should be consulted.

8.2.9 Maintenance fluid therapy

When prescribing maintenance fluids to children, young people and adults, the following scheme would be standard practice. For

- children use the calculations as indicated in the Regional Paediatric Fluid Therapy Group wallchart[2].
- young people and adults prescribe
    - 2 litres fluid for females over the weight of 40 kg.
    - 2.5 litres fluid for males over the weight of 60 kg.

8.2.10 The type of fluid selected must be tailored to the patient's needs as set out in the guideline. For example, following surgery, children who require intravenous fluids will be prescribed either sodium chloride 0.9% with or without pre-added glucose or Hartmann's solution in the post-operative period for maintenance fluid needs.

8.2.11 Children must not receive intravenous fluids unnecessarily. This guideline emphasises that assessment of each patient should include a decision on whether oral fluid therapy could be appropriately initiated instead of intravenous therapy and further prompts reconsideration of this question when IV therapy is reviewed.

8.2.12 This advice does not override or replace the individual responsibility of health professionals to make appropriate decisions in the circumstances of their individual patients, in consultation with the patient and/or guardian or carer or for consultation with a more senior clinician. This would, for example, include situations where individual patients have other conditions or complications that need to be taken into account in determining whether the guidance as detailed in the wallchart[4] is fully appropriate in their case.

8.3 Training

NPSA 3 RQIA 3,6,8,10

The BHSCT will use various forms of training on paediatric fluid management; didactic lectures, staff induction training and computer based training:-

1. a training presentation in the policies and guidelines section of the Intranet. This multidisciplinary presentation is accessible from any computer terminal within the BHSCT.
2. BMJ e-learning module
3. 'Training Tracker' (Multimedia Design Studio Limited).

The BHSCT advocates the adoption of a regional computer based educational tool that allows:-

- creation of an unlimited number of educational and training courses; to include mandatory modules.
- 'training' of all grades of staff.
- content of the training to be tailored to our own needs.
- tracking
    - who has taken each module.
    - who has not taken each module.
    - who has passed and who has failed.
    - precisely which questions each trainee got right and wrong.
- competency assessment tools.
- training record to be obtained at any time.
- to award personalised certificates to those who reach a stated passmark.

8.3.1 *NPSA 3 RQIA 6,8,10* All staff involved in prescribing, administering and monitoring IV fluids to children will be made aware of this policy and the Paediatric Parenteral Fluid Therapy wallchart[2] through the BHSCT intranet and Service Group dissemination.

All staff working exclusively with children and especially those prescribing fluids to children will be encouraged to ensure they are conversant with the knowledge required to prescribe intravenous fluids to children and that it is within their scope of practice.

They will be encouraged to use the intranet training presentation and the BMJ learning module on hyponatraemia - http://learning.bmj.com/learning/search-result.html?moduleId=5003358

The production of the certificate on completion of the above module may be sought at staff assessments, RITAs, performance review, personal development plans and appraisals.

The future BHSCT policy and guideline on the general principles of intravenous therapy (8.2.1) will also be available in the various training modules.

8.3.2 *NPSA 3 RQIA 6,8* All professionals caring for children must be familiar with the signs of hyponatraemia and its emergency management.

8.3.3 *NPSA 3 RQIA 6,8* For those caring for young people, they should either have received adequate training in intravenous fluids or if they exclusively care for young people in an adult ward, they should know where to obtain such expertise on children should it be needed. (Appendix 5).

Furthermore, they should be familiar with the guidance on intravenous fluids for children outlined in this policy and Regional Paediatric Fluid Therapy Group wallchart[2].

8.3.4 *NPSA 3 RQIA 9* The BHSCT has identified that young people aged 14 - 16 years old can be cared for (even if only occasionally) on most wards that are generally regarded as adult wards with the obvious exceptions of wards like Care of the Elderly. Staff in those locations will be made aware of the training opportunities mentioned in 8.3 and 8.3.1.

BHSCT Service groups will consider cohorting young people in dedicated wards - where this can be done safely and will not lead to any diminution in the level of care.

8.3.5 The BHSCT will work with the NIMDTA to ensure that the principles of paediatric fluid therapy and its potential risks, as highlighted in the National Patient Safety Agency Alert, are highlighted in postgraduate training programmes.

8.3.6 All professionals caring for children must be able to diagnose and manage acute hypoglycaemia.

8.4 *NPSA 4 RQIA 11* <u>Fluid prescription/ balance chart</u>
A new fluid prescription/ balance chart has been developed within the Royal Belfast Hospital for Sick Children (RBHSC) with guidance from all other areas in the BHSCT that treat children. It will be used for the prescription of fluids for all children and young people treated in the BHSCT with the exception of treatment of diabetic ketoacidosis (DKA) when a specialised fluid prescription chart may be used.

If needed, they should avail themselves of advice from the sources as detailed in Appendix 5.

8.4.1 All children, other than emergencies, must have a blood sample taken for electrolyte and blood glucose estimation before intravenous maintenance fluids are started. This must be repeated at least 24 hourly, more often in the circumstances described. Clinical and other methods of monitoring are outlined in the guidance.

8.4.2 Monitoring

Monitoring of the child receiving parenteral fluid will include considerations of:-

- Body weight to be measured or assessed as a baseline and at least daily thereafter.
- Clinical state to be closely monitored and recorded on a regular basis.
- All fluid intake of any kind (intravenous, oral and medicines) must be measured and recorded on the fluid balance chart.
- All fluid output must be assessed and, if clinically indicated, measured and recorded on the fluid balance chart.
- An assessment of input/output and need for plasma glucose estimation should be made and documented every 12 hours.
- A formal reassessment of the fluid prescription and the need for intravenous fluids must be made and documented every 12 hours.
- Measurement of E&U and blood glucose/BM should be made at least daily.
- If hyponatraemia exists, these measurements should be 4 – 6 hourly.
- Urinary osmolarity and electrolytes measurements should be considered when dealing with hyponatraemia.
- The ill child will require more frequent and detailed investigations.

For more detailed information about the monitoring requirements the wallchart[2] should be consulted.

8.5 **Audit**

NPSA 5 RQIA 12 The BHSCT will implement the following governance measures.

8.5.1 *NPSA 5 RQIA 13* The BHSCT clinical biochemistry department will collate, analyse and report quarterly on paediatric hyponatraemia incidents to designated clinicians for children and young people. They will regularly audit these incidents, collate them with the Trust Adverse Incident Reporting System and instigate actions linked to the NPSA Alert 22. Appendix 3 outlines this audit process.

8.5.2 Incident reporting

NPSA 5 RQIA 14 The BHSCT will report these potential adverse incidents related to intravenous infusion through the Trust Adverse Incident Reporting System.

A system of 'triggers' (adapted from those developed by the NHSCT) will be used to

- generate a list of hospital acquired hyponatraemia episodes
- highlight variance from best practice guidance as highlighted in this document
- generate a Trust Adverse Incident Form whenever such incidents occur.

These triggers (Appendix 3) will cover the choice of fluid prescribed at ward level, charting relevant findings in the medical notes, the frequency of electrolyte analysis and the detection of biochemical abnormalities.

8.5.3 Audit

NPSA 5 RQIA 15,16 The BHSCT will implement an audit programme for intravenous infusion therapy in children throughout the trust.

The audits will be based on the

- NPSA audit checklist
  http://www.npsa.nhs.uk/EasySiteWeb/GatewayLink.aspx?alId=5308
- the BHSCT trigger list (Appendix 3).
- Regional GAIN hyponatraemia audit

8.5.4 Where young people are cared for in general adult wards, special audit arrangements will be put in place to ensure they receive appropriate and safe fluid management.

9. Additional policy statements:

9.1 Senior medical advice must be sought when treating the child with hyponatraemia.

9.2 Where additional electrolytes are required, they should only be administered as supplied by the manufacturer and in line with guidance.

Children at or below the age of 13 years must not have electrolytes added to bags of intravenous fluids.

Ordinarily children from 13 to 16 should also not have electrolytes added to bags of intravenous fluids; in certain, predominantly adult areas, children of this age group may have magnesium sulphate or phosphates added.

9.3 Apart from boluses for shocked patients, fluids may only be administered by way of an infusion device. Details of the pump must be recorded on the fluid prescription and balance chart.

9.4 When referring to this policy, staff should consult the BHSCT policy on the management of strong intravenous potassium solutions and/or injections.

10. Implementation / Resource requirements:

The implementation requirements for this policy include:-

- Wallchart production and distribution
- Fluid prescription/ balance chart production and distribution
- Staff training costs – induction, postgraduate courses.

Raising staff awareness of the issues surrounding hyponatraemia and the subsequent staff training will be encouraged, as suggested by DHSSPSNI circular[4], by using the BMJ e-learning module.

11. Source(s) / Evidence Base:

The following sources were used:-

a) NPSA Alert 22
b) NPSA background information
   http://www.npsa.nhs.uk/EasySiteWeb/GatewayLink.aspx?alId=5310
c) HSC (SQSD) 20-07 - reducing risk of Hyponatraemia in children (27/04/2007)
d) HSC (SQSD) 20-07 - addendum (16/10/2007)
e) Paediatric Parenteral Fluid Therapy wallchart.

12. References, including relevant external guidelines:

1. Reducing the risk of hyponatraemia when administering intravenous infusions to children. National Patient Safety Agency, Patient Safety Alert 22, March 2007.
2. Paediatric Parenteral Fluid Therapy initial management guideline, DHSSPSNI 2007. http://www.dhsspsni.gov.uk/hsc_sqsd_20-07_wallchart.pdf.
3. HSC (SQSD) 20-07 reducing risk of Hyponatraemia in children
4. http://www.dhsspsni.gov.uk/hsc_sqsd_20-07_-_addendum.pdf

5. Regulation and Quality Improvement Authority (RQIA). Reducing the risk of hyponatraemia when administering intravenous infusions to children - September 2008. http://www.rqia.org.uk/cms_resources/NI%20%20report%20Hyponatraemia%20FINAL%20v%203%200.pdf

13. Consultation Process:

This policy is adapted from the

- NPSA Alert 22,
- Northern Ireland Regional Paediatric Fluid Therapy Working Group
- HSC (SQS) 20/2007 and its addendum documentation from the DHSSPSNI.

It has been assured through the Standards and Guidelines committee.

14. Equality and Human Rights screening carried out:

In line with duties under the equality legislation (Section 75 of the Northern Ireland Act 1998), Targeting Social Need Initiative, Disability discrimination and the Human Rights Act 1998, the Belfast Trust has carried out an initial screening exercise to ascertain if this policy should be subject to a full impact assessment.

√ Screening completed ☐ Full impact assessment to be carried out.
No action required.

15. Procedures:

Appendix 1 - Paediatric Parenteral Fluid Therapy wallchart
Appendix 2 - Estimating the percentage dehydration based upon physical examination findings.
Appendix 3 - Paediatric Hospital Acquired Hyponatraemia Audit
- Triggers for potential adverse events
Appendix 4 - Availability of intravenous fluids throughout the BHSCT (500ml bags)
Appendix 5 - Sources of advice regarding Paediatric fluid therapy
Appendix 6 - Areas where it is permitted to stock/order No. 18 Solution* - as of August 2009
Appendix 7 - RQIA independent review - September 2008 - Recommendations

Director **Author**

Date: **Date:**

PAEDIATRIC PARENTERAL FLUID THERAPY (1 month – 16 yrs)

Initial management guideline

Sept 2007

Monitoring & observations essential

ALL CHILDREN

Admission Weight. U&E *(unless child is well & for elective surgery)*

12 Hourly – Assess In / Output, plasma glucose

Daily – Clinical reassessment. U&E (more often if abnormal; 4-6 hourly if Na^+ < 130 mmol/L).

ILL CHILDREN

May need:

Hourly - HR, RR, BP, GCS. Fluid In/ Output (urine osmolarity if volume cannot be assessed)

2-4 hourly – glucose, U&E, +/- blood gas.

Daily – weight if possible

Each shift

Handover and review of fluid management plan.

If plasma Na^+ < 130 mmol/L or > 160 mmol/L or plasma Na^+ changes > 5 mmol/L in 24 hours ask for senior advice

Is shock present? — YES →

ADMINISTER RAPID FLUID BOLUS

Give 20 ml/kg sodium chloride 0.9% IV or Intraosseous

[10 ml/kg if history of haemorrhage or in diabetic ketoacidosis]

Reassess. Repeat bolus if needed. Call for senior help.

(Up to 60 ml/kg may be needed. Use blood after 40 ml/kg if patient has haemorrhaged)

NO ↓

Can child be managed with oral fluids? — YES →

PRESCRIBE ORAL REHYDRATION SOLUTION

DKA / burns: initiate departmental protocol. Renal / cardiac / hepatic - get senior advice.

Is there a fluid deficit? — YES →

ESTIMATE DEFICIT

FLUID DEFICIT = (% dehydration x kg x 10) as mls of:

sodium chloride 0.9%

The volume of fluid to be prescribed is: fluid deficit MINUS volume of any fluid bolus received

Prescribe this residual volume of deficit separately from the maintenance prescription.

Give over 24 hours (but over 48 hours if Na^+ < 135 or > 145 mmol/L)

ONGOING LOSSES: calculate at least 4 hourly. Replace with an equal volume of:

sodium chloride 0.9% (with or without pre-added potassium)

Be prepared to change fluid type and volume according to clinical reassessment, electrolyte losses and test results

NO ↓

Prescribe Maintenance fluids →

PRESCRIBE INITIAL IV MAINTENANCE FLUID AND TIME FOR REASSESSMENT

Patients particularly at risk of hyponatraemic complications:

peri-operative patients; patients with head injuries; gastric losses; CNS infection; severe sepsis; hypotension; intravascular volume depletion; bronchiolitis; gastroenteritis with dehydration; abnormal plasma sodium, particularly if less than 138 mmol/L but also when greater than 160 mmol/L; salt wasting syndromes.

Fluid choices: glucose containing fluid normally required if under 1 year old and may also be required by older children

sodium chloride 0.9% (with/ without pre-added glucose 5%)

or

Hartmann's Solution

or

Solution Corporately Approved at Trust Level

Other Patients:

sodium chloride 0.45% with pre-added glucose 2.5% or 5%

All Patients:

Alter fluid rate according to clinical assessment. Change electrolyte and glucose content of infusion fluid according to test results.

COMMENCE ORAL FLUIDS & DISCONTINUE IV FLUIDS AS SOON AS POSSIBLE

CALCULATION OF 100% MAINTENANCE RATE

(a) for first 10 kg:	100 ml/kg/ day	=	4ml/kg/hr
(b) for second 10 kg:	50 ml/kg/ day	=	2ml/kg/hr
(c) for each kg over 20 kg:	20 ml/kg/ day	=	1ml/kg/hr

[for 100% daily maintenance add together (a) + (b) + (c)]

MAXIMUM: in females 80 mls per hour; in males 100 mls per hour

If risk of hyponatraemia is high consider initially reducing maintenance volume to two thirds of maintenance

Hypokalaemia (< 3.5 mmol/L): Check for initial deficit. Maintenance up to 40 mmol/L IV potassium usually needed after 24 hrs using pre-prepared potassium infusions as far as possible. Consult Trust Policy on IV strong potassium.
Oral intake and Medications: volumes of intake, medications & drug infusions must be considered in the fluid prescription.
Hypoglycaemia (< 3 mmol/L). Medical Emergency: give 5 ml/kg bolus of glucose 10%. Review maintenance fluid, consult with senior and recheck level after 15-30 mins. **INTRA-OPERATIVE PATIENTS:** consider monitoring plasma glucose.
Symptomatic Hyponatraemia: check U&E if patient developes nausea, vomiting, headache, irritability, altered level of consciousness, seizures or apnoea. This is a Medical Emergency and must be corrected.
Commence infusion of sodium chloride 2.7% at 2 ml/kg/hour initially and get senior advice immediately.

Appendix 2

Estimating the percentage dehydration based upon physical examination findings.

Estimated Percentage Dehydration	Physical Examination Findings
<3	History of fluid loss but no findings on physical examination
5	Dry oral mucous membranes but no panting or pathological tachycardia
7	Mild to moderate decreased skin turgor, dry oral mucous membranes, slight tachycardia, and normal pulse pressure.
10	Moderate to marked degree of decreased skin turgor, dry oral mucous membranes, tachycardia, and decreased pulse pressure.
12	Marked loss of skin turgor, dry oral mucous membranes, and significant signs of shock, pallor, cool peripheries, prolonged capillary refill time, hypotension, confusion.

Appendix 3

PAEDIATRIC HOSPITAL ACQUIRED HYPONATRAEMIA AUDIT

Laboratory Report Details (to be completed by audit dept)

Patient No. Patient Date of Birth:

Date of specimen: Time of specimen: Result :

Admission Details

Date of admission: Time of admission:

Diagnosis: 1.

2.

Hospital acquired hyponatramia (defn)

- Na ≥130mmol/l at time of admission, & a subsequent Na of < 130mmol/l whilst on IV fluids.
- Na< 130mmol/l on their initial U&E's, where the U&E's are done >48hrs after admission and they are on IV fluids.
- Admitted from another hospital with Na < 130mmol/l at time of admission whilst on IV fluids.

1. Is this hospital acquired hyponatraemia? Yes / No

   If no, reason: _____

   If yes, was it acquired whilst in this trust? Yes / No

   If no, patient transferred from: _____

Treatment and monitoring of hyponatraemia

2. Was the fluid prescribed appropriate? Yes / No

   If no, details: _____

3. Was IV fluid prescription reviewed 12hrly whilst on IV fluids? Yes / No

4. Were U&E done 24hrly whilst on IV fluids? Yes / No

Following the Na of <130mmol/l,

5. Was appropriate advice sought? Yes / No

   Grade: _____ Speciality: _____

6. Was the frequency of repeat U&Es appropriate? Yes / No

   If No, details: _____

Recording and communication of incidents (to be completed by Audit dept)

7. If yes to Q1, was adverse incident form completed? Yes / No

8. Was copy of form sent to other trust if acquired outside BHSCT? Yes / No

Triggers for potential adverse events related to the administration of intravenous fluids to children (1 month – 16 years old)

(adapted from Northern H&SCT policy)

CHOICE OF IV FLUID

1. Bolus fluid: use of a solution with sodium concentration of <131mmol/L for treatment of shock.
2. Deficit fluid: use of a solution with sodium concentration of <131mmol/L for correction.
3. Maintenance fluid: use of a solution with sodium concentration of <131mmol/L in a peri-operative patient (intraoperative period and first 24 hours following surgery).

BIOCHEMICAL ABNORMALITIES

4. Any episode of symptomatic hyponatraemia while in receipt of IV fluids.
5. Any episode of hypoglycaemia (blood glucose less than 3mmol/L) while in receipt of IV fluids.
6. Any episode of severe acute hyponatraemia (i.e. sodium level dropping from 135mmol/L or above to < 130mmol/L within 24hrs of starting IV treatment).

ASSESSMENT

7. Electrolytes not checked at least once per 24 hours in any patient receiving IV fluids exclusively.
8. Failure to record the calculations for fluid requirements on the prescription sheet.
9. Failure to note in the case notes/ prescription sheet a serum sodium of less than 130mmol/L.
10. Failure to document in the case notes the steps taken to correct a serum sodium of less than 130mmol/L.

If any of the above occurs an IR1 Form must be completed.

October 2010

Appendix 4

AVAILABILITY OF INTRAVENOUS FLUIDS THROUGHOUT THE BHSCT (500ML BAGS)

SITE	RGH	BCH	MPH	MATER
Sodium chloride				
Sodium chloride 0.45%	√	√		√
Sodium chloride 0.9%	√	√	√	√
Sodium chloride 1.8%	√	√	√	√
Sodium chloride 2.7%	√		√	√
Combined solutions				
Sodium chloride 0.45% Glucose 2.5%	√	√	√	
Sodium chloride 0.45% Glucose 5%	√		√	
Sodium chloride 0.9% Glucose 5%	√			
Glucose solutions				
Glucose 5%	√	√	√	√
Glucose 10%	√	√	√	√
Glucose 15%	√			
Glucose 20%	√	√		
Potassium containing solutions				
Glucose 5% 10mmol Potassium chloride	√			
Glucose 5% 20mmol Potassium chloride	√	√	√	
Glucose 5% 40mmol Potassium chloride	√	√	√	
Glucose 10% 10mmol Potassium chloride	√			√
Glucose 10% Sodium chloride 0.18% 10mmol Potassium chloride*	√			
Sodium chloride 0.45% Glucose 2.5% 10mmol Potassium chloride	√	√		
Sodium chloride 0.45% Glucose 2.5% 20mmol Potassium chloride	√			
Sodium chloride 0.45% Glucose 5% 10mmol Potassium chloride	√			
Sodium chloride 0.45% Glucose 5% 20mmol Potassium chloride	√			
Sodium chloride 0.9% 10mmol Potassium chloride	√			
Sodium chloride 0.9% 20mmol potassium chloride	√	√	√	√
Sodium chloride 0.9% 40mmol potassium chloride	√	√		

* commonly known as Basic solution

Sites: RGH = Royal Hospitals
BCH = Belfast City Hospital
MPH = Musgrave Park Hospital
MATER = Mater Hospital

Appendix 5

Sources of advice regarding Paediatric fluid therapy

For help and advice regarding

- management of fluid therapy
- especially to prevent and/or treat hyponatraemia

in all children, but especially for those children aged 13 – 16 years old being managed in adult wards,

please use the following sources of help and advice. Ordinarily, advice should be for complex cases and should be Consultant to Consultant discussions even though contact will often have to be made through trainee on-call rotas.

Team		Address	Extension
RBHSC Paediatricians	Paediatric On Call Rota	Allen Ward Musgrave Ward	Bleep [redacted]
RBHSC Paediatric ICU	Paediatric ICU		[redacted]
Musgrave Park	Orthopaedic theatre – Anaesthesia team during working hours.		
BCH Dufferin theatres	ENT theatre – Anaesthesia team during working hours.		
General Biochemistry	**Clinical Biochemistry**		
	Inside working hours	**Outside working hours**	
RVH Tie line: [redacted] Ext [redacted]	Ext [redacted]	Contact Medical doctor on call either via the laboratory or via switchboard.	
BCH Tie line: [redacted] Ext [redacted]	Ext [redacted]	Ext. [redacted] or Contact Medical doctor on call either via the laboratory or via switchboard	
MIH Tie line: [redacted] Ext. [redacted]	Ext. [redacted]	Contact Medical doctor on call either via the laboratory or via switchboard	

Other sources of help are:

1 APA consensus guideline on perioperative fluid management in Children
http://www.apagbi.org.uk/docs/Perioperative_Fluid_Management_2007.pdf

2 Royal Children's hospital Melbourne Clinical Practice Guidelines
Intravenous fluids
http://www.rch.org.au/clinicalguide/cpg.cfm?doc_id=5203#Other%20Resources

3 Royal Children's hospital Melbourne Clinical Practice Guidelines
Hyponatraemia
http://www.rch.org.au/clinicalguide/cpg.cfm?doc_id=8348

Appendix 6

Areas where it is permitted to stock/order No. 18 Solution* - as of August 2009

SERVICE GROUP	SITE	SPECIALITY	Stock on Ward	Named patient supply – consultant request only.
Clinical Services	RGH, BCH	High Dependency Unit	X	
Clinical Services	RGH, BCH, MATER	Intensive Care	X	
Clinical Services	Mater, BCH, RGH	Recovery Wards		X
Clinical Services	Mater, RGH	Theatres		X
Clinical Services	BCH	Tower Theatres		X
Clinical Services / OPMS	Mater, RGH, BCH	Day Procedure Units		X
Specialist Serv	RGH	Wards 4E and 4F (Neurosciences)		X
OPMS T&O	MPH	Recovery Ward - Orthopaedics		X
OPMS T&O	MPH	High Dependency Unit		X
OPMS T&O	MPH	Theatres - Orthopaedics		X
SS, Women, family and childcare	RBHSC	Barbour Renal	X	
SS, Women, family and childcare	RBHSC	PICU	X	

* "No. 18 Solution" = sodium chloride 0.18% and glucose 4%

Appendix 7

RQIA INDEPENDENT REVIEW - SEPTEMBER 2008 - RECOMMENDATIONS

Recommendation 1	All hospitals should monitor the ongoing use of No. 18 solution to enable assurance that infusions are removed from stock and general use in areas that treat children.
Recommendation 2	Where appropriate, hospitals must be able to demonstrate that an active strategy is in place for minimising risk of use in clinical areas that continue to stock No 18 solution and where children are accommodated. For example, provision of additional labelling or separate storage for those No.18 solution bags still stocked in such clinical areas.
Recommendation 3	All hospitals should continue with the ongoing work of disseminating clinical guidelines. This should be undertaken in conjunction with multidisciplinary awareness-raising and education on the use of the guidance and wall chart in all settings where children may be treated. This is particularly important in adult wards where older children are treated.
Recommendation 4	Independent hospitals must be assured that all visiting doctors who may manage patients up to 16 years old use the clinical guidelines when managing children being treated with intravenous infusions.
Recommendation 5	All hospitals should ensure that only the DHSSPS Paediatric Parenteral Fluid Therapy wall-chart *issued by DHSSPS in October 2007* is displayed in clinical areas where children may be treated, with a list of available local fluids available alongside it. All previous versions of the wall chart should be removed from clinical areas.
Recommendation 6	Hospitals should assure themselves that staff have the appropriate skill and knowledge in this clinical area. Competency assessment tools in administration of intravenous infusion to children should be developed, formalised and implemented for all relevant, multi-professional staff.
Recommendation 7	Hospitals should continue to review, collaborate and implement organisation wide policy and guidelines, in relation to intravenous infusion for children.
Recommendation 8	All hospitals should ensure that the development and provision of multidisciplinary education opportunities in administration of intravenous infusion to children and that all relevant clinical staff uptake this education.
Recommendation 9	Hospitals should develop mechanisms to identify the location of patients aged 14-16 years who are in adult wards and ensure staff who care for those children are provided with competency based, assessed education in administration of intravenous infusion to children.
Recommendation 10	All hospitals should make wider use of training sources available such as BMJ E-Learning Module on Hyponatraemia to address different learning styles and devise a mechanism to ensure 100% multi-professional uptake of such learning.
Recommendation 11	Priority must be given to the completion of a Trust-wide review, and implementation of revised paediatric intravenous fluid prescription and

fluid balance charts in all settings where children may be treated including adult wards where children are treated.

Recommendation 12 All hospitals should develop a culture of incident reporting, analysis and learning generally and specifically in respect of intravenous fluids and hyponatraemia.

Recommendation 13 Plans for development of systems for reporting, analysing and monitoring incidents to assure organisations of safe practice and that actions linked to NPSA Alert 22 should be implemented and regularly audited by all hospitals to ensure adherence to the process.

Recommendation 14 The development of 'trigger lists' that have been adopted by a the Antrim Area Hospital to aid understanding of the types of incidents to be reported should be shared and taken up more widely .

Recommendation 15 The development of an audit tool which may include wider aspects but should address as a minimum aspects of NPSA Alert 22 should continue to be progressed and used at least annually.

Recommendation 16 Trusts should continue to seek approval and funding for a regional audit (GAIN proposal) on the uptake of the Paediatric Parenteral Fluid Therapy guideline and potential unexpected clinical consequences of the guideline.