Tuesday, 15 January 2013

(10.00 am)

(Delay in proceedings)

(10.31 am)

PROFESSOR FENELLA KIRKHAM (continued)

PROFESSOR DIETZ RATING (continued)

Questions from MS ANYADIKE-DANES (continued)

THE CHAIRMAN: Good morning. I'm sorry for the delay; there were a few questions to be sorted out before we started, but we're ready now. Thank you.

MS ANYADIKE-DANES: Good morning. If I may go to one of the first points that I had put to you, which is to do with blood loss. Professor Kirkham, this goes to one of your risk factors, if I can put it that way. We had touched on it a little bit yesterday, but just for clarity, the issue is this: Dr Taylor, who was the person who said there had been substantial blood loss, mistakenly believed that Adam had lost a lot of blood due to a blood gas reading of 6.1 at 9.32.

There is an issue as to whether that figure was actually mostly due to haemodilution, too much fluid, as opposed to actual blood loss. That's the issue between Mr Keane, the surgeon, and Dr Taylor. The packed cells and the HPPF were given at 250 ml at 9.30 and 250 ml at 10.45, which is on that chart that I showed you

yesterday, and then more red cells were given than were lost, according to Simon Haynes, the inquiry's expert paediatric anaesthetist, and he says that, just for recording purposes, at 204-006-336, and also on to 337.

If one looks at it in this way, Adam's haemoglobin was 10.5 at 7, 6.1 at 9.30 and then 10.6 at 11.30. And the issue is that that perhaps suggests that Adam was overtransfused and his haemoglobin is noted at 4 am on the 28th.

So the question on the basis of that information -- and I recognise that none of it is particularly conclusive because there are different views as to what actually was happening with the blood -- is: do you still consider that an acute dilutional hyponatraemia could cause the additional hypoxia required to overcome the brain's compensatory mechanism?

PROFESSOR KIRKHAM: The dilutional hyponatraemia could cause hypoxia?

Q. No, the acute dilutional anaemia.

PROFESSOR KIRKHAM: The anaemia could cause enough hypoxia?

Q. To overcome the brain's compensatory mechanisms. As I understood what you had said to the chairman yesterday, those cells go out, pumping out their sodium, unless something happens to interfere with that. They require energy, so if those cells are damaged in such

a way as to prevent them doing that, then that is one of the ways in which the brain's compensatory mechanism would become overwhelmed or at least compromised, if I can put it that way.

PROFESSOR KIRKHAM: I do think that the degree of anaemia ... If hyponatraemia played a role, then I think there must have been some additional hypoxia to have overwhelmed the sodium pumping mechanisms, and acute anaemia, whether it's blood loss -- as I suspect -- or dilutional, would be a risk factor for having hypoxia.

Q. Yes. But having said that, does the evidence so far as we have been able to gather it point to sufficient blood loss to have had that effect?

PROFESSOR KIRKHAM: Well, the haemoglobin fell from 10 to 6.1, so that is about a 40 per cent drop in haemoglobin.

Q. But if that's doing that because it's haemodilutional, in other words it's recording that because it's actually fluid as opposed to actually blood, if I can put it that way, so if that's the reason why it is falling, does that remain part of your factor in it being able to have the effects that you've ascribed to it, if it were just blood?

PROFESSOR KIRKHAM: Well, I don't think there's any data that I know of on dilutional anaemia, whether that would

cause sufficient hypoxia. There is available data on blood loss, and I think that could be an additional risk factor. But I don't know of any data on dilutional anaemia causing sufficient hypoxia to stop the sodium-pumping mechanism.

Q. In other words, you can get as far as anaemia being a factor, but what kind of anaemia is not something that's sufficiently clear in the research?

PROFESSOR KIRKHAM: As far as I know. I don't know of any data on dilutional anaemia.

Q. Thank you.

THE CHAIRMAN: Sorry, professor, you prefaced that answer by saying if hyponatraemia played a role. I understood that you did accept that hyponatraemia played a role, but you didn't accept that it played the primary role. Do you not accept that it played a role at all?

PROFESSOR KIRKHAM: I don't think that the hyponatraemia on its own played a role, no.

THE CHAIRMAN: Sorry, maybe it's a difference in language. "Playing a role" means being a cause, whether primary or secondary. Do you accept that hyponatraemia played a role in Adam's death?

PROFESSOR KIRKHAM: Not on its own, no. If hyponatraemia played a role, there would have had to have been hypoxia as well.

THE CHAIRMAN: But does that mean it may have played a secondary role but not a primary role?
PROFESSOR KIRKHAM: I don't think there's any evidence that it played a secondary role. I think there would have had to have been hypoxia for it to have played a primary or a secondary role.
THE CHAIRMAN: If it didn't play a primary role and it didn't play a secondary role, then your evidence is that hyponatraemia played no part in Adam's death?
PROFESSOR KIRKHAM: I think, on the balance of probabilities, the cause of Adam's death was not the hyponatraemia.
MS ANYADIKE-DANES: Can I just pick up on that? Because I just want to be sure that we're understanding the same thing about roles and parts. So can I put it this way: in your view, was hyponatraemia a factor at all in Adam's death?
PROFESSOR KIRKHAM: Not unless there was hypoxia and we have no evidence that there was hypoxia.
THE CHAIRMAN: So the answer's no?
MS ANYADIKE-DANES: The answer is no.
THE CHAIRMAN: It's quite clear. Whether it's described as a role or whether it's described as a factor, Professor Kirkham's evidence is that hyponatraemia did not play a part in Adam's death. That's it. I don't

think we need to keep going back over it. I have to say, I didn't quite understand Professor Kirkham's evidence previously to be as stark as that, but I now understand that Professor Kirkham is saying that hyponatraemia had nothing to do with Adam's death.
MR FORTUNE: I'm in the same position as you, sir.
THE CHAIRMAN: There it is, that's the professor's evidence.
MS ANYADIKE-DANES: So -- because it might affect some of the other things we ask you -- when you say there was no evidence of hypoxia, there's no evidence of a number of other things that you say might necessarily be relevant, and there's no evidence of those things because the means by which to get that evidence wasn't available or wasn't sufficiently sophisticated for it to be seen. Is hypoxia one of those things?
PROFESSOR KIRKHAM: Yes, I think -- we don't have any evidence that there was hypoxia. His saturations were absolutely fine throughout the operation, so there is no systemic hypoxia. The available evidence on dilutional anaemia I don't think gives us reason to think that there would be hypoxia, and my understanding of the autopsy was that there wasn't evidence of hypoxia at autopsy.
Q. I'm just going to get something in a minute because it's one of those areas that became a little unclear, if I

can put it that way. There was an issue as to the extent to which Dr Armour had shown certain slides to other doctors. One of them was a neuropathologist, Dr Mirakhur. But there is a note from the coroner in relation to two others to whom she might have shown the slides. It is a note of 8 December 1995, I believe, from memory.

But in any event, in that note, it refers to those two doctors seeing evidence of hypoxia. So that's why I'm asking you, is it possible that at that stage -- and maybe it wasn't looked for in the way that Dr Squier has said certain things were not looked for -- is it possible that there might be hypoxia that was not detected?
PROFESSOR KIRKHAM: What does Dr Squier say about hypoxia?
Q. Let me just put this to you for a moment now that I've mentioned it. It's 011-025-125. It's in that final paragraph about halfway down:

"Today, Dr Armour showed slides [et cetera] to Dr O'Hara and Dr Bharucha. Both stated that there was clear evidence of hypoxia/anoxia/anaphylactic reaction. Those are virtually all the same thing."

In fact, it was because of that that they thought there might have been a problem with the anaesthetic equipment and the anaesthetic equipment was examined.

THE CHAIRMAN: Whose note is this?
MS ANYADIKE-DANES: This is the coroner's note.
PROFESSOR KIRKHAM: What does Dr Squier say about the --
Q. I don't know that immediately, I'd have to check. What I'm asking you is: if there was hypoxia, then does that make the hyponatraemia a relevant factor in Adam's death?
PROFESSOR KIRKHAM: Well, if there was hypoxia, it makes the hypoxia the strongest factor in Adam's death, but that would also mean that the sodium pumps weren't working and therefore there would be more swelling. But the hypoxia itself would have to be the major factor. Hypoxic brain damage is a very, very major problem for children of all ages.
Q. I only raise this because when the chairman asked you, you said "not unless there was hypoxia", so I'm trying to tease out what do you regard in any of the circumstances as being the potential relevance of his hyponatraemia. We are going to deal with this a little bit more when we actually get into the hyponatraemia, but now that the chairman has asked the question and you have answered in the way that you have, I'm trying to see if we can distinguish some of these things.
PROFESSOR KIRKHAM: Well, I think if there was hypoxia, then one would have to say that the sodium pumps may have

failed and that would have increased the cerebral oedema -- the risk of significant cerebral oedema.

Q. And in those circumstances, could the hyponatraemia have been relevant?

PROFESSOR KIRKHAM: In those circumstances, the hyponatraemia might have played a role, although I have to say that if there's hypoxia I would put most of the blame on the hypoxia rather than the hyponatraemia.

Q. Okay. I think Dr Squier on hypoxia can be found at 206-002-005. I think it's where she refers to "hypoxic ischaemic injury":

"There is no significant pathology to indicate this in the brain. Only a few cells in the dorsal pons show early neuronal death."

And so on.

There was an issue as to whether him being on a ventilator for 24 hours might have affected things.

But then Dr Squier does not see pathology for some of the things that you are suggesting might be relevant. Sometimes she doesn't see them because it's too early perhaps to see them and other times she doesn't see them because the relevant part where you might see them has not been examined.

PROFESSOR KIRKHAM: Well, my understanding of neuropathology undertaken by an expert such as Dr Squier would be that

more subtle abnormalities such as venous sinus thrombosis might be quite tricky to diagnose, but hypoxic brain damage is very much ...

Q. You'd expect her to see that?

PROFESSOR KIRKHAM: It's a common problem and the stains should have been done by Dr Armour to look for hypoxia. And assuming Dr Squier had access to all the material I would expect her to be able to say very clearly whether there was hypoxia or not. It would be unusual to have had hypoxic brain damage and not to be able to see it at post-mortem if it was really there.

Q. Dr Armour didn't see it. That's why it was an issue when the coroner made the note that he did. But Dr Armour didn't see it at autopsy and this --

PROFESSOR KIRKHAM: And Dr Squier didn't see it. Could we just go back again to the people who may have seen it? What evidence do we have that they really did see the slides?

Q. I'm just trying to ... I think it's 011-025-125. Yes. This is dated 8 December. I think the autopsy was done on 29 November, I believe. Where we see again is:

"Today, Dr Armour showed slides to Dr O'Hara [who is a pathologist] and Dr Bharucha. Both stated that there was clear evidence of hypoxia."

PROFESSOR KIRKHAM: Has Dr Armour confirmed that she did

slow the slides to those two doctors?

Q. No.

PROFESSOR KIRKHAM: No?

Q. No. Well, I mean -- sorry, I think that it's not clear whether people don't remember what they did. We have had no positive evidence.

THE CHAIRMAN: The problem, professor, is Dr O'Hara, who's referred to there, is dead, and this issue arose before he could be quizzed about it. Dr Bharucha had no recollection of these events at all.

PROFESSOR KIRKHAM: Okay. Well, the slides are available and Dr Squier, who's an expert, has been asked to look at them, and she didn't find any evidence of hypoxia and Dr Armour's report didn't find any evidence of hypoxia.

MS ANYADIKE-DANES: If we leave Dr Armour's report to one side for a moment because there might be a conflict between Dr Armour and Dr O'Hara. We'll never be able to resolve that. But Dr Squier in her report at 206-008-118, I think she says that it might take 24 hours to show those signs. There it is there:

"The classical reactive changes which characterise hypoxic damage may not have had time to become fully apparent."

PROFESSOR KIRKHAM: Well, I would accept that. Dr Squier is an expert and she's saying that she can't see any

evidence of hypoxia, but she can't completely exclude it. If there was hypoxia, then that would cause massive brain swelling. I mean, you get swelling after hypoxic insults in head injury, in cardiac arrest. The hypoxia causes a lot of swelling.

Q. Just so I understand what you're saying: are you saying that if there was hypoxia, that is what would have actually led to the cell death, that's what would have affected the ability of the brain to pump out the sodium? And that would have been enough, irrespective of whether you were getting contributory oedema from the hyponatraemia?

PROFESSOR KIRKHAM: Yes. Hypoxia, once you have hypoxia, you have got brain swelling and significant risk of significant damage.

Q. We are going to come on to that whole issue of hyponatraemia in just a minute.

Can I just deal with two other things that arose yesterday? One is that another of your risk factors was the speech. I think it was part of his subtle neurological problems, the particular way he used his mouth to form his speech or his difficulty with speech in certain respects and also the action of his mouth as he was eating as opposed to not wanting to eat.

I think you might have placed some significance on

the fact that he attended a speech clinic. Would it make any difference to how you receive those facts about the way his mouth action operated if you were told he wasn't seeing a speech therapist, actually he was attending a feeding clinic?

PROFESSOR KIRKHAM: Um ... Well, Dr Coulthard made the point at the experts' meeting that a lot of children with renal failure have feeding problems.

Q. Yes.

PROFESSOR KIRKHAM: And I would accept that many children with renal failure would need feeding clinic from that point of view. The speech and language therapists who saw him mentioned that he'd had expressive language problems as well, but if it really was just a feeding clinic then one would have to accept that's a component of having chronic renal failure.

Q. And then what is the significance of the particular feeding action that was described? Does that remain a risk factor or is that just part of what they were trying to deal with because that's an idiosyncrasy to do with him?

PROFESSOR KIRKHAM: I think Dr Coulthard wasn't entirely clear exactly what the cause of the problems in feeding are in chronic renal failure. My personal interpretation would be that it might be anorexia, that

you didn't feel like eating, and that wouldn't usually be associated with any problems in chewing of the sort that were described by the feeding clinic or the speech and language therapists. So I would expect more of a problem with not wanting to eat rather than difficulty in chewing. But I'd have to really check with Dr Coulthard as to what he thinks the problem is with children with chronic renal failure.

Q. So absent that, for you, the particular action that is described is still significant?

PROFESSOR KIRKHAM: I think so. I mean, I did a renal job as an SHO and the children I saw didn't fancy eating rather than had chewing problems. But I think it's -- I don't look after children with chronic renal failure now, so the world may have moved on, but my understanding is that it would be an anorexia rather than difficulty chewing.

MR FORTUNE: Could we find out from Professor Kirkham whether, if a child is being fed through a tube and therefore not exercising the muscles that you would expect to be exercised in that way, whether that makes any difference, firstly, to the ability to speak, or secondly, the need to attend a speech therapy clinic?

PROFESSOR KIRKHAM: I think the situation with mouth movements is usually a fixed problem, a static problem.

I think you're implying that perhaps there might be a lack of exercise of the mouth muscles. I don't think I've ever seen that. Most children chew if they can and they ... I don't think that if you have a nasogastric tube that would stop you being able to chew. I know of no evidence of that.

MS ANYADIKE-DANES: Okay. Then can I go back to the point that the two of you had asked about, which was the blood pressure in PICU? I think, Professor Rating, you were particularly interested in that, and you also wanted to know if we could identify the time at which the medication was prescribed to address that. We can do that in this way. The information from PICU can be found in a series, it starts at -- if these could be pulled up relatively quickly one after the other, 057-009-010. These are the PICU records. Then after that, 010A.

PROFESSOR RATING: Sorry, sorry, the time is -- oh, I see, 12 o'clock, okay.

Q. Yes. Then after that, I'm just going to show you what there is, and then you can identify what you would particularly like to look at. This of course is showing the blood pressure there. Then there's 010A. This might be relevant, I'm not sure that the other charts are relevant for your purposes, but there's also

057-009-012.

Then, just to show you some of that graphically, we've put together two of the printouts, the printout from the surgery and then the printout from the monitor in PICU, and the new combined chart is at 306-108-001. So then you see that series. You had seen up to 12 -- I think you, Professor Rating, had seen yesterday, which was during surgery, then we've added on to that the monitor, which goes up to practically 5 o'clock, really, for when he was in PICU. If you look at the middle band, that shows graphically at least what the monitor was showing.

Then in terms of what the medical notes and records show, I'm not going to pull all these up, but there is a series that goes from -- perhaps pull up the first one -- 058-035-135. It goes on to 142, so these are the extracts from his medical notes and records, and you can see that it starts there at 12.05, you see his blood pressure is 118/78 and his central venous pressure is about 30. This is the entry made by Dr O'Connor.

In terms of when the inotropes were given, which is nifedipine, one sees that at 058-005-011. You can see 5 milligrams is given at 1.30, and that's signed off. And then another 5 milligrams is given at 1.55. Then if one goes over the page, you see it there under the

heading "regular non-parenteral drugs".

As to why it was being given, one sees that in the notes, and if I just pull out two pages to have alongside each other, 058-035-137 and 138. Then you can see under "1 pm", this, I think -- I'm not quite sure whose writing that is there, but anyway you can see three lines up from the bottom:

"Dilated pupils on examination with bilateral papilloedema and haemorrhages, CVP 12 but steadily rising BP over the past hour."

And then you can see at the top of the other:

"Response needs anti-hypertensive, BP now 170/100."

And then if we pull up 139, the next page, we can see at 5.10:

"Decerebrate movements, BP was 145/110 earlier, had 10 milligrams. If persistently high later ..."

And then there's what to do about that.

So that's the information we have of what his blood pressure was after his surgery. That's the information we have as to what was prescribed to address that.

PROFESSOR KIRKHAM: One of the questions I had yesterday was when the inotropes were stopped; do we have that? Because he was given inotropes to perfuse the kidney or perhaps it was that Dr Taylor gave the extra fluid to perfuse the kidney. Did he have inotropes? I thought

he was given dopamine.

Q. He was given dopamine.

PROFESSOR KIRKHAM: And I wonder when that was switched off.

Q. I'll have to find that for you. Yes, if we could go back to 058-005-012. Look under "E" at the top, "regular parenteral drugs: dopamine".

MR UBEROI: If I can assist, if memory serves me correctly, there was some confusion over this, sir. Dr Taylor was able to say he gave the dopamine at a particular stage in the operations, but couldn't recall a time. It was around 10 am, but he couldn't be precise.

PROFESSOR RATING: Yes, that's it.

THE CHAIRMAN: Thank you.

PROFESSOR RATING: And it was one bolus, not an infusion, I have in my mind, but I don't know. It was not a permanent infusion, but I thought it was one bolus.

MS ANYADIKE-DANES: I think he might have given two, actually.

MR UBEROI: I think the language used was two small boluses.

MS ANYADIKE-DANES: Yes, but during the course of an operation.

PROFESSOR RATING: Yes, but not an infusion with it. For an infusion for a time going on for one or two hours, or something like that. Two times a bolus, yes.

Q. Now that we have given you the best information we can

on those issues, where does that take you as to the matters you thought were of concern yesterday?

PROFESSOR KIRKHAM: Well, Adam was given fluid, and I think the plasma expander, HASS, I think he was given, and the boluses of dopamine to make sure that his adult-sized kidney was perfused. However, once that stopped, his blood pressure continued extremely high, and it's not entirely clear why it was so high, but I think raised intracranial pressure is probably a very reasonable explanation of why the blood pressure stayed so high on intensive care. I don't think that we have any disagreement about the fact that he had raised intracranial pressure on intensive care and the most likely diagnosis would be that high blood pressure was secondary to the raised intracranial pressure.

Q. Yes. For Professor Rating, the reference to the boluses as opposed to the transfusion can be seen at 011-014-101. About seven lines down from the top:

"There are two small increases in the systolic BP at around 10 am, corresponding to two small boluses of dopamine."

And I think both of you had asked us to find out if there was a target blood pressure they were aiming for, bearing in mind they were going to transplant a very nearly adult size kidney. The answer that I've been

given is that there wasn't, actually. What they were trying to do, at least, was to ensure that it didn't fall below its starting value. But there didn't seem to be an agreed value that they were aiming for. And the evidence when both Dr Taylor and Mr Keane were asked about that in terms of what you do to try and give the kidney its optimum chance -- the evidence was all about the level of central venous pressure that you're trying to achieve. They didn't really give any evidence of the blood pressure. CVP.

PROFESSOR RATING: I don't understand and I don't believe ...

Q. That was the evidence.

PROFESSOR RATING: Because for the surviving of the kidneys, the central venous pressure may have some influence, but it's most important the arterial side.

Q. That seemed to be the evidence. We can check it again.

PROFESSOR RATING: You should have second. And I remember that in the discussion with Professor Coulthard, he made the point that it is usually done to give a little increase. That's in the statement of Dr Coulthard. I would think that they would want to have it because he started with diastolic pressure of around about 50, they want to have it at 70 or something like that, but not those high levels at the end of the operation and during

the PICU. That has nothing to do with increasing the pressure for the kidney, but has to do much with the perfusion of the brain, the brain needs ...

Q. Yes. I understand that your view is that the arterial pressure was what was important and, if you're going to elevate anything, to elevate that. All I'm saying is that the evidence the inquiry received is that the focus was on the CVP. That is what caused the --

PROFESSOR RATING: I don't believe -- sorry, I will never argue against ... I don't believe that you have it right in your memory. Dr Coulthard spoke of arterial pressure --

Q. Not Dr Coulthard, sorry, the evidence of the surgeon and the anaesthetist as to what they were trying to achieve and the concerns they had.

PROFESSOR RATING: Sorry, okay.

Q. That's what it was. And their concern and the discussion to the extent that any discussion happened between them was about CVP.

PROFESSOR RATING: Okay, fine.

Q. Okay. But in any event, do I understand what you're saying is that the higher pressures are, you consider, related to or caused by the fact that his intracranial pressure was high and not that the doctors were trying to raise the pressure because the doctors would not be

trying to raise the pressure to that level and that even after the medication had been stopped, his pressures remained abnormally high; is that what you're saying?

PROFESSOR KIRKHAM: I think that during the operation, the pressures are high. He's being given colloid and blood and fluid to try to maintain kidney perfusion and dopamine, oral, to try to keep ... So I think the initial issue is hypertension, deliberate hypertension to perfuse an adult kidney. And I think that that hypertension was significant for him because he then gets papilloedema with haemorrhages, so I think he has a degree of hypertensive encephalopathy from the hypertension to perfuse that kidney, and then when he's on intensive care, I think that some of the hypertension is almost certainly related to raised intracranial pressure, secondary to the hypertensive encephalopathy. That's a scenario I've definitely seen in my 1984 patient.

Q. Thank you.

PROFESSOR RATING: Could we say due to high intracranial pressure, not due to hypertensive encephalopathy? Can we agree on intracranial pressure?

PROFESSOR KIRKHAM: I think he had hypertensive encephalopathy.

PROFESSOR RATING: Yes, but it's different. We are speaking

of hypertonic encephalopathy or however we speak of a high intracranial pressure.

PROFESSOR KIRKHAM: No, I agree, but I would like to distinguish that. I think he had hypertensive encephalopathy and then he had high intracranial pressure, at least in part, related to that.

Q. You had been raising the issue of the significance of -- at least, I think Professor Rating, you were wanting to look again at the paper of Shiau in relation to the role of intracranial pressure and the evidence you might expect to see of renal haemorrhage. Your view was that you would expect to see renal haemorrhage. And I think you undertook to have a look at that paper over the evening.

I think that paper has been circulated, it's to be found at 306-109-001. It's titled:

"Retinal haemorrhages in children. The role of intracranial pressure."

PROFESSOR RATING: I have to say that I didn't read the paper because I didn't get it last evening. Sorry, she went to bed --

PROFESSOR KIRKHAM: Apologies.

PROFESSOR RATING: I have not seen it, I have not read it, therefore I cannot argue on that. I can do it during the lunchtime and then comment on this. Sorry.

Q. We will break maybe shortly -- we'll have a break at some point this morning, and maybe you could take an opportunity to look at it.

THE CHAIRMAN: Let's move on, we'll cover the next issue, and then that can be read at the break.

MS ANYADIKE-DANES: Yes.

PROFESSOR RATING: Should I read it now?

THE CHAIRMAN: No, we'll move on.

MS ANYADIKE-DANES: There'll be a break. We'll move on.

PROFESSOR RATING: Is it possible to have a copy, not on the screen?

MS ANYADIKE-DANES: Yes, of course. We can provide you with one during the break.

You have sort of been dealing with this on various points, and the raised intracranial pressure is one of them, and the answer to the chairman is another area. But I want to focus directly now on the differences between you in relation to the dilutional hyponatraemia and its role.

If I could start with you, first, Professor Rating, just so that I understand one thing. Are you able to identify cases reported in the literature of isolated acute hyponatraemia with documented intracranial hypertension and/or death?

PROFESSOR RATING: As in the sense as it is needed here for

this inquiry? No.
Q. You did, though, provide --
THE CHAIRMAN: Sorry. Why do you think that is?
PROFESSOR RATING: Because the papers where the deaths are described are older and by that there is quite a lot of missing data, and by that everyone can see: that's not looked after, that's not looked after, that's not looked after. That's the problem with this situation because it is an old situation, which happens nowadays -- I would not say no more, but very seldom -- and when it happens, it is in small hospitals where it's not investigated, as had to become investigated, and so on. By that, there's a difficulty with this, from the paperwork.
MS ANYADIKE-DANES: I think, though --
PROFESSOR RATING: There are quite a lot, even if you go to ... I have spent half the night searching the Internet for further papers on that to the basic science, and every basic science paper, even in the last year, started with: there are deaths in children or in adults with dilutional hyponatraemia, and they probably have to investigate that and that. That means the papers are all reflecting to these old data that patients with dilutional hyponatraemia died. But the evidence -- and there Professor Kirkham is very clear --

if you look there, which are those cases and you can start: that is not given, that is not given, that is not given. It is not as convincing as it is or as it should be because data are missing. There's no intracranial pressure from Arieff's group that has been published, but you can all criticise these papers because they would not fulfil the criteria you need in this moment to be quite sure about that.
THE CHAIRMAN: Can I ask you: just as we finished yesterday afternoon, I asked Professor Kirkham on the issue of why it seemed to me to be counter-intuitive or unexpected that if you give a child an excessive amount of fluid which is low in sodium and that brings down the child's sodium level, why would the child not die?
PROFESSOR RATING: You have to realise that medicine is not a basic science. That means that if one position was reached, then the cascade had to go in that and that and that direction. I think it's a great difference -- I mean, if you have ten children brought nearly in the same time from a sodium of 135 to, say, 120, not all will die.
THE CHAIRMAN: Yes.
PROFESSOR RATING: But maybe some will die because the genetic impact on the fluxes, on the membranes, they are different, but all will come into great problems, and

part of them, let's say [inaudible] 10, a part of them will die.
THE CHAIRMAN: So in the same way as some people who get pneumonia die and some people who get pneumonia live, some people who get cancer die, some people who get cancer live, it depends on a number of other factors.
PROFESSOR RATING: On a number of other factors, yes. But all the children became really difficulties, they will get difficulties if they are ... They will not be quite happy with 120 sodium concentration. They are ill, severely ill, but some will survive and some will die.
THE CHAIRMAN: And some can be brought back from 120?
PROFESSOR RATING: Yes.
THE CHAIRMAN: That depends on things like whether it's recognised that they're seriously ill and how --
PROFESSOR RATING: No, even if they have the same protocol, it's impossible to do such a protocol, but only thinking of ... They brought down from 135 to 120 within one hour. Let's say that's our ... And then they left there. Not everybody will die. I think Adam, because of his renal failure, had problems because he could not get rid of water and you could not correct the water in the body and the brain as quick as a child which is healthy.
THE CHAIRMAN: Thank you.

MS ANYADIKE-DANES: When you said that the problem about looking at the papers and the research or the studies that were done previously around about the time for Adam's case, or that era, if I can put it that way, the problem about that, I think you were saying, is that when you look at the papers, they don't now include the sorts of things that, for example, Professor Kirkham and yourself would discuss now to be able to distinguish better what exactly was going on. If that's the case, how can people be so confident that those children died of hyponatraemia?
PROFESSOR RATING: Difficult question. Can I come back to it another way?
Q. Yes.
PROFESSOR RATING: Professor Kirkham stated that she had not found any good evidence that the velocity of decrease of sodium in the cell(?) is of any greater impact. That was one of them which I have made last night, that I have found basic work from a Mexican group, coming from Mexico, I have sent it this morning to you, and one of these papers described in experimental design that ... And that is the paper of Pasantes:
"Mechanisms counteracting ... adapting ..."
Wait a minute. Regarding the cell swelling, there is a difference in between an acute and more gradual

decrease of sodium concentration in plasma.

Q. Sorry, let me pull it up and see if it's this. Is it 306-113-001:

"Mechanisms counteracting swelling in brain cells during hyponatraemia"?

PROFESSOR RATING: Yes. There it is, and it is clearly shown that it is different in regard to brain swelling. It's a nice paper reporting much on swelling of cells. And I learned by this that there is a very, very quick response and counteraction that ions were taking out. It was really in between minutes it started. But it was an indifference(?) if you make it very, very quick or if you make it more gradually, and if you make it more gradually there is no cell volume change at all in it. If you do it very quick, cell volume increase in it.

That's my first argument in the direction that the velocity has nothing to do with ... The other cases coming from the literature, as bad or as good as you like, that is very clearly stated of everybody who started to write on that, that it is the difficult first of the acute hyponatraemia and then the second, the correction of a chronic hyponatraemia, which is a pitfall that children can die. I find it very interesting that in this basic work they have reproduced cell damage [inaudible] in the other case when they make

a very quick correction of the Natrium in a hyponatraemic stage which were chronically then they could show all the cell death. But they were in this moment they have difficulty to do it the other way round. I cannot tell you why, I am not ... Maybe I have not found right papers in this moment. There is one sentence in this that, again, from the basic researchers, they wrote a sentence that this very quick counteracting actions can be overrun by ... If it is too quick, if the decrease is coming up too quickly.

But there is no really good data on it.

Q. I wanted to ask you about that.

THE CHAIRMAN: Sorry, I need to clarify that answer. You were saying after you referred to this paper, you said -- I just need to --it's not quite clear to me what you're saying. You said it's a nice paper reporting much on the swelling of cells. And you then said:

"That's my first argument in the direction that the velocity has nothing to do with ..."

To do with what?

PROFESSOR RATING: This was a statement of Professor Kirkham, that she has not seen any paper in which the velocity of decrease has any impact on it. That was one of my criticisms when she made some sort of classification for the hyponatraemic state, that she

omitted, and that I have brought out in my second report very clearly, that you have principle to distinguish between the acute and the chronic. And if you mix them up, then you will be lost. And she made the statement at the time that she had not found any paper which convincingly shows that the velocity and the timescale is of any greater impact. And therefore, this is a basic experimental cell model where it is shown that it has influence on the cell volume whether the gradient is coming down quickly or it's going gradually.

THE CHAIRMAN: So if it's coming down quickly because too much fluid is being given in too short a time, then the rate of decrease in a short time is -- that's more serious?

PROFESSOR RATING: Yes.

THE CHAIRMAN: Sorry, is that more serious than a gradual decline?

PROFESSOR RATING: Yes. In my thinking, yes. She says not because she has not found convincing evidence for the time schedule. For me, it is very clear because you are more often confronted with a patient chronically ill, coming in a clinic, and you find during either hyponatraemic states and hypernatraemiaic states in a chronic way and they are breathing and walking, but they are not so fit as usual. But you can stand for

a long time, hyper and hyponatraemic states, when these stages were reached slowly.

THE CHAIRMAN: Is it more difficult then to reverse a very speedy decline?

PROFESSOR RATING: The problem with the speedy decline, in which way you have to correct it, is really very, very tricky because you must be very -- you have to meet(?) the information. It is only three, four, five hours, it is 12 hours, 24 hours. Beyond 12, 24 hours, then the acute goes in the direction of a chronic hyponatraemia and the chronic hyponatraemia, you have to correct very, very slowly. You can only make one mistake to correct it too quickly. And in the first 12 hours, you really have the difficulty to make a good infusion schedule to bring the patient back to normal. But yes, somebody has written it, you are damned if you correct it and you are damned if you don't correct it.

THE CHAIRMAN: On any of the cases which appear in the literature, is there an example of an excess of fluid being given in such a short period as two to three hours?

PROFESSOR RATING: I have not found it an intravenous way. There are some papers where children have drunk quite a lot of time. There is one paper you cited that would be a good example, but this was a lady who made it for

a longer time, that means it was chronic hyponatraemia. There is a paper with a boy, between 1 or 2.5 hours, or something like that, drank 4 litres of water. But he has a normal kidney and he belonged to the ... And he has very low sodium concentrations and he survived.

THE CHAIRMAN: Okay. Whereas Adam got this in a very short period, Adam got an excess of fluid and didn't survive and did not have a working kidney. In fact, that was the point of the operation.

PROFESSOR RATING: Maybe that it is a contributing factor. For me, it is a contributing factor because if the body starts to ... His regulation, then you need your kidney to bring out, for example, water. And that was for Adam not possible because he couldn't regulate his water. The boy with the 4 litres of water started immediately to excrete quite a lot of water. But everybody knows who started to drink a lot of water in a short time, you have to go to the toilet. And that's the same too. But that was not possible for Adam. That means that his potency to regulate the water income was reduced.

THE CHAIRMAN: Okay, thank you.

MS ANYADIKE-DANES: Can I ask you to clarify something about the rate of change? When the experts met in Newcastle, there was quite a bit of discussion about that, and the example that Dr Coulthard gave is of children, very

often babies, who have very low serum sodium levels, and his example was you have to be very careful about how you raise the serum sodium level to within the normal parameters because if you do it too quickly you can kill them. It seems an odd thing to do. You'd think that you'd want to get them to something normal as quickly as possible, but no --

PROFESSOR RATING: I tried to have said this, but I have not said it, sorry.

Q. Okay, that's fine. And I think to some extent Dr Haynes agreed with him about that.

PROFESSOR RATING: Yes.

Q. He then had to deduce that it worked in exactly the same way the other way round, so if you started with a child who had normal parameters of serum sodium and that child was taken to very low serum sodium levels very quickly, it would be the same as if you started low and raised them to normal very quickly. But he wasn't able to identify any paper or research that showed it did work precisely the same way round. Are you able to point to anything that shows it does work the other way round?

PROFESSOR RATING: When I came here to Belfast, I didn't realise that these are the most important point. Therefore, I have looked a little bit in Heidelberg for it, but not as deeply. And therefore overnight I stayed

on the Internet, searching for it. I can only say that basic sign(?) has done science on this, there is a greater band of literature. I was not able to read them and to come to a really hard conclusion, but I realised that is much more written about the other way round, that you have hyponatraemic going quick, then you have brain damage. That is very many papers show that. But the other way round, that you have a normal going down and then to show in animal experiments the brain damage, they have difficulty with it.

Q. Thank you. You did provide us with a paper, and I'm hoping that you can help us with the significance of it, of a study that was done of pigs. That's the Witt paper in 2010. The reference for that is 306-104-001, which is --

In that paper, as I understand it, they were trying to replicate it and to see what -- obviously you can't set up the control using human beings, so they were trying to see with piglets, whose anatomy and responses might be comparable, what would happen. That paper, though, didn't seem to, from my reading of it, and that's why I want you to help, didn't seem to produce the sort of result that one might expect from what you've said about the science. Why is that?

PROFESSOR RATING: First, I put the paper in my --

Q. You're right, you refer to it in your first report.

PROFESSOR RATING: I put it in my report because I think it is fair, I found it and it was against me, against my thinking, and I think I have to write it down and give you the information. At that time I wrote that perhaps the time schedule was not enough. That means the piglet experiment started and was finished after one hour, and they have shown that sodium came down remarkably. I have to say that those with free glucose they died already at 45 minutes because of cardiac arrest, which was not further comment on why they were dying. But they were unable to show an increase of intracranial pressure, neither an increase of oedema.

The one thing could be is that it is a problem of time. If you would have extended this experiment for two hours or three hours, maybe you will have seen a little bit more in the direction, I don't know. That would be my argument. But at the end, especially of what I have read this afternoon, as Professor Kirkham stated, the body and the brain is very clever and very effective to compensate osmotic changes. And some of the basic science have written the sentence that it was puzzling that they have not found what they thought they should have seen because of only thinking on osmotic diffusion. And then it comes up that there is a quick

regulating mechanism, which included ions, electrolytes on the one side, but on the other side neurotransmitters, which were brought out of the cell, and by that they decrease the volume of water. And yes, that was new for me in this scientific -- I have not read that before.

That means the point of Professor Kirkham that there are very effective mechanisms to control especially these osmotic diffusions, that's a good point. The difficulty I have in this moment is the timescale. I am seeking for an experiment which would have been a little bit longer seen afterwards, whether those very, very quick reductions, even in animal models, will show us an osmotic brain damage.

Q. Yes. Okay. I wonder if --

THE CHAIRMAN: Sorry. Can we just stay with this? If you look at the paper that's on the screen, professor, under the heading "Background". The first sentence is:

"Errors in fluid management can lead to significant morbidity in children."

PROFESSOR RATING: Yes. That's it. Even mortality. Very often it is written that children had died. It is a background, it is a basic science. Maybe it's not as basic as I thought. It is clinicians who started that and ...

THE CHAIRMAN: That's your basic thesis, isn't it? In fact, what you say to this inquiry is that Adam's case is an example of an error in fluid management.

PROFESSOR RATING: Yes.

THE CHAIRMAN: Leading to morbidity in Adam's case.

PROFESSOR RATING: Morbidity and, very often those papers, from basic science, not only morbidity but mortality.

MS ANYADIKE-DANES: Is that not the difference then? Mortality is the death?

PROFESSOR RATING: Morbidity is you become very ill, yes. Morbidity is change in clinical state. Mortality, you are dying.

MR FORTUNE: Before my learned friend moves on, can we find out from both professors in relation to the intracranial pressure, because Professor Rating has referred to this, whether that pressure results from one of three possible causes: cause 1, dilutional hyponatraemia causing cerebral oedema; cause 2, high blood pressure, that is hypertensive encephalopathy; or cause 3, PRES or venous sinus thrombosis?

MS ANYADIKE-DANES: I wonder, Mr Chairman, before they both address that, in fairness, I was going to ask Professor Kirkham to respond to what Professor Rating had been saying about the two papers, just so that we keep the evidence together.

MR McALINDEN: There's just one further issue that might be of relevance in relation to this matter. It's the same paper, 306-104-004. It's the sentence beginning:

"Moreover, gross and microscopic examination of brain tissue revealed no major cerebral oedema or cell hydrops suggesting no major changes in blood-brain barrier permeability."

THE CHAIRMAN: Just one second: 306-104-004.

PROFESSOR RATING: But I tried to give this information, that they have not found anything in that.

MR McALINDEN: Perhaps both could comment on that.

MS ANYADIKE-DANES: Thank you very much, Mr McAlinden.

THE CHAIRMAN: Sorry, Mr McAlinden, what you were reading was?

MS ANYADIKE-DANES: "Moreover, gross and microscopic ..." -- about halfway down --

THE CHAIRMAN: In the right-hand column, just near the bottom of the page?

PROFESSOR RATING: Intracranial pressure -- they couldn't show any increase in intracranial pressure. And I have to say that piglets are very near to humans regarding their biochemistry ... They are a little bit difficult to handle because they very often get heart problems, but perhaps that they are dying, but they are very near to human biochemically and biophysiologically.

MS ANYADIKE-DANES: Thank you, Mr McAlinden. I was going to ask Professor Kirkham to address this paper and also the other paper that Professor Rating had referred to, unless you would like more time to look at that other paper.

PROFESSOR KIRKHAM: Professor Rating sent me this morning about six papers, which I would like a little bit more time to look at. I have read the piglet paper.

Q. Are you in a position to address this?

PROFESSOR KIRKHAM: I can probably address the piglet paper.

MR FORTUNE: I don't have a copy of the piglet paper. I was served with a number of papers, but not the piglet paper.

THE CHAIRMAN: We'll make sure you get a copy.

Okay, Professor Kirkham, if you can indicate what you think the piglet paper establishes.

PROFESSOR KIRKHAM: So this paper is obviously a scientific attempt to reproduce the circumstances of accidental hypoosmolar hyperinfusion in children. Just out of interest from the point of view of the background, references 10, 11 and 12 are used as the background in addition to the Arieff papers, but two of those are actually media articles rather than --

MS ANYADIKE-DANES: Sorry, just so people can see what you mean, that is to be found at 306-104-005. It's

reference 10, "Fatal mistake in hospitals ...", then 11, "A case of hypoglycemic ...", and then 12, "Physicians [sic] mistake ..." Those are the references you mean?
PROFESSOR KIRKHAM: Yes. So one of those is actually a non-ketotic coma, which is not really the same, and the other two are actually from media rather than scientific articles. So we are, as Professor Rating has already said, left with the original literature from Arieff and the number of cases reported is relatively small. Nevertheless, this is a good attempt to try and reproduce those circumstances, to give hyperinfusion of low hypoosmolar fluids. And surprisingly, the piglets did not have cerebral oedema or raised intracranial pressure. And although I appreciate Professor Rating's point that if things had gone on for longer there might have been something to show, nevertheless the argument is that it's a very rapid infusion, so I would argue that if is really is a very rapid infusion, you should see it within this time frame. That's the whole point of this experiment to say that a very rapid infusion of hypoosmolar fluids would overwhelm this situation or overwhelm the body's ability to compensate. And I think this is a very rapid infusion. Some of the piglets died but they died cardiac deaths, not brain deaths.
THE CHAIRMAN: If you have a rapid infusion over a longer

period, in other words say three hours rather than one hour, and the infusion is into a child who has medical problems, which is why the child is being operated on, would you not expect a more severe reaction from the child than you would from the piglet? These are healthy piglets, aren't they?
PROFESSOR KIRKHAM: These are healthy piglets.
THE CHAIRMAN: These are piglets who do not have fundamental problems with their organs.
PROFESSOR KIRKHAM: I understand that. I don't think there is any data from animals or humans in renal failure. I don't think that any of the cases reported in the original Arieff papers actually had renal problems and none of the experimental data has been undertaken in animals with any renal problems.
THE CHAIRMAN: What I'm wondering is: if you have a longer period of excessive fluid into a child who has a problem with a kidney which is being replaced, is that child not more likely to be overwhelmed by the excess fluid than a piglet is in an hour?
PROFESSOR KIRKHAM: Well, there is no evidence for that. There are no data, either clinical or experimental. So one is in the realms of speculation. There isn't any data suggesting that that is what happens.
THE CHAIRMAN: Excuse my ignorance. How could it not be

true? How could it not be true that if you extend the period over which the excess of fluid is given and if the fluid is given accidentally, of course, to a child who already has a significant medical problem, how could the outcome for the child not be significantly worse?
PROFESSOR KIRKHAM: Because the brain is compensating, as Professor Rating says. The body is -- if it's not hypoxic, the body is basically doing what it can to keep in homoeostasis, in other words to keep everything balanced. That's why --
MS ANYADIKE-DANES: The greater the time, the better the chance the body has to -- I think that was Professor Rating's point: the longer the time, the more opportunity the body has to deal with it and accommodate to it.
THE CHAIRMAN: If the body can --
PROFESSOR RATING: I don't know whether that is right. I think the most impact for the brain to react is the time when the fluid comes in and you started to get the fluid out of the cells and it started to get the cell of the same volume. And at the beginning it is ionic exchange and then starts other organic organelles and chemical substrate to use to prevent that the cells are the same size. I don't know whether the period -- whether it is a greater period, if it is done in one

hour or it is standing for two hours. I am thinking whether the time of one hour is enough to bring up all the problems you can see, that means intracranial pressure, and you can see the swelling of the cells and the brain swelling. Maybe that if the piglets were followed a little bit longer, I think it's bad that they have not extended the experiment, not to kill them all, but to have them for five, six hours, survived and looked after that time. But I cannot argue on that.
MS ANYADIKE-DANES: Professor Kirkham, can I ask you then, you have described the compensating mechanism that the body has is the brain has those cells pumping out sodium, and that's part of what is preventing the sodium crossing or the fluid crossing the blood-brain barrier and leading to the fatal cerebral oedema; is that approximately right?
PROFESSOR KIRKHAM: Yes.
Q. Well, if that's the case --
PROFESSOR RATING: It should be corrected because it is chloride and ...
PROFESSOR KIRKHAM: Potassium.
PROFESSOR RATING: This ion exchange in process is mostly chloride and Kalium and Natrium is not so much in the cell that therefore they cannot react all right.
Q. What I was going to ask you is to follow on from what

the chairman had asked you: if that's how it works, what in your view is the role of the kidneys?

PROFESSOR KIRKHAM: Well, the kidneys obviously do get rid of free water and electrolytes.

Q. I'm just trying to see, after those cells are pumping out the sodium, as is what they have to do, what is it that the kidneys do?

PROFESSOR KIRKHAM: The kidneys excrete urine, which has got a lot of water in it, so if you do drink too much, you would normally expect to get rid of it.

Q. Where I'm going with it is this: if the cells are pumping out the sodium, as they're designed to do unless they're compromised in some way, but the kidneys can't concentrate the urine, can't excrete it past a certain amount in an hour because that's the nature of the chronic renal failure, what happens then?

PROFESSOR KIRKHAM: You'd have fluid overload, and that's what happens in renal patients. But unless there's actually hypoxia and the pump is not working, the patient is overloaded, but they don't suddenly have cerebral oedema. Otherwise that would happen all the time in renal units and it doesn't.

THE CHAIRMAN: Sorry, the reason it doesn't happen all the time in renal units is because children in renal transplants don't typically get excessive intravenous

fluids; is that not the difference here? The awful mistake which was made in Adam's case was that there was a misunderstanding or a miscalculation of how much intravenous fluid Adam should be given. He was given far more than he should have been and, it seems to me on one argument, far more than he could cope with. So this is not a typical renal problem, it is not a typical renal transplant. And the fundamental difference between Adam's case and other cases is that we have here a boy who had renal failure, who was having a renal transplant, who was then given excessive fluid. That drove down the sodium level in his body and it was, on this approach, disastrous for him because he has no way of getting rid of the excess fluid and his body is overwhelmed.

PROFESSOR KIRKHAM: I just don't think there's any evidence that that would cause fatal cerebral oedema.

MS ANYADIKE-DANES: Sorry, I framed the question badly, it's my fault.

What I was trying to get at is that if you have a situation like that, so long as nothing has compromised the sodium-pumping action, if I can put it that way, is what happens that the body becomes bloated because the kidneys are not excreting the fluid, but the brain isn't damaged because that mechanism is still

functioning; is that what you're saying?

PROFESSOR KIRKHAM: That's what I'm saying. You don't get fatal cerebral oedema even if the patient is fluid overloaded. And fluid overload does happen very frequently in patients with kidney failure. It's very difficult to get the fluids completely right minute by minute in a patient with --

Q. So the kidneys could be relevant, the fact that he had polyuria and an inability to concentrate and excrete his urine, that would be relevant and that is why you would expect his body to become oedematous, if I can put it that way?

PROFESSOR KIRKHAM: Yes.

Q. But if the ion-pumping mechanism was still intact, you wouldn't expect to see a fatal cerebral oedema?

PROFESSOR KIRKHAM: I don't think so.

THE CHAIRMAN: And that's a difference between the two of you?

PROFESSOR KIRKHAM: Yes, I think so.

PROFESSOR RATING: But I want to make the point, this ion-exchanging process is not limited to the brain, it is limited to the everywhere: to the renal, to the testes, to urea -- to everything. That means you need the kidney to get rid of the water, which is too much, and if you cannot get it out, the process of too much

water in the body is the same. It is corrected in the kidney as well as in the brain, as well as in the heart, as well as in the liver. That means it is not a shift out of the brain to any other place, but it is as a hole in -- it is in every living cell try to do that. And by that, it is not ... The only chance you have to get rid of it, to get the water out of it, and if you didn't get the out the water of it, then you stay in it.

THE CHAIRMAN: Can I come back to Professor Kirkham? I understand what you said a few moments ago that you can't -- I think you said a fluid overload does happen frequently in patients with kidney failure. It's very difficult to get the fluids completely right minute by minute. But is the difference in Adam's case -- I'm not sure it's much of an exaggeration to say the fluids were completely wrong. This isn't some minor miscalculation of fluid. This was a gross miscalculation of fluid. That doesn't make a difference from your perspective?

PROFESSOR KIRKHAM: In my opinion, it did not cause the fatal cerebral oedema.

THE CHAIRMAN: Okay.

MS ANYADIKE-DANES: Then can I ask this: in your view, why is it, Professor Kirkham, that if you do have low sodium in the way that the chairman was putting to you, why is it that that doesn't -- and developing as quickly as

Professor Rating is saying it would have developed -- why doesn't that have an impact on the brain's mechanism for dealing with sodium or, sorry, dealing with the fluid? Why doesn't it?

PROFESSOR KIRKHAM: Well, because the cells are still pumping, so they're dealing with the fluid and they'll get it out of the brain cells. You won't have a fatal cerebral oedema however rapidly the sodium's going down unless there's an additional stoppage from hypoxia of the sodium pump.

Q. But if the cells are still pumping, do they not have a limit to the capacity of how quickly they can pump out sodium?

PROFESSOR KIRKHAM: I have not been able to read all of Professor Rating's papers this morning, but I have not found any literature to suggest that there is a maximum capacity.

PROFESSOR RATING: I have not read all the papers too. I have only given it to -- that we can read it both. In one paper I got the idea that they are speaking of some enzymatic activity and maximal capacity and if that is written in, then we're at the point that we can he say here it is written that there is a maximum of capacity and then we have to discuss whether this maximum of capacity is reached in Adam's case, and I can tell you

that we will not solve the problem. We can only say that we have found in the literature that there is a maximum capacity, but whether this maximum capacity is reached in Adam's case, it will be impossible to argue right. But it would be some sort of piece in the direction that this ion-driving process is not, yes, without any front ...

Q. Not infinite?

PROFESSOR RATING: Can expand to any incoming water. I don't believe that it can expand to any. Therefore I say this little piece of work that I have found, that they have cells, if it is quickly given, they are becoming greater. If it's gradually given, they stay in the same size. That is for me a first hint in that direction that the velocity of decrease of Natrium is very important for the capacity to handle the ... Of the enzymatic process bringing out the ions of the cell.

Q. Professor Rating, are we not actually dealing with a series of things that you believe or find instinctively difficult to accept don't happen, and then we have Professor Kirkham, who also has some things that she is feeling must happen because of the other research? So it's not as if anybody can place precisely Adam's circumstances on very robust research ground, if I can put it that way?

PROFESSOR RATING: I'm quite happy that I'm a medical doctor, not a lawyer.

Q. And in the same way as in the past people had thought it quite clear that what was happening was the dilutional hyponatraemia was having a particular effect and have now had to see: well, the brain has these mechanisms so perhaps the situation is not quite as straightforward as we thought. And that's because of the developments in research and understanding of the body's processes, and that might be part of the problem, that people don't know enough to be able to ascribe Adam to one category of mechanism of death as opposed to another; is that possible?

PROFESSOR RATING: Yes.

Q. But I wanted to -- when you had talked about papers, in fairness, Dr Coulthard felt that he had identified some early papers which, in his view, closely approximated Adam's case. And I wondered, Professor Kirkham, if you could comment on them, because I think you were going to do that, not you personally, but the experts were going to do that at some time following Newcastle, and I don't think we ever got round to having that happen. The cases are to be found in his report at 200-018-223. There we are. One of those, I think the Sicot case, anyway, you might be familiar with. I am not quite sure

familiar with -- maybe the Paut cases you are also familiar with. Are you able to see whether those cases lend support for dilutional hyponatraemia being the main agent or main cause or sole cause of Adam's death as opposed to the other factors that you believe would have had to be present?

PROFESSOR KIRKHAM: I have been through the French cases quite carefully and they are in my Excel spreadsheet. I wasn't expecting this question, so I think I'd have to go back to this report and the French cases to look more carefully.

Q. But in any event, when you did look at them, did you form the view, even if you can't analyse and parse them now, that they did indicate that Adam could have died from hyponatraemia or that they were missing other kinds of factors that would have been necessary to give a proper explanation?

PROFESSOR KIRKHAM: When I went through the French cases before, I thought that -- which are the Paut case and the Sicot case. I don't know about the Auroy case. They have the same problems as the original Arieff cases in that most of the ... Basically, the cases had not had other problems excluded such as hypoxia or they hadn't had a scan. I'd have to look again more carefully. But in each case I don't think that other

explanations have been completely excluded.

Q. Well, I think you and Professor Rating have a different interpretation of what one can understand from the original Arieff paper, the 1992 paper. How do you interpret that paper? Sorry, what is that paper telling us about the development of hyponatraemia and its significance? Maybe I should refer to it. 011-011-074.

I'm sure you've looked at that many times. I know that Professor Rating has taken issue with you as to how you interpret that paper. So what is it that you believe is being communicated from that by Arieff and his colleagues about the research that was done?

PROFESSOR KIRKHAM: Well, the paper, as published in 1992, reported 16 children from a retrospective series, who had had a low sodium and had died of respiratory arrest with a low oxygen tension and cerebral oedema at post-mortem or radiologically. And some -- I can't remember exactly how many died, actually. I'll look at this. Seven deaths.

So the original paper presented data which, for 1992, was very reasonable, suggesting that hyponatraemia had caused these children's deaths. But if you look at Arieff's later work, he and Ayus did quite a lot of work looking at the additional factors that patients with hyponatraemia had in association with the cerebral

oedema. And if you look at their more recent work, they emphasise the importance of hypoxia. In fact, these patients had hypoxia, but in the 1992 paper it's not very clear whether the arterial oxygen tension was measured after the respiratory arrest, in which case it might not have anything to do with the original ... It might not be a risk factor because it might have happened after the respiratory arrest.

But if you look at the actual patients, they often had risk factors for hypoxia, it had an adenotonsillectomy. Again, I outlined this in my Excel spreadsheet.

Q. Let's pull that up if that helps you. It's 208-007-116.

MR FORTUNE: I think, in fact, ten patients died in the original Arieff experiment.

THE CHAIRMAN: Thank you.

MS ANYADIKE-DANES: Thank you.

I don't know if you've got your spreadsheet with you, Professor Kirkham, a hard copy of it. If you want one --

PROFESSOR KIRKHAM: I think I've got one here.

Nine apparently died of brain death in the original Arieff paper. It's not entirely clear which of the patients -- whether the patients who died had the hypoxic risk factors. But seven of these children

either had tonsillitis or had a tonsillectomy, which is definitely a risk factor for hypoxia.

Q. Sorry, I think you're looking at 208-007-118.

PROFESSOR KIRKHAM: No, it's actually the next page I'm looking at.

Q. Sorry, 119. There we are.

PROFESSOR KIRKHAM: So those children had other reasons, they had reasons for the sodium pump to be a major problem. And then not only did some of them have conditions predisposing to hypoxia, but some of them actually had conditions that predisposed to neurological problems because they had hydrocephalus, trauma, they didn't necessarily have head trauma, but they might have had head trauma, it's very difficult to be sure that they didn't. One had had an orchidopexy, and many children with undescended testes do have developmental problems. So they had other reasons for having a problem.

Q. All right. So then you went to his subsequent research and what is it that his subsequent research tells us about the ability for hyponatraemia on its own to cause sufficient cerebral oedema to lead to death?

PROFESSOR KIRKHAM: Can we go to his opening paragraphs in the original 1992 paper, please?

Q. Yes. That's at 011-011-074. That captures the

introduction. Would you like the next page brought up?

PROFESSOR KIRKHAM: Let me just have a look. I think he actually says even in the introduction ...

THE CHAIRMAN: Could you blow up the bottom half of the page, please?

PROFESSOR KIRKHAM: Certainly, in one of his early papers he says, when he describes the previous literature, that it's much commoner to have the hyponatraemia in the context of hypoxia, even in the early stages. And in his later paper, he makes that point more clearly. I'm not sure it is in this paper. I don't know if it's in that report. (Pause).

At paragraph 45 in my final report, I see:

"... recent work from the research group, which includes Arieff ..."

THE CHAIRMAN: Just a moment, professor. It's 208-007-084. "Recent work from the research group", is that what you're referring to?

PROFESSOR KIRKHAM: Yes.

THE CHAIRMAN: I have just brought it up so everyone can follow it. Are you emphasising here the point about the hypoxia?

PROFESSOR KIRKHAM: Yes. Moritz & Ayus (2005) and Ayus et al (2008).

MS ANYADIKE-DANES: If we can bring up the next page

alongside it, 085. I'm just trying to distil from that what you are saying about it. Are you saying that Arieff, who to some extent is credited with starting the greater examination of this issue, has not found yet in his studies that hyponatraemia without any of the other predisposing factors, if I can put it that way, leads to death?

PROFESSOR KIRKHAM: His original 1992 paper is retrospective, so if you're looking ... In clinical studies, there are two options: you can do a retrospective study, which is easier, but it means you are going backwards and you don't necessarily have all the information about each patient because it's not collected unless you ask for it. Then there's a prospective study, which is more difficult to do because you have to go forwards. It's usually got to be funded, but it provides better quality data because you ask for the things that you want the information on.

So Arieff's original 1992 paper was a retrospective study, and, as such, can be criticised for not necessarily having all the information. It's also from 20 years ago, so some of the things that we now know about hyponatraemia weren't considered then. Arieff is clearly a good scientist and he has, throughout his writing, looked more widely at the question of cerebral

oedema in the context of hyponatraemia. And even at an early stage, when he quotes one of the previous -- some of the previous papers, I think it's actually the Crumpacker paper from 1973, which actually also mentions the hypoxia, and in one of his early papers I know that Arieff actually says it's unusual to get hyponatraemic and cerebral oedema without a degree of hypoxia. And certainly, in his 2008 paper, he says that again.

PROFESSOR RATING: Do you think that at the end of his active life when he was writing he has changed his mind that hyponatraemia alone will not bring up cerebral oedema?

PROFESSOR KIRKHAM: I don't think he changed his mind. He was quite careful in his early research to acknowledge that there were often other factors. My interpretation of Arieff's work is that he was interested in hyponatraemia, he was interested in trying to look at whether it was an important problem clinically, so he did a retrospective study, which would have not needed much funding, and he wrote that paper quite carefully and he acknowledged it was a retrospective study and some of the previous research --

PROFESSOR RATING: Your comment on this paper, everything you say about it is retrospective and it's totally okay,

but I have difficulties, and therefore I wrote in my paper some sentences in that direction, that first I didn't know in which way it would place ... What would happen here and which are our roles. And at that time, when I wrote this report, when I got the second report, I got the impression that there are two different persons who have to defend her views and I got the impression that it was your task to bring together very, very small pieces of different things to make the argument that hyponatraemia will not bring brain oedema, to make this more reliable. And therefore, I was a little bit astonished when you write there was a tonsillitis. You say that is a risk of hypoxaemia. There was a non-descended testicle. There's a risk that there's a central problem. Tonsillitis, tonsillectomy, non-descended testis is so often, and now it starts to become ... I think it's worthwhile that Arieff has put it down, that everybody can read about it. But I have a little bit of difficulty that these are factors really ... There is no case of a hypoxaemia written by Arieff. He has not said, "This child has had an additional hypoxia", but he writes that there is a tonsillectomy, orchidopexy, and then you are setting a fracture or, coming out of a fracture, could it be some brain trauma. That means ...

I realise that later on he has given information in that direction that especially endocrinological(?) processes -- for example, the [inaudible] have some impact, and that nearly-proven hypoxia have impact on the brain oedema that I can admit easily because you can explain why the hypoxia will worsen, ongoing, or in starting brain oedema. But in this context, I think it is not very -- in some way, artificially to say that they are really risk factors that bring up -- without an orchidopexy I will not get a brain oedema by osmotic ... By too much ... This association is here, but it's closely connected --

PROFESSOR KIRKHAM: But scientifically, I think the evidence remains retrospective and the case is, in my opinion, not proven. I'm not saying that it couldn't be -- I've never said it couldn't be -- but I'm just saying that in many of the cases there were risk factors for hypoxia and other central nervous system problems, and that has to cast doubt on whether dilutional hyponatraemia -- on its own and without anything else -- actually causes fatal cerebral oedema.

THE CHAIRMAN: Okay. We've almost reached an impasse between our experts.

Mr Fortune?

MR FORTUNE: Sir, as my learned friend has referred to

paragraph 46, could Professor Kirkham particularly help me, but I suspect others? Is Professor Kirkham saying that Adam had a pre-existing or preoperative risk of hypoxia that may have affected, firstly, him suffering intracranial pressure or indeed having a greater effect from the volume of fluid put into him by Dr Taylor at the rate at which we know that it was infused? I hope that question makes sense.

PROFESSOR KIRKHAM: I think Adam was anaemic. He had a fall in haemoglobin during the operation. That is a risk factor for cerebral hypoxia. There's no evidence of cerebral hypoxia at the post-mortem, but I think it's another of the factors that we don't actually know whether it was there or not in Adam's case.

THE CHAIRMAN: Thank you.

MS ANYADIKE-DANES: Mr Chairman, I was going to ask if we might perhaps break now. I'm conscious that Professor Kirkham wants to look at some paper. Professor Rating wants to do the same --

THE CHAIRMAN: Yes.

MS ANYADIKE-DANES: -- to deal with some of these live matters. And I would like to gather together what we've heard so far and see what's left of what I would still like to ask.

THE CHAIRMAN: I can't think there's very much left to ask

because we've been through this major issue. I think the question is how to organise this. I see Dr Carson has arrived and he's available now to give evidence. Since both witnesses want some time to read papers, we can do a number of things. We can take an early lunch and come back at 1.15 or 1.30 and allow these two experts to finish and go into Dr Carson or we can take an early lunch and then start Dr Carson at 1.15 and give these two witnesses more time.

Why don't you discuss that? It depends how much time -- let me ask. Do you have any idea of how much time you'd want to read?

PROFESSOR KIRKHAM: Whatever you think is most reasonable.

THE CHAIRMAN: Both of you will finish your evidence today, so this won't -- it's just a question of how we sequence it today without everybody here sitting around for an hour or so while you're reading papers to catch up.

PROFESSOR KIRKHAM: I don't think that will be necessary. I've read all these papers before except the few from Professor Rating. I think I can read them quickly.

THE CHAIRMAN: Okay. Professor, do you --

PROFESSOR RATING: I agree, the same, yes.

THE CHAIRMAN: If we broke now and took lunch, if we come back at 1.15 or 1.30 and finish these two professors --

MS ANYADIKE-DANES: Say 1.30.

THE CHAIRMAN: And, Dr Carson, we'll start your evidence this afternoon. I can't say exactly when, but we'll start it this afternoon. Thank you very much. 1.30.

(12.23 pm)

(The Short Adjournment)

(1.30 pm)

THE CHAIRMAN: You have caught up on the reading?

PROFESSOR KIRKHAM: Yes.

THE CHAIRMAN: Good, okay.

MS ANYADIKE-DANES: So Professor Rating, perhaps I could ask you about the -- I have called it the renal haemorrhage paper.

PROFESSOR RATING: The renal haemorrhage paper, yes. They make the point that renal haemorrhage will come mostly in accidental -- that means shaken baby or some other accidental -- and is less often in others. But at the end, they give the information, what is not my experience, because I have seen it, that renal haemorrhage which was never seen in intracerebral, high intracerebral pressure due to hydrocephalus. I have seen it that there have been haemorrhages, but they said for children it was not there, therefore I quoted a little bit what the significance is of this paper.

But at the end, I would not take this paper to make the clearly discussion in between -- that was your

point. I believe it was, on the one side increased, hypertensive encephalopathy on the one side, and on the other side it was ... No, you are make it because of venous sinus thrombosis of the one side and osmotic diffusion, that means hypoosmolarity-driven intracranial pressure on the other side. That was I think your first ...

PROFESSOR KIRKHAM: My point is that you do definitely get haemorrhages in hypertensive encephalopathy, but not necessarily in raised intracranial pressure from any other cause.

PROFESSOR RATING: Yes. I'm not convinced that this is -- that you can -- this really cut(?) make(?) out of this paper.

MS ANYADIKE-DANES: Why is that?

PROFESSOR RATING: They have not given an example. We have seen(?) that amount of retinal haemorrhages, they didn't give at which time they have seen it. It isn't a paper for giving an overview, but they have not given any data. They have not gone there: we have seen 1,000 haemorrhages and from these 1,000 haemorrhages, so many have accidents, so many have intracranial pressure so-and-so have cerebral palsy, so much have ... There are no data in it that you can follow their conclusion. Their reports are experienced, but they didn't give any

data why they came to that. You understand?
Q. Yes, I do. Professor Kirkham, maybe you can respond to that.
PROFESSOR KIRKHAM: Well, they've reviewed the literature. Could you pass me ...
PROFESSOR RATING: Yes. (Handed).
PROFESSOR KIRKHAM: They basically did -- I think they did review the literature and their experience that extensive retinal haemorrhages are not common in acute raised intracranial pressure is actually my experience. So my experience is different from Professor Rating's. I don't see extensive retinal haemorrhages in children with acute raised intracranial pressure.
PROFESSOR RATING: We have to be a little bit careful here because I have just read that. There is no classification on the haemorrhages and, to my remember -- but I may be wrong -- where they are seen in Adam. There is especially round about the papilla, there are reported haemorrhage, small haemorrhages, but I don't know where it was in Adam's case and how great they have been. And they claim that it is very, very bad to say mild, less severe haemorrhages because it suggested that you have to count it to give some more precise data. And this paper is not a meta-analysis from literature; it is some sort of literature back-up

that I accept they have more than 60 papers as a reference. But at the end, there are no data in this paper.
THE CHAIRMAN: Do I understand it correctly, this paper is a review of other published papers?
PROFESSOR RATING: Yes, but not in the sense of a meta-analysis. They tried to give the original data in some form of a table and then you can have it out. They have, for example, 100 intracranial pressures due to, say, cerebral palsy, hydrocephalus. That means you don't have the right data on it.
THE CHAIRMAN: So it's a summary or an analysis?
PROFESSOR RATING: A summary, yes.
THE CHAIRMAN: For instance on page 103 on our version, which I think is internally page 625, they say:
"Despite the suggestions just discussed, there is abundant literature grounded in clinical data and human and animal experiments that speak to the contrary."
So this is not new research, this is an analysis of existing literature?
PROFESSOR RATING: It's an analysis of existing literature, but not giving what is nowadays you had to do that, some sort of meta-analysis, to give the information, how many patients were seen and tried to do clusters and say something to that.

MS ANYADIKE-DANES: Mr Chairman, if you look at the first page of the paper it gives its design:
"To review published clinical post-mortem and experimental research findings worldwide, pertinent to the objective."
And the objective is:
"To evaluate the role of intracranial pressure in the production of retinal haemorrhage in young children."
In fact, I had put to Professor Kirkham what you take to be the significance of this paper and what weight you think, from your point of view, you would be prepared to place on it.
PROFESSOR KIRKHAM: In Adam's case, there were very obvious retinal haemorrhages when he was first examined as well as papilloedema. This paper reviews the literature on whether extensive retinal haemorrhages are a feature of acutely-raised intracranial pressure and finds that there's little evidence that that's the case, which is my experience. My experience is that. In fact, it's relatively unusual to get papilloedema in acute raised intracranial pressure. The pressure can go up and there's not necessarily papilloedema and there's very rarely haemorrhage. And this paper, having reviewed the literature, finds that it's unusual to have extensive

retinal haemorrhages of the sort that would have been so obvious to the people looking after Adam in the immediate post-operative period.
Q. But you have heard Professor Rating's criticism of the paper. He said if you were going to set out that you should have had a better description of the data and how you went about or at least how people analysed it so that one can be clearer about how robust your conclusions are. So can you respond to the criticisms that he has made against the paper or about the paper?
PROFESSOR KIRKHAM: I would agree that a full meta-analysis would be reasonable, but in fact these also did actually do an extensive literature search. They actually used PubMed, MedLine and Ovid, and then did what's called hand-searching the references that they found for other papers. So it may not be a meta-analysis as defined, but it is actually quite a comprehensive review of the literature. I don't think they've missed major papers.
THE CHAIRMAN: What is the term that you and Professor Rating are both using about a meta-analysis? M-E-T-A?
PROFESSOR RATING: I would agree with most of you, but you take this paper to an argument that this is in one direction and to exclude it in the other direction. That means you make with this paper a hard split between

those poles and that, I think, you cannot create out of the paper. If I look how often you are arguing with possibilities and risk factors end on end, I am a little bit irritated that you take this paper without any data as such a hard data source.

PROFESSOR KIRKHAM: Well, I'm sorry to irritate you, but this paper --

THE CHAIRMAN: I think the irritation is probably a translation issue. "Irritation" might be a translation issue.

PROFESSOR KIRKHAM: Okay, fair enough.

THE CHAIRMAN: If I understand Professor Rating's point, and you'll correct me if I'm wrong, in your reports, Professor Kirkham, you have said a number of times that despite the fact that something isn't there, you can't exclude it; is that the point you're getting at?

PROFESSOR RATING: Mm-hm.

THE CHAIRMAN: Then he's putting that against the fact that on this paper, it has reached this conclusion and you say that he thinks that you take too strong a conclusion from this paper by saying that because something is not allowed for in this paper, you exclude it.

PROFESSOR KIRKHAM: Well, just to make it very clear, Professor Rating and I are in complete agreement that Adam had raised intracranial pressure post-operatively

while he was on the intensive care unit. I don't think there's any doubt about that. However, he had retinal haemorrhages very obviously on readmission to the paediatric intensive care unit and, on the balance of probabilities, given that retinal haemorrhages are a definite feature of hypertensive encephalopathy and relatively rarely seen in my experience clinically and -- from this review of the literature, I appreciate that this paper has weaknesses. But nevertheless, on the balance of probabilities I feel that Adam had an important clinical sign of hypertensive encephalopathy with retinal haemorrhages in addition to the papilloedema.

PROFESSOR RATING: But I would like to insist on the point that you cannot get out of this paper the message that because there are haemorrhages that you have to exclude all those cases which are not going along the line of hypertensive encephalopathy. That means it is only increase of intracranial pressure by osmotic swelling if you accept that there could be something like that.

PROFESSOR KIRKHAM: Can I just ask you, Professor Rating, have you found any of the cases reported with hyponatraemic dilutional hyponatraemia to have either papilloedema and/or retinal haemorrhages?

PROFESSOR RATING: I think there are papilloedema ... if

I remember ... haemorrhages spontaneously. I cannot answer. It's not in my memory, no. From the literature, papilloedema is written. That I can remember well. I had to look for it. But haemorrhages, I don't remember that, that's right. And you have read it. You have not found any papilloedema in your papers?

PROFESSOR KIRKHAM: Actually, I think that may be a weakness of the reporting methods. I think that the cases are from a long time ago and the papilloedema may not have been reported. But actually it has not been a major feature of the cases and haemorrhages have not been reported as far as I can see in the hyponatraemic dilutional hyponatraemia cases reported.

PROFESSOR RATING: I have to agree that I don't remember a single case in these papers.

MS ANYADIKE-DANES: Is the significance of that, then, if they're not reported as being associated with the hyponatraemia, then if you do see it, is that what you take to lend credence to the view that something else was going on?

PROFESSOR KIRKHAM: Yes.

Q. Thank you. Then can I ask you this question. If the sodium-pumping mechanism, as I'm calling it, to use a layman's expression, is impaired in some way, maybe not hugely, but impaired, and therefore not able as well

to protect the blood-brain barrier from water going across, which is one of its functions, I suppose. Is it possible then that if you have hyponatraemia and therefore an accumulation of water in the body because of the normal osmotic process because of the low sodium in the body, is it possible in those circumstances for the water to cross into the brain?

PROFESSOR KIRKHAM: Yes, I think that if the sodium pump mechanism is faulty for whatever reason and hyponatraemia is present, there would be more ... There would be water crossing into the brain, which was not necessarily then being pumped out or sodium wouldn't be pumped out quickly enough for the water to follow down the gradient.

Q. What I'm putting to you is a situation where, in and of itself, without the development of the hyponatraemia, the level of compromise to the sodium pumping mechanism may not have been sufficient to have led to death, but it's enough compromise when you are faced with significant hyponatraemia and accumulation of free water in the body for that then to lead to the water passing into the brain and leading on to the type of sequelae that you saw with Adam; is that possible?

PROFESSOR KIRKHAM: I certainly think it is possible that the amount of free water that Adam had on board in the

absence of a fully-functioning sodium pump would have meant that there was an excess of water in the brain.

Q. Yes. And if --

PROFESSOR KIRKHAM: That might have then been a factor in the severity --

Q. That's the very word you used. That's a question that I did not put to you before the break. That's what I was trying to ask you when I was asking you about the possible significance of hyponatraemia.

THE CHAIRMAN: Sorry, I want the professor to finish that sentence. That might have been a factor in the severity of what?

MS ANYADIKE-DANES: The oedema.

PROFESSOR KIRKHAM: In the severity of the cerebral oedema. If the pump was not working, I don't think it would have happened if the sodium pump were working, but I think if the sodium pumps were not working -- and we don't know either way, but I certainly think if the sodium pumps were not working -- then more water would have been going into the brain than would have been coming out. Then if you have a further insult such as the hypertension, then as in many things -- and I think this point has been made throughout the inquiry -- one little thing may not make a difference, but a lot of things can ... You can have a number of things which end up

with a major problem.

Q. That's the point I'm getting at. In that scenario, hyponatraemia would have played a role, been a factor, whatever the expression you want to use is, in his ultimate demise?

PROFESSOR KIRKHAM: Excess free water might --

Q. The excess free water might have been the product of the hyponatraemia.

PROFESSOR KIRKHAM: The actual evidence that it's sodium as opposed to the excess free water in the brain is -- the sodium is probably a marker for the fact that there is too much free water. I do think that if the sodium pumps were not working, free water will have been going into the brain and not coming out along the gradient generated by the sodium pumps.

Q. Thank you. But the point that I was putting to you is that if you've got too much free water accumulated in the way that Dr Coulthard spoke about it, which is that you're putting very quickly in a lot of low-sodium fluid, the body --

PROFESSOR KIRKHAM: A lot of free water.

Q. A lot of free water. The body doesn't have a way of excreting that because the kidneys, which would be part of that process, are compromised. Then if you're in that situation and you've got some effect to the

sodium-pumping mechanism in the brain, then that water can go across and then set up some sort of sequence of events that could lead to death.

PROFESSOR KIRKHAM: It could be a component of cerebral oedema, which eventually leads to a raised intracranial pressure, which, with shift between brain compartments, can lead to cerebral herniation. There's a number of factors. But the amount of free water in the brain, if it is not going out down the sodium-pump mechanism, could be a factor. I don't think it is the only factor and I think it would have to be predicated by saying that the sodium pump was not working.

Q. I have predicated it in that way. That's how I started the proposition I was putting to you: it's not working --

PROFESSOR KIRKHAM: Yes.

Q. -- to some degree. And that, which is what I was putting to you, allows the free water to go across. What I was putting to you is that you could have the free water in the body because you've put too much low sodium in --

PROFESSOR KIRKHAM: Too much free water.

Q. Too much free water in. Yes, okay, you've put too much free water in.

PROFESSOR KIRKHAM: It's free water. That's what

Dr Coulthard says in his report: it is a free water problem.

Q. You are right: you put too much free water in. So then, if that's happening, you've put too much free water in, is then the hyponatraemia merely incidental to that or just a way of marking the fact that you have got too much free water in?

PROFESSOR KIRKHAM: The low sodium is a marker for the --

Q. Because all the hyponatraemia is a low sodium --

PROFESSOR KIRKHAM: Yes.

Q. -- so what you have done is simply label the condition of having put too much free water in; is that right?

PROFESSOR KIRKHAM: I think so, yes.

Can I just ask you what the evidence is that Adam passed no urine during the operation?

Q. There isn't because it was never measured.

PROFESSOR KIRKHAM: Because that's fairly crucial to the argument, isn't it? You need him to be anuric for that and we don't know whether he was anuric or not.

Q. There were two things that the evidence showed. One, that the condition of his kidneys meant that he had a maximum amount that he could pass per hour irrespective of what amount was administered to him. That's the one thing. And that was part of the error that Dr Taylor made. He didn't, at that time, appear to

have factored that into his fluid calculations.

The second thing was that they were not measuring his urine output for various reasons and if you have read the transcripts you'll see the debate about that back and forward with Mr Keane and so on and so forth as to whether they should have and whether they could have.

They do have some measurements, which is that some of what is in that total figure, what previously was thought to be all blood, may actually be some urine that was there when they opened the bladder, but actually what happened in terms of urine output during the course of the surgery, we have not been able to identify that from the evidence.

PROFESSOR KIRKHAM: And do we know how much additional free water compared with the maximum amount that Adam could have passed as urine?

Q. I suspect Dr Coulthard's made that calculation. I'll try and see if we can find it. We certainly know what his maximum amount per hour was. I will find out whether you can then do the calculation and see what amount over and above that he was receiving.

THE CHAIRMAN: But is your concern that there has to be a gross discrepancy between those two in order for the free water issue to stand up as a cause of death?

PROFESSOR KIRKHAM: I think the sodium pump has to be not

working and I think there has to be no urine being passed and we're not sure that there's no urine being passed.

THE CHAIRMAN: You mean none at all or very little?

PROFESSOR KIRKHAM: Well, the argument is that you get a massive fluid overload in a very short period of time and I think we need to just review exactly what the maximum and minimum figures are for that.

MS ANYADIKE-DANES: One thing that might help us: just before we broke for lunch, I was asking you about if the sodium pumps are working and you are putting in that amount of free water, what happens, and you said effectively, I think you said, the body just becomes more oedematous because the kidneys can't deal with it but the brain's being protected by the mechanism you've been discussing. Adam's body generally is described as being puffy, variously "puffy", "very puffy" or "bloated" in fact. That's his mother's evidence, that he was bloated, and there is a photograph of him. That's the information that we have. It is not recorded anywhere else. It certainly wasn't recorded on autopsy, but that's what the mother has said about his body.

I think Mr Fortune had a question.

MR FORTUNE: Sir, before Professor Kirkham asked the question about what do we know about urine in this

particular instance, the discussion seemed to me to recall Dr Taylor's 13 key arguments, which Dr Coulthard dealt with in his third report. It's at 200-005-089. It's argument number 12. Dr Taylor explains that osmosis is a process in which salt passes from areas of high concentration to areas of low concentration. But if we can go on, please, in that report to 096, which is the page where Dr Coulthard actually addresses point 12. If we can ask for point 12 to be enlarged.

Perhaps Professor Kirkham could read that and then would Professor Kirkham agree that what Dr Coulthard is saying is that the excess water has overcome or exceeded the power of the cellular sodium pump and, if so, what then is the result?

PROFESSOR KIRKHAM: My understanding of the situation is that water is passing into the brain down an osmotic gradient. That does not involve any salt. However, salt is being pumped out by an active process in a cell that's not hypoxic or compromised, and therefore water is coming out down a gradient alongside the salt. So you've got two processes continuing. One is osmosis is water going in and the other is an active transport of sodium out of the cell with water following it.

Would you be happy ...

PROFESSOR RATING: I want to make a principal comment to the

protocol later on. Because we are now always speaking of "sodium pumps"; that's incorrect. We have to speak of ion pumps. It is not sodium alone, but it is chloride and potassium and therefore -- sodium is the most false word you can use because it's mostly chloride and potassium.

MS ANYADIKE-DANES: That's my fault. It is actually been referred to as "ion pumps" and I have, in a colloquial way, said "sodium pumps".

PROFESSOR RATING: But this is not the sodium which is coming out here and it should be corrected in all the protocol. Otherwise we --

Q. I understand. Sorry, Professor Kirkham, as you're answering this question, just so I'm clear about how you're addressing this, do you read this to be an issue to do with the way the brain works or an issue to do with the way that cells in the rest of the body are working? Because I'm not sure from what you said that you have described the ion-pumping mechanism as something that happens in all cells in the body or something that is there to protect the brain.

PROFESSOR KIRKHAM: The ion-pumping process does occur across all cells in the body. There are probably additional mechanisms for the brain, which are quite complicated, but I think that the ion-pumping mechanisms

are present in all cells.
Q. Is the brain more protected by them than anywhere else in the body?
PROFESSOR KIRKHAM: There are additional mechanisms for pumping water out in the brain because it's pretty critical that you don't get cerebral oedema, otherwise if you drink too much tea, you'd get cerebral oedema.
Q. Just so that Mr Fortune has a clear answer to this, your answer to this point that Dr Coulthard is making?
PROFESSOR KIRKHAM: I would agree with it. I think osmosis is a process which does not involve salt.
Q. Thank you. There was one other related question, not to this, but the previous one that I asked you, that somebody would welcome an answer to. That is: if free water carries on being administered and even assuming that the ion-pumping mechanism in relation to the brain is not compromised, so that's still working, could you reach a stage where simply the volume of free water that's been administered is something that the body can't -- I'm assuming now compromised kidneys -- something that still can't continue? What happens? Is there a heart attack? What happens?
PROFESSOR KIRKHAM: There must be a theoretical maximum, but I don't know that the literature is very ... I don't think there's a literature on what that point is.

Q. But if you reached that point, what happens? Even though you've got a perfectly, still healthy, ion-pumping mechanism in the brain, so nothing yet has happened there, it's not like you have some sort of blockage or anything, that's just working, but the kidneys can't excrete the water and you keep on administering free water, if you reach the theoretical maximum what happens in the body?
PROFESSOR KIRKHAM: Well, if you reach the theoretical maximum and osmosis is continuing and water is still crossing in, you probably will get cell swelling, but there's not very much evidence that that actually happens.
Q. If that doesn't happen, what does happen?
THE CHAIRMAN: Sorry, there's no much evidence that it happens generally or there's no much evidence that it happened in Adam?
PROFESSOR KIRKHAM: There's not much evidence generally or in Adam. There's not much evidence that it happens in general, and therefore it is difficult to state that that must have been the mechanism of Adam's death. Because there's not very much evidence in the past, it means that it's quite a dangerous assumption to consider that Adam's death was caused by that mechanism.
MS ANYADIKE-DANES: If you take that there's not much

evidence of it happening generally, is that because nobody would allow a situation to continue? It would be addressed so you'd never know what would happen if you reached that theoretical limit?
PROFESSOR KIRKHAM: Well, children have ... Patients have been given volumes of hypotonic fluids before and that's why there's been a scientific literature leading to the piglet experiment, for example. So Adam's case is not unique by any means. But actually, the evidence that it's possible to overcome the pumping mechanisms and cause fatal cerebral oedema without other factors is not very strong, and therefore I think it is not necessarily likely to have happened in Adam's case.
THE CHAIRMAN: It is a curious phrase, isn't it, professor, "not necessarily likely"?
PROFESSOR KIRKHAM: Sorry I was ...
THE CHAIRMAN: I'm not critical of you for using it, but I'm observing that we're into -- yesterday there was inevitably, you would say, some speculation. We've also been talking about probabilities and possibilities. And now you use a phrase like "not necessarily likely".
PROFESSOR KIRKHAM: Okay, I am going to say it is possible but not probable.
THE CHAIRMAN: Okay. Let me just pause there. That was at the end of a sentence that there's no strong evidence

that excess fluid leads to cerebral oedema.
PROFESSOR KIRKHAM: Fatal cerebral oedema. I think you may get some cell swelling, but whether you get -- you have to have a chain of events to get to herniation. You have to have a cerebral oedema, the raised intracranial pressure, the brain shift, and the herniation of the brain through the foramen magnum. Those four points all need to happen. And I think that the evidence that just giving a massive volume of free water leads right to the cerebral herniation point is weak and, therefore, the evidence base is not very robust.
Therefore, even if Adam has the highest volume of hypotonic fluid that has ever been given -- and I'd be surprised if that were the case -- I still think that it is only possible that the excess free water is a factor in his death. I certainly don't think it's the only factor in his death. I think to say that, in legal terms, "This is the cause of his death", is based on an evidence base which is relatively weak.
MS ANYADIKE-DANES: We have the answer for the fluid. The experts say that Adam's urine output would have been between 56 to 62 ml per hour. They think that the excess fluid at the end was about 2,000 ml. And that's from Professor Gross, Dr Haynes and Dr Coulthard. What

we don't have is what it was hour-by-hour because that's essentially the way that Professor Rating has put it. That's the damage, the way it is done in that way, and we don't know, at least not at the moment, the matching excess as you go. It may be that we can deduce that from the information we have, but I don't have that figure at the moment.

MR UBEROI: Could I ask where that figure came from?

MS ANYADIKE-DANES: If one looks at Professor Gross' report at ... Sorry, just give me a moment. I think that was the table that Dr Coulthard did when he analysed all the other experts' figures. 300-077-148.

This is a schedule that the inquiry put together, having got the figures from each of the experts, including Dr Taylor's and Dr Savage's figures. You may recall that your clients were asked to complete a table. So we've shown all those on a single table to try and give the information that's been asked, which is how much.

THE CHAIRMAN: So it's either side of 2,000 ml.

MS ANYADIKE-DANES: Mm-hm.

THE CHAIRMAN: Okay.

MS ANYADIKE-DANES: As I understand it, Dr Coulthard calculated the free water because he and Dr Haynes had slightly different calculations. Dr Haynes was 668,

Dr Coulthard's was 1,181 ml. Those figures come -- I think the figure for Dr Haynes comes from 200-020-248.

THE CHAIRMAN: It's okay, we don't need to go back into that. We've got the --

MS ANYADIKE-DANES: Just so that Mr Uberoi knows where they're coming from.

And Dr Coulthard's comes from 200-020-247.

So those are the figures. The question that you were putting to the inquiry, Professor Kirkham, is whether, if we knew that, and we knew what his hourly output was assessed to be, would you have some insight into whether the excess over his output was enough to set up the scenario that I had put to you. Is there any way of knowing?

PROFESSOR KIRKHAM: I don't think there is any way of knowing. Can I just point out -- I found the reference to it. We did discuss it at the experts' meeting. The ion pumps are universal throughout the body. The blood-brain barrier, which you have been discussing, does have additional functions for ways of getting rid of water, including the aquaporins. So the brain is relatively protected. These mechanisms are still being discovered. It's a very active area, and Professor Rating has provided some new literature, which is complex, but very relevant. The brain probably has

better mechanisms for making sure it doesn't become significantly oedematous than the rest of the body, so you could see a scenario where Adam would be generally oedematous, but his brain still would not be fatally compromised. He might well have some swelling in the brain, but whether he would actually have had fatal cerebral oedema simply from that mechanism is questionable.

Q. Professor Rating, do you accept that the brain has better mechanisms for protecting itself from the egress of free water than other cells in the body?

PROFESSOR RATING: I cannot answer the question quite as you like it. I know -- and she is speaking of the other substrates which are there, which are involved to get body [sic] out of the cells. I do not know whether these other substances play a role in the kidney or the liver or the other thing. I don't know. In this moment, I cannot answer you, your question, that the brain has more mechanisms than other cells. I only know for the ionic pump, that's the same. Whether the other, which play a major role in the brain -- and the aquaporin is very clearly described. I remember that aquaporin is described as a mechanism in the kidney too. Therefore, I cannot say it's a better one. I don't know.

Q. Well, Professor Kirkham, do you have any evidence to show that, that the brain is better protected?

PROFESSOR KIRKHAM: I'm not sure that that many scientists have looked at -- there are aquaporins in other tissues and I think this is a very active area of research. I think it's difficult to be absolutely sure.

Q. I thought you had suggested that the brain does have a better way of protecting itself.

PROFESSOR KIRKHAM: The brain has a number of additional mechanisms, including the aquaporins, for maintaining cell volume, and those are quite complex and some of them are specific to the brain.

Q. Could you give some examples?

PROFESSOR KIRKHAM: Aquaporin 4, for example, is specific to the brain, and some of the other mechanisms --

PROFESSOR RATING: And the neurotransmitters which are not expressed in the kidney and not expressed in the liver. You asked me whether this is better. I think it would be logical that it will be preserved better than other organs. But I cannot say, yes, there is evidence that it is better. I didn't know. Maybe it is. I would believe it is better, but I cannot answer your question so simply.

Q. Okay. Can I ask you, Professor Rating, a question I was asked to put, which is: why, in your view, acute

hyponatraemia is able to defeat the protective mechanisms? That's the blood-brain barrier that Professor Kirkham's been talking about. Why do you think that that, in and of itself, without any other factor, can achieve that end?

PROFESSOR RATING: First is the argument from the literature, though we have learnt that the literature may be weak. But I am interest by the point that even in the last literatures -- 2010, 2012, and 2013 is the newest one -- they all are speaking of mortality and great problems with that. And there has been, in the past, some cases, which for a clinician I would like to accept: yes, here is given too much water and the child dies, and I would accept that this child died because of it.

During this inquiry, especially during the last two days, I learnt that you want to have much more precise and go to the mechanisms, and there we are now, that you are very clearly asking how great is the evidence that this -- what for me as a clinician I would accept immediately. Can you prove it? And there we are with the literature, that it is difficult, and we cannot prove it. Now you ask me why I'm convinced, why I think that it would be possible. As a medical doctor, you have seldom all information you probably want to have,

but you have to make decisions on possibilities or probabilities -- I think mostly on probabilities -- to go to the next step. And that's the same for me here in this situation too.

What was the greatest mistake in this case? And the greatest mistake in this case was a wrong calculation of free water intake. For me, that would be the first step to bring on a stone for rolling. Whether then as a mechanisms because there is some brain swelling, because of the length of the parenchymal cell on one side and the vessel on the other side, that because of vein swelling become a little bit farrer [sic], that means that there is some sort of not-so-good energy supply of the cell that could alter the ion pump or something like that. Whether perhaps there is some sort of an ischaemic, very small ischaemic, hit too because of the reduced brain perfusion. That this can play a role, that's for me clear, but I would stick to it that at the beginning there was this wrong decision, then there was water intake, and this water intake leads to some sort of brain swelling and then this [inaudible].

If I go the other way round, why on earth this child, who had never had a hypertensive crisis up to now, now in the theatre for the first time had

a hypotonic crisis, which brings them directly to death, what's the likeliness of that? Why came up that ... I think that I would like to see was it first, was it the second, and to all the discussion we have during these two days I am not convinced that there is any other thing which was first and which was triggering off all the effects, including the hyperosmotic state that was a secondary effect of it.

Q. But Professor Rating, what you have said -- and correct me if I'm wrong -- seems to amount to: well, I believe that hyponatraemia in that way can lead to fatal cerebral oedema because there are cases -- I think that's what you said in your first point -- there is the literature, which seems to suggest that. But then you carefully said: but the literature is not very robust and a lot of it is quite historic and we didn't know or we didn't have the evidence about whether these other things could play a part. In a way, you have built that first point on something that you have acknowledged might be a little weak.

Then when you go to talk about what actually happened in Adam's case, doesn't that not in fact amount to an association? Nobody has denied the fact that he had an awful lot of free water. That has been measured, that's accepted, it's known, so far as it can

be done, what his normal output was, and therefore a calculation is made as to what his ability to excrete water would be. So those parameters are known. And then, when he has that amount of free water, ultimately within a few hours he has the crisis that he does, and, with that association, you have attributed one as the cause of the other. But when you were discussing with Professor Kirkham yesterday, you talked about her associations. In the absence of knowing that actually that is how the body would work, for which you rely on the literature which you say is weak, is yours also not just an association?

PROFESSOR RATING: I would give ... That's the problem of evidence. You know probably digitalis and everybody in this room knows that you give digitalis to men who have problems with his heart, and therefore you give digitalis to our children and even to term and pre-term children. You know that there is no study which ever showed that digitalis has an effect, it was never shown by a study, which would have to do today to get digitalis on the medical -- to get a licence as a drug.

That means there is old evidence, it is empirical evidence, for me it has some strength, that hypoosmolality infusion or infusion of free water could lead to brain swelling and I cannot answer all

questions, I think that there's quite a lot of mechanisms not well-known. I have read out this night that I can show papers that if it goes quickly that the cell swelling is more pronounced instead of if it is gradually going -- and I think I have to dig a little bit more, I have to find really that this mechanism of pumping out his barriers, you cannot exceed, but in this moment I cannot give you the evidence therefore, and therefore I cannot say that is ... But it is for me as a clinician the most logical and most reliable explanation. I cannot say any other thing.

Q. Maybe, Professor Kirkham, you were going to respond to the papers or at least address the papers that Professor Rating had provided. Can you explain what you think their significance is?

PROFESSOR KIRKHAM: The papers that I read at lunchtime?

Q. Yes.

PROFESSOR KIRKHAM: Do you have the ...

PROFESSOR RATING: 306-115-001.

PROFESSOR KIRKHAM: There are three relatively recent papers on control of cell volume in brain cells, which discuss quite complicated mechanisms for cell volume control. This is one of them and then there are two others. And then there's a useful --

PROFESSOR RATING: Can I go to 004 of this paper? In the

middle on the right side, it says "exposed to GOR". GOR stands for a gradual increase or decrease of the hypoosmolar(?) state:

"... exhibit a progressive increase in cell volume, which continued over the time of the experiment, up to 83 minutes, when the osmolarity was decreased to 50 per cent. These results indicate the absence ..."

Then:

"However, cells swelled significantly less [that means GOR significantly less] than those exposed to sudden decreases."

That means here is a paper, basic science, which shows that in a gradual increase, there is an increase of cells and that is more pronounced if that is given very quickly than if it is gradually. And that's one of the points I want to make. And there is on --

MS ANYADIKE-DANES: Sorry, before you do that, maybe Professor Kirkham can just deal with that first.

PROFESSOR KIRKHAM: Yes. This is a basic science paper and it does suggest that cell volume increases are different with the speed of ... But I don't know how much this directly relates to Adam's case.

Q. Sorry, just why do you say that? Why do you say it might not be relevant to his case?

PROFESSOR KIRKHAM: It's looking at cell volume rather than

brain volume --

Q. Okay.

PROFESSOR KIRKHAM: -- and under experimental circumstances.

Q. Why is that not useful if you're trying to understand the possible impact of the speed with which he was given the free water?

PROFESSOR KIRKHAM: Well, it doesn't say anything about intracranial pressure or cerebral herniation, it just talks about cell volume.

Q. Are you not able to extrapolate from that?

PROFESSOR KIRKHAM: I wouldn't want to extrapolate.

Q. Why?

PROFESSOR KIRKHAM: Well, I think it's unscientific to extrapolate.

Q. What about the other papers that Professor --

PROFESSOR RATING: May I please go in this paper to 008? There in the first row of the right side:

"Thus a mechanism activated by GOR [that means by the gradual decrease] in our conditions, although not sufficiently to fully prevent swelling, can substantially reduce it."

That means that there is cell swelling, even if it is going slower and it is even greater if there's an acute. That you can read out of this paper, not more. And yes, it's not scientifically to extrapolate, but

brain volume, cell volume, has to do something with brain volume, but I cannot calculate it up, that has increased 5 per cent. [inaudible] percentage whether it goes 5 or 10 per cent or 15 per cent, it means it cannot go up there because it is known that not every cell in the brain has the same amount of swelling. That means astrocyte and the neurons have not the same amount of swelling. But there is swelling, which is more pronounced in an acute situation.

Q. Professor Kirkham?

PROFESSOR KIRKHAM: I would agree with that. There may be more acute cell swelling with a rapid --

Q. Was not the point, though -- it's not whether there would be more acute swelling, but whether the --

PROFESSOR KIRKHAM: Cell swelling.

Q. Yes. Whether the rapidity of the administration of the free water would produce the effects that Professor Rating is saying, which ultimately led to the cerebral oedema that killed him. That's the proposition. So are you saying that you can't take from a study that indicates there would be some cell swelling right to the end that that would have produced, in that short period of time, a fatal cerebral oedema?

PROFESSOR KIRKHAM: Yes, exactly. I would not want to extrapolate from where I would agree with

Professor Rating that you would get more cell swelling to a situation where you would get fatal herniation. It's the herniation that's fatal, not necessarily the swelling. Swelling can happen, probably happens all the time, but whether that actually leads to fatal cerebral herniation is the issue that we disagree on.

Q. Or whether it swells so much that there is no more space and that drives itself down the foramen magnum, that's the point you're talking about?

PROFESSOR KIRKHAM: Yes, that's the point that I think is very weak in the literature.

Q. And the other papers?

PROFESSOR RATING: But you have to accept that if you compare the graduate [sic] and the acute experiment, that in the acute experiment the mechanisms are not sufficient -- they are not even in the slowly increase or decrease sufficient to preserve the cell volume. Even in the more chronic form of experiment, the cell volume goes a little bit up.

PROFESSOR KIRKHAM: Yes, I agree.

PROFESSOR RATING: That is an indication that it belongs to the amount of the free water coming in, that this process cannot be held on.

PROFESSOR KIRKHAM: I would agree that --

PROFESSOR RATING: I cannot show it to you now, I have not

found data, but it is a puzzle in that direction.

PROFESSOR KIRKHAM: There would indeed be an increase in cell volume, but I think it ... I don't think you can extrapolate from that to say that that would cause fatal cerebral herniation.

PROFESSOR RATING: But we are on the way to come to the point that we have to accept that by hypoosmolic [sic] infusion -- or giving too much free water, is a better phrase -- that there comes up cell volume increase.

PROFESSOR KIRKHAM: Yes, cell volume increase. I think --

PROFESSOR RATING: Brain oedema.

PROFESSOR KIRKHAM: I think -- brain oedema is quite a complex subject. You can have cytotoxic oedema and vasogenic oedema, so let's just keep it at "cell volume increase". I'm happy to agree these papers are in line with the other literature that we've read that suggests that cell volume can increase.

Q. So where the two of you seem to diverge now then is that what happened to Adam could have led to the cell volume increase. Although the paper doesn't show it, but you believe there is enough, Professor Rating, to permit the conclusion that that carried on and ultimately the increase was at the level that it produced his fatal cerebral oedema. Your view is, it wouldn't carry on without some other factors that would have had to be

overwhelmed for it to get to that stage.

PROFESSOR KIRKHAM: Yes.

Q. Is that it?

PROFESSOR KIRKHAM: That's my position. The increase in cell volume might be one of the factors, but I cannot find good evidence in the literature that on its own the increase in free water is fatal.

Q. And Professor Rating, would your view be that although that's what you consider happened and that these papers, as I think you put it, were a step along the way because they establish the increase in cell volume, would you agree or not with Professor Kirkham's view that there is not yet research and papers that take that to the end of fatal cerebral oedema on its own?

PROFESSOR RATING: Scientifically there are missing papers, yes. There is missing data.

May I ask a question? I asked a little bit polemically why hypertensive crisis came up at 10 o'clock in the theatre and not before and never had any problems in that direction.

PROFESSOR KIRKHAM: Well, I have been trying to find the paper and I haven't been able to find it. My understanding of the literature on hypertensive encephalopathy is that you're more likely to have hypertensive encephalopathy if your blood pressure's

always been completely normal and then you have an acute rise. So in fact, Adam would have been more at risk having had well managed blood pressures before. I don't think he'd ever had a high blood pressure. So he would have been more at risk of acute hypertensive encephalopathy.

PROFESSOR RATING: And in that direction, the amount of free water has no triggering factor or nothing in that direction?

PROFESSOR KIRKHAM: I think the amount of -- I mean, in fact, leaving aside the crystalloid fluids he was given, he was also given some colloid to try and perfuse the kidney, and all of that will have increased his circulating volume. And in the context of the fact that he became -- his blood pressure then increased, the amount of fluid he was given may have increased the risk of him becoming significantly hypertensive with the risk of encephalopathy. But I don't think that the major factor is the free water. I think that the free water may be a factor, but that the major factor is the increase in blood pressure.

Q. Can I ask you to clarify something that I have asked for you to clarify, which is: what do you think caused Adam's oedema and how do you think that led to his death?

PROFESSOR KIRKHAM: I think ... I think that the oedema is likely to have had several factors. I do think that the sudden increase in blood pressure will have been a significant factor. You do get vasogenic oedema if the blood pressure goes up suddenly and I do think that's a major factor. If, as has been put to me this afternoon, Adam had no way of pumping out sodium and some of the other mechanisms that keep the blood-brain barrier intact and water always coming out in balance with water going in, I do think that, for example, if he was anaemic as well as significantly ... If he had a significant fall in haemoglobin and became a little hypoxic and the pumps failed, that is a possible factor, but I don't think it's a definite factor, whereas I do think the blood pressure went up. The oedema is predominantly posterior and he had retinal haemorrhages as well as papilloedema, so I do think that the major factor in his cerebral oedema is vasogenic oedema in the context of hypertensive encephalopathy.

Q. Thank you. If I can ask Professor Rating the question relating to the cases in Berlin where the children died. You did give it yesterday and I apologise for not precisely remembering it. When did you say that happened?

PROFESSOR RATING: That was around about 1974/75.

Q. They all happened within about a year or 18 months; is that correct?

PROFESSOR RATING: Yes. That was the time, yes.

Q. At the time, those treating the children thought that the thing to do was to restore them to the normal level, presumably as quickly as they could, and that seemed to have positive effects initially and then not.

PROFESSOR RATING: In the first few hours and then ...

Q. What was explained to the families?

PROFESSOR RATING: Oh, I don't know, because I have not been involved directly. It was in the hospital, it was great discussion involving different Berlin clinics because we had been the university and we are high. But the most important impact came from the small adult hospital where somebody heard of a discussion and brought it forwards and changed it so it became protocol. But I have not been directly involved with the parents, I have not spoken with the parents.

Q. Thank you.

PROFESSOR RATING: I believe at that time, because we didn't understand it any better, that we said it was very, very ill child, and the children came ill in and the parents saw that ... And we could not get it. I believe it would be the declaration at that time. Because it needed some times after the last case that we started

a discussion and then we have not ... I suppose we don't have any contact with the parents at that time.

THE CHAIRMAN: Sorry, professor, I'm not clear what you mean. The children came in very ill and the parents saw that, but what do you mean when you say, "And we could not get it"?

PROFESSOR RATING: The children have been as ill, we tried everything we could, but the diseases were going on.

THE CHAIRMAN: Okay.

PROFESSOR RATING: Because that was the most reliable cause for dying for small children, was gastroenteritis. We have to remember that the first needle infusion was started in 60-something. Up to that time, we could not do any infusion in the small children, infants. We don't have any system at that time. They had to be all fed orally and if there is something going wrong, then a second hit of, again, a dehydration and vomiting and loose stool, they die.

MS ANYADIKE-DANES: Thank you. Mr Chairman, I've been asked if we might have a couple of minutes. I think there is a question under consideration.

THE CHAIRMAN: But otherwise, the questioning is complete?

MS ANYADIKE-DANES: I think so. I think I've managed to -- there might be somebody else who wants me, but I think I've managed to ask most of them.

THE CHAIRMAN: What we do is we typically allow a few minutes at the end of the questioning so that the families or the other interested parties can confirm that they don't want anything further asked. So I will rise just for a few minutes. This will be a very short break to sort out if there are any other questions, but apart from that your evidence is complete. So if you just give us a few moments. Thank you.

(2.50 pm)

(A short break)

(3.00 pm)

THE CHAIRMAN: Is there anything further?

MS ANYADIKE-DANES: Yes, Mr Chairman. There are some points from two different sources. The first relates to the paper that Professor Rating kindly provided on the volume changes and whole cell membrane currents activated during gradual osmolarity in C6 cells. The paper is at 306-115-001, but the question is directed to the discussion at 306-115-008.

So the discussion is the discussion of the findings. If you see, it starts on the right-hand column, at least the point that I want to put to you:

"According to the study of Lohr & Yohe, in C6 cells, swelling is prevented only when the osmolarity decrease is of ... and the osmolality reductions do not exceed 20

per cent. Therefore [and this is the conclusion the paper reaches] C6 cells possess mechanisms to counteract hypoosmotic swelling, which, however, appear less efficient than those present in renal cells, A6 cells, and some neurons, which are able to maintain constant volume in the face of osmolarity reductions similar to those used in the present study."

The question is, that seems to indicate -- and I think Professor Rating, you had conceded that -- that it indicates that the effect of that kind of reduction is not uniform, and therefore different cells have different ways of responding to it, and the C6 cells, according to this paper, apparently can be more resistant to that than A6 cells and those present in the renal cells. So the question is for you, Professor Kirkham, which is: are you able to assist with what proportion of the brain cells are C6 cells?

PROFESSOR RATING: It's a glioblastoma cell line. That is the cell line coming out from a glioblastoma, from the tumour, and because they are easier to grow in culture, they use them as an example.

Q. Yes. But the question --

PROFESSOR RATING: You have no glioblastoma cells in the brain.

Q. So those aren't in the brain [OVERSPEAKING]?

PROFESSOR KIRKHAM: They are tumour cells, so you wouldn't --

Q. Okay. So that wouldn't be relevant.

Are there differential responses to the fluid in brain cells than in perhaps other cells?

PROFESSOR KIRKHAM: Well, I think one point that is worth taking is that neurones are relatively protected, in other words, actual brain cells, neurones, are relatively protected. What swells is the glial cells, mainly. So there are differences between cells, even within the brain, and then, to be honest, I think it would be very hard to extrapolate from this paper on tumour cells. I think the important point here is that tumours often have some oedema associated with them, which needs treatment in its own right, because once you've got a mass lesion and swelling around it then there is a risk of herniation. But this is a paper specifically on tumour cells.

Q. So that doesn't help, but I think the only thing that you took out of it that might go to the argument that we're dealing is the relative protection of neurones.

PROFESSOR KIRKHAM: Yes.

Q. I was also asked to ask both of you to look at the before and after photographs, if I can put it that way, of Adam. So the before photographs relate to a party,

which was obviously before he was admitted for his renal surgery, and the after photographs are after his surgery. If I pull up the two that we have from before. 300-079-150 and 300-079-151 alongside each other.

The child towards the bottom of the table is Adam and the child on the right-hand side, that's Adam.

PROFESSOR RATING: Age of?

Q. Sorry?

PROFESSOR RATING: At the age of?

Q. The same age, it's the same year. It's very shortly before he was admitted to hospital.

THE CHAIRMAN: Is this a birthday party?

MS ANYADIKE-DANES: Yes.

THE CHAIRMAN: Is his fourth birthday party? So this was taken in August and the operation was in November.

PROFESSOR RATING: Okay, fine.

Q. So that's how he would have appeared when he was admitted. And then if one puts up two photographs alongside each other, 300-080-152 and 300-080-155. In terms of the oedema in the body that I think, Professor Kirkham, you indicated might have happened differentially from the cerebral oedema in the brain. Does that difference in his appearance assist?

PROFESSOR KIRKHAM: Well, I think there is ... It does look as though his face and arms are quite swollen. So

I think there is oedema, systemic oedema.

Q. And if there is, how do you interpret that in terms of what you think led to his death?

PROFESSOR KIRKHAM: I don't think it's actually particularly helpful. I think he has systemic oedema, but it doesn't tell us why he had cerebral herniation.

Q. But it's evidence -- sorry.

MR FORTUNE: Sir, what allowance should Professor Kirkham make for any fluids administered in PICU after the collapse? Because we've been down this route before, have we not, with Dr Armour?

MS ANYADIKE-DANES: We have. Yes, we have been down that route. It's a matter of how much you make the allowance for the fluids he was administered, how much you make the allowance for the fact that he was given mannitol and so on. So there are -- he was administered --

PROFESSOR RATING: He was kept dry, as we medical doctors say. They tried to get out and not infuse any more. As dry as possible.

THE CHAIRMAN: Well, I think Professor Kirkham, what you're saying is this shows oedema, but it doesn't particularly help in advancing any further explanation on the cause?

PROFESSOR KIRKHAM: I don't think it actually particularly helps. Can I just ask, because I think there was a new report that I hadn't seen before about whether there was

pulmonary oedema. What's the final decision on whether there was pulmonary oedema or not?

MS ANYADIKE-DANES: I'm not aware of the report.

PROFESSOR RATING: Regarding pulmonary oedema, it is said that there is no pulmonary oedema, but we have to recognise that the pulmonary oedema, this child was ventilated for a long time, 24 hours, and that's very effective to throw away any pulmonary oedema. Therefore of the pulmonary oedema at the end in the autopsy, we cannot argue on pulmonary oedema at 10, 10.30 or 11 or 11.30.

MR FORTUNE: Professor Kirkham refers in her second report at 208-007-080 at paragraph 35 to the review by Dr Landes. Is that the report that you have in mind, professor?

PROFESSOR KIRKHAM: I thought there was a subsequent report because I think Dr Landes' report says there's no pulmonary oedema.

MS ANYADIKE-DANES: Sorry, whose report?

PROFESSOR KIRKHAM: Dr Landes' report.

MS ANYADIKE-DANES: We're just checking it now.

PROFESSOR KIRKHAM: I don't think it's in the bundles that we've got here, but I think it was something that I was sent recently where there was a further report from a chest physician.

MS ANYADIKE-DANES: 207-006-011.

THE CHAIRMAN: Literally the bottom line on that page.

MS ANYADIKE-DANES: "The pulmonary oedema is seen on the chest X-ray."

MR FORTUNE: Is this Dr Landes?

MS ANYADIKE-DANES: Yes.

THE CHAIRMAN: It must be. Can we ask the same question to Professor Rating about the photographs?

MS ANYADIKE-DANES: Yes. That's where I was going to next, sorry.

Professor Rating, first I just wanted to clarify something that Professor Kirkham said. When you said it didn't help, it doesn't help with the fatal cerebral oedema?

PROFESSOR KIRKHAM: It doesn't help with what caused the herniation. It is the herniation caused death.

Q. What caused the herniation? Sorry, yes.

Professor Rating, how do you interpret those two sets of photographs?

THE CHAIRMAN: Do you interpret anything from them at all?

PROFESSOR RATING: No, I cannot see any ... The child seems to have oedema, but if the child, for example, had another -- meningitis or something like that -- and he was ventilated for 24 hours longer than he already was, it could be the same appearance. You don't can

trust from that it must be oedema in the brain.

THE CHAIRMAN: Thank you.

MS ANYADIKE-DANES: Professor Kirkham, I have the correct reference, I beg your pardon. It's 207-007-001.

THE CHAIRMAN: Okay, there's no pulmonary oedema.

MS ANYADIKE-DANES: Actually, no, Mr Chairman, that's why I was checking it because I seem to remember there was a second report that came, and I think Professor Kirkham was right, there is a second report. It is 207-007-001.

THE CHAIRMAN: Is there a date on it?

MS ANYADIKE-DANES: Yes. 25 May 2012. It's a report by Dr Landes. What she says is:

"The chest X-ray dated 27 November 1995 at 1.20 [which is just after he came out of theatre] does not show pulmonary oedema. The chest X-ray dated 27 November 1995 at 9.30 pm shows evidence of pulmonary oedema."

PROFESSOR KIRKHAM: 9.30 pm?

Q. That same evening. So at 1.30 pm, the chest X-ray shows no pulmonary oedema; at 9.30 that evening the chest X-ray shows evidence of pulmonary oedema.

MR FORTUNE: That's not what Professor Kirkham is led to believe in paragraph 35 of her report.

PROFESSOR KIRKHAM: But I think that my report was completed before Dr Landes re-reported the second chest X-ray.

THE CHAIRMAN: If it is the case that there is, on the second X-ray, evidence of pulmonary oedema, how does that affect your evidence?

PROFESSOR KIRKHAM: I'm going to assume that the photograph of Adam is taken the following day.

MS ANYADIKE-DANES: I think it is. I am just going to get some instructions.

PROFESSOR KIRKHAM: So I think that in terms of the aetiology of cerebral herniation, it doesn't really help. It does suggest that there wasn't any pulmonary oedema at the time that he came back from theatre, which I think would be consistent with the pumping mechanism still working at that stage throughout the body with the sodium being pumped out of the cells and therefore the mechanism -- the overall systemic mechanism not being overwhelmed. However, if there's pulmonary oedema at 9.30 and the following day Adam has widespread oedema, I think that would be consistent with there being a more serious problem with the pumping mechanisms later on, after the herniation has already occurred.

Q. Firstly, let me give you the time of the photographs. The photographs were taken by the PICU nurse at about 11 o'clock on the 28th. And the reference for that is witness statement 001/2, page 14. Not to be pulled up, just for the record. So then you are saying that the

pulmonary oedema shown on the later X-ray, but not on the earlier one, when he first comes out, is actually consistent with your view that the ion-pumping mechanism, if I can put it that way, was working and subsequently became overwhelmed?

PROFESSOR KIRKHAM: Yes.

Q. If that's the case and it was working at that stage, then where does that take you in terms of trying to see what the supporting evidence is for the cause of his death?

PROFESSOR KIRKHAM: I think it means that there's no evidence that the pumping mechanism will have been overwhelmed and therefore that the body, lungs and brain will have been so full of fluid that the herniation was caused by the fluid, the free water.

Q. Yes, thank you.

Professor Rating, can I ask you --

MR FORTUNE: Sir, before we move from that, I'm reminded by Professor Savage that the chest X-ray taken after leaving theatre, so that's at 13.20, was taken and it is marked "on expiry", and perhaps Professor Kirkham would confirm that it is difficult to read a film in such circumstances.

PROFESSOR KIRKHAM: Yes, but we are left with the evidence we have. I think even an expiratory film will have

shown significant pulmonary oedema if it was there.

MR HUNTER: Just on that point, sir, of course there is evidence from Professor Savage and Dr O'Connor and Adam's mother that he was swollen immediately after theatre when he was brought out.

THE CHAIRMAN: Yes.

MS ANYADIKE-DANES: Well, Mr Chairman, I don't want to get entirely into that because -- well ...

THE CHAIRMAN: Let's hear what Professor Rating says.

MS ANYADIKE-DANES: The date of Professor Kirkham's report is 28 March 2012, so she would not have seen this expert's report by that time.

THE CHAIRMAN: Professor Rating, what did you want to say?

PROFESSOR RATING: We cannot discuss the pulmonary oedema only on the basis of pump mechanisms because if the child which is in intensive care unit, which is going bad, it could have ... We cannot say he is pump -- because it could be a cardiac problem, it could be problems with ventilation, and I think it's a little bit difficult to say that is all with the pulmonary oedema that has all to do with the pumping mechanisms.

MS ANYADIKE-DANES: Can I ask this question though: if your assessment of what happened is that he received an overwhelming amount of free water, that lowered his sodium levels and the result of that ultimately was

that, by 11.30, he had such massive cerebral oedema that he coned, and that that really was all that was involved, if that is the case would you have expected to see any evidence on an X-ray of pulmonary oedema by 1.30, which is two hours or so after the coning?

PROFESSOR RATING: I cannot answer your question. I don't know.

Q. You don't know whether you would have expected it or not?

PROFESSOR RATING: Yes, I don't know.

Q. Would you have expected to see pulmonary oedema at any stage on an X-ray?

PROFESSOR RATING: The other way round. If I would have seen the pulmonary oedema in the first X-ray, it would not have puzzled me. I'm now thinking about why the first one didn't show it and the second one did show it. Okay, it could be more difficult because in an experienced situation to calculate on pulmonary oedema, it is a better one later on. Maybe that's the explanation for ... If that would be a pulmonary oedema, I would say, yes, that goes with what I'm thinking on. But if it's not there, that would mean I cannot say that ... Because the difference is -- the brain has a skull, which is rigid and it cannot give any space. All other organs can have some space. And by

that, the kidney, the liver and even in the skin you see it, it can be stored quite a lot of water. And I think in some way the most water will be in the skin tissue.

MS ANYADIKE-DANES: Thank you.

THE CHAIRMAN: Okay, thank you very much. I think that finally brings an end to your questioning. I'm very grateful to you for coming from Germany and to you, Professor Kirkham, for labouring through what is clearly a very heavy cold or flu. Thank you for your time. You're now free to leave.

Ladies and gentlemen, we'll take a break for 15 minutes and we'll get at least one session in with Dr Carson this afternoon. Thank you.

(3.24 pm)

(A short break)

(3.26 pm)

THE CHAIRMAN: Sorry, there's apparently something outstanding.

MS ANYADIKE-DANES: I beg your pardon. The question is really directed to Professor Kirkham.

You had said that, I think your wording was that Adam was not unique. Adam's case was not unique, I beg your pardon. Adam, of course, was unique. Adam's case was not unique; you said that in one of your answers to the chairman. The question to you is: what did you mean

by that and what's the evidential basis of it?
PROFESSOR KIRKHAM: I think in fact I have to check the transcript. But I think what I was actually saying was that there were --
Q. I can give it to you now. What you said was:
"Patients have been given volumes of hypotonic fluids before and that's why there's been a scientific literature leading to the piglet experiment, for example. So Adam's case is not unique by any means."
And just to complete your sentence:
"But actually, the evidence that it's possible to overcome the pumping mechanisms and cause fatal cerebral oedema without other factors is not very strong and therefore I think it's not necessarily likely to have happened in Adam's case."
The question is: what do you mean when you say that Adam's case is not unique?
PROFESSOR KIRKHAM: What I meant there because I think I said something slightly -- about whether Adam's case followed on from the other cases in a different context earlier. I think what I meant in that context was that other children have been given large volumes of free water.
Q. So in that sense other children have also received large volumes of free water?

PROFESSOR KIRKHAM: Yes.
THE CHAIRMAN: And not necessarily died?
PROFESSOR KIRKHAM: And not necessarily died.
MS ANYADIKE-DANES: Okay. Thank you very much indeed.
THE CHAIRMAN: Thank you very much.
(The witnesses withdrew)
(3.27 pm)
(A short break)
(3.45 pm)
DR IAN CARSON (called)
Questions from MR STEWART
THE CHAIRMAN: Can I say, doctor, my intention is to try to do up to an hour of your evidence this afternoon, and hopefully that will ensure that you get your evidence finished tomorrow and, if we don't finish Mr McKee, we'll come very close to finishing him.
MR STEWART: Dr Carson, you were good enough to supply the inquiry with five witness statements. They were: WS077/1 of 8 July 2005, supplied in your capacity as deputy Chief Medical Officer; WS077/2, of 14 May 2012, in relation to Adam Strain's case; WS077/3, of 9 January of this year, in relation to both Adam's and Claire's cases; WS270/1, in relation to Claire's case, on 4 September 2012; WS306/1, on 13 December 2012, in relation to Raychel Ferguson's case. Are you content

that the inquiry should adopt those statements as part of your formal evidence?
A. I am, chairman. Can I maybe just point out two small errors that I've included within those? The first relates to WS077/2. I cited under paragraph 4 the GMC guidance that "Good Medical Practice" was first published in 2001. As the inquiry will know, it was first published in 1995, with revisions in 1998, 2001 and 2006. So that was an error of transcription.
The other relates to witness statement 270/1, and under paragraph 2 I was asked to comment on:
"Please detail changes in clinical and corporate governance in the Royal Group of Hospitals/RBHSC as between 1995 to 1997 and 1997 to 2004."
And against both subsection A and subsection B I had stated, "None that I can recall". That related to 1995 to 1997. The period 1997 to 2004, I had actually detailed those in witness statement 306/1. My apologies for that.
Q. I'm grateful for that. You were, in fact, the medical director and deputy chief executive of the Trust from 1993 to 2002. So in fact, your period in office covered the period when both Adam and Claire received their treatment and died.
You have supplied us with your CV, which starts at

306-088-001. We can see it gives your professional background, your postgraduate education, I see this is the third bullet point in the postgraduate education as being relevant. You were appointed to the Northern Ireland regional educational adviser to the Royal College of Anaesthetists, 1988 to 1996. So again that covers the period with which we are principally interested. And below that, we see at the bottom that you also have experience as a clinical director, having served in that capacity in anaesthetics and intensive care from 1990 to 1993.
A. Correct.
Q. So that was preparatory to the Trust coming into being?
A. Correct.
Q. And again, if you turn the page to 002, medical director and deputy chief executive. We see then the dates:
"Reporting to and accountable to the chief executive."
I'm going through this, with your leave, to point out one or two things of relevance. In the bullet points that follow that, the third one down, you served on the Audit Committee of Northern Ireland Council for Postgraduate Medical and Dental Education. So your interest in education is marked?
A. Yes. From my appointment as a consultant in 1975,

I have taken an active interest in medical education. I was, for many years, the clinical tutor in the Royal Group of Hospitals on behalf of the then Faculty of Anaesthetists in the Royal College of Surgeons, later the Royal College of Anaesthetists, and I later served then as a -- and that was with responsibilities internally in the hospital when it was still a directly managed unit of the Eastern Board. Later in my career, the mantle extended to cover Province-wide responsibilities on behalf of the college as the regional educational adviser.

Q. And of course, your career then in 1993 became one where you started to concentrate more on the governance aspect of the hospital rather than your clinical duties.

A. I maintained -- and most clinical directors and certainly all of the -- most clinical directors and most medical directors across the Health Service, both in Northern Ireland and elsewhere in Great Britain, would have retained some clinical practice. I had one day a week in which I continued to work as a cardiac anaesthetist. And I continued with my on call responsibilities along with other members on the rota during that period of time, right up until I left the hospital in 2002.

Q. We then find your interest in the governance side of

things, you being a founder member of the British Association of Medical Managers.

A. Yes.

Q. What was the approximate date of the foundation of that association?

A. I honestly can't remember, but it would have been in the early 90s, probably not very much distant from 1993 when the Trust was established. It would have been around 1993, 1994, I would think.

Q. And in the bullet point beneath, we find your reference to your special interest in the development of medical appraisal and the handling of doctors with performance difficulties. When does that interest date from?

A. That would have -- during my period as Trust medical director, that would have been a growing interest at that time. There was a huge amount of change going on within the Health Service in relation to modernising systems and processes for handling doctors with problems, and I would have been very much involved in the early days of that development.

Q. Over the page, then, to 306-088-003, your key areas of responsibility. That is, first:

"To ensure an effective medical contribution to the formulation and implementation of policy."

On the board, you were, as an executive director,

really the sole medical man.

A. Yes.

Q. Of course, there was the director of nursing, but amongst the non-executive directors, there would have been a medical academic.

A. The Queen's University were represented on the Trust board from commencement in 1993. In fact, I can't remember who the first Queen's University representative was, but I don't think they were clinically -- had a clinical background. I know, for example, that Mary McAleese at one period represented the university on -- it was because of our teaching responsibilities and our responsibility to the university in regard to undergraduate education within the Trust that the university had a seat on the Trust board.

Subsequently, I know that then Mr James O'Kane, who had finance responsibilities, I think, within Queen's University. I think he was the final member of the Trust board at the time I think I left the Trust.

Q. So the board and the chief executive really relied upon you to a large extent in relation to clinical input?

A. Myself and the director of nursing would be the two sole representatives on the Trust board with a clinical background.

Q. So then moving on down to the bullet point, "My main

area of responsibility", this is in the department. So these are, of course, your responsibilities within the department after you become deputy Chief Medical Officer; is that correct?

A. Yes.

Q. And that was from 2002 --

A. To 2006.

Q. And it was during that period that the UTV broadcast its programme, "When Hospitals Kill", and when the death of Claire Roberts went to inquest; was that during that period of your career?

A. Correct.

Q. We'll deal with that later. Over the page to 005, you list the various learned societies to which you belonged, both currently and previously. And the previous section of that category, apart from the first one, all the other associations are based outside of this jurisdiction. In Britain, USA and indeed the rest of Ireland. Did you go off to conferences and have much liaison with these organisations?

A. During my time as Trust medical director?

Q. Yes.

A. Well, yes, I would have -- first of all, I would have had to retain my continuing medical education responsibilities. As a registered medical practitioner,

you need to keep abreast of developments. I was still practising as a clinical anaesthetist in the cardiac surgical unit, so I would have taken steps to ensure I was keeping up-to-date with developments in cardiac anaesthesia. In relation to -- but I had other areas of interests and my developing interest in the area of clinical management would have been areas that I would have pursued as a Trust medical director, yes, principally through the British Association of Medical Managers, which was an organisation that was set up, as I say, in the early 90s to assist those doctors who had taken that unique decision, if you like, to get involved in the administration and management of Health Service Trusts. This was a new area for doctors to work in. There was a limited amount of training provided on appointment. It was a whole new area for doctors to get involved in, both not just as clinical directors, but particularly as Trust medical directors.

Q. And so this association helped you receive information and training?

A. Well, I wouldn't maybe use the word "training" quite specifically, in the same way as you'd apply that to maybe undergraduate education or postgraduate education, but it was certainly a forum in which you learnt from other colleagues working in other parts of the UK. The

pace of change, if you like, in relation to NHS reforms was different, faster if you like, in England than it was here in Northern Ireland. So I used it very much as an opportunity to see how the developments might take place within Northern Ireland in due course. And it was an opportunity to share -- again there's a tremendous ... In 1993, when trusts were beginning to be established in Northern Ireland, we had quite a range of size of organisations, different natures of services, some were community based, some were acute hospital based, some were large, some were small.

So I was very keen to liaise and to have contact and to network with trust medical directors working in larger teaching hospitals like Leeds, Manchester, Birmingham. And that was where I had the opportunity to undertake that engagement.

Q. Were you able to capitalise on those contacts with Birmingham and Leeds and keep up to date with what they were doing?

A. Very much so, and we did -- I did that obviously at a personal level when I was meeting particularly through the Association of Trust Medical Directors, but also as a Trust, the chief executive and other members of the senior management team in the Trust -- we had particular relationships with Manchester, Leeds and Birmingham at

various stages during the development of the Trust, trying to innovate and to learn from each other. So there was a lot of that learning and networking, and that was encouraged within the Trust, I have to say. So there was a very positive approach to that.

THE CHAIRMAN: Doctor, can I ask you about that? In these formative years of the trusts, would that mean that part of the advantage of being involved in the Association of Medical Managers would be that instead of you having to wait to take the lead from the Department of Health and Stormont about something, you could exchange ideas and find out if things are developing more quickly in England and you could import their ideas to Northern Ireland without having to wait for anything from Stormont?

A. That was very much the case. There was considerable difficulty in the Northern Ireland context because of the political developments, the assembly up, the assembly down, local ministers in, Northern Ireland officers, ministers taking responsibility for health and social care.

THE CHAIRMAN: And some more interested than others --

A. Possibly.

THE CHAIRMAN: -- or some more knowledgable than others?

A. Certainly. I think for those Northern Ireland Office

ministers who came in, they were very reluctant, I think, to impose an English model of governance or quality for Northern Ireland, whenever they knew that the whole area of devolution of health education was going to be an issue for local ministers. So that -- there was tremendous reluctance I think on their part to do that. I would also suggest that at the time the Trust was established, when Bairbre de Brun eventually became on as the first devolved Minister for Health, there was maybe a reluctance for her to take on English models as well.

So the drive to develop and put in place a model for quality and safety was slow here. So I was -- and I to a certain extent -- at a personal level maybe -- was quite frustrated by that because I was seeing some excellent work coming out in England that I really felt would have been beneficial if it had been in place in Northern Ireland, and also I was keen to try and adopt and adapt that in the context of our own Trust, and we did manage to do that.

THE CHAIRMAN: Can I ask you two things? First of all, were the problems which you gathered from your English colleagues they were facing, were they similar or perhaps sometimes even identical to the problems you were facing?

A. The underlying problems of managing a very complex organisation was common across particularly the larger hospitals. The span of responsibility for trust medical directors at board level was very, very broad. The vast majority of trust medical directors, certainly first wave trust medical directors -- I had a secretary who worked with me, who managed my diary and did very little else. I had no infrastructure, no department, as the medical director, that would enable me to manage all of the elements of the medical director's responsibility. And that was not uncommon across the NHS in Great Britain as well.

So many, many trust medical directors found that they were paddling very ferociously under the water. So we did share and learn from each other.

THE CHAIRMAN: The second point is: if you did see some scheme or system working or being developed in England, could you bring that over the to Royal with the approval, presumably, of the chief executive and the board, but without necessarily having to get approval from the Eastern Board or the department?

A. Well, in 1993, the Eastern Board's responsibilities were solely those of commissioners of services. The department's oversight of the Trust -- I mean, I think the transition and the move into the self-governing

Trust status was actually a difficult one in many ways because it did allow trusts certain freedoms and the opportunity was there. I have to say that the board and the chief executive in particular were very supportive of me in enabling me to take forward a number of initiatives in relation to medical management within the Trust. I had a particular interest in training clinical directors and equipping them for what I thought actually was the most difficult task, that of a clinical leader within an area of the hospital, working very closely with clinical colleagues, managing clinical colleagues. That was a very difficult -- a tense interface at times for clinical directors, in some ways more difficult than medical directors.

THE CHAIRMAN: Because you're a step back?

A. I was a little bit distant from that.

THE CHAIRMAN: So you could have the anaesthetic director potentially having to confront or speak fairly bluntly to a colleague?

A. They have to work with their colleagues on a daily basis and quite often when difficult issues did emerge, it was uncomfortable for them, maybe, to say the least, at times. But they were -- the vast majority of them, I have to say, did work very closely with myself and I would have given them whatever support they needed.

MR STEWART: Indeed, that very theme finds reference in a letter written to you in July 1992 by WGH Quigley, who was the chairman of your Trust.

A. Yes.

Q. This appears at WS306/1, page 13. In this letter, which is at the establishment of the Trust, he is sketching out his view of the post of medical director and how he sees it. Halfway down that first paragraph, there is a sentence beginning:

"The medical director has to be able at one and the same time to empathise with colleagues and to avoid the temptation simply to act as their representative and spokesman."

So in other words, he sees an element of objectivity and independence from your colleagues. Was that important to the system of being put in place?

A. I think it was extremely important. It was also extremely important for myself in conducting that role. I remember when I was being interviewed for the post as Trust medical director, a number of what I would call senior colleagues came up to me and said was I in my right mind going forward to apply for this post. And I had one other senior colleague who supported me in this initiative, but he certainly spoke to me afterwards and still to this day says I really feel sorry that

I encouraged you to take on this role because he could see the burden that was carried by a Trust medical director, and he felt that in many ways I had sacrificed other aspects of my clinical career to take on the management role.

I think there was a difficult relationship for Trust medical directors, but I think I myself, and certainly I know others, were very clear about this distinct management function that we were required to do on behalf of the Trust as an executive director. We were very clear that we had to stand back, even from the clinicians in our own specialty within our own directorate, if you like, that we had to carry this corporate board responsibility.

Q. In this letter, is it Sir George Quigley?

A. Yes.

Q. Sir George continues down towards the bottom of the page at paragraph 13 to hope that these indications are helpful. He goes on to say:

"They reflect my strong feeling that the Trust's medical director has an indispensable contribution to make in shaping, in the new environment, a patient-centred institution, driven by the imperative of clinical excellence and supported by an organisational structure and systems."

So he's setting out there what he sees as the fundamentals. It's quite a tall order, but it's what he reckons, I think, is the distillation of his vision for the Trust.

A. That would be correct. I submitted this document, it was the only document I had actually retained from the time of my appointment. It was in the context of whether I had a job description, and I couldn't find a job description for the post of medical director in 1992/93 when I was appointed. That was the only evidence that I could produce that maybe helped to illustrate the nature of the transition that was taking place from when doctors involved in running services, when we were a directly managed unit -- he draws a distinction between the representative role of doctors, if you like, in management to the management role of doctors.

A very bold decision was taken, particularly in the Royal Trust, I have to say, where there was a very clear and distinct devolution of resources, funds, to clinical directorates. Some of the trusts -- and I was nearly going to say "many of the trusts", and I think that probably would be right. In very few of the trusts in the early days in the 1990s was that bold initiative taken. Clinical directorates were set up with clinical

directors with certain responsibilities, but they did not necessarily have the funding responsibility devolved down to directorate level. In the Royal, staff resources, funding, was devolved down to the directorate. So the clinical director and his management team were ultimately fully responsible for the management of those resources and accountable to the chief executive for that.

So this was quite a change for the hospital as well. Not all of the doctors professionally UK-wide, not even in Northern Ireland, and certainly not in the Royal Trust, were absolutely in favour of this move to Trust status, and you know... And there were those who were for it, saw it as being an opportunity for the Trust to develop services. Others were very reluctant because it brought management right up into their front garden, if you like.

Prior to 1993, the Eastern Board, for many doctors, might as well have been on the other side of the moon. They had no dealings with the Eastern Health and Social Board or any of the other social boards and the department likewise. Their contract as a consultant was held at the Eastern Board, they sent in their applications for study leave and annual leave and that was it. Very little interface. But now, with

management coming right into the proximity of the hospital or the group of hospitals, some doctors found that as being quite a challenge.

THE CHAIRMAN: Doctor, just briefly: on your CV, you were clinical director from 1990 to 1993 and then, in effect, the first medical director in 1993. Was that right?

A. Yes.

THE CHAIRMAN: Was the clinical director's job which you did from 1993 really quite different from what a clinical director would do after 1993 or after the Trust was established?

A. Not really. The Royal Trust was part of a resource management initiative. This was something that was taking place in Great Britain, resource management initiative. And the Royal had -- when we were a directly-managed unit of the Eastern Board and with the blessing of the Eastern Board and, I suspect, the department at that time, there was recognition that there might be benefits for the Royal being aligned with this resource management initiative across the water. And this was all about managing resources in a period of time when resources were becoming a huge issue within the Health Service -- increasing demands on the service, limited budget -- and so the whole efficiency drive within the Health Service following the Griffiths review

and the Thatcher reforms, there was tremendous work being done on that, particularly in England. So the Royal participated in that.

One of the steps that we undertook as a hospital, when we were directly managed, was to move from the old cogwheel representative structure into a clinical directorate structure and what used to be the chairman of the anaesthetic division, that position evolved into being the clinical director for anaesthetic theatres. So it was not that dissimilar; it was a journey towards a full implementation, if you like, in 1993.

THE CHAIRMAN: So it was a step almost towards the Trust, but then the big step was 1993?

A. Correct, and prior to 1993 there would have been no devolution of resources or the budgets that were applicable to that particular clinical area, anaesthetics and theatres, for example.

THE CHAIRMAN: Thank you.

MR STEWART: So 1993 was something -- you described it as a revolution?

A. It was a sea change.

Q. You described that devolution of budgetary responsibility to the directorates. Were you yourself responsible or involved in that decision to configure the Trust in that way?

A. Not that I can recall. Are you talking about the financial --

Q. Yes.

A. No. Personally, I wasn't. The director of finance at the time and the chief executive would have shaped the extent of the budget devolution to directorates. This was a particularly difficult time for the Royal as a new Trust. I'm sure other trusts faced similar issues, but it was a particular issue within the Royal. The Royal was seen, I suspect, by many in the department and the Eastern Board as being a great black hole that money just kept being poured into and the Royal kept asking for more. So there was tremendous pressure and the challenge for Sir George Quigley was that he would bring this ship under control and manage the system efficiently, effectively and at the same time deliver high quality of service.

So the devolution of budgets in relation to the Children's Hospital, which might be an area that the inquiry wanted to pursue a little bit further -- because it was quite complex. I suspect each and every directorate when they had the budget devolved to them said, "This isn't enough". I'm sure every clinical director and every directorate manager probably said the same thing. Some funds were held centrally for what I

would call central activities or central functions of the trust, but the funds that were delegated down to the individual clinical directors, I suspect many of them said, "This isn't enough".

Q. So there must have been a great deal of debate about corporate issues, corporate governance issues, structures and so forth. To what extent did the old NHS mantra of "a patient-first organisation" continue?

A. That's an interesting question. To use your exact phrase, patient-first didn't emerge until much later in the 1990s. It was part of the Health Service reforms that took place in England or were being driven forwards. Dare I say it, after, in England, the decision was taken to discontinue the "internal market", the focus in the early 1990s was very much on this internal market, separation of purchasers, the health boards, from providers of services, trusts. And this market, internal market, was often described as being red in tooth and claw. Funding being supplied by commissioners and the trusts having to deliver those services within the context of that funding.

The opportunity was there for trusts to generate income from other sources other than the funding that came centrally through what -- that ultimately came from the department to the four health boards and then into

the trust. So this was actually quite a tense era because for a hospital like the Royal, the service that was provided was, I would say, threefold. There were services that were, if you like, local to our community in north and west Belfast, if you put it that way, very much local services that were being provided by the Trust. But we also had a wider Eastern Health Board responsibility in Greater Belfast and then we had this regional responsibility, particularly for regional specialties.

These regional specialties were often commissioned by what was called the Regional Medical Services Consortium acting on behalf of the four health boards because they were recognised as being services that were being commissioned for everybody. There was no point individual boards negotiating for half a dozen of this and a dozen of that.

So when it came to devolving budgets down to the individual directorates, one of the challenges that was faced for clinical directors was to try and identify how much of this budget was due to services that they provided locally or regionally. So it was a very complex -- and that got into the whole area of ... I noticed issues around depth of coding and coding and a lot of that was to try and clarify and explain how

much of the -- to what extent the service was a regional service, what extent of it was a local service, how much of it was the responsibility of the Eastern Board alone, how much of it should be shared by other boards.

Q. It does sound a difficult, challenging and complex time.

To what extent, in the midst of this tooth-and-claw negotiation and reconfiguration, did people say this should be a people-centred institution; did that arise as a debate?

A. I can't recall, but certainly the ethos of the Trust -- and even before it was a trust -- was that within the Royal, when it was a directly-managed unit, there would have been an ethos of delivering high quality services. That's what the hospital was all about, that's what the staff were very, very committed to. And there have been many, many examples down through the years -- and even at the time we're specifically talking about -- of what I would call excellence in care. And that was at the heart of every clinical team and not -- but it also pervaded the whole way right up through the ethos to the Trust board. And the board would have -- I know that the non-executive directors took particular interest in the quality of services, they walked around the hospital, they visited departments, and they were there not infrequently meeting doctors, nurses and other staff

within the hospital and learning about the quality of care that was being delivered to patients.

THE CHAIRMAN: I think part of where that last question is coming from is that while the doctors and nurses who are handling and dealing with the patients directly -- it almost doesn't matter to them whether it's the Eastern Board which is their employer or the Royal Trust: if somebody is coming into casualty or cardiology, you still have a doctor, you still have a nurse looking after the patient. I think perhaps where Mr Stewart's question was coming from is that, at board level, amongst all the organisation, setting up the structures, the devolution of roles, the management of roles, did that ethos get lost a bit at the top level?

Sorry, let me give you an example from a very narrow perspective. It doesn't appear to have appeared on the agenda very often.

A. I would have to agree with that. I think the focus for Sir George -- and for the board as a whole -- was financial survival. And I put it as blunt as that because there would have been views to say that this Trust was a problem because it was always over budget. We need to manage this place much -- get a grip on things. The whole future of the organisation as an

independent organisation was under threat because in 1995 we had, under the chairmanship of ... I've gone blank. The acute hospitals reorganisation project. That was a real threat to the delivery of services in the Royal Group of Trusts because vascular surgery could have moved from currently being delivered in two sites to one site or another site, so -- there was a threat to clinical services being removed or moved elsewhere or even the whole Trust as a whole being considered to be unmanageable or whatever.

So I would have to -- chairman, I would agree: the focus and the emphasis at board level was very much around survival of the organisation and getting it into financial equilibrium. Huge pressure on resources and funding.

MR FORTUNE: My learned friend used the phrase "patient-centred." It went on the transcript as "people-centred".

MR STEWART: I did say "people-centred". That's my mistake. It's "patient-centred".

MR FORTUNE: We have also heard -- certainly from Dr Steen -- about the terms "consultant-delivered service" or "a consultant-led service". At that time in this evolutionary process did those terms ever appear at board level, particularly when the board was fighting

for survival?

MR STEWART: Can you recall, in relation to a consultant-led service, when that emerged?

A. I'm not sure that the two terms were actually ever discussed at Trust board level. The distinction between a consultant-led service is where a consultant, a senior consultant would lead a team, maybe with another consultant in it, junior medical staff, nursing staff, the whole concept of the team, and the consultant would have delivered a service or led a service through a team approach.

A consultant-delivered service is where a consultant is maybe working on their own without junior medical staff, would be called in because there were no juniors, between them and the patient. So a consultant-delivered service was something that would be much more specific to the size or other of the team.

The vast majority of services in the Trust, in the early 1990s, would have been consultant-led. As the consultant ... The problem, I think, in a number of what I'll call regional sub-specialties was that quite often you could have had a consultant working on their own, and therefore delivering a totally consultant-delivered service with little in the way of infrastructure below. The use of the terms

"consultant-led" and "consultant-delivered" didn't -- I can't recall it being a distinction that was drawn to the attention of the Trust board at all as far as I'm aware.

Q. Very well. However, as medical director, quality of care remained a major consideration for you.

A. Absolutely.

Q. And in October 1995, over two years after creation of trust, the management executive wrote to your chief executive at WS306/1, page 15, to set out more fully your professional responsibilities.

In the first paragraph, line 5, we see:

"The annex to this letter concentrates on the role of the medical executive director and thereby completes the guidance on the role of the professional executive directors."

And we go to page 16, we find that annex, which, although it's dated at the top "2/94", in fact it dates from October 1995. Paragraph 3:

"In addition, however, the management executive expects such a director [this is your post, that's you] to have three specific areas of responsibility: professional standards and practices; oversight of clinical functions discharged by the Trust; and management or development issues relating to medical

services generally."

That's a broad remit of responsibility and it goes on to clarify that at paragraph 4 in the second sentence:

"It will expect the post holder's role to be set out in such a way that it covers the following clearly and unambiguously."

And at paragraph (b) you are charged unambiguously to:

"Advise the Trust on medical workforce policy, including staffing levels."

So staffing comes within your specific remit. And at (c) that includes:

"Agreeing job plans with consultants."

And, further on down:

"Disciplinary matters."

So you were able, as I understand it, to include within job plans quality assurance undertakings. Can I ask you about disciplinary matters? Did that include disciplining individual clinicians for competence issues?

A. If that emerged, yes. In relation to disciplinary matters, the medical director's role and contribution there would have been very much in close association with the director of human resources in the Trust. The

issues around, if you like, what I will call professional or personal conduct, for example, were covered by Trust standards and procedures for handling personal behaviour. So those policies and procedures were drawn up by the director of HR and then, in relation to competency, professional performance or professional competence, that would have been other procedures that we would have had to embark on.

It's interesting that this document from the management executive came out two years after the Trust was established. So you can understand maybe some of the frustration that I, as a Trust medical director, was experiencing, whether I had a job description in 1993 or not, but it was largely on the basis of this guidance that I started to modify the job description for the Trust medical director.

My initial appointment, I think, was for three years, renewable -- I'm not sure whether it was annually or whatever -- but when it came up to 1996 I would have been three years in post, so working with the director of HR, I personally got involved in drafting and redrafting a job description for the Trust medical director, and that continued to evolve right up to the time that I left in 2002.

Q. So you were in a sense given the opportunity to --

A. To write my own script, yes, for better or worse.

THE CHAIRMAN: Subject to the HR director.

A. Well, I have to say, if you were to ask me professionally as a Trust medical director, who did I spend my time with, obviously I had a very close working relationship with the chief executive and I deputised for him in his absence. And his office was next door to mine. But if you were to ask me of all the other executive directors in the trust, who would have occupied my diary most, it would have been the director of HR: handling contracts, appointments, and on occasion -- rare occasions I have to say, thankfully -- issues in relation to discipline.

MR STEWART: Over the page, page 17, at (d) we come back here to you:

"... leading [clinical directors] in managing particular services with budgetary information and quality responsibilities."

So your influence is reaching right the way down into the directorates. Even though the budgetary responsibility may be devolved to them, it seems as though you were supposed to lead them.

A. Mm. Well, the role of medical director was one about leadership. Many people say that that's really what it was all about, it was clinical leadership in the Trust.

I was in many situations, I was in many -- was quite often the public face of the Trust. So medical leadership was key with the appointment as Trust medical director.

Can I make another little -- because I observed in various transcripts prior to now, the issue about reporting of clinical directors, who were they, who were they responsible to, who did they report to. Can I just say that we obviously had clinical directors in place in the late 80s, early 90s, before we became a trust, and some of the people who were appointed as clinical directors in the late 80s, 90s, moved into the position as being the clinical director within the Trust.

The job descriptions I think that they had around that time in 1993 would have been quite clearly saying that they reported to and were accountable to the chief executive. They were not accountable to me as the Trust medical director, nor did they report to me. However, professionally, there would have been what's been described, I think in earlier transcripts, as a dotted line through to the Trust medical director. I would have had very close contact with clinical directors, my door was always open, I would have met them formally and informally.

So although their job descriptions said that they

reported to and were accountable to, that was very much in relation to the devolved responsibilities that they had, financial, staffing and so on, through to the chief executive. But when it came to professional matters, they would have come to me first, without a doubt.

Q. So they've reported to you, but would be ultimately accountable to the chief executive?

A. Their job description said that they reported to the chief executive and were accountable to him. They would have reported -- they would have communicated or -- let's use the word "reported" -- reported to me professionally if there were issues in relation to professional issues, whether that was clinical services, clinical service development that they wanted to see, if they wanted to appoint new consultants, if there were issues in relation to training of junior doctors, they would have reported to me.

THE CHAIRMAN: And in essence, that's because you yourself are a doctor and you would have had -- might have a better understanding than Mr McKee, who's not a doctor, would have had about various aspects of the things for which they're responsible?

A. That would be right, yes. And ultimately, I would be the person that Mr McKee would turn to at any Trust

board if an issue came up and said, "Ask Dr Carson to speak to that".

MR STEWART: And those self-same clinical directors would have reported to you if they had an issue with a clinician's performance, that would have come to you?

A. That would be my expectation.

Q. Expectation.

A. Yes.

Q. Of course, in the cases we are dealing with, Adam and Claire, in neither case was the clinical director informed of the death. And in neither case did information come to you directly through that route.

A. That's correct.

Q. Did that surprise you, looking back?

A. Um ... I think I was more surprised that Claire Roberts' case hadn't been brought to my attention than maybe Adam Strain's.

Q. Why is that?

A. Well, as I had the privilege of sitting in this afternoon or this morning and this afternoon's discussion ... Again, as a clinician, I would have seen Adam Strain as being a case, as being really a very complex case. The issues surrounding his death were quite complex. So in some ways, I wasn't surprised that his death wasn't reported to me and the first that I was

aware of that was at or around the time of the inquest. And again, one of the things I'm struggling with now is having read so many transcripts in relation, particularly to Claire's case, was trying to put myself in the position of what it would have been in 1996 rather than what I've read and heard and learnt. But I would have thought there was sufficient happening in Claire's case that that should have been brought to the attention initially of the clinical director and then subsequently ... There were issues there that should have been explored that would have been my responsibility.

Q. Fair enough. Would you classify that as a failing in the system?

A. I think the system did not do justice to Claire.

THE CHAIRMAN: Doctor, I have to say to you that I can understand what you said about Claire, but in terms of Adam there has been -- the debate which you heard today in fact is a debate which has emerged only very recently about the extent to which hyponatraemia played a role in Adam's death. Because at the inquest in 1996 the finding was that hyponatraemia was the main cause. And I've understood from the evidence that has been given previously to the inquiry in the spring that that was the accepted position in the Royal. But whether that's

accepted or not, there was one unfortunate and awful mistake made in Adam's case, made by Dr Taylor, and while I understand perhaps -- this will be developed more tomorrow perhaps -- about what did or didn't happen after Adam and Claire's case, is it not surprising, since you would expect any issue of professional performance to come to you, that Dr Taylor's professional performance in Adam's case didn't come to you?

A. Um ... It's difficult. And this, I think, in some ways illustrates the complexity of the responsibilities of a trust medical director in handling any underperformance issue within an organisation. It would have been, I think ... A trust medical director would more likely have been required to act if there was a pattern of underperformance in regard to a doctor, if complaints were beginning to emerge or if colleagues were expressing concern around the capability of a doctor, the capacity of a doctor to carry out their clinical responsibilities. That would have been when a trust medical director would have to take action. As far as Dr Taylor was concerned, at no stage in the run-up to Adam's surgery had I ever had any concerns, either me personally or concerns or complaints expressed through the professional reporting line in regard to his

competence, neither before nor subsequent to.
THE CHAIRMAN: Yes, but let me look at two examples with you. One is if you have a doctor who -- doctors are the same as lawyers, same as any other people, some develop drink problems. If there's an emerging pattern of a doctor coming to work smelling of drink, then that is the sort of thing which -- it's a pattern of behaviour which you would expect to come to you.
A. Absolutely.
THE CHAIRMAN: That's because that pattern of behaviour might sooner or later endanger the safety of the patients.
A. Mm, yes.
THE CHAIRMAN: Okay? But if you have a case where there is a doctor like Dr Taylor, with a very good record, who is trusted and liked in the hospital, but he has a terrible day and it appears that that leads to the death of a child, since a child has died, surely you don't wait for a pattern.
A. Well, I mean, I indicated, I think, in previous statements that deaths, either expected or unexpected, were not reported to a trust medical director. I didn't know that Adam Strain had died until roughly, as I said, some time around the inquest. I didn't even know.
So patterns of behaviour are extremely important

triggers. That doesn't -- and I think if there were indications that a doctor required training or supervision, yes, that's the sort of thing. But that would normally come to the clinical director or the trust medical director on the basis of reports from others. If that doesn't come to you as trust medical director, then you're in ignorance.
MR FORTUNE: Sir, without jumping the gun as to what we might discover tomorrow, having listened carefully to Dr Carson, it rather begs the question as to what Dr Carson will make of paragraphs (f) and (m), particularly against the background, as we now know, of the many discussions in the meetings involving George Brangam as the Trust solicitor, leading up to the inquest into Adam's death and the reconciliation or the attempt to reconcile the diametrically opposed positions. Surely those matters would be well within ambit or the remit of the medical director, paragraph (m).
THE CHAIRMAN: That depends, I think, on the point at which Dr Carson became aware of Adam's death. Do you remember if that's prior to the inquest or afterwards?
A. I honestly can't remember. As the inquiry knows, and it's been part of ... Dr Murnaghan's role as director of medical administration in terms of supplying and

supporting the coroner's remit if you like.
MR STEWART: Perhaps I can assist. We can return to this another time, but Dr Murnaghan's evidence of 25 June 2012, page 165, starting at line 1, this is Dr Murnaghan telling you about Adam Strain's death and the inquest. He told this inquiry:
"I'm almost certain that I would have told him that Dr Taylor had a different view and he was advancing various arguments in his support. How much more I told him of that, I don't know. I would have told them that the coroner was involved and was going to hold an inquest. I do not know what we agreed after that, I can't remember, but I know that Dr Carson is on the witness list."
He's saying he can't remember, but you may remember more, but he's definitely saying that it was before the inquest and that there was a difference of opinion.
A. I honestly can't recall here. It would not have been a surprise to me that Dr Murnaghan says I'm down to -- I'm going down to the coroner's inquest. I certainly cannot recall at all Dr Murnaghan saying to me that there was a difference of view, I suppose, in relation to Dr Sumner's evidence to the coroner. Is that what we're referring to? I do not recall at all Dr Murnaghan having that discussion with me.

Q. Perhaps Professor Savage.
THE CHAIRMAN: I think it's a bit more than Dr Sumner's view. It's the view held by Dr Taylor on the one hand and by Mr Keane and Professor Savage on the other about what went wrong in Adam's treatment.
A. I certainly was not aware of that prior to the inquest.
THE CHAIRMAN: Okay.
MR STEWART: When Adam died, his death was brought to the attention of Dr Murnaghan immediately because there was a referral to the coroner.
A. Mm-hm.
Q. Dr Murnaghan's reporting and accountability lines were somewhat different to the other clinical leads and people in his position in the corporate structure, were they not?
A. I can't recall accurately. Dr Murnaghan was in post as director of medical administration before we became a trust. I can't remember when he was appointed to take on this medical administrative role. I can't remember the commencement of that. Dr Murnaghan, prior to that, had been a consultant obstetrician in the Royal Maternity Hospital. And prior to trust status, there would have been what was called a unit clinician, who sat on the executive team of the hospital, as we're a directly-managed unit, and I think Dr Murnaghan and

his predecessors would have acted as literally a medical administrative position in the hospital.

Prior to 1993, when the organisation was directly managed by the Eastern Health Board, a consultant's contract -- my contract at that time, as a consultant anaesthetist, was held in the Eastern Board. But doctors in training or junior doctors who might have been appointed for one year or three years as part of a rotation, their contracts were held at hospital, at unit level. So there was an administrative structure within the hospital. And Dr Murnaghan managed and administered that aspect, if you like, of medical administration among other responsibilities, working in association with the coroner, handling negligence cases, looking after clinical or medical audit, as it was in those days.

So Dr Murnaghan was in position and I suspect his contract or whatever contract he had as a director of medical administration probably ran seamlessly through from the period when he was working in a directly-managed unit to when he became in the trust. And again, I suspect that his ... I would know that his contract initially would have been just the same as those first wave clinical directors, "accountable to and reporting to the chief executive". He, however, was, if

you like, my left hand in many ways.

As I said, I, as a trust medical director, had one personal secretary who administered my diary and my commitments. Dr Murnaghan delivered many of the responsibilities that I would have had to answer for or report to the trust board on. So the whole area of risk management, clinical audit, junior doctors' hours, those things were the responsibility of Dr Murnaghan. He would have reported -- and it is "report" with a small R.

THE CHAIRMAN: The two of you worked very closely together then?

A. Very close as his office was convenient to mine, the same building.

MR STEWART: Indeed, he's told us that he was accountable to you and also accountable to the chief executive.

A. I suspect that's not correct. He was accountable to the chief executive and he also reported to the chief executive. I think. That's what my understanding is.

THE CHAIRMAN: You would have been senior to him as you're the deputy chief executive as well as being the medical director, aren't you?

A. I was, yes. He was senior to me in years. He was in position before I was, but ...

THE CHAIRMAN: In hierarchical terms, you were senior to him. Your query is whether he's quite right in saying that he was accountable to you.

A. Yes. He would not have been accountable to me.

THE CHAIRMAN: Okay.

A. He discharged many functions for me, let's put it that way.

MR STEWART: Were those functions that you delegated to him?

A. I personally didn't. They were functions that he delivered before I was appointed as trust medical director and it continued seamlessly on into the period when we became a self-governing trust.

Q. It would seem that unexpected deaths were reported to Dr Murnaghan and, for example, Adam Strain's death was reported to him.

A. Yes.

Q. It wasn't reported to the clinical lead, it wasn't reported to you, it went to him. This is a case where the anaesthetist, Dr Taylor, said, "I don't know what happened, I don't know why the child died". This is a case where they look at the machinery and the equipment and they say, "It's okay". They don't know at the beginning what caused this death. Would you not have expected Dr Murnaghan to report that to you, the totally unexpected, totally inexplicable death. Would

that not have been reported to you?

A. That would not have been unreasonable, yes.

Q. Would you go further to say that that should have happened?

A. Should it have happened? I think so. In the light of -- certainly in the light of, I would say, very early developments in our clinical governance agenda within the Trust, that should have happened.

THE CHAIRMAN: But, sorry, doctor, I can understand that -- I'm querying whether we get hung up on what stage governance had developed. I think that might be more relevant if we were looking at cases here where children hadn't died, but when we're looking at cases where children died, is it not the case that whatever the precise development of governance and governance theory and governance systems, you have here a child who has died unexpectedly where the equipment in the hospital is checked, it turns out not to be the problem. The anaesthetist who is in charge of the operation, he's saying "I don't know what went wrong". Two others who are very closely involved are saying, "Unfortunately, we think we do know what went wrong and we think it was Dr Taylor who went wrong". Surely, on any view, that should reach you well before the inquest.

A. I would have expected that, I would have to say that.

THE CHAIRMAN: That's why I was a bit surprised when you said earlier that you were more surprised that Claire's case hadn't come to you than Adam's. Because --
A. I think I've been influenced in Claire's case by a lot of the factors that I've read through the transcripts. I have to say, chairman, that in Northern Ireland the vast bulk of deaths occur in hospitals. That's a fact of life. Patients either are admitted to hospital in a terminal condition and they die there or some patients are brought to hospital and ultimately die there. The Royal, again, being a regional centre, would have had a significant number of complex cases admitted to it, and the history of the hospital was such that there were many other traumatic deaths taking place. A lot of our patients were referred to HM Coroner for -- I don't know how many inquests a year would have taken place. I would say it was certainly on average somewhere between 6 and 10 inquests a year on patients dying in the Royal.
Now, there is absolutely no way that I as Trust medical director in 1993/1995, or dare I say it, even slightly later than that, would I have been able to investigate each and every death that took place in the Trust, even ones that were referred to the coroner.
THE CHAIRMAN: No, and I don't think that's -- I'm not

saying the bar is being raised that high. I think what the suggestion is that you should at least have some information about what's going on because that will help you to decide: is this something that I should be investigating or the hospital should be investigating internally or is it something which we can leave to the coroner at least for the moment?
A. I have to say that would be my expectation. There was, however, I think, a prevailing view at that time that the coroner's inquest was the ultimate evaluation of what went on, what was the cause of death. So in many ways, I suspect many organisations would have looked to the coronial system to provide that independent assessment of what happened to a particular patient. Maybe there was over-reliance on that and maybe the governance arrangements within self-governing trusts weren't sufficiently sophisticated at that time to enable trust medical directors to probe more fully. There's no doubt that in the later 1990s and into the 2000s, and certainly when Dr McBride took over from me, the trust did put in place further developments in relation to what to do when something went wrong, but I have to say maybe that at that time it maybe wasn't as refined as it could have been or it should have been.
THE CHAIRMAN: Okay.

MR STEWART: I hope tomorrow to go through a number of the guidelines and directives and circulars that would have been in your armoury when dealing with risk management and patient safety issues. One of them we're going to look at tomorrow is -- you were talking about people seeing the coronial system as being the ultimate investigative force. Just at this stage, having said that, I draw to your attention 314-016-010. This is from the guidance issue with effect from 1 April 1996 on complaints. Here at paragraph 4.18:
"The fact that a death has been referred to the coroner's office does not mean that all investigations into a complaint need to be suspended. It is important for the trust or FHS practitioner to initiate proper investigations regardless of the coroner's enquiries and where necessary to extend these investigations if the coroner so requests."
So even at that time, can I suggest to you that the referral to a coroner was not regarded as the end of the matter?
A. Could you remind me what this extract is from?
Q. The front page is 314-016-001. Do you recognise that document? It's not the actual directive itself, it's the guidance procedure.
A. Yes. And again, the inquiry will be aware that the

process for handling and managing complaints investigation was the responsibility of the director of nursing, and obviously the chief executive responded ultimately to complainants in writing as a definitive end stage of that process. But I mean, I don't ... It is quite clear what the guidance from the HPSS was at that time and the HPSS executive in that regard. I would agree with that.
Q. You'd agree with that?
A. Yes.
Q. Also, it says elsewhere at 314-016-001 in relation to proper -- sorry, I've got that there. If you'll allow me a second, I'll find it. Initially, it says when there is an indication of litigation that the principles of good risk management should be applied and that a full and thorough investigation be pursued. So it's fairly strong in its guidance on when investigations should be pursued. Was this document given much credence or recognition at the time?
A. Is it coming up on the screen?
Q. If you'll allow me a second, I'll try to find --
A. I think there were ... I mean, a lot of the guidance that was being issued by the management executive at that time came down into the trusts and they were certainly disseminated down to clinical directorates.

It would have been the responsibility of the directorate management team to put in place any recommendations that came through from circulars that arrived in the chief executive's office. So the short answer is, yes, they were followed through to the best of our ability at that time and the infrastructure that was in place.

And certainly complaints, if a complaint had ... I wasn't aware of a complaint in relation to Adam Strain. I may be wrong there. If there was a complaint raised about a doctor, the director of nursing would have brought that quite specifically to my attention.

Q. The reference I was trying to draw your attention to was at 314-016-017, which deals possible claims for negligence. At paragraph 5.45:

"In all prima facie cases of negligence or where the complainant has indicated that they propose to start legal proceedings, the principles of good claims management and risk management should be applied. There should be a full and thorough investigation of the events. In any case, where the Trust/Board accepts there has been negligence, a speedy settlement should be sought."

In April 1996 a formal solicitor's letter of claim was dispatched and received by the trust in relation to

Adam Strain. So it would seem that this would indicate that a full and thorough investigation was indicated.

A. I would accept everything that's written under 5.45 there as being what should happen. But what was missing was how that investigation should be conducted. There was no guidance that I'm aware of as to how an investigation should take place, and I think that's still an issue today.

Q. Well, in 1955 --

THE CHAIRMAN: Okay, well, forget about 1955, if we look at 5 o'clock tonight, if you don't mind taking a break at this point.

A. I'm at your disposal.

THE CHAIRMAN: Can we pick it up tomorrow morning? Thank you very much. We'll sit at 10 o'clock tomorrow morning and resume with Dr Carson. Thank you.

(5.00 pm)

(The hearing adjourned until 10.00 am the following day)

I N D E X