

STATEMENT OF WITNESS

STATEMENT OF: DR RAYMOND FULTON MB,
FRCP London
Name

Rank

AGE OF WITNESS (If over 18 enter "over 18"): OVER 18

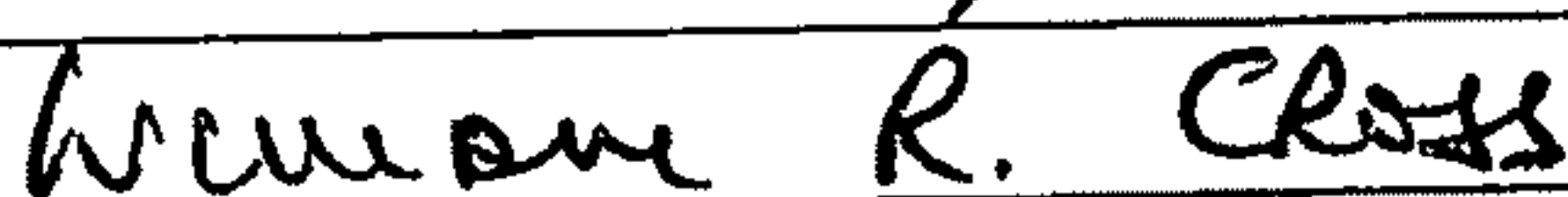
*To be completed
when the statement
has been written*

I declare that this statement consisting of 13 pages, each signed by me is true to the best of my knowledge and belief and I make it knowing that, if it is tendered in evidence at a preliminary enquiry or at the trial of any person, I shall be liable to prosecution if I have wilfully stated in it anything which I know to be false or do not believe to be true.

Dated this

14th day of March 2006


SIGNATURE OF MEMBER by whom
statement was recorded or received



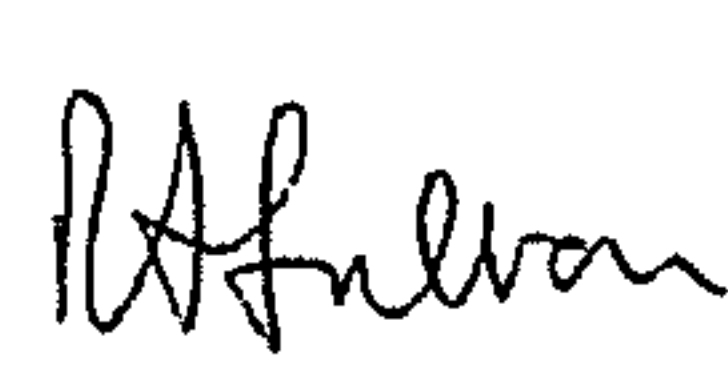
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SIGNATURE OF WITNESS

I am a Consultant Dermatologist at Altnagelvin Hospital. At the time of Raychel Ferguson's death on 09/06/01 I was Medical Director of Altnagelvin Hospital H&SS Trust and was responsible to the Trust for monitoring the quality of medical care at Altnagelvin. I was chairman of the team that investigated any serious clinical incidents (also known as critical incidents) and was therefore responsible for investigating the circumstances of Raychel's death within the hospital and to make recommendations for any action to prevent recurrence. I left this post in March 2002 but I chaired the Review Meeting on 09 April 2002. After then Dr Nesbitt was involved in investigating the incident and I had no further involvement. During my clinic at Tyrone County Hospital on the morning of Monday 11 June 2001 I was telephoned by Mrs Burnside, Chief Executive, Altnagelvin Hospital. She informed me that there had been a post-operative death of a child, Raychel Ferguson. She explained that Raychel had developed seizures and cerebral oedema following a routine appendectomy on 08 June 2001. Raychel died on 10 June 2001 after

SIGNATURE OF WITNESS:


(41)

STATEMENT OF: DR RAYMOND FULTON MB, FRCP London

transfer to the Royal Hospital for Sick Children in Belfast. Mrs Burnside asked me to investigate this very serious event in my role as Medical Director and in accordance with the hospital Critical Incident policy. I was also telephoned on Monday morning 11 June 2001 by Mr Robert Gilliland who had been the consultant surgeon on call at the time of Raychel's admission. He also told me the same sequence of events though he personally had not seen Raychel as his junior staff had carried out the treatment including the appendectomy. I returned to Altnagelvin on the early afternoon of Monday 11 June 2001 and met Mrs Therese Brown, Risk Management Co-ordinator. We agreed to set up an immediate Critical Incident Enquiry on the next day, Tuesday 12 June 2001, in accordance with the Critical Incident Protocol (WRC 27). This protocol was based on the recommendations in the standard textbook "Clinical Governance" by Myriam Lugon, 1999 (pages 94-96) ISBN 1 85315 383 4. We had invited the author to Altnagelvin to give a Power Point presentation to the Trust on 25 October 2000. As a result of her advice on investigating critical incidents we introduced the Altnagelvin Critical Incident Protocol in late 2000. This protocol was followed in investigating Raychel Ferguson's death. My concern was to form an accurate account of the events leading to Raychel's death while it was still clear in everyone's memory. I was also keen to ascertain whether lessons could be learned so that a recurrence of this tragic event could be avoided. In accordance with the hospital policy staff were informed that this was the purpose of the meeting and that it was not going to be judgemental or disciplinary. Mrs Brown then contacted the relevant staff on the afternoon of Monday 11 June 2001 and asked them to attend a meeting at 4 pm on Tuesday 12 June 2001. This meeting would be chaired by myself. All contacted staff agreed to attend. On

STATEMENT OF: DR RAYMOND FULTON MB, FRCP London

12/06/01 I set up a Critical Incident Enquiry involving all relevant clinical staff to establish the clinical facts. The Critical Incident Enquiry started at 4 pm on Tuesday 12 June 2001 in Trust Headquarters. The staff who attended were (WRC 54): Dr Raymond Fulton (Chairman), Mrs Therese Brown, Risk Management Co-ordinator, Dr Bernie Traynor, Registrar Paediatrics, Dr Brian McCord, Consultant Paediatrician, DR Jeremy Johnston, SHO Paediatrics, Dr Makar, SHO, Surgery, Mr Zafar, SHO, Surgery, Mr Robert Gilliland, Consultant Surgeon, Dr Geoff Nesbitt, Consultant Anaesthetist, Dr Claire Jameson, SHO Anaesthetics, Dr Gund, SHO Anaesthetics, Sister Millar, Ward 6, Margaret Doherty, Clinical Services Manager, Child Care Directorate, SN Anne Noble, SN Fiona Bryce, NA Elizabeth Lynch, SN Sandra Gilchrist, Anne Witherow, Clinical Effectiveness Co-ordinator. I was immediately struck by how subdued and shocked all the nurses and doctors appeared at the start of the meeting. It was clear to me that they regarded this as a very serious and highly unusual event. I restated that the purpose of the meeting was to establish an accurate detailed picture of all the events leading to Raychel's death. I said that it was important to do this quickly while everyone had good recall of the details. I said everyone would find this difficult and distressing but that it was essential to understand what went wrong so that we could reduce or avoid the likelihood of another death or injury. I also stressed that the purpose of the meeting was to establish facts and not to blame individual staff members. This was the approach recommended for Critical Incident investigations to allow staff to give essential information in a non-judgemental atmosphere. To reassure all staff I said I would not take detailed minutes of the meeting but we would have to produce an Action Plan to address any issues identified. I also said that I would need



(43)

STATEMENT OF: DR RAYMOND FULTON MB, FRCP London

statements from key staff which would contain a detailed description of their involvement in Raychel's treatment. I said these would be available to the Coroner, as a Coroner's Inquest would probably be held. Everyone present agreed. We had in the room the original case notes so that we could refer to individual details. I then asked individual doctors and nurses to describe their part in Raychel's treatment in chronological order from her admission to Altnagelvin to her transfer to Belfast. I recall the following discussions and have brief summary notes written shortly after the meeting (WRC 55). Dr Makar (SHO Surgery) described how he made a diagnosis of appendicitis in the A&E Department on 07 June 2001. He had ordered an electrolyte test which was normal. He set up an IV infusion of Hartman's solution and he prescribed the infusion rate. Raychel was transferred to the Paediatric Ward (6) prior to operation. Dr Makar changed the infusion to Solution 18 on Ward 6 at the request of SN Noble as solution 18 was the standard paediatric infusion used on Ward 6. SN Noble confirmed she had asked Dr Makar to do this and that this was ward policy. Dr Jameson (SHO Anaesthetics) said Raychel had arrived in theatre with no IV infusion (normal policy is to disconnect drip during transfer to theatre). Dr Jameson had set up an IV infusion of 1 litre of Hartman's solution in theatre. Dr Gund (SHO Anaesthetics) confirmed that Hartman's solution was set up on theatre and thought about 200 mls was infused. Dr Gund remembered discarding the remaining fluid in the bag of Hartman's solution and left the prescription of further fluid to ward protocols (i.e. Solution 18 on Ward 6). Dr Makar described a routine appendectomy at 23:40 on 07 June 2001 and he encountered no technical difficulties. SN Noble stated that Solution 18 was restarted on Ward 6 on return from theatre and continued until she returned to night duty on 08 June

STATEMENT OF: DR RAYMOND FULTON MB, FRCP London

2001. Sister Millar and SN Rice confirmed Solution 18 was given after the operation at 80 ml/hour and throughout Friday 08 June 2001. SN Rice (on day duty 08 June 2001) remembered asking a Paediatric SHO to write up another bag of Solution 18 as the chart prescription had expired. I recall several nurses, including Sister Millar who were on day duty Friday 08 June 2001 say that Raychel appeared to be making a normal recovery until later on Friday afternoon. She had walked to the toilet with her father. Her parents felt reassured enough to go home for a few hours on Friday evening. The nurses had noticed several episodes of vomiting on Friday which they felt was not excessive or unusual. The vomit was recorded in the nursing charts on a + to +++ scale as the nurses felt it was impossible to quantify the volume more accurately. The nurses also believed they could not measure urinary output accurately as Raychel had gone to the toilet. Raychel became drowsy and had a seizure on Friday evening. Dr Jeremy Johnston (SHO Paediatrics) was called to investigate the seizure. He sent a blood sample for urgent electrolytes. Dr Bernie Traynor (Registrar Paediatrics) was then called by Dr Johnston when the blood sample showed a low sodium (118). Dr Traynor changed the infusion to 0.9% saline and reduced the volume to 40 ml/hour. Dr McCord (Consultant Paediatrician) described how he was called in and found Raychel seriously ill. He was unsure at this stage of the diagnosis but was concerned by the low sodium and agreed with the treatment. Dr McCord ordered a CT scan of the brain which initially suggested a sub-arachnoid haemorrhage and cerebral oedema. A second CT scan a few hours later showed cerebral oedema and ruled out a sub-arachnoid haemorrhage. Raychel was transferred to RBHSC on Saturday 09 June 2001. Dr Nesbitt, Consultant Anaesthetist, described how he accompanied Raychel in the ambulance

STATEMENT OF: DR RAYMOND FULTON MB, FRCP London

to RBHSC and still appeared shocked by the experience. He commented on the fluid balance charts and infusion rates. Dr Nesbitt reviewed the infusion rate of Solution 18 and felt it was too high for Raychel's weight. However he said the recommended rate was for maintenance of normal fluid loss and therefore a slightly higher rate would have been appropriate in the early stages of Raychel's illness to allow for the higher fluid loss in an ill child. Dr Nesbitt also felt a low sodium solution such as Solution 18 could be unsuitable for post-operative children as they were predisposed to hyponatraemia. However he was aware that the use of Solution 18 was common practice in such situations in other hospitals in Northern Ireland. Dr Nesbitt offered to ring other hospitals in Northern Ireland to establish the current use of Solution 18. I also asked him to review the medical literature. Following this detailed description of Raychel's admission to Altnagelvin we agreed that future management should be changed to reduce the chances of recurrence of post-operative hyponatraemia.

1. The routine use of low sodium infusions such as Solution 18 in post-operative children should be reviewed by Dr Nesbitt. Dr Nesbitt was asked urgently to review the practice in other hospitals in Northern Ireland and made urgent recommendations.
2. To detect early hyponatraemia all post operative children on IV infusion should have routine electrolyte blood tests every 24 hours. Sister Millar would ensure this was done and make the results known to the surgical staff.
3. Junior surgical staff should be made aware of this requirement (Mr Gilliland undertook to do this).

STATEMENT OF: DR RAYMOND FULTON MB, FRCP London

4. Sister Millar was asked to ensure nursing staff record all urinary output in post-operative children.
5. Dr McCord agreed to put in Ward 6 a chart to give optimal infusion volumes for different weights in children. This would guide both medical and surgical staff (WRC 32).
6. It was felt that the paediatric fluid balance charts could be redesigned to increase accuracy. Nurse Ann Witherow, Clinical Effectiveness Co-ordinator, was asked to review the current charts.

These points were summarised by me in an Action Plan dated and sent on 14 June 2001 to all present at the meeting (hand written notes, WRC 29, and typed notes, WRC 56). At the end of the meeting I asked key staff involved in Raychel's treatment to prepare a detailed statement which would be available to the Coroner. These statements were to be sent to Mrs Therese Brown within 1-2 weeks. Everyone agreed. Throughout this process I was struck by the wish of all concerned to learn from this death, which is unique in their experience. I received full co-operation from all clinical staff who are extremely distressed by Raychel's death. As a result of this six Action Points were agreed and circulated to all present on 13/06/01 (WRC 29). Directly after the meeting Mrs Therese Brown and I met with Mrs Burnside, Chief Executive and gave her a verbal summary of the discussion. Mrs Burnside agreed with our approach and Action Plan. Mrs Therese Brown subsequently summarised in writing our discussion (WRC 57). On 14/06/01 following Action Point 1 Dr Nesbitt, Clinical Director for Anaesthetics, wrote to me saying he had found that Solution 18 was also currently used postoperatively in children in Craigavon and the Ulster Hospital (WRC 30). He said he had reviewed

STATEMENT OF: DR RAYMOND FULTON MB, FRCP London

the literature, which had convinced him that Solution 18 should not be used in surgical paediatric patients. He stated that henceforth Solution 18 would not be used in these circumstances in Altnagelvin. He pointed out that the Altnagelvin policy of using Solution 18 was common practice throughout Northern Ireland. However he had decided with Dr McCord, Consultant Paediatrician, that, with immediate effect, Solution 18 should no longer be used routinely in post-operative children and Hartman's solution should be the routine IV solution. A notice dated 12.06.01 to this effect was typed and displayed on the paediatric ward 6 (WRC31). I personally saw this chart in the treatment room of ward 6 when I visited a few days later. On 18 June 2001 I attended the regular meeting of Medical Directors at Castle Buildings. This is normally chaired by the Chief Medical Officer and is a regular interchange of information between Medical Directors from all the Trusts in Northern Ireland and the CMO. On this occasion the CMO was absent and the meeting was chaired by Dr Ian Carson, Medical Director at the Royal Group of Hospitals. At the end of the meeting under "Any Other Business" I described the chain of events which had led to Raychel's death from hyponatraemia. There were several anaesthetists present, some of whom said that they had heard of similar situations though it was not clear if there had been fatalities. I said that Dr Nesbitt had reviewed the literature on hyponatraemia and he concluded that Solution 18 should not be used routinely in post-operative children. I said that he had discontinued the use of Solution 18 in paediatric surgical patients in Altnagelvin a day following our critical incident enquiry. I said also that Dr Nesbitt had confirmed that several other Trusts in Northern Ireland were using Solution 18 in paediatric surgical patients. I told the Medical Directors present at the meeting that in my

R. Fulton

STATEMENT OF: DR RAYMOND FULTON MB, FRCP London

opinion there was evidence that Solution 18 was hazardous in post-operative children and there should be regional guidelines drawn up to prevent recurrence of the death in Altnagelvin. I said I intended to inform the CMO and recommend that regional guidelines should be published. I clearly remember that several Medical Directors were very shocked by the description and that two Medical Directors who were Consultant Anaesthetists said that they would immediately review the practice in their Trusts. I think some Medical Directors had left at this stage. On 22 June 2001 I personally rang the Chief Medical Officer, Dr Campbell and gave her an account of the death of Raychel Ferguson. I said that I had described the same details to the Medical Directors at the meeting on 18 June 2001 and they were concerned. I suggested that the Chief Medical Officer should draft Regional Guidelines on the risk of hyponatraemia in surgical children. I suggested that Dr Campbell might use her regular bulletin to alert clinicians to the dangers of hyponatraemia. Dr Campbell said that the latest bulletin had just been published. Dr Campbell said that the CREST Group, which is responsible for drawing up Regional Guidelines, might look into this. She said she would approach CREST. I informed Mrs Burnside of my conversation with the CMO. Mrs Burnside said she would also contact the CMO and request a regional review (WRC 58). Around mid June 2001 I rang Mr Martin Bradley, Chief Nursing Officer of the Western Area Health Board, to give him details of the death. I also rang the Director of Public Health at the Western Health Board (Dr W McConnell) and gave him full details. Dr McConnell was very concerned and said he would discuss the problems of hyponatraemia at his next meeting with the Chief Medical Officer and also with the Directors of Public Health at the other three health boards. I sent Dr McConnell

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SIGNATURE OF WITNESS

49

R. Fulton

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STATEMENT OF: DR RAYMOND FULTON MB, FRCP London

reprints from the British Medical Journal which gave details of the problems of hyponatraemia in children (WRC62). Dr McConnell wrote on 05 July 2001 (WRC 59, WRC 60) to confirm that he had discussed the case with the CMO and the other three Directors of Public Health. He said that they had agreed to alert the paediatricians in their Boards about the hazards of hyponatraemia. I had informed Mrs Burnside, Chief Executive, Altnagelvin, of all these contacts with colleagues, members of the Western Health Board, Medical Directors and the CMO. I was aware that Mrs Burnside also contacted the CMO on 26 July 2001 by email to suggest a regional review of the hazards of hyponatraemia. I remember seeing a reply from the CMO saying that she would set up a Regional Group to review hyponatraemia and bring forward guidelines. She said Dr Nesbitt would be a member of this group. On 14/01/02 I arranged for the CMO to view a presentation by Dr Nesbitt on Hyponatraemia while she was visiting Altnagelvin Hospital to present accreditation to the Trust's HSDU. Dr Nesbitt had prepared this presentation himself and had previously shown it to me. I found it very helpful in understanding the complex subject of hyponatraemia (WRC 35). On 25 March 2002 the CMO circulated guidelines "Prevention of hyponatraemia in children" with a covering letter (WRC 53). On 09/04/02 I chaired a meeting of relevant clinical staff to review the Action Plan of 12/06/01 in light of the publication of Departmental Guidelines on Hyponatraemia. (WRC 41). On 01/05/02 Dr Nesbitt, who succeeded me as Medical Director, wrote to the CMO enquiring if the death of a child some years previously from hyponatraemia in the RBHSC had been reported to the Department. Dr Nesbitt had become aware of the RBHSC case whilst investigating the death of Raychel Ferguson (WRC 43). On 10/05/02 Dr Campbell replied that

R. Fulton

STATEMENT OF: DR RAYMOND FULTON MB, FRCP London

the Department had not been made aware of the first case either by the Royal Victoria Hospital or the Coroner. She had only become aware of the original case whilst working on developing guidelines following the death of Raychel Ferguson (WRC 44). I had no personal communication with the family of Raychel Ferguson as I felt my role was to investigate the events leading to Raychel's death. I was aware that Mrs Burnside, Chief Executive, had written to the Ferguson family offering to meet them to explain the events and offer sincere sympathy on behalf of all the staff involved. During my visit to Ward 6 following the Critical Incident meeting on 12 June 2001 I noticed that there was no chart on the ward giving the optimal infusion volumes as had been agreed at the meeting. I saw the notice (WRC31) discontinuing Solution 18. I contacted Dr McCord who had undertaken to do this and he said that he was in the process of designing a chart. I subsequently received a letter from Dr McCord confirming that an infusion volume chart was in place on Ward 6 (WRC 61). I subsequently saw the infusion rate chart pinned to the notice board in the treatment room in Ward 6. I confirmed with Sister Millar that electrolytes were being measured in all surgical children every 24 hours while on infusions. A review of the fluid balance charts has been undertaken on a Regional basis and a model chart has been produced. Dr Nesbitt got agreement that the anaesthetists would be responsible for writing up the first 12 hours of infusion following any operation in children. Thereafter the responsibility for the infusion rate and solution type would rest with the surgical team. Non-adherence to this policy is reported by Ward 6 nurses as a Clinical Incident to Mrs Therese Brown. The CMO set up a Regional Group on the prevention of hyponatraemia. The draft guidelines were discussed with me by Dr Nesbitt. He felt that the guidelines were

STATEMENT OF: DR RAYMOND FULTON MB, FRCP London

too general and did not specifically refer to the hazards of Solution 18. I wrote to Mrs Burnside highlighting Dr Nesbitt's concerns (WRC 52). Following publication of the DHSSPS document "Guidance on the Prevention of hyponatraemia in children" in March 2002 we set up a review meeting on 9 April 2002 to assess progress on the Action Plan dated 13 June 2001 and I prepared specific questions in advance (WRC 40). I have no record of who attended though I can remember Ms Therese Brown, Sister Miller, Dr McCord, Dr Nesbitt and Anne Witherow. No formal minutes were taken. I completed an Action Plan dated 11 April 2002 (WRC 41). The completed action is shown in bold type. The first bold paragraph should read "from 12.06.01" This date was omitted in error but is confirmed by chart (WRC31). A review of each point on the Action Plan of 12 June 2001 was made in the light of Regional Guidance. The items in order were: 1. On 12 June 2001 after the Critical Incident Meeting Dr Nesbitt decided to change from Solution 18 to Hartman's solution in surgical paediatric patients, including orthopaedic, with immediate effect. He informed Sister Millar and asked her to display a notice to this effect and to inform nursing staff (WRC 31). I saw this notice myself a few days later on Ward 6. Dr McCord advised that 6 hourly blood sugars should be carried out on patients receiving Hartman's and this had been included in the ward notice. 2. From 12 June 2001 Sister Millar implemented with nursing staff a policy of sending blood samples for electrolytes 12 hours following surgery and then every 24 hours in surgical children on IV infusions. Routine results are available within 2-3 hours on computer. The nurses ring the surgical doctor with the results. The results are also accessible on computer to surgical doctors. It had been hoped that the normal ranges could be available on computer as a guide but Dr O'Kane, Head of



STATEMENT OF: DR RAYMOND FULTON MB, FRCP London

Laboratories, advised that this was not possible for technical reasons. 3. Information on the prescribing of IV fluids in children is included in the Altnagelvin Doctor's handbook (page 41 August 2004 edition). 4. The Fluid Balance charts had been reviewed regionally by the Northern Ireland Bench Marking Group of Senior Paediatric Nurses including Sister McKenna from Altnagelvin. This allowed standardised recording in Northern Ireland and was introduced in 2002. In Altnagelvin after the meeting of 12 June 2001 the nurses changed the recording of vomit from a + scale to a "small-medium-large" scale. The nurses attempted to record urinary volume for several months after the 12 June 2001 meeting but this proved unachievable. 5. The infusion rate chart was put in a strategic position on Ward 6 by Dr McCord. I saw this myself on Ward 6. 6. The revised Fluid Balance Chart recommended by the Bench Marking Group was introduced in 2002 to Ward 6. 7. Dr Nesbitt subsequently confirmed that the anaesthetists would prescribe IV fluids for the first 12 hours of the post-operative period. Thereafter it was the responsibility of the surgical team. 8. Nursing staff confirmed that the Department Guidelines on hyponatraemia were displayed on several areas of Ward 6 immediately after receipt in April 2002.

SIGNATURE OF WITNESS

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RA Fulton

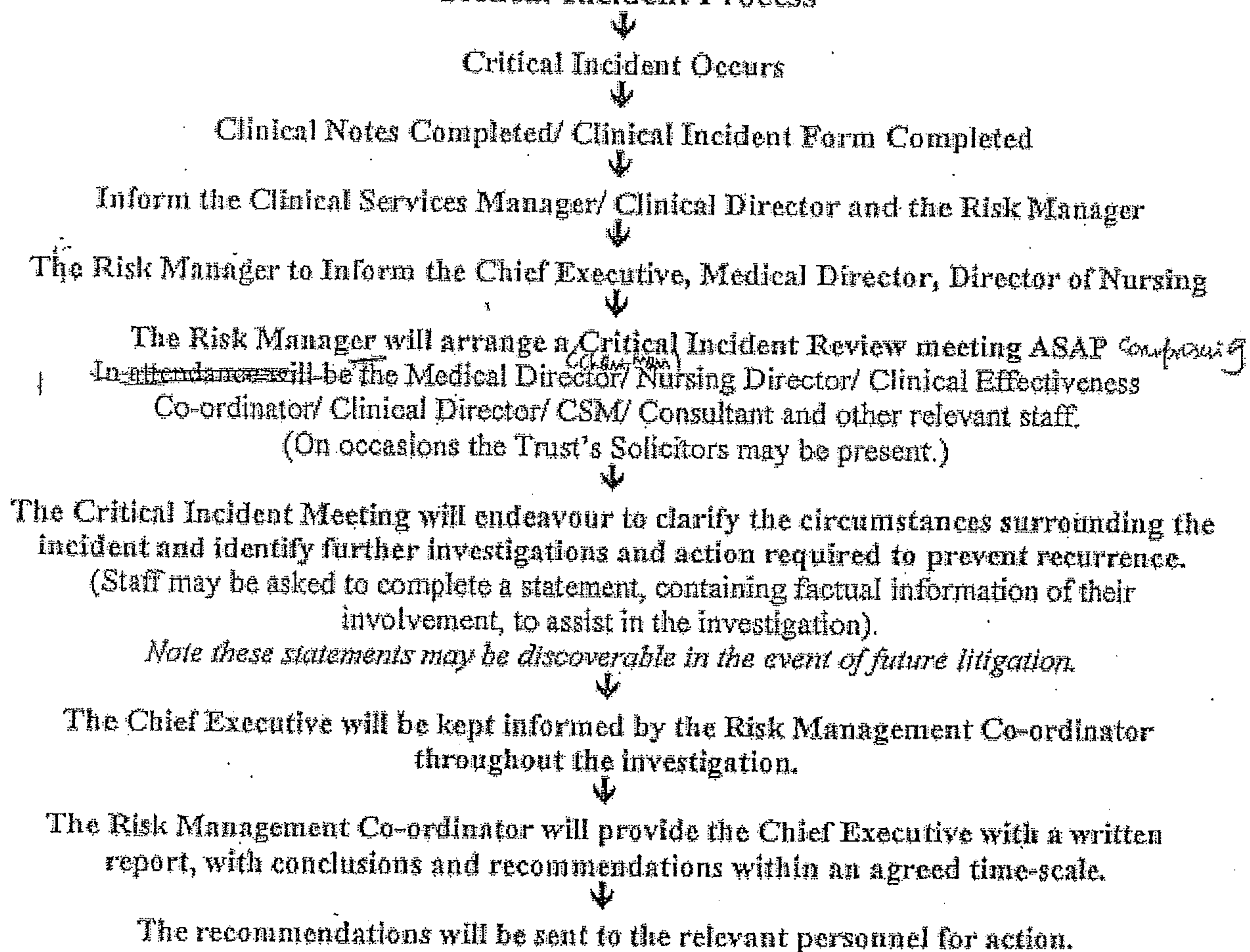
CRITICAL INCIDENT PROTOCOL

Introduction

On occasions serious incidents involving patients may occur. These would include an event resulting in or with potential to develop into, serious damage, injury or death of a patient. They are usually termed Critical Incidents and are events, which will likely attract media attention.

This protocol details the procedure to be followed in the reporting and investigation of a Critical Incident. This protocol supplements the Trust Clinical Incident Policy dated February 2000.

Flow Chart Critical Incident Process



12.0.07 142

Dr Benet Thompson flag Paed
 Dr Brian McLeod
 Dr Jeremy Johnson SHO

Mr Maker SHO
 Mr Zafar SHO
 Robert Gilchrist

} Surgeon --- x CP

Jeffrey Geoff Nesbitt Anaesth
 [Clare Jamieson] Anaesth
 General

Sister Piller
 Nazanah Doherty

SN Ann Noble Wylor Nurse
 SN Fiona Byrne " "
 SN Elizabeth Lynd UA Friday night
 SN Sandra Gilchrist Friday night

M. MAKAR

7/6/01

A+E A Appendixes R. HARTMANE (in A+E)

Changed to Sch 18 in Wd 6 by M. Makar at
 Request of SN Noble in accordance with protocol
 EP email in A+E

R. Jansson (SHO Areas)

in camera with. Wajlins in Annual in the
 300 ms Hartman in the area

SN Noble

in duty
 Mon + Friday

Pre-op: Confirmed Request of R. to change Hartman (in A+E)
 to Sch 18

Post-op:

" Solution 18 is in progress so we have
 continue to work SN Noble required
 to begin duty on 8/6/01

W. Mulgela R. R.

(Day Friday)

in Sch 18 so we have

" Asked of R. R. to work up the other part
 of Sch 18

L. Jansson

Site Area 1

dealt with files - sent of U+E

W. Jansson

by R. R.

Called by Dr. Jansson on 11/8 by 0.59

files changed to 0.99 wall & Rate to 40 ml/min

Dr Gund
410 Ar

Ref THOMAS : set up / in 4 hours
" About 200ml Hankman given
during surgery "

" Banded the remaining fluid and left the
prescription of fluids on ward protocols "

SUMMARY

Dr Narian R W Hankman W A+E 2000 THURSDAY 7 JUNE 2001

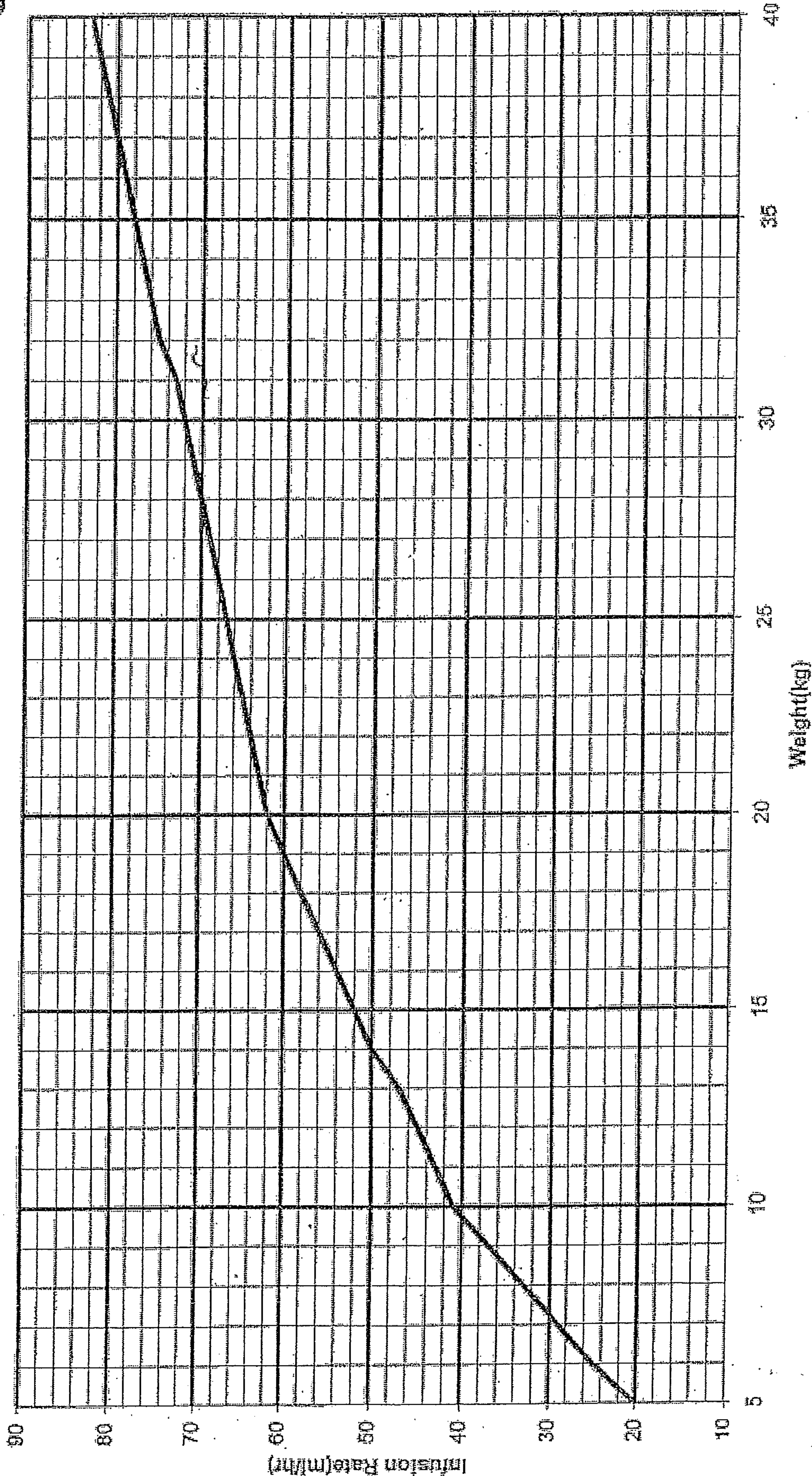
Dr Narian changed to Soln 18 C bsd b [2340 appendectomy]

Dr Gund gave 200ml Hankman on theatre
(300ml in Jamison)

Dr Noble
Rice
with Miller } Soln 18 given post op @ Poul / in throughout
Friday 8th until
day 9th

For Surgical Patients (Guidelines)

Suggested Rates for IV Fluid Maintenance



WRC 32

ACTION SHEET 12/6/01

1. Evidence ✓
Change to Harmanus In Nesbitt
2. Daily VTE all part ap Sister Rella
3. Infant junior Surgical class Dr. Giddland
4. Monitor urinary (+? vomit) output Sister Rella
5. Chart for W fluid rats Dr. N. Card
6. Fluid balance document at Ann Giddland

AGREED ACTION FOLLOWING CRITICAL INCIDENT MEETING 12/06/01

- 1 Review evidence for use of routine post-operative low electrolyte IV infusion and suggest changes if evidence indicates. No change in current use of Solution 18 until review.
Action Dr Nesbitt
- 2 Arrange daily U&E on all post-operative children receiving IV infusion on Ward 6.
Action Sister Miller
- 3 Inform surgical junior staff to assess these results promptly.
Action Mr Gilliland
- 4 All urinary output should be measured and recorded while IV infusion progress in progress.
Action Sister Miller
- 5 A chart for IV fluid infusion rates to be displayed on Ward 6 to guide junior medical staff.
Action Dr McCord
- 6 Review fluid balance documentation used on Ward 6.
Action A Witherow

R A FULTON
Medical Director

13/06/01

**UPDATE FOR CHIEF EXECUTIVE
RE: CRITICAL INCIDENT MEETING 12-6-01**

This is an update relating to the agreed action highlighted by Dr Fulton's note of 13-6-01.

1. Dr Nesbitt has had discussions with anaesthetic colleagues and has made a decision to discontinue the use of Solution 18 for Paediatric Surgical Patients. One of the Surgeons is not supporting this change. (see attached correspondence from Dr Nesbitt).

Further action required. Mrs Brown to undertake a more extensive review of the research regards the use of Solution 18.

2. Daily U&E levels will be checked on all post operative children with an IV infusion. Sr. Millar has already actioned.
3. Nursing staff advise surgical junior staff of the U&E results. Medical staff are bleeped by the nursing staff.
4. A meeting has been held with Mrs A Witherow, Mrs M Doherty, Sr Millar, Sr. Little, Nursing Staff and Nursing Auxiliary Ward 6 to discuss in detail the fluid balance management. The following has been agreed:
 - a. Fluid balance sheet must be correctly completed.
 - b. A record should be kept of total fluids given.
 - c. Accurate recording of output. To be measured. Parents to assist.
 - d. Vomit to be recorded as, small, medium or large as opposed to ++.
 - e. Nursing staff to be proactive in advising medical staff regarding discontinuation of fluids.
 - f. Nursing staff to be proactive in management of fluids required after 4.00 p.m. (Refill bag not just automatically put up).
 - g. Sr. Millar to be involved in the training of staff in relation to e and f above.
5. Dr McCord has actioned the display of the chart detailing infusion rates.
6. The Fluid balance documentation currently in use will continue to be used. The documentation will be kept under review by Mrs Witherow.

Further Action Required. Mrs Witherow to keep documentation under review.

Note: There is a concern by Nursing Staff that Surgeons are unable to give a commitment to children in Ward 6 unless they are acutely ill and are bleeped. Could Paediatricians maintain overall responsibility for surgical children in Ward 6?
These
The list
reviewed in relation
to Adults - also

[Signature]
 TERESE BROWN

9TH JULY 2001

Dr Fulton → to discuss with Paediatricians - list

Dr G A Nesbitt
Clinical Director
Anaesthetic Department
Altnagelvin Hospital

Date: 14th June 2001

14 JUN 2001

Dr Raymond Fulton
Medical Director

Re: Fluid management in Children

Dear Dr Fulton,

I have contacted several hospitals including The Royal Hospital for Sick Children and made enquiries about peri-operative fluid management.

The Children's Hospital Anaesthetists have recently changed their practise and have moved away from No.18 solution (fifth normal NaCl in 4% Dextrose) to Hartman's solution. This change occurred 6 months ago and followed several deaths involving No.18 solution.

Craigavon Hospital and the Ulster Hospital both use Hartman's intra-operatively and No.18 post-operatively as is our practise. The Anaesthetists in Craigavon have been trying to change the fluid regime to Hartman's postoperatively but have met resistance in the Paediatric wards where, as in Altnagelvin, they have followed a medical paediatric protocol.

In view of recent events, and papers on the subject, and the fact that the Children's Hospital no longer uses No.18 solution, I have decided to recommend that we do the same. I have spoken to Sister Miller in the Paediatric ward and also to Dr McCord who both are in agreement. Dr McCord has agreed to add this to the protocol he is developing for calculating the amount of fluid to be prescribed. He has further agreed that, pending discussion with his colleagues, fluid management in postoperative children should be under the supervision of paediatricians.

To summarise: Altnagelvin Hospital has followed what is a widespread and accepted policy of using No.18 solution for postoperative fluids. There is evidence to show that this policy is potentially unsafe in certain children who have undergone a surgical procedure. The Children's Hospital has ceased to use it and Craigavon is trying to effect a change in this direction. As from today we will no longer be routinely using this fluid in the management of surgical cases.

Yours sincerely,

G A Nesbitt Clinical Director

cc Theresa Brown

Risk Management Coordinator

NOTICE

FROM NOW ONWARDS

12/6/01

ALL SURGICAL PATIENTS (INCLUDING
ORTHOPAEDIC) ARE TO HAVE IV HARTMANS
SOLUTION

ALL POST-OPERATIVE CHILDREN ON IV
HARTMANS SOLUTION ARE TO HAVE DAILY
ELECTROLYTES & 6HOURLY B.M's

MEDICAL PATIENTS TO CONTINUE ON SOLUTION
18 OR UNLESS PRESCRIBED OTHERWISE BY
DOCTOR

(25)

~~026-010-011~~

4

Sally Doherty

From: Sally Doherty
Sent: 26 July 2001 11:08
To: 'Henrietta.campbell' [REDACTED]
Subject: electrolyte balance in post operative children

I am writing further to Dr Fulton's conversation with you regarding the above, and am concerned to ensure that an overview of the research evidence is being undertaken. I believe that this is a regional, as opposed to local hospital issue, and would emphasise the need for a critical review of evidence.

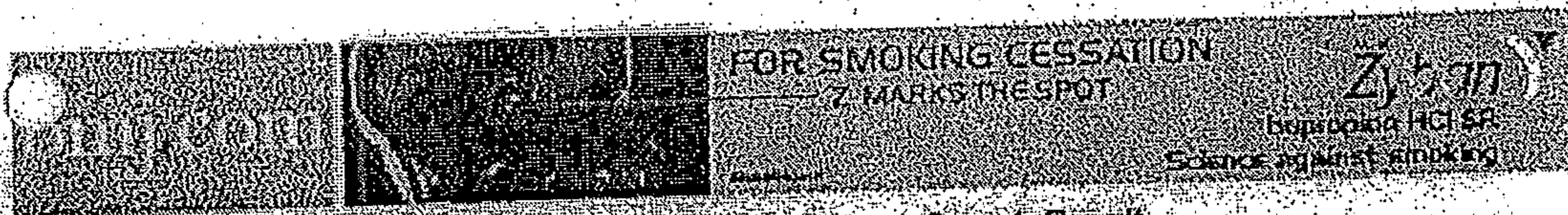
I would be extremely grateful if you would ensure that the whole of the medical fraternity learned of the shared lesson.

I await to hear further from you.

Stella.

390

22



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BMJ 1999;319:1269 (6 November)

Letters

Children are another group at risk of hyponatraemia perioperatively

EDITOR—Our poor understanding and practice of giving fluid and electrolytes perioperatively spans all age groups. The editorial by Lane and Allen highlighted elderly postmenopausal women as being particularly at risk of hyponatraemia postoperatively,¹ as has been emphasised in several case series,^{2 3} and the electronic responses to the editorial also concentrated on this age group (www.bmj.com/cgi/content/full/318/7195/1363#responses).

The use of hypotonic saline is standard practice for the paediatric age group. This practice is based on calculations of normal physiological requirements for salt and water homeostasis. These principles were laid down over 40 years ago and have never been challenged, although every year otherwise healthy children suffer brain damage associated with acute perioperative hyponatraemia.⁴ Isotonic solutions are not used in children because it is assumed that their kidneys cannot handle a salt load.

The basic flaw that prevents us understanding the cause of these catastrophes is our assumption that normal physiological rules apply. They don't, and we are frequently undone by the subtleties of secretion of antidiuretic hormone. Practically everything that happens to a patient in the perioperative period is guaranteed to turn on secretion of antidiuretic hormone and inhibit the excretion of electrolyte free water when the situation demands.

Even when an isotonic or near isotonic solution is given surgical patients can become hyponatraemic. In a study by Steele et al 21 out of 22 patients who received only these types of fluid showed a fall in serum sodium concentration from a mean of 140 to 136 mmol/l.⁵ The explanation became evident from the urine sodium measurements, which showed that most patients were excreting a hypertonic urine (sodium concentration 150 mmol/l) and were in positive water balance. This implied that antidiuretic hormone was acting, a combination of events referred to by the authors as "desalination."

In a case series of 23 children with acute hyponatraemia presenting with convulsions that I have collected seven of them were excreting a hypertonic urine at presentation despite having a serum sodium concentration of <125 mmol/l (data submitted for publication). Much can be learnt from measuring urine sodium concentrations and calculating not only fluid but tonicity balances (sodium plus potassium).

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1269-1269-019

ute hyponatraemia leading to brain damage is largely preventable but only if we learn to understand that normal physiology is frequently perturbed perioperatively. We need to recognise the prodromal symptoms and be aware that any postoperative patient is potentially at risk. Finally, the use of hypotonic saline should be prohibited perioperatively and reserved only for situations in which the administration of electrolyte free water is genuinely needed.

Desmond Bohn, paediatric intensive care specialist

Department of Critical Care Medicine, Hospital for Sick Children, 555 University Avenue, Toronto, Ontario M5G 1X8, Canada dbohn@sickkids.on.ca

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Related editorials in BMJ:

Hyponatraemia after orthopaedic surgery.

Nick Lane and Kathryn Allen

BMJ 1999 318: 1363-1364. [Full text]

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BMJ 2001;322:780-782 (31 March)

Clinical review

Lesson of the week

Acute hyponatraemia in children admitted to hospital: retrospective analysis of factors contributing to its development and resolution

Do not infuse a hypotonic solution if the plasma sodium concentration is less than 138 mmol/l

Michael Halberthal, fellow,^a Mitchell L Halperin, professor,^b Desmond Bohn, professor^c

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Hyponatraemia (plasma sodium concentration less than 136 mmol/l) is acute if the decrease in natraemia occurs within 48 hours. The major dangers from this are brain cell swelling and herniation.^{1,2} Two factors are required for hyponatraemia to develop: a source of electrolyte free water and vasopressin to prevent the excretion of that water.³ Electrolyte free water is given routinely as maintenance fluids based on formulas developed in studies in healthy children more than 40 years ago.^{4,5} There are many reasons to anticipate that vasopressin will be released in sick patients (box).⁶ Patients with an acute illness may arrive in hospital with a low plasma sodium concentration because of previous water intake. Hence, to minimise the potential threat of brainstem herniation it is important to measure the plasma sodium concentration if intravenous solutions are to be given.

Causes of vasopressin release

- Hypermnatraemia (most important stimulus, but not in these patients)
- Low "effective" circulating volume (greater than 7% decrease in extracellular fluid volume)
- Nausea, pain, anxiety
- Drugs (some act through inducing nausea)
- Afferent stimuli by way of the vagus nerve ☒ for example, lung lesions

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97

- Disturbances of the central nervous system (meningitis, encephalitis)
- Metabolic and endocrine disorders ☒ for example, hypothyroidism, hypoadrenalism, porphyria

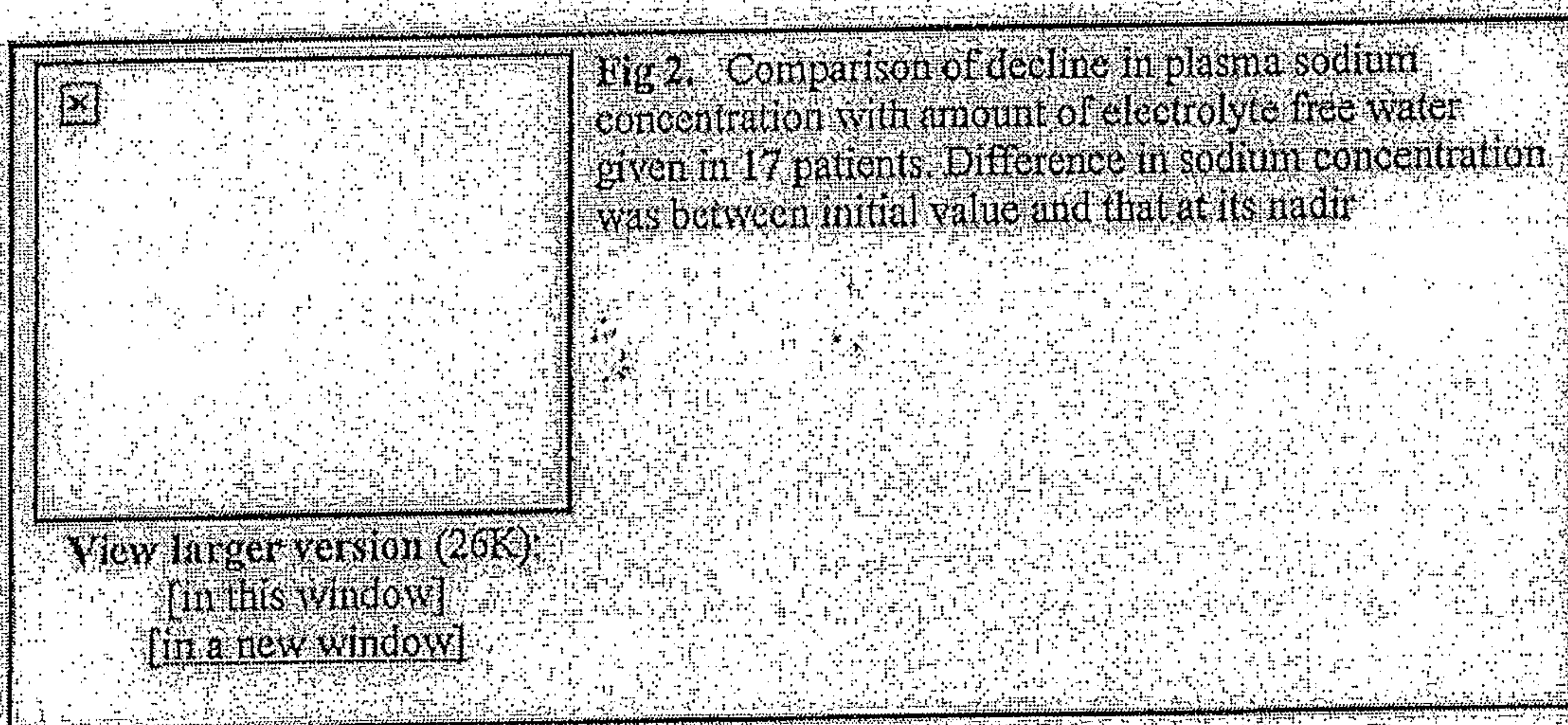
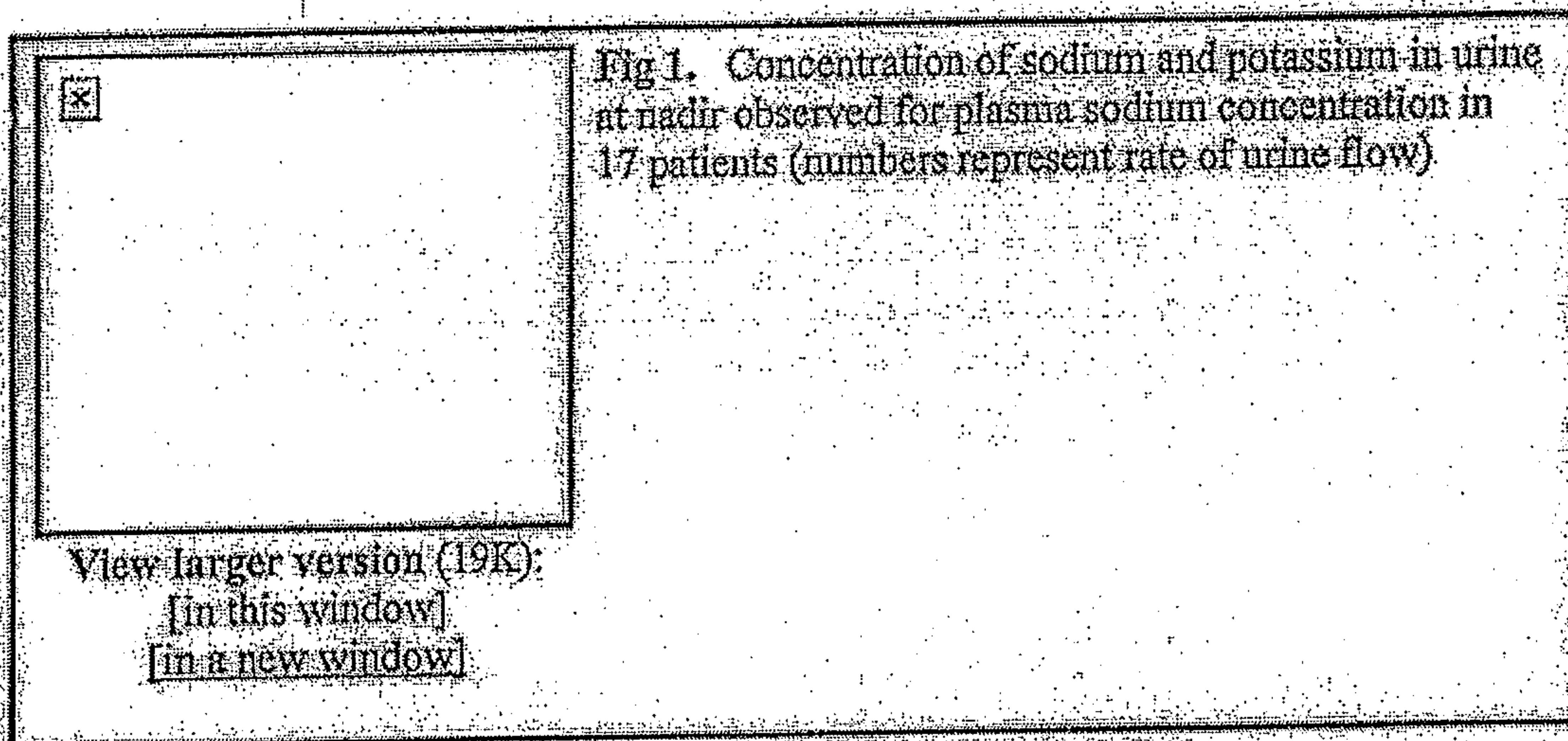
We describe symptomatic hyponatraemia developing over 48 hours in children. In each patient, hypotonic solutions were infused using current guidelines.⁷ We related the volume of electrolyte free water given to the decrease in natraemia and assessed whether actions of vasopressin persisted to guide emergency corrective therapy.⁸

We reviewed all patient charts (306 charts) with a recorded diagnosis of hyponatraemia for the past 10 years. Patients were included if their decrease in natraemia was to less than 130 mmol/l and this occurred within 48 hours, if intravenous fluids were given, and if an underlying disease did not compromise renal handling of sodium or water. Thirty patients had acute hyponatraemia. Crucial information was missing for seven, leaving 23 patients in the study group. The median age was five years (range one month to 21 years), with males predominating (18 of 23). 13 developed hyponatraemia in the postoperative period. Fifteen patients were referred to the critical care unit after the development of symptomatic hyponatraemia while receiving intravenous fluids ☒ 11 were from the hospital wards and four were transferred from other institutions. Symptoms included seizures (18 patients) and vomiting, 17 a warning sign of an increased intracranial pressure. Treatment was withdrawn from five patients after brainstem coning. One patient sustained permanent, severe neurological damage.

Results

All the children received hypotonic fluids while their plasma sodium concentration was less than 140 mmol/l, because of the wide belief in paediatric practice that "maintenance fluids" should be hypotonic.⁹ In fact the volume of maintenance fluid given was 50% greater than recommended values in 16 of the 23 patients. This infusion of hypotonic fluids increased the risk of acute hyponatraemia and brain swelling because vasopressin is typically present in this setting.^{1 2 10 11} In quantitative terms, some of the electrolyte free water infused was retained in six of the patients because their urine sodium plus potassium concentration was less than 25 mmol/l (fig 1). In six patients more electrolyte free water was infused than needed to cause the observed decline in natraemia (points above line of identity in fig 2). The remainder of the patients had a decrease in natraemia that exceeded the decline if the entire volume of electrolyte free water infused was retained (points below broken line in fig 2). Therefore there was either another non-recorded input of water or the excretion of a large volume of hypertonic urine (a desalination of infused isotonic saline¹²).

☐ Top
☒ Results
☐ Discussion
☐ References



Discussion

One objective of our study was to assess the renal actions of vasopressin. Because six patients had very hypotonic urine at their recorded nadirs of hyponatraemia, their plasma sodium concentration might have been much lower before water diuresis began (fig 1). Had their plasma sodium concentration been measured after this large water diuresis, the erroneous conclusion might have been drawn that acute hyponatraemia had never been present. Hence its incidence may be much higher than shown by an analysis of hospital records. Therefore acute hyponatraemia could have been an occult cause of morbidity and mortality.

Another implication of cessation of the release of vasopressin concerns treatment. Treatment for acute, symptomatic hyponatraemia causes a prompt decline in the size of brain cells.¹⁰ Hypertonic saline (3%) is the commonest treatment for shrinking brain cell volume, thereby lowering intracranial pressure. Treatment must be prompt because deterioration may be rapid and irreversible, even when symptoms are mild. Enough hypertonic saline (a total of 5 mmol of

☐ Top
☐ Results
☐ Discussion
☐ References

sodium chloride per litre of body water¹³) is needed acutely to lower intracranial pressure sufficiently to minimise this risk (the plasma sodium concentration should be increased by 5 mmol/l over several hours). Because an excessively rapid rate of correction of hyponatraemia might have deleterious effects,⁶ hypertonic saline should not be given if there is a brisk water diuresis. For example, the plasma sodium concentration will also increase by 1.2 mmol/l/h if 6 ml of electrolyte free water are excreted per kilogram per hour (total body water is close to 600 ml/kg; 6 ml is a 1% change of 120 mmol/l). Whereas excretion of hypotonic urine indicates that electrolyte free water is being excreted (6 of 17 patients, fig 1), it is also important to consider the rate of urine flow. Little electrolyte free water was excreted in the index oliguric patient (flow 0.16 ml/kg/h). By contrast, the excretion of electrolyte free water was high enough to increase the plasma sodium concentration by close to 3 mmol/l/h in the polyuric index patient who recovered (15 ml/kg/h). Vasopressin continued to act in patients excreting isotonic or hypertonic urine, so hypotonic intake must be avoided in them. With these high urine tonicities a further decrease in natraemia would be anticipated if the urine output was high (index case designated with a urine output of 5.3 ml/kg body weight, fig 1).¹² Finally, vasopressin concentrations may decline abruptly, increasing the excretion of electrolyte free water.

Serious symptoms may become evident when hyponatraemia approaches 120 mmol/l, but there are cases where symptoms become evident with a higher plasma sodium concentration, whereas others tolerate this electrolyte disorder without developing seizures.¹⁴ Apart from underlying conditions that might make a patient more susceptible to seizures, a possible important factor could be the extracellular fluid volume of the brain. If this volume was expanded by a large infusion of isotonic saline, a higher intracranial pressure might be present at a given degree of hyponatraemia. Moreover, because there is a relatively larger proportion of brain cell volume to extracellular fluid volume in young patients, they are more vulnerable to an increase in brain cell volume.

Study limitations

Because of a reporting and referral bias, the incidence of adverse outcomes from hyponatraemia cannot be deduced from these data. Our results highlight the dangers of the routine use of hypotonic solutions when vasopressin acts. The currently used guidelines for maintenance fluids in children admitted to hospital must be changed because they do not take into account the unpredictability of vasopressin secretion. We recommend that the concentration of plasma sodium should be measured when starting an intravenous infusion. If it is less than 140 mmol/l then isotonic and not hypotonic fluids should be given. The use of hypotonic solutions should be reserved for patients who have a plasma sodium concentration greater than 140 mmol/l. If a patient receives intravenous fluid that exceeds 5% of total body water (30 ml/kg) then their plasma sodium concentration should be measured. If an intravenous infusion is started to give drugs, a small volume should be used, and the solution should be isotonic if possible.

Acknowledgments

Contributors: MFI collected the data and drafted the original manuscript. MLH analysed the data and coauthored the manuscript. DB had the original idea and coauthored the manuscript; he will act as guarantor for the paper.

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Footnotes

Competing interests: None declared.

References

☐ Top
☐ Results
☐ Discussion
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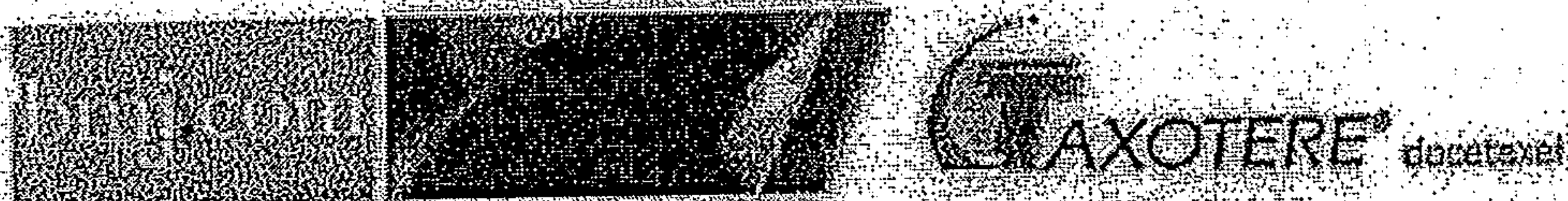
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(Accepted 26 July 2000)

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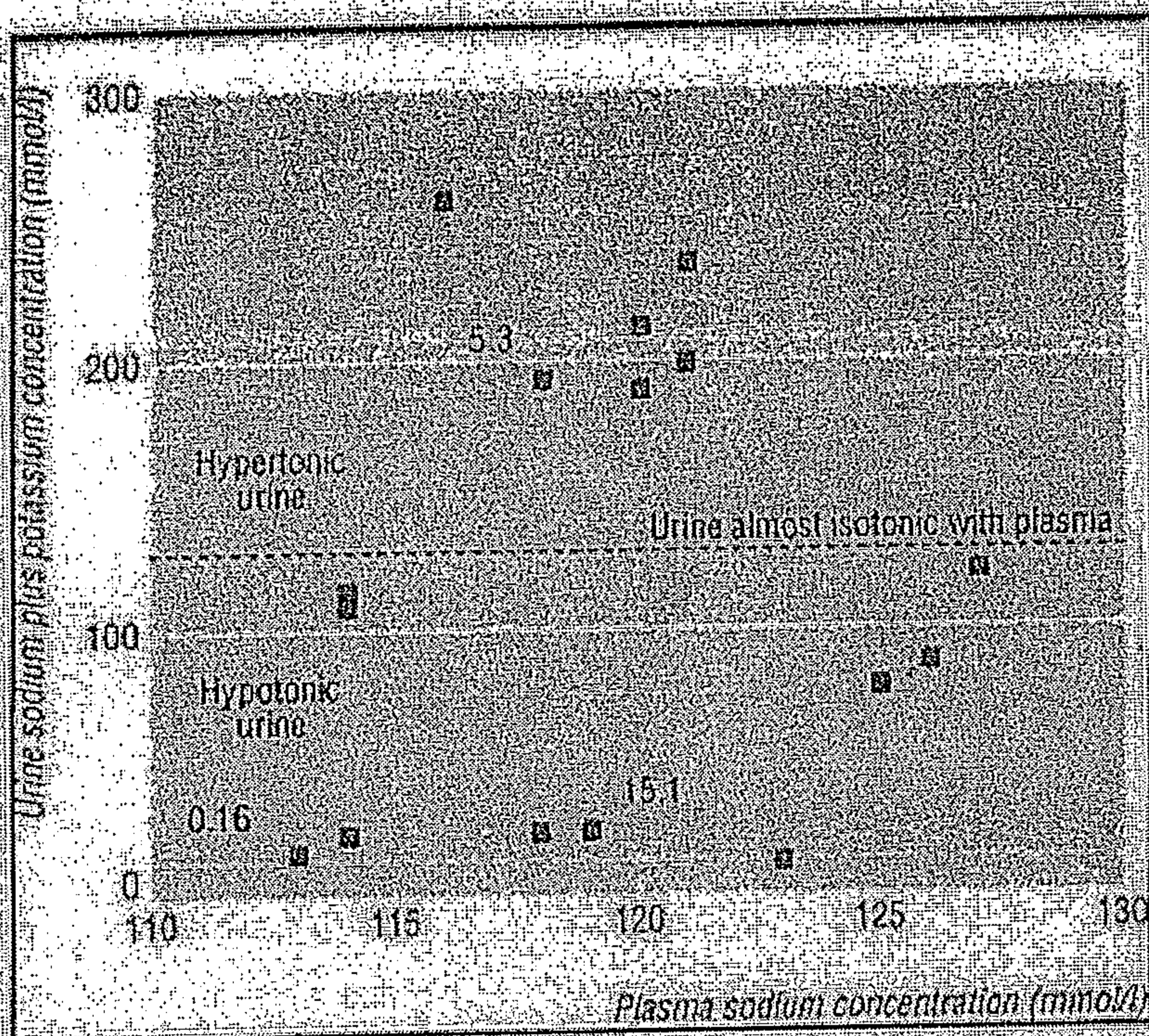


Fig. 1. Concentration of sodium and potassium in urine at nadir observed for plasma sodium concentration in 17 patients (numbers represent rate of urine flow)

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Neonatal Formulary



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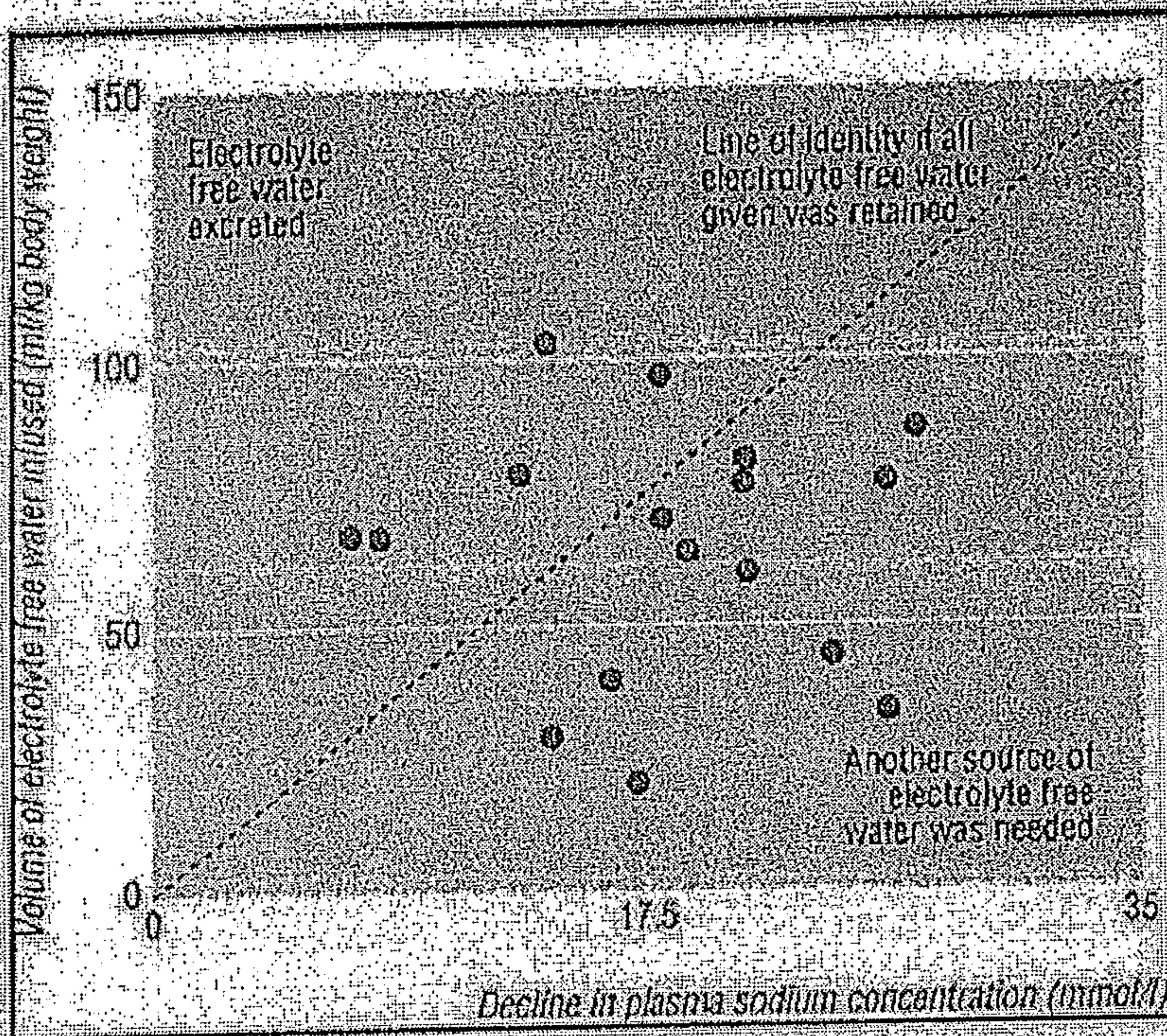
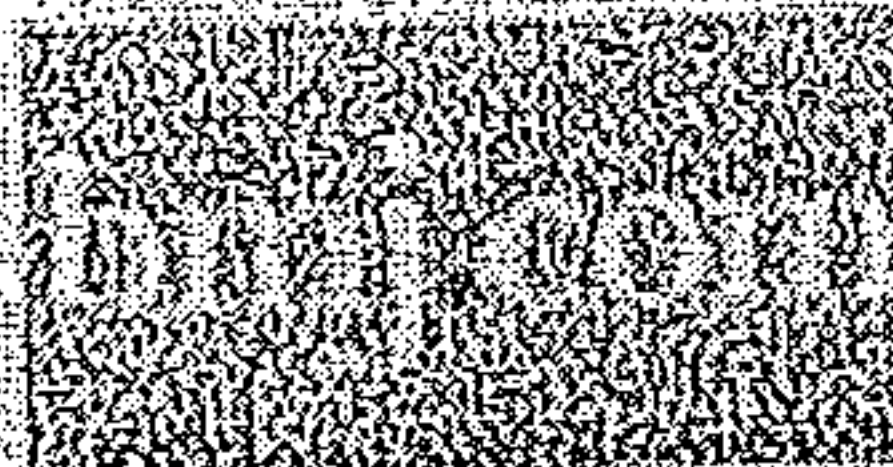


Fig. 2. Comparison of decline in plasma sodium concentration with amount of electrolyte free water given in 17 patients. Difference in sodium concentration was between initial value and that at its nadir

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**LATEST
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W E S T E R N
HEALTH AND SOCIAL SERVICES BOARD



WRC 59 (3)
AREA BOARD HEADQUARTERS

WMcC/HP

5 July 2001

Dr R Fulton
Medical Director
Altnagelvin Health & Social Services Trust
Glenshane Road
Altnagelvin
Londonderry

Dear Raymond

As we agreed, I raised this issue for discussion at the recent CMO/DPH meeting. Dr Campbell indicated that her CMO update was already at the printers and therefore it would be difficult to include anything within it. Knowing this, it was suggested that I would write to each of my Director of Public Health colleagues who would then take responsibility for drawing the issue to the attention of any relevant paediatric settings within their respective Boards.

I enclose a copy of the letter which I have sent to them and I have also taken the liberty of copying to them the articles which you helpfully sent to me. I hope you do not mind my suggestion within the letter that anyone who wanted more detailed discussion might contact you for further information.

Best wishes.

Yours sincerely

Dr W W M McConnell
DIRECTOR OF PUBLIC HEALTH

Enc

92

15 Gransha Park, Clooney Road, Londonderry, N. Ireland BT47 6TG.
Telephone: L'Derry [REDACTED]
Fax. No. [REDACTED]

~~026-006-007~~

WMcC/HP

5 July 2001

To:

Directors of Public Health

Dear

I am writing to you, as agreed at our recent meeting, with further details regarding the unfortunate death of a young girl at Altnagelvin Hospital. It appears that the use of hypotonic saline is still common practice in a number of paediatric units although there has been information around for a few years suggesting this does present risks to a very small number of children in the acute perioperative period. I have enclosed some articles which you might find of benefit in relation to this.

I know from discussions about this issue with Dr Raymond Fulton, Medical Director at Altnagelvin Hospital, that some paediatric settings within Northern Ireland have made appropriate changes but that in others, while the information may be known by anaesthetic staff, there has not necessarily been discussion regarding change between anaesthetists, surgeons and paediatricians.

I felt it might be helpful to draw this issue to your attention in order that each of us can check with those paediatric settings in our respective Boards to see whether modification in practice may be needed. I hope that the articles are helpful to you. If further more specific information is required I am sure that Dr Fulton would be happy to discuss this with anyone who contacted him.

Best wishes,

Yours sincerely

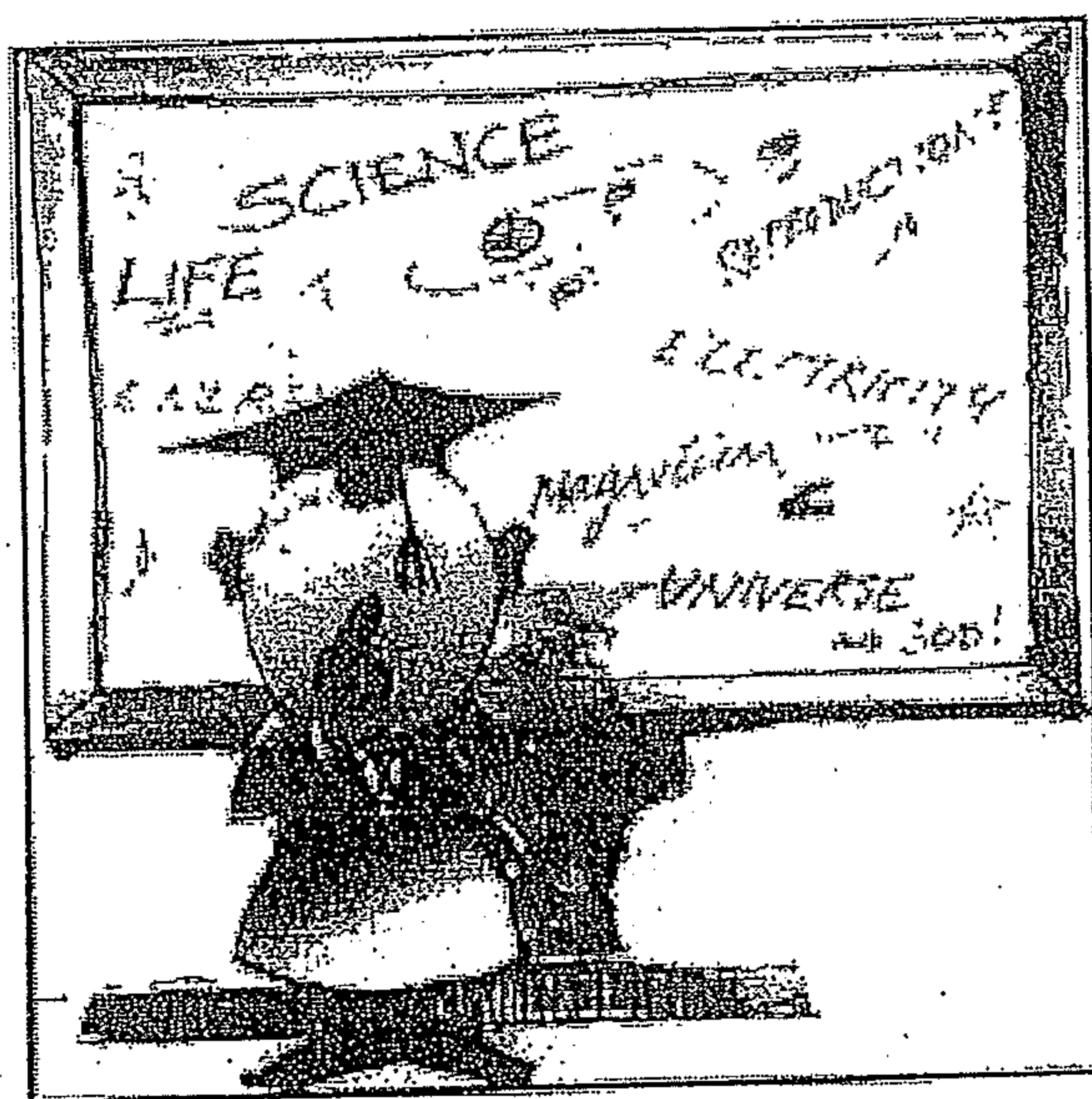
Dr W W M McConnell
DIRECTOR OF PUBLIC HEALTH

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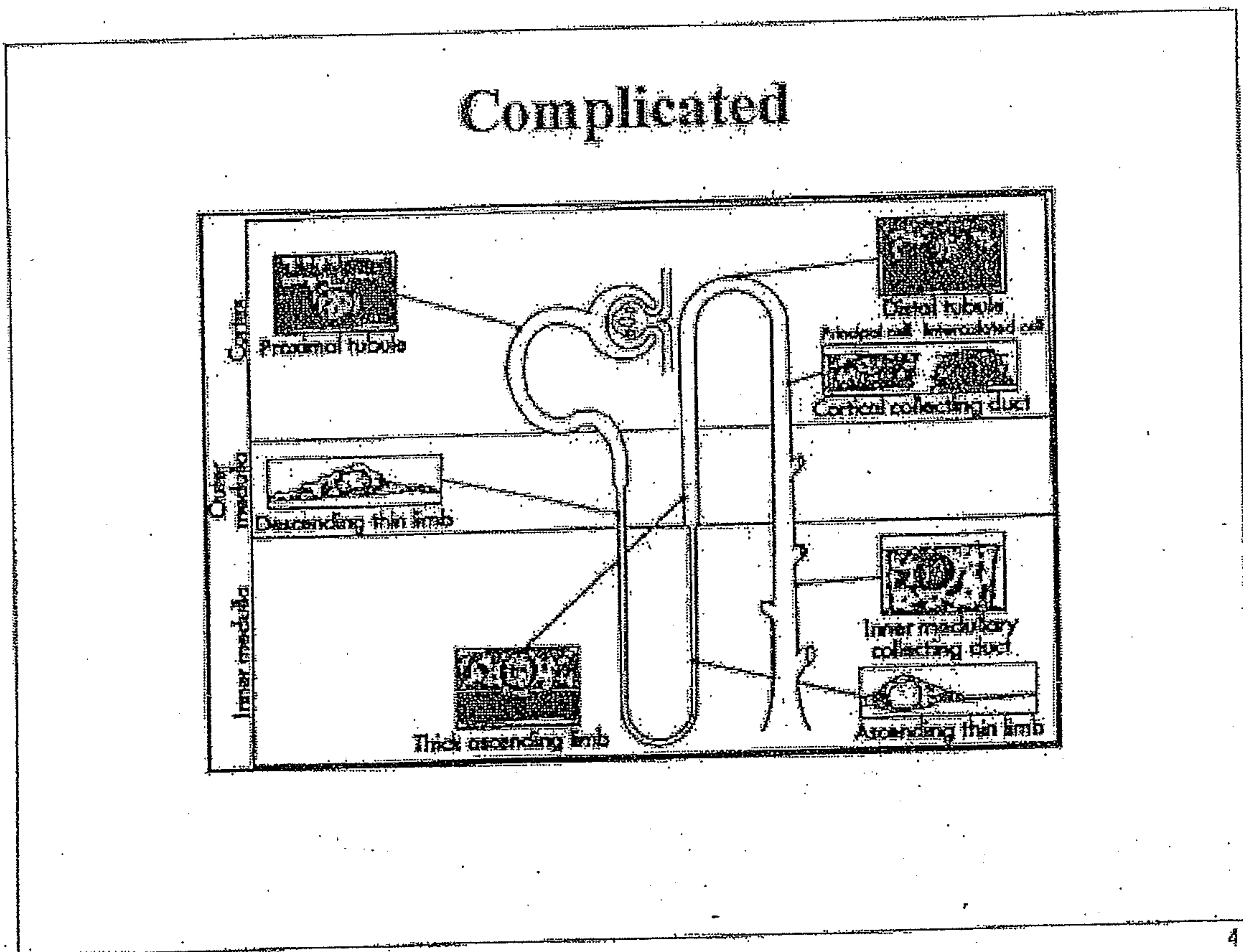
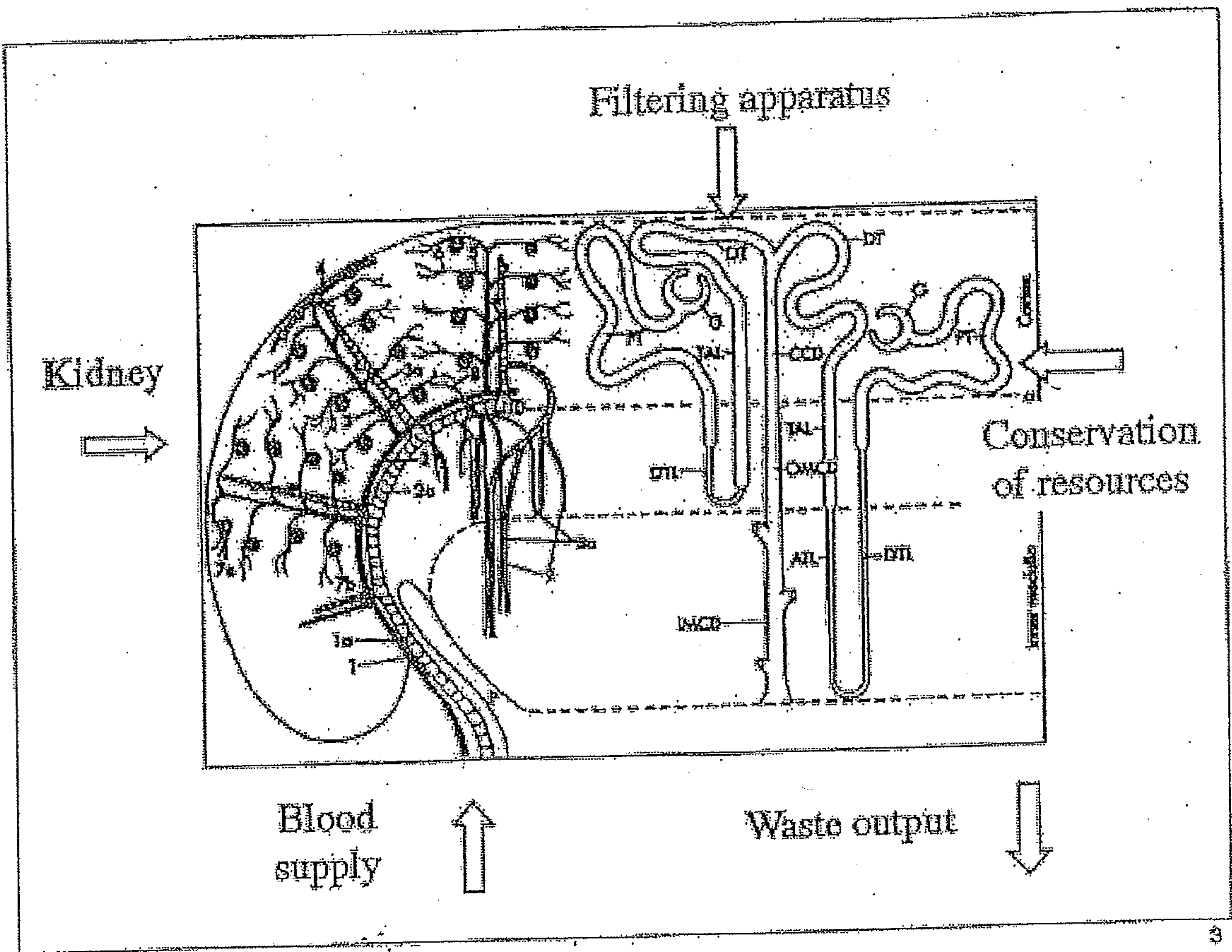
Fluid Balance

1. Renal Physiology made easy
2. A case report of Hyponatraemia
3. Recommendations for Fluid Therapy in Children (& now Adults)

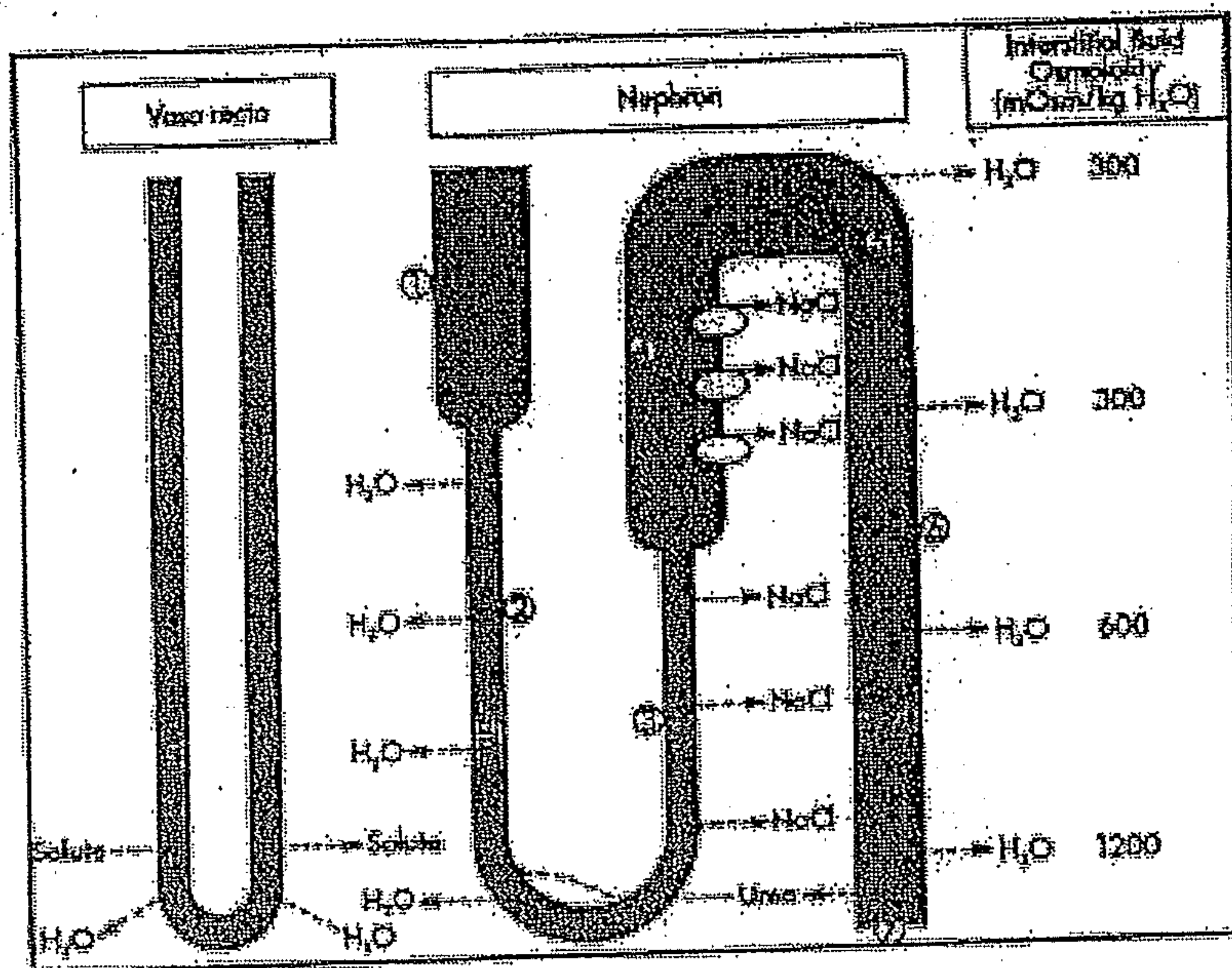
Renal Physiology - is it complicated?



Yes it is !

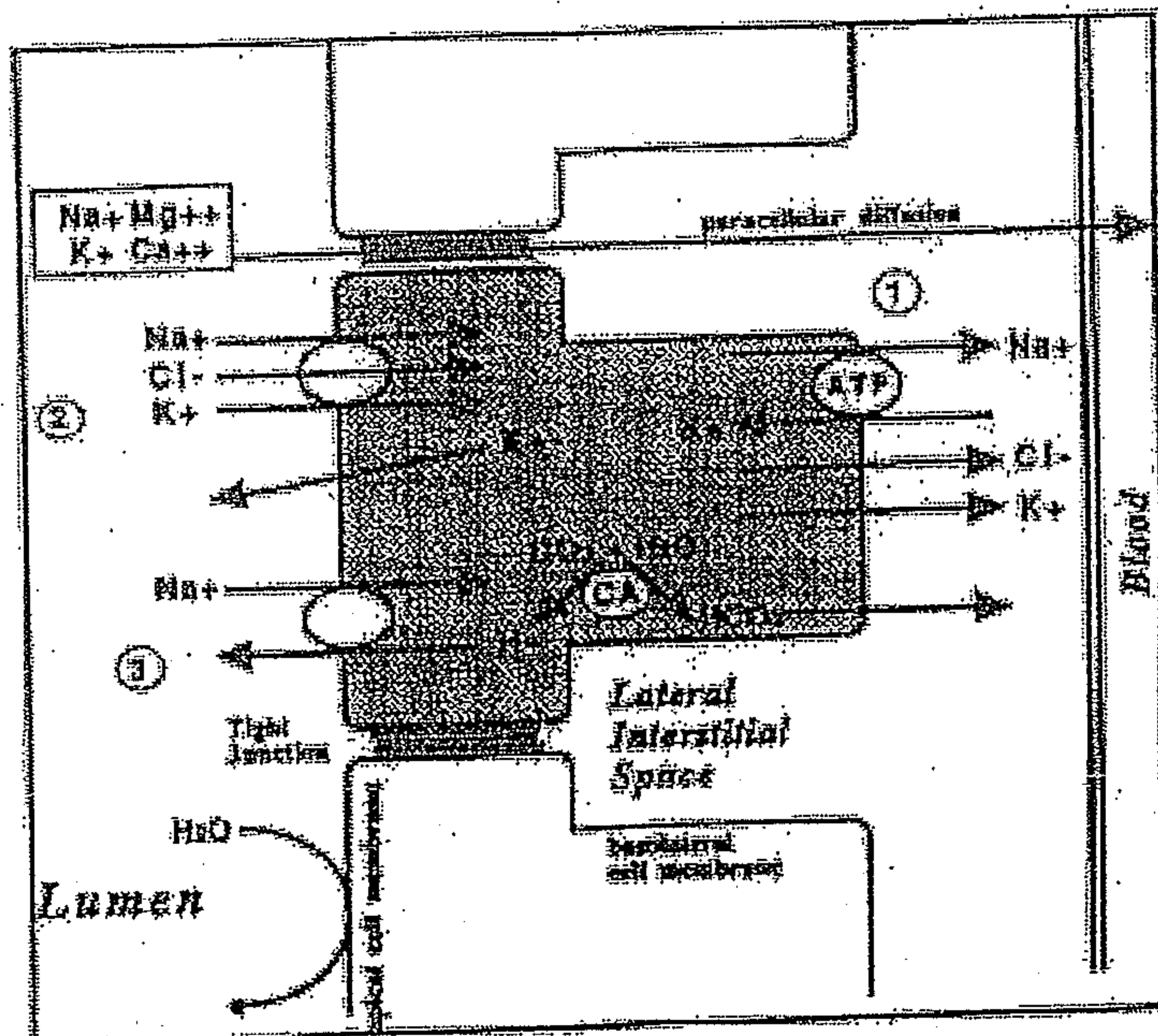


Very Complicated

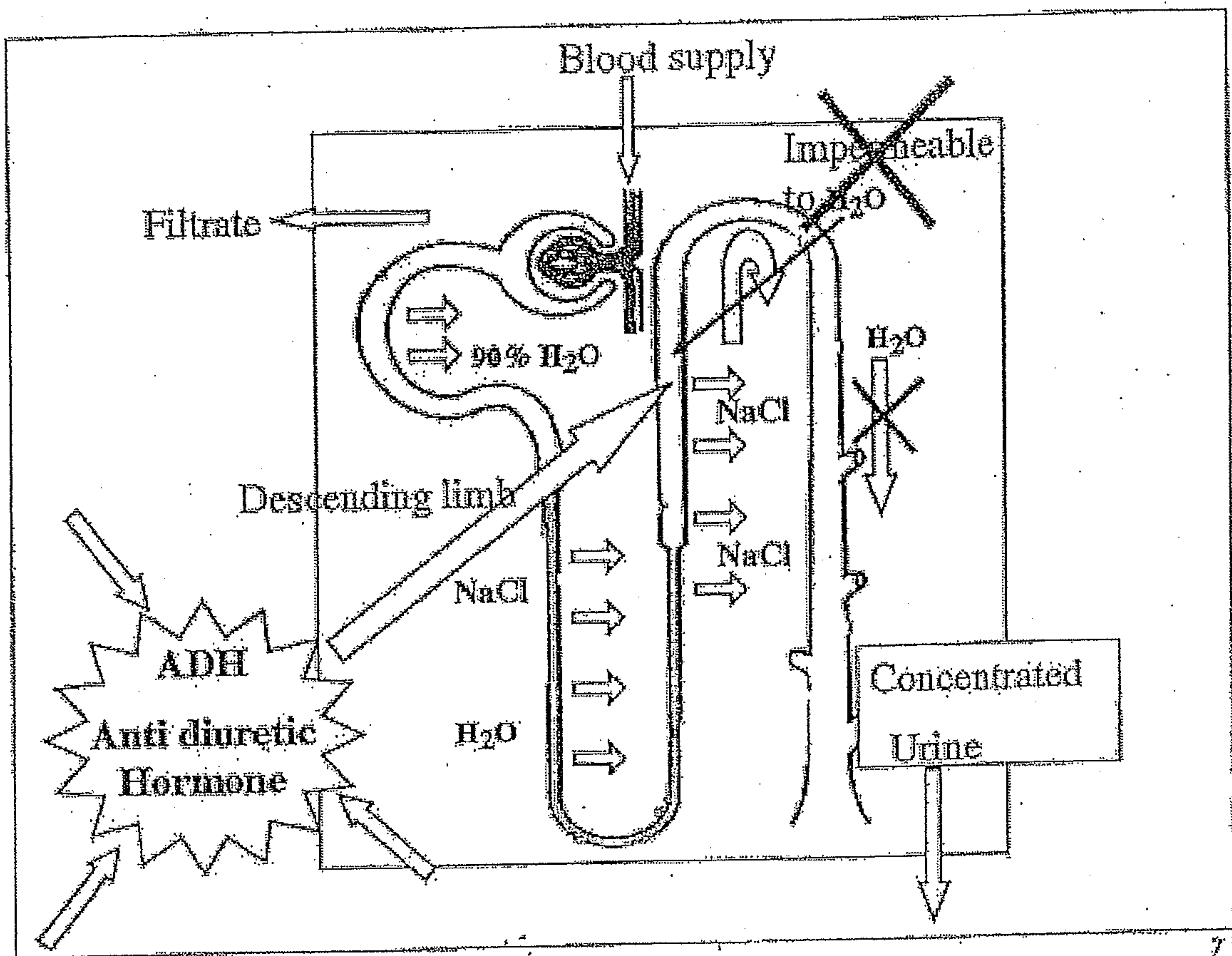


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Unbelievably Complicated



6





ADH

At risk patients

- ➔ Hyponatraemia / hyposmolality
- ➔ Dehydration / shock
- ➔ Stress, nausea, pain, anxiety
- ➔ Drugs
- ➔ CNS disease
- ➔ Metabolic / Endocrine disorders

Just about every surgical patient!

Fatal Hyponatraemia following surgery

A case report

- 9yr old girl. Weight 25kg
- Admitted via A&E 20.00hrs
- Diagnosis: "Suspected appendicitis"
- Treated with intravenous Morphine and admitted to ward 6

Na 137, K 3.6, Urea 4.8, Glucose 7.2

- Seen by Anaesthetist

- IV fluids prescribed (Hartmann's 80mls / hr)
- IV fluids changed to No.18 solution 80ml / hr
(This was the "default solution" in paediatrics)

[illegible][illegible]

History of events

- Returned to ward 02.00hrs. 8/6/01
- Seen by surgeons in am. Patient was well and being nursed by her father. Out of bed and "colouring in"
- Several episodes of vomiting
- "Seen" by several doctors throughout the day and anti emetics prescribed
- No notes and no U&E requested
- Headache at 21.30hrs. Treated with paracetamol
- Settled and sleeping 23.30hrs

15

History continued

- Further episode of vomiting 00.30hrs
- Found fitting at 03.00hrs
- Seen and treated by SHO in Paediatrics
- Check U&E
Na 118, K 3, Mg 0.59, Urea 2.1, Glucose 11
- Treated with benzodiazepines to control seizures 03.30
- Consultant paediatrician called 04.30
- Anaesthetic Registrar contacted because of desaturation
- 04.45 sudden deterioration. Anaesthetist fast bleeped
- Respiratory arrest
- Intubated and ventilated

16

CT scan & Transfer to RBHSC

- CT scan showed cerebral oedema and suspected subarachnoid bleed 05.30hrs
- Transferred to ICU
- Re scanned at request of Neurosurgeons
- Transfer to Belfast RBHSC 11.00hrs

Diagnosis: Brain Stem death

Parents told that "the wrong fluid had been given"

(Allegedly)

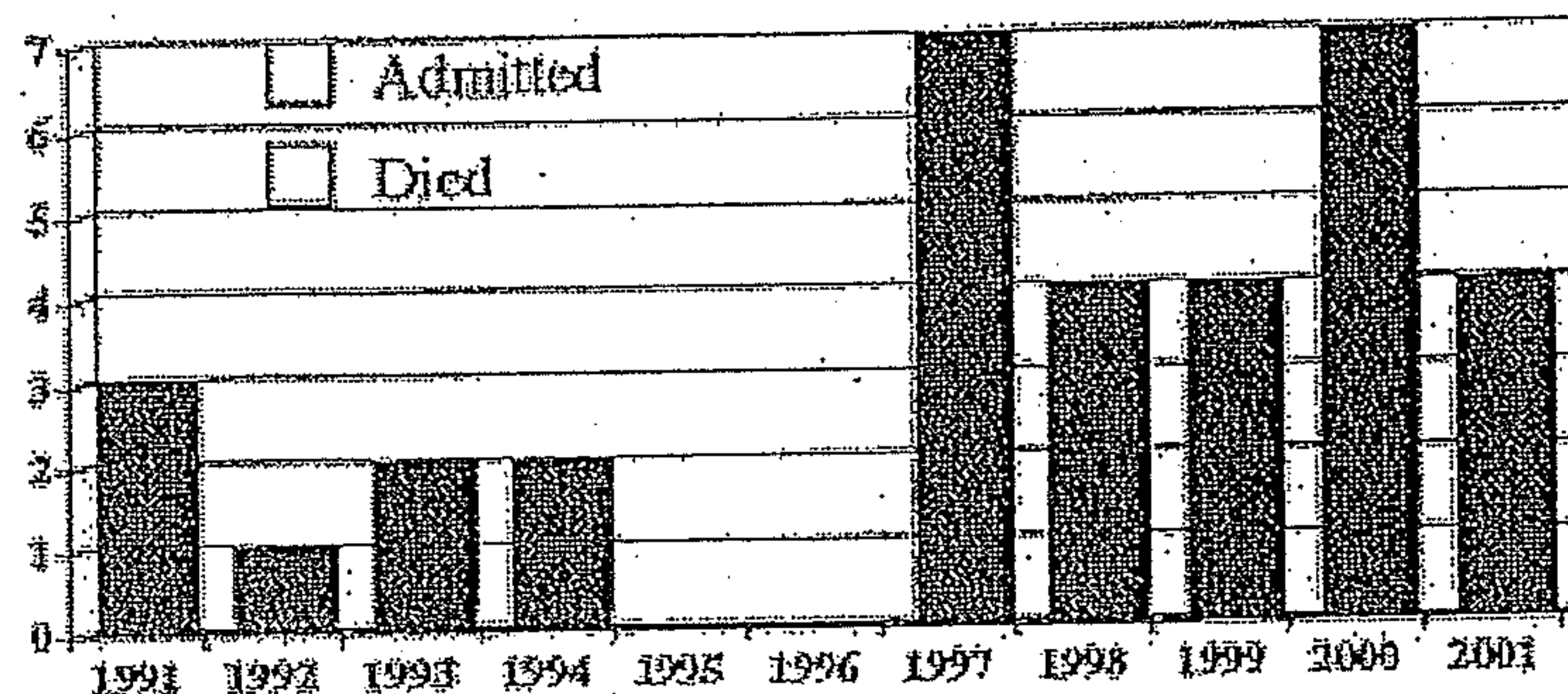
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Background

- Incidence in N Ireland
- Review of literature
- Intravenous fluids & Sodium content
- Recommendations following meeting with Department of Health

18

Incidence of Hyponatraemia RBHSC



19

History

The traditional view held for 40 yrs...

- Paediatric fluids should be hypotonic
- Children cannot handle a salt load
- Children must be given sugar

20

Evolution of the problem

- Standard solution was No.18. Isotonic containing 30 mmols/l Sodium, provided the correct amount for the day.
- Free water is produced as glucose metabolised, especially by the sick child.
- ADH /Arginine-Vasopressin secretion adds to the problem by causing water retention and excretion of small volumes of hypertonic urine.
- A fluid challenge may be tried to improve the "poor urinary output" (often with hypotonic fluids)
- Large shifts of water lead to tissue and more importantly brain cell swelling.

21

Study findings

Halberthal et al - BMJ 2001;322:780-2

- 23 patients with acute hyponatraemia
- Median age 5 years (range 1mth - 21yrs)
- 13 (57%) were postoperative;
- 18 (78%) developed seizures
- 5 (22%) died
- 1 severe neurological deficit

22

Study findings

Halberthal et al - BMJ 2001;322:780-2

- 23 patients studied
- All received hypotonic fluids
- All had plasma Na < 140 mmols/l pre-treatment
- 16 (70%) received excessive maintenance fluids

23

Our Case

- Received hypotonic fluids
- Had a preoperative Na < 140 mmols/l
- Received excessive maintenance fluids
- 25kgs = 65 mls/hr
- Patient prescribed 80 mls/hr

24

40

Study findings - conclusions

Halberthal et al BML 2001;322:780-2

- Avoid hypotonic solutions if $\text{Na} < 138 \text{ mmols/l}$
- Measurement of Na mandatory prior to IV therapy
- Hypotonic solutions only indicated if $\text{Na} > 145 \text{ mmols/l}$
- Check plasma Na if child receives more than 30mls/kg fluids

25

Measure the body weight

- Measurement should be in Kg
-
- Estimate weight using formula
 - $(\text{Age} + 4) \times 2$
 - i.e. a 2 yr old = 12kg
-
- Plot on a centile chart as a cross check

26

Maintenance fluids

- For first 10 kgs body weight give 4 mls/kg/hr
 - 40 mls/hr for a 10 kg infant
- For second 10 kgs body weight give 2mls/kg/hr
 - 40mls + 20 mls = 60mls/hr for a 20kg child
- For each subsequent kg give 1 ml/kg/hr
 - 60mls + 10 mls = 70 mls/hr for a 30kg child

24hr requirements: 100mls/kg for first 10kg
 50 mls/kg for next 10kg
 20mls/kg for each kg thereafter

27

Sodium content

- 0.18% NaCl in 4% glucose contains 30 mmols/l
- 0.45% NaCl in 2.5% glucose contains 75 mmols/l
- 0.9% NaCl contains 150 mmols/l Normal Saline
- Hartmann's contains 130 mmols/l

28

42

Recommendations

- Body weight measured or carefully estimated
- Total fluid not to exceed the maintenance
 - Once replacement has been given
- Maintenance should be at least 0.45% NaCl in 2.5% glucose
- Measurement of urine output, or serial body weight, is mandatory and should be recorded daily
- Baseline and regular measurement of blood biochemistry (Na & glucose) at least daily
- Do not use glucose containing solutions for fluid bolus or resuscitation fluids

28

A Change of Practice

Not just a change of fluid

- Regular electrolyte & Blood sugar checks
 - This means blood tests on children
 - What about "short cases" who receive fluids ?
- A review of fluid balance at 12 hrs
 - Why is this patient still requiring fluids?
- Avoidance of No. 18 solution
 - Use at least 0.45% NaCl
 - Perhaps only use 0.9% NaCl or Hartmann's ?

29

WRC 53

Department of Health, Social Services & Public Safety
An Roinn Sláinte, Seirbhísí Sóisialta agus Sábháilteachta Poiblí

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Theresa
CSWS

Medical Directors of Acute Trusts
Directors of Nursing in Acute Trusts
Consultant Paediatricians
Consultant Surgeons
Consultant Neurosurgeons
Consultant Anaesthetists/Intensivists
Consultants in Plastic Surgery/Burns
Consultants in A&E Medicine
Consultant Pathologists

25 March 2002

DIRECTOR
27 MAR 2002
OF NURSING

Dear Colleagues

PREVENTION OF HYPONATRAEMIA IN CHILDREN

Guidance on the Prevention of Hyponatraemia in Children has been published and will be forwarded to you under separate cover. It has been prepared as an A2 sized poster and I ask you to ensure that the posters are prominently displayed in all units that may accommodate children. The Guidance has been developed by a multidisciplinary working group established by the Department and the work has been supported and endorsed by CREST.

Hyponatraemia can be extremely serious and has in the past few years been responsible for two deaths among children in Northern Ireland. Hyponatraemia is a problem of water balance and most often reflects the failure to excrete water. Stress, pain and nausea are all potential stimulators of the antidiuretic hormone ADH which inhibits water excretion.

Any child receiving IV fluids or oral rehydration is potentially at risk of hyponatraemia. The administration of excess or inappropriate fluid to a sick child may result in serious or life threatening hyponatraemia. There is a particular concern about the use of 0.18% Sodium Chloride in Glucose among children as it has been implicated in cases of hyponatraemia. While it may pose a risk because of the relatively low sodium content no specific fluid is without risk. This has been emphasised in a recent letter received from the Medicines Control Agency which stated that while hyponatraemia is a risk with 0.18% Sodium Chloride, electrolyte imbalance is a risk with all intravenous solutions.

The Guidance emphasises that every child receiving intravenous fluids requires a thorough baseline assessment, that fluid requirements must be calculated accurately and fluid balance must be rigorously monitored. Following this simple advice will prevent children from developing hyponatraemia.

The Guidance is designed to provide general advice and does not specify particular fluid choices. Fluid protocols should be developed locally to complement the Guidance and provide more specific direction to junior staff. This is particularly important in subspecialty areas such as renal medicine, burns units and



84

neurosurgery. It will be important to audit compliance with the guidance and locally developed protocols and to learn from clinical experiences.

I would like to extend my thanks to all members of the multidisciplinary group who have worked together to provide clear and practical guidance to improve the care of sick children. The Guidance is also available on the Departmental website www.dhsspsni.gov.uk.

Yours sincerely



HENRIETTA CAMPBELL (Dr)

CRITICAL INCIDENT REVIEW MEETING 09/4/02

To review the Action Plan of the critical incident meeting of 12-6-2001 following the death of Rachel Ferguson.

12/6/01

- 1 Review evidence for use of routine post-operative low electrolyte IV infusion and suggest changes if evidence indicates. No change in current use of Solution 18 until review.

- * An immediate review was undertaken and a decision was taken that from all Surgical patients (including orthopaedic) to receive I V Hartmans Solution and 6 hourly BM's.

- 2 Arrange daily U&E on all post-operative children receiving IV infusion on Ward 6.

- * This was immediately actioned by Sister Miller. The phlebotomists take the blood. It is not clear who is responsible for ordering the blood. Mrs Witherow and Mrs Brown will prepare ward guidelines

Action T Brown A Witherow

- 3 Inform surgical junior staff to assess these results promptly.

- * This was immediately actioned by Mr Gilliland. All staff are informed at induction. This information should be included in the Junior Doctors handbook. At the moment blood results come up on the computer. This does not show the normal range. Agreed that all bloods are to be reported to the Surgeons routinely. Anne Witherow to speak to Dr. M O'Kane to ascertain if the normal ranges can be put on the computer.

Action A Witherow

- 4 All urinary output should be measured and recorded while IV infusion is in progress.

- * The fluid balance sheet has been revised to allow recording of urinary output and vomit.

5. A chart for IV fluid infusion rates to be displayed on Ward 6 to guide junior medical staff.
 - The chart was prepared and displayed by Dr Mc Cord by July 2001.
6. Review fluid balance documentation used on Ward 6.
 - The fluid balance sheet has been revised to show exact timing of IV Fluids, and when they have been discontinued. It was noted that there is a Regional Group currently reviewing this form. We will await receipt of the revised form.
7. Need to agree responsibility for the prescribing and management of fluids post operatively. Agreed that Dr. Nesbitt will discuss with Anaesthetists and agree a maximum time that postoperative fluids will be prescribed by anaesthetists.

Action Dr. Nesbitt

8. Departmental guidelines received April 2002 regarding fluid management in all children have been displayed on ward 6, theatres and A&E.

R A Fulton

R A FULTON
11-4-2002

WRC 4311

Dr G A Nesbitt
Medical director
Altnagelvin Hospital

1st May 2002

Dr Henrietta Campbell
Chief Medical Officer
Castle Buildings
Upper Newtownards Road
Belfast BT4 3SJ

Re: Hyponatraemia in Children receiving intravenous fluids

Dear Dr Campbell,

Following the death of a child in Altnagelvin Hospital, which is thought to have followed severe hyponatraemia, many steps have been taken to ensure that such an event does not occur again. We are all anxious to learn from what was a dreadful experience and to share vital information with others. Guidance issued from your Department will help in this regard and we are grateful for the recent posters on the subject.

I am interested to know if any such guidance was issued by the Department of Health following the death of a child in the Belfast Hospital for Sick Children which occurred some 5 years ago and whose death the Belfast Coroner investigated. I was unaware of this case and am somewhat at a loss to explain why.

I would be grateful if you could furnish me with any details of that particular case for I believe that questions will be asked as to why we did not learn from what appears to have been a similar event.

Yours sincerely,

G A Nesbitt Medical Director

WRC 44

Department of Health, Social Services & Public Safety
An Roinn Sláinte, Seirbhísí Sóisialta agus Sábháilteachta Poiblí

From The Chief Medical Officer:
Dr Henrietta Campbell CB

Castle Buildings
Upper Newtownards Road
Belfast BT4 3SJ

Telephone: [REDACTED]
Fax: [REDACTED]

E-Mail: henrietta.campbell@[REDACTED]

Dr G A Nesbitt
Medical Director
Altnagelvin Hospitals HSS Trust
Altnagelvin Area Hospital
Glenshane Road
LONDONDERRY
BT47 6SB

10 May 2002

Ge-A

Dear Dr Nesbitt

HYPONATRAEMIA IN CHILDREN RECEIVING INTRAVENOUS FLUIDS

Thank you for your letter of 1 May regarding guidelines for the prevention of hyponatraemia in children receiving intravenous fluids.

Your letter referred to a Coroner's case five years ago in which the cause of death of a child was reported to be due to hyponatraemia. This Department was not made aware of the case at the time either by the Royal Victoria Hospital or the Coroner. We only became aware of that particular case when we began the work of developing guidelines following the death at Altnagelvin.

I would like to thank the staff at Altnagelvin for alerting me to the need for guidelines and for all the assistance which was given to their development.

With kind regards.

Yours sincerely

Elia

HENRIETTA CAMPBELL (Dr)

Gras
WRC



INVESTOR IN PEOPLE

022-090-297

(71)

RF - PSNI

095-011-059aq

WRC 61.

ALTNAGELVIN HOSPITALS HEALTH & SOCIAL SERVICES TRUST
ALTNAGELVIN AREA HOSPITAL
PAEDIATRIC DEPARTMENT
LONDONDERRY BT47 6 SB
TELEPHONE - [REDACTED]
FAX - [REDACTED]

24 September 2001

Dr R Fulton
Medical Director
Altnagelvin Area Hospital
Londonderry

Dear Raymond

Re: Paediatric i.v. infusion rate charts

Thank you for your recent memo. In reply these charts have now been actioned and are with Sister Millar in ward 6.

Yours sincerely

B721

F B McCORD, MB, FRCP, DCH
Consultant Paediatrician

94

022-096-306

ALTNAGELVIN HOSPITAL HEALTH & SOCIAL SERVICES TRUSTMEDICAL DIRECTORS OFFICE

MEMORANDUM

To: Mrs Burnside
From: Dr R Fulton
Date: 14 November 2001
Subject: INTRAVENOUS FLUIDS IN CHILDREN

You may have received a copy of the enclosed correspondence about intravenous fluids in children together with the draft guidelines. I have told Dr Nesbitt that I think the "choice of Fluid" section is totally inadequate considering the gravity of our local experience. As Geoff says it is a "fudge" and fails to address the use of No. 18 solution.

I firmly advised Geoff to challenge this section.

DR R FULTON
MEDICAL DIRECTOR

cc Dr Nesbitt

QUESTIONS for 9.4.02

Dr Nisbett - 111 Who writes up post op. findings and how long
anesthetists

121 reply from PB to letter

Dr Gillham - What is pre-op role of anaesthetists for Ws?

- What is post-op

Mr D'Card - ~~who writes up~~ Are paediatric sites current?
Increasingly it's a surgical patients?

Mr Miller - What is your understanding of role of
Surgeons / Anaesthetists / paed & is there?

- Are U-tubes done daily? ✓

- Are Surgeons informed? ✓

- Open prescription

(66)

026-002-002