Witness Statement Ref. No. 357/2

NAME OF CHILD: CONOR MITCHELL

Name: Dr. Michael B.H. Smith

Title: Consultant Paediatrician, Craigavon Area Hospital

Present position and institution:

Consultant Paediatrician, Craigavon Area Hospital

Previous position and institution:

Aug 1981 - March 1983	Junior House Physician Craigavon Area Hospital
March 1983 - June 1983	Family Physician, Langley, B.C. Canada
July 1983 - June 1984	Family Medicine training program UBC Vancouver Canada
July 1984 - June 1989	Paediatric training program UBC and Dalhousie Universities Canada
July 1989 - June 1990	Paediatric Emergency Physician IWK-Grace Health Centre, Halifax, Canada
July 1990 - June 1991	Fellowship training in Ambulatory Pediatrics, University of Ottawa
July 1991 - August 1992	Consultant Paediatrician in Sydney, Nova Scotia Canada
Sept 1992 – Oct 1999	Assistant Professor, Department of Paediatrics, Dalhousie University and the IWK-Grace Health Centre, Halifax, Canada

Membership of Advisory Panels and Committees:

- Designated liaison paediatrician to Emergency Department (1999-present)
- Co-director Pulmonary Function laboratory and AIR centre – 1999-present
- Clinical Director of Acute Paediatrics/Neonatology (2009-2012)
- NI IV Fluid Care Pathway regional group (2005-2007)
- Lead NI Clinical Research Network for Children (2007-present)
- Study Adoption committee - UK Medicines for Children Research Network (2007-2012)
- NI Regional Allergy and Respiratory Network (2007- present)
- NI Paediatric Safety and Quality Network (2012-present)
- American Academy of Pediatrics ALTE guideline committee (2013-present)

Previous Statements, Depositions and Reports:

8 June 2004 - 087-037-168 Deposition

OFFICIAL USE:

List of previous statements, depositions and reports attached:

Ref:	Date:	

IMPORTANT INSTRUCTIONS FOR ANSWERING:

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

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

(1) Please confirm that in or about 2001 you worked with Dr. Darrell Lowry (Consultant Anaesthetist) and Dr. Peter Sharpe (Consultant Biochemist) as part of an informal group to develop guidance on the prevention and management of hyponatraemia in children.

In 2001 I met informally on two occasions with Dr Darrell Lowry to discuss the general management of IVF in children. We did not meet with Dr Peter Sharpe.

If so, please address the following matters:

(a) Identify the person who appointed you to this group or asked you to participate in it.

Dr Lowry or I were not appointed to, or asked to participate, in any group. Please see answer (c) below.

(b) Identify any other person (apart from those named above) who was appointed to this group, or who was asked to participate in it or assist it in its work.

We received some written material from Dr Bob Taylor (Consultant Paediatric Intensive Care) which we incorporated into our own guideline (see attached).
This is labelled Appendix 1- "Intravenous fluids in children".

(c) Describe in detail what you and the other members of this group were asked to do.

We were not asked to develop guidance. This initiative arose from a mutual desire to improve the use of IVFs in hospitalised children. We received some written material from Dr Bob Taylor (Consultant Paediatric Intensive Care) which we incorporated into our own guideline (see attached). Other material obtained was from previous training in our specialties. The purpose of this guideline was to inform the training doctors in our respective specialties of

paediatrics and anaesthetics. This was distributed to our trainees and incorporated into induction sessions.

(d) Insofar as you are aware, describe the circumstances in which it was deemed important to bring together an informal group to develop guidance on the prevention and management of hyponatraemia, or otherwise explain the reason for the decision to constitute this informal group.

We had read of instances of incorrect IVF use in hospitalised children in the UK and worldwide. We therefore sought to standardise IVF prescribing according to best practice.

(e) Describe the work which you and this group carried out, and explain how this work was carried out.

Following a review of the literature and discussions with our colleagues we collected written material and developed a guideline for use by the anaesthetic and paediatric trainees.

(f) Provide a copy of any policy, guidance, procedure, protocol, advice or any other output of this group. If you do not hold a copy of any such document, please provide a detailed description of the output of this group.

Please see attached guideline

(g) Specify the date or the approximate date when this group completed its work.

I cannot remember the exact date of completion. It was around the summer of 2001 in time for inclusion at the induction of the new doctors in August.

(h) When this group completed its work, who did it report to?

We did not report to a particular group but our colleagues were aware of this training initiative.

(2) Since completing your work as part of the informal group referred to at 1 above, have you undertaken any other work in the Craigavon Area Hospital of the following kind:

(a) The development of advice or guidance in relation to the management of hyponatraemia;

I was a member of the NI Regional IV Fluid Guideline development group chaired by Dr J MacAloon in the Antrim Area Hospital from 2005-7. This group produced the 2007 guideline which was introduced into Craigavon.
See attached DHSSPS Regional Clinical Guideline Wallchart HSC(SQS) 20/2007

I led a GAIN audit on IV fluid use in hospitalised children (with bronchiolitis and appendicitis) completed and published in 2012. This survey assessed IVF use in children with high risk conditions in all paediatric units in NI (including Craigavon) for one year. See attached GAIN publication "Intravenous fluids use in children hospitalised with Appendicitis or Bronchiolitis - a Northern Ireland audit"

(b) The production of protocols or procedures in relation to the management of intravenous fluids;

I was a member of the NI Regional IV fluid guideline development group chaired by Dr J MacAloon in the Antrim Area Hospital from 2005-7. This group produced the 2007 guideline. see attached

(c) The provision of education, training or induction to nursing staff, medical staff or trainees in relation to issues surrounding hyponatraemia and fluid management;

I have provided educational sessions on IVF management to paediatric trainees and nurses from 2005 to the present.

(d) The conduct of audits in relation to compliance with guidance or protocols applicable to fluid management and the management of hyponatraemia.

I participated on behalf of Craigavon hospital in a regional audit of IVF in children in May 2003 which was published in a medical journal (Ulster Med J 2005;74:93-7 See attached

If you have undertaken any work of the kind described above, please address the following matters:

(i) Describe the work you carried out; Please see responses above 2 (a)-(d)

(ii) Identify any other person you worked with in carrying out this work; Please see responses above 2 (a)-(d)

(iii) Identify the person who asked you to carry out the work, and the person who you were asked to report to upon the completion of the work; Please see responses above 2 (a)-(d)

(iv) State the date or approximate date when the work was carried out and completed; Please see responses above 2 (a)-(d)

(v) Provide copies of any document produced in the completion of such work. If you do not hold a copy of any such document, please provide a detailed description of the document. See attached.

(3) The Chief Medical Officer published 'Guidance on the Prevention of Hyponatraemia in Children' in or about March 2002. The correspondence which explained the purpose of this Guidance was addressed to Consultant Paediatricians amongst others (Ref:007-001-001).

Please address the following matters arising out of this correspondence:

(a) Did you receive a copy of this correspondence in your capacity as Consultant Paediatrician in Craigavon Area Hospital?

Yes.

(b) The CMO's correspondence indicated that local fluid protocols should be developed to complement the Guidance. Did you formulate any such protocols or did you work with or use any such protocols? If so, identify the relevant protocol, and provide a copy of same.

At the time of the CMO correspondence, Dr Lowry and I had developed a protocol which complemented the Guidance received by providing more specific advice. (See attached)

(c) The CMO's correspondence stated that it would be important to audit compliance with the Guidance and the locally developed protocols.

(d) Did you carry out any such audit or was your work or the work of your department the subject of any such audit insofar as you are aware?

If so, provide full details of the audit which was carried out, and the results or conclusions produced by the audit. If a report of any such audit exists, please provide a copy.

I participated on behalf of Craigavon hospital in a regional audit of IVF in children in May 2003 which was published in a medical journal (Ulster Med J 2005;74:93-7)

(e) Did you take any steps whether individually or as part of a group to take this Guidance forward within Craigavon Area Hospital?

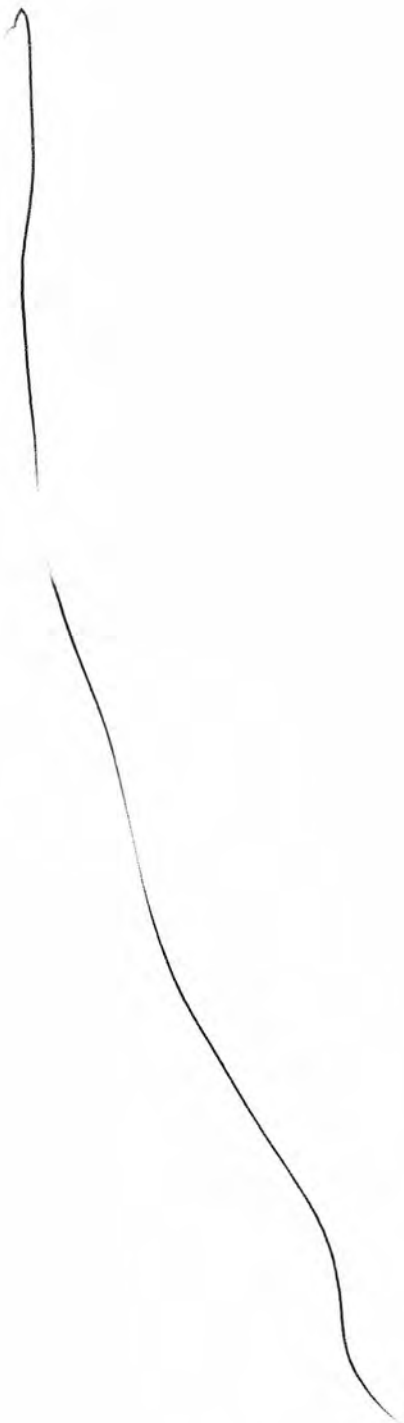
I combined this Guidance with our paediatric protocol on IVF use and trained our junior doctors at each induction in August and February each year. Posters of the Guidance were placed in the treatment rooms and resuscitation areas of the paediatric ward and children's area of the Emergency Department. I was assisted by Dr Lowry from Anaesthetics. I also provided training sessions for the anaesthetic trainees. My training sessions were reported to the Postgraduate Supervisor for the Paediatric trainees.

If so -

(i) Describe in detail all of the steps that you took in order to take the Guidance forward within Craigavon Area Hospital; Please see responses to question 3 (e) above.

(ii) Identify any other person who worked with you on this task; Please see responses to question 3 (e) above.

(iii) Identify the person who asked you to carry out this work, and the person you reported to. NA



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

Signed: M Bill Smith **Dated:** Oct 5 2013

Appendix 1

Intravenous Fluids in Children

Dilutional hyponatraemia has been documented in otherwise healthy children following routine elective surgery. It occurs in (often female) children 3-10 years of age and is associated with "stress" such as postoperatively.

A fluid for children recommended for many years as a standard is 0.18 NaCl in 4% Glucose. It contains 40 mmol/l of sodium which when administered at the calculated rate (4 mls/kg/hour for the first 10 kgs body weight) provides the daily requirement of sodium and glucose.

0.18 NaCl in 4% Glucose is **isotonic** ***in vitro*** ie has the same osmotic potential so will not cause fluid shifts within the body. However in the catabolic (sick) child the glucose is metabolised rapidly causing the fluid to become ***hypotonic*** thereby leading to massive fluid shifts. At the same time because of the loss of fluid from the circulation often combined with a degree of dehydration a potent anti-diuretic hormone (ADH) response causes the kidneys to retain water resulting in a low volume concentrated urine, high in sodium. This may be compounded by the administration of a "fluid challenge" to elicit an improved urinary output.

This is a "double whammy" excess free water is administered and excess free water is retained. Water is drawn across blood capillaries into the interstitial and intracellular spaces. The child will become "puffy" looking and of greater consequence the brain will swell with the shift of water, leading to seizures and herniation of the tentorium and death. Therefore to prevent hyponatraemia we must limit the free water component of intravenous fluids AND monitor urine output and serum chemistry.

Recommendations:

1. Regular measurement of blood biochemistry, including a baseline measurement and measurements following each intervention, eg, fluid resuscitation or surgery.

2. Maintenance fluids should be calculated separately from "replacement" fluids. The rate of maintenance fluid is critically dependent on body weight, which should be accurately measured or estimated by a professional with substantial paediatric experience.

3. DO NOT give GLUCOSE containing intravenous fluids for fluid resuscitation. This is in keeping with APLS recommendations (use 0.9% NaCl, Normal Saline or other salt solution). You MUST measure blood sugar and administer a GLUCOSE bolus if there is hypoglycaemia (< 3 mmol/L).

AVOID albumin as an immediate fluid bolus unless there are specific indications. Fresh Frozen Plasma (FFP) is indicated if there are infection or coagulopathy problems.

The usual resuscitation volume is 10-20mls/kg bolus over 15-60 minutes depending on the clinical state.

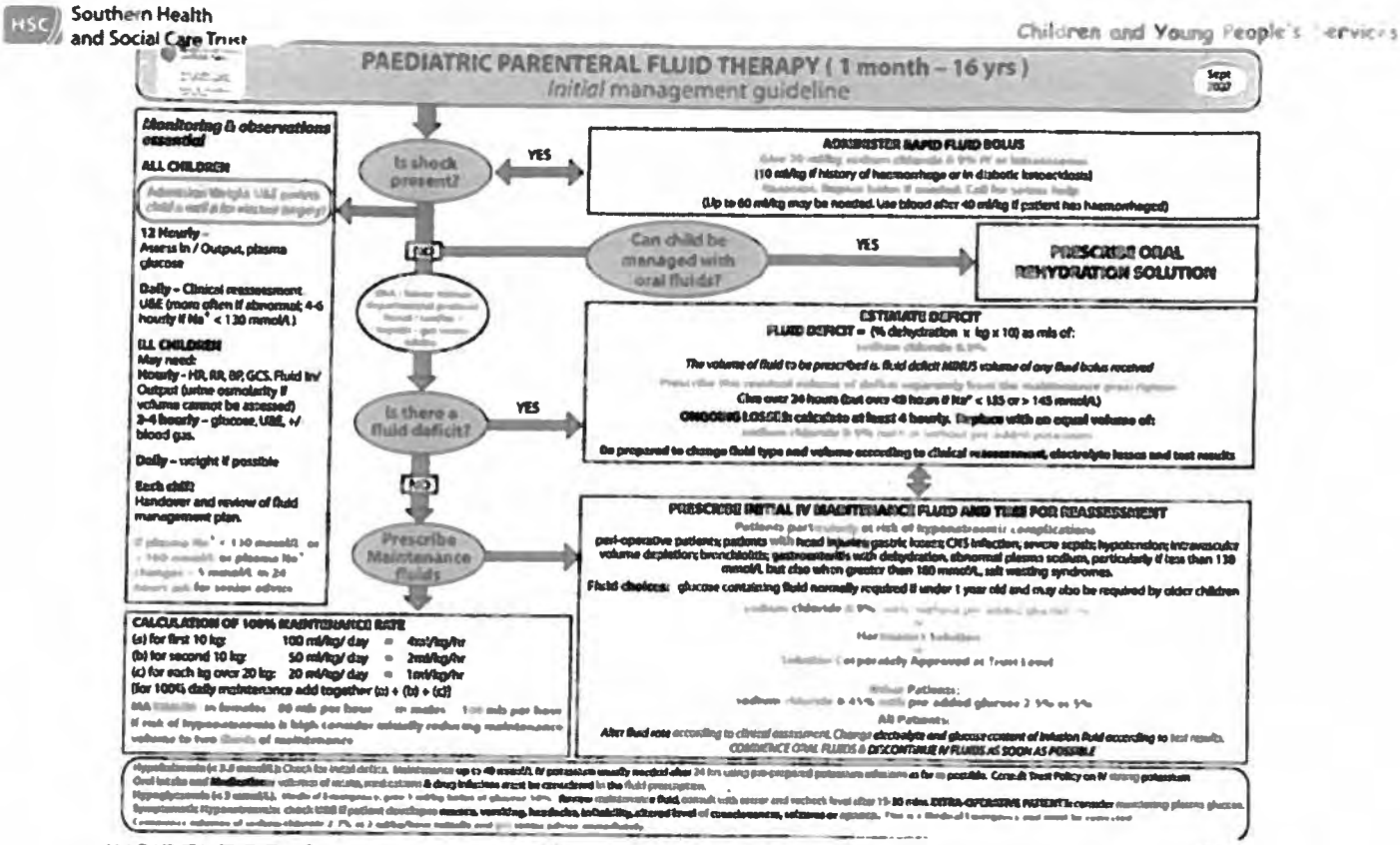
4. Maintenance fluid should contain at least 0.45%NaCl in 2.5% Glucose. A balanced salt solution such as Normal Saline or Hartmann's does not contain glucose. Regular, 12 hourly, blood sugar estimation is required and must be documented.

5. Measurement of urine output or body weight is mandatory. Daily body weight measurement will accurately assess free fluid but is not feasible in the surgical bed bound child with acute pain. Urine output must be measured and clearly documented. An experienced doctor must assess fluid balance at least twice daily and take appropriate action to correct fluid loss or retention. If urine output is problematic a urinary sodium, potassium and urea should be measured.

6. Care must be exercised when additional fluids are administered as this may seriously complicate the maintenance fluid regimen. Intravenous antibiotics, oral fluids or contrast media are commonly forgotten additional fluids.

Type of IV fluids	**Volumes**	**Type of solution**		
		<10kg and Na=140-145 mmol/L	>10kg and Na=140-145 mmol/L	All weights and Na< 140mmol/L
Maintenance Fluids in 24 hour period	**1st 10 kg (0-10) = 4 mls/kg/hr** **2nd 10 kg (11-20) =2mls/kg/hr** **Subsequent kg = 1 ml/kg/hr** i.e. for a typical 4 year old of 16kg this would translate to 52mls/hr (40mls+12mls)	0.18 NaCl solution in 4% glucose (if well) 0.45% NaCl solution in 2.5% glucose (if sick or post-op)	0.45% NaCl solution in 2.5% glucose	Ask for advice Usually Normal saline or Hartmann's
Replacement of previous losses	Replace equivalent volume lost ie correction of dehydration over 24-36 hours	Usually Normal saline or Hartmann's		
Ongoing losses	Replace equivalent volume lost at intervals	Depends on type of loss ie gastric losses replaced with Normal saline		

IV Fluid replacement = maintenance + replacement + ongoing losses



INCIDENT REPORTING REQUIREMENTS FOR HOSPITAL ACQUIRED HYPONATRAEMIA:
If sodium drops below 135 after a child is admitted to hospital an incident form must be completed immediately and forwarded to the central reporting point. If it drops below 130 the relevant risk manager must be contacted immediately to notify an SAI.

Ulster Med J 2005; **74 (2)** *93-97*

Papers

A study of current fluid prescribing practice and measures to prevent hyponatraemia in Northern Ireland's paediatric departments

Jarlath McAloon, Raj Kottyal

Accepted 30 August 2005

SUMMARY

Guidance on the prevention of hyponatraemia in children was issued by DHSSPSNI in March 2002. Two years later Dr Henrietta Campbell, the Chief Medical Officer, wrote to the Chief Executives of acute and combined trusts to seek assurances that the guideline had been incorporated into clinical practice and its implementation monitored. This paper reports the findings of the first prospective study undertaken to examine practice following introduction of the guidance. The evidence suggests that implementation has so far been incomplete and highlights problem areas. The paper reflects on potential explanations for the findings and makes practical suggestions for improvement.

INTRODUCTION

In November 2004, following the broadcast of the UTV Insight programme 'When Hospitals Kill' alleging that three children had died unnecessarily, the Minister with responsibility for Health, Social Services and Public Safety, Angela Smith announced that she had appointed Mr John O'Hara QC, to lead an inquiry into their hyponatraemia-related deaths. Examination of the care and treatment in relation to the management of fluid balance and the choice and administration of intravenous fluids will be a key component of the Inquiry in all three cases. Earlier in the same year Dr Henrietta Campbell, the Chief Medical Officer (CMO), had written to the Chief Executives of acute and combined trusts to seek assurances that the guidance issued by DHSSPSNI in 2002 on the prevention of hyponatraemia in children receiving prescribed fluids[1] had been both implemented and incorporated into clinical practice. In 2003, to promote further awareness and also to elaborate on the rationale underpinning the guideline, Jenkins and colleagues[2] in an Editorial in this journal highlighted the clinical situations where children are at greatest risk for developing elevated vasopressin levels, described associated risk factors and discussed how the choice of prescribed fluids can contribute to dilutional hyponatraemia. Specifically the guideline recommends 0.9% saline as an appropriate crystalloid for resuscitation; directs that the anticipated Na^+, K^+ and glucose requirements, for which age is an essential factor, should determine the type of maintenance fluid and proposes that for most replacement scenarios fluid with minimum sodium content 130mmol/l should be used. Also incorporated is advice on patient assessment that includes checking the weight of the child; advice on how to calculate fluid requirements and details of the clinical and biochemical monitoring required while in receipt of IV fluids.

In response to the CMO's request for assurance that the guidance had been implemented the prospective

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study described in this paper, the first to examine guideline adherence in local paediatric units, was undertaken to examine practice and to identify any component(s) presenting implementation difficulty and if present to in turn reflect on possible practical solutions.

METHODS

All eight acute paediatric inpatient units in Northern Ireland were invited by one of the authors (JMA), through a lead clinician, to participate in a simultaneous snapshot of paediatric practice around the Province and readily accepted. It was proposed that the management of all patients in receipt of intravenous (IV) fluids between 12.00 and 14.00hrs on the same day in May 2003, and who had also been in receipt of IV fluids in the previous twenty-four hours, would be assessed for compliance with the guidance. This time window was chosen in the expectation that a morning ward round would normally by then have been conducted, thus providing a pragmatic method of targeting a high risk group requiring ongoing therapy post baseline assessment and for whom there would have been adequate opportunity for management plans, monitoring and associated decision making to have been put in place. Neonates and intensive care patients, whose management is different, were excluded. The lead clinicians were asked to inform the relevant Clinical Director(s) that the study was being planned; asked to identify a medical assistant for local data collection and to ensure that the date was kept confidential in order to avoid a positive influence on clinician behaviour. To facilitate maximum participation coordinators were reminded of the study date in the preceding week. The same single page data collection form, previously piloted and refined by a paediatric SHO (RK) during two one week trial periods at Antrim Hospital, was used in each contributing unit. Details of diagnosis, presence of dehydration, weight recording, fluid prescription and clinical and biochemical monitoring were transcribed from the case notes, fluid prescription and fluid balance sheets.

Details of the specific elements involved in monitoring, such as records of urinary output and vomiting were, for practical reasons, not included. Instead it was assumed that a documented record of any reassessment of requirements indicated that assessment of all the key components had occurred.

Consistency of data interpretation for the purpose of comparing actual management with expected guideline management was facilitated by having the same experienced clinician (JMA) analyse the returned data forms and cross reference the diagnosis and assessment of fluid balance status against the record of prescription for each individual patient. Also, when the adequacy of data return permitted all calculations of fluid volumes prescribed were recalculated by JMA. To facilitate collation of information a prescription for maintenance fluids was judged to be inconsistent with the guideline if the volume prescribed was greater than +/- 5% and inappropriate if greater than +/- 10% of the guideline calculation. The rationale for this percentage limit is that in terms of degrees of dehydration a larger variation could correspond to incorrect management e.g. treating a moderately dehydrated patient for mild dehydration or vice versa.

As the recruitable numbers able to satisfy the strict inclusion criteria were small an identical exercise was repeated on two further days, one in June 2003 and one in January 2004.

RESULTS

There were thirty-eight eligible children for whom forms with complete/near complete data were returned. All units contributed at least one patient. Twenty-six children had a medical diagnosis and twelve had a surgical problem, eight of whom were in the post operative period. Four children had conditions for which not all elements of the guidance were relevant (see sections b, e). The grades of staff prescribing the fluids were PRHO (4); first term SHO (19); second term SHO (5); SpR (5); SAS (1); consultant (3) with one unknown. The results for adherence to each key component of the guideline are described below with the main findings summarised in table 1.

a. Was the child's weight recorded?

   Data were returned for thirty-five children. Weight was measured in 33 cases and estimated in 2.

b. Was the calculation for maintenance IV fluid volume consistent with the guidance?

   Of the thirty-seven children with this data returned there were two children receiving fluid treatment in association with chemotherapy and one with a diagnosis of benign intracranial hypertension in whom an alternative protocol was being followed and for whom the guideline maintenance calculation was not applicable. Eighty-two percent of relevant calculations

TABLE I

Guideline adherence question	*Total*	*yes*	*no*
b. was maintenance calculation consistent with guidance?	34	28	6
c. was IV fluid composition appropriate?	35	35	0
d. were maintenance & replacement prescribed separately	7	2	5
e. was fluid balance assessed at least 12 hourly?	33	15	18
f. was U&E checked at least once per 24 hours?	34	30	4
g. was oral intake considered in IV prescription?	23	12	11

Adherence to DHSSPSNI guidance[1] on prescribed fluids and hyponatraemia

were consistent with the guidance. There were three calculations judged guideline inconsistent and three others judged inappropriate.

c. Was the composition of IV fluids used appropriate?

Data were returned for thirty children who had received either maintenance fluids alone or both resuscitation and maintenance fluids plus five other children who also had a prescription for replacement and/or ongoing losses. The electrolyte and glucose content of the fluid utilised was suitable in all thirty-five cases.

d. Were maintenance and replacement fluids prescribed separately?

The return for this question provided information on a further two children i.e. a total of seven, who had both maintenance and replacement losses prescribed. Two of the seven had replacement prescribed separately but five did not.

e. Was fluid balance assessed at least every twelve hours?

Of thirty-seven data returns the guidance was considered applicable only to thirty-three as three were following an alternative fluid regimen and one was terminally ill. Forty-five percent had documented evidence of reassessment of requirements in the first twelve hours of treatment. Sixty-six percent had reassessment within the first twenty-four hours. Thirty-three percent had no record of reassessment.

f. Was U&E checked at least once per twenty-fours?

There were thirty-four data returns for whom the guidance was applicable. Twelve percent had not had a U&E checked any time in the preceding 24 hours. There were no children with severe hyponatraemia (Na+ <130mmol/l) though nine children had a Na+ <135mmol/l at some point.

g. Was the oral fluid intake considered in the most recent IV fluid prescription?

Allowance for oral intake occurred in only fifty-two percent of the twenty-three children for whom the guidance was relevant.

h. What oral fluids were used during this period?

Information was provided for seventeen of the twenty-three treated with both oral and IV fluids and is summarised in table 2.

Table II

Fluid type	*n*
Water	2
water and juice	4
water and soup	1
Juice	2
juice and milk	1
Milk	5
rehydration solution	2

Types of oral fluid administered concurrently with IV fluids

DISCUSSION

While the number of children in the study was inevitably small the information obtained should be a valid reflection of clinical practice following issue of the guidance and it is consequently important. As the study period included three induction periods for new/ changing medical staff it is reasonable to conclude that there was sufficient opportunity for the guideline to be both fully disseminated and introduced. Also the patients reported were those with the highest risk of fluid therapy associated complications for whom greatest awareness and attention to the application of the management guidelines would be expected.

The standard for weight, namely that it should always be measured or estimated in a bed bound child, was met. However this may not necessarily reflect guideline conscious behaviour as recording of weight has become part of normal paediatric practice regardless of diagnosis.

The standard achievement rate (82%) for maintenance fluid calculation was also high but with some evidence of the co-existence of potentially significant variation from advised practice. Jenkins and colleagues[2] acknowledge that guidance on maintenance fluid requirements is general guidance and emphasise that assessment should be individualised. We allowed for this in our evaluation by accepting a total calculated volume within +/- 5% of the guideline value as meeting the standard. Of the six children whose calculation was outside the guideline there were three whose prescriptions were classified as inappropriate, two being underestimates and the third an overestimate. The two underestimates were in a fifteen year old (-17%) on day 1 post appendicectomy with a first term SHO as prescriber and in a thirteen year old (-19%) with urinary infection and prescriber not indicated. The overestimated child was a six year old (+27%) admitted with vomiting and constipation but no dehydration and for whom the prescriber was a first term SHO. The management of his child is of concern though close monitoring did take place with the U&E checked on four occasions and the lowest Na+ recorded was 134mmol/l.

While there was full compliance in implementing the standard for appropriate fluid choice problems were encountered at the next step, namely recording the prescription. A separate prescription for maintenance and replacement fluids is recommended to reduce the potential risk of excess fluid administration resulting from a combined prescription inadvertently over running the deficit correction period. Separation of the prescriptions did not occur in seventy percent of relevant situations. While this may reflect lack of clinical awareness, another factor may be lack of user friendliness of available prescription sheets.

Monitoring of hydration status and fluid balance is essential. The guideline specifies that reassessment should occur at least twelve hourly but this was only recorded in the minority of cases. It is unlikely that this finding is attributable more to poor record keeping than lack of reassessment as there were four children identified who had no U&E checked during twenty-four hours of IV therapy, three of whom had actually been on full maintenance. These three included two post-operative, hence relatively high risk, patients aged 6 weeks and 11 years and a 8 year old with septic arthritis. The rigour of some assessments is also of concern as, contrary to advice, no consideration had been allowed for the oral intake in fifty percent of relevant prescriptions.

The guidance mentions hyponatraemic risk in association with use of inappropriate oral fluids but there were only two children whose oral fluid was a commercial rehydration solution (*Table 1*). The prevalent use of hypotonic solutions in this high risk group suggests that common practice needs to be reviewed.

In summary the evidence is that implementation of the Regional guidance has so far been incomplete. This could indicate that there is inadequate guideline awareness due to failure of training programmes and/ or failure of units to provide direction to junior staff. An alternative explanation is that there may be intrinsic operational hindrances to implementing the guideline. If not done already, units should organise a review by nursing, pharmacy and medical staff, both junior and senior, to identify the difficulties and possible solutions. Relevant issues for discussion and action could include: the redesign of prescription sheets to facilitate separation of prescriptions when only one IV infusion/line is present; the facility to indicate required infusion finish times; the provision of action boxes on fluid balance sheets to trigger clinical and biochemical reassessments; appending for reference a simplified maintenance fluid calculation formula on the back of prescription sheets; outlining clinical descriptions for assessment of hydration status on the back of fluid balance forms; provision of oral fluid management information and advice for carers and the introduction of a method for effective nursing and medical handover of management plans for all children receiving IV fluids. Redrafted or new documentation could be

standardised in all trusts and a consensus should be developed on the appropriate use of hypotonic oral fluids with the original guideline Working Group providing a strategic overview.

To conclude, it is probable that the current guidelines will be modified in conjunction with the developing evidence base on appropriate fluid therapy in situations where physiology is not normal, such as illness or postoperatively. Internationally best practice is still controversial[3,4] and preparation of definitive protocols is not yet possible, unlike hyperkalaemia where a consensus is now being reached.[5] Until then it is essential that all clinicians in Northern Ireland caring for children in receipt of fluid therapy know of the associated risks and are aware of our Regional best practice guidance and that paediatric departments initiate a process of regular monitoring of guidance adherence as part of their multidisciplinary audit and clinical governance programme.

The Authors have no conflict of interest.

ACKNOWLEDGEMENTS

The willing collaboration of Mr A Bailie, Drs A Bell, C Corkey, N Corrigan, J O'Donohoe, M Rollins, M Smith in arranging the data collection is acknowledged. Thanks to Dr J Jenkins for reviewing the paper and his helpful suggestions for improvement.

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3. Duke T, Molyneux E. Intravenous fluids for seriously ill children: time to reconsider. *Lancet* 2003; **362(9392):** 1320-23.
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Intravenous fluid use in children hospitalised with Appendicitis or Bronchiolitis – a Northern Ireland Audit

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Tables & Charts

Background

Intravenous (IV) fluids may be prescribed for children admitted to hospital. The type of fluid and rates for administration for different ages were initially devised in the late 1950s and rapidly adopted by major textbooks and used widely in paediatric practice. With the increasing sophistication and reliability of micro-infusion pumps, the use of IV fluids has increased. International studies have shown that over the past two decades there have been a number of deaths and cases of significant neurological damage due to hospital acquired hyponatraemia in children receiving hypotonic intravenous fluid[1-3]. As a result there has been a significant shift in the type of intravenous fluid used and the level of monitoring of children hospitalised with this treatment[4-8].

In 2007 the National Patient Safety Agency (NPSA) issued an alert in order to reduce the risk of hyponatraemia when using intravenous infusions in children[9]. In the same year, the Northern Ireland Regional Paediatric Fluid Working group produced specific, local guidance which was in accordance with NPSA advice.[10] (Appendix A). Implementation of this regional intravenous fluid guideline for children and young people in hospital required a significant guidance from the previous 30 years. It was therefore important to assess the effects of this change in practice to see whether there had been universal uptake and/or important clinical outcomes, including potential unanticipated adverse effects. Moreover, practice in this area had a weak evidence base, despite its potential impact on patient safety. A regional audit therefore was required to fill the evidence gap and where deficiencies were identified, bring about widespread change in all stakeholders and thus improve the safety of this vulnerable population. In addition, implementation and monitoring of NPSA alerts forms an integral part of the patient safety initiative, which was endorsed by DHSSPS.

Appropriate use of the recommended IV fluids and regular monitoring according to the guideline should reduce the likelihood of electrolyte imbalances, and most importantly should reduce the likelihood of hyponatraemia. The purpose of this audit was to ascertain the level of adherence to the guideline (appropriate use of isotonic IV fluids in hospitalised children and young people), increase awareness of any problems and document, where applicable, adverse effects (either from inappropriate use of certain IV fluids or use of appropriate fluids).

Objectives

To measure compliance with DHSSPS guideline on Paediatric Parenteral Fluid Therapy (September 2007) and NPSA Patient safety alert 22 through:

1. Documentation of IV fluids and laboratory monitoring in two key conditions in hospitalised children and young people at high risk for hyponatraemia (not resuscitation) – Appendicitis and Bronchiolitis (including ages greater than one month up until 15 years and 364 days)
2. Documentation of any adverse clinical outcomes (clinical deterioration or electrolyte abnormality) in any patient associated with:
    a. Correct use of guideline directed IV fluids
    b. Incorrect use of guideline directed IV fluids
3. To provide essential data required for subsequent review/revision of the new regional guideline.

Methodology

An audit assessment form (Appendix B) was developed to assess the charts of children admitted for either of the index conditions (Appendicitis or Bronchiolitis). These two conditions were chosen as they have a high incidence of associated hyponatraemia and were commonly admitted to hospital[11]. Patients from general paediatric and surgical wards were assessed only and specialty units were excluded. Using only two diagnostic groups with a predictable course reduced the variation in IV fluids care and blood sodium abnormalities associated with other disease states.

It was assumed that not all patients admitted with these conditions will have received IV fluids. However, all charts were reviewed to ensure that all relevant patients were included. The audit form was developed to incorporate, as far as possible, outcomes considered important to users. A pilot audit in one hospital was undertaken to assess the sensitivity and validity of the assessment tool. The project team assessed the results and modified the form according to suggestions.

The audit tool was based on the requirements of the new guideline and listed:

1. Anonymous patient demographic data (age, sex, co-existing medical conditions, postal code), hospital site and diagnosis
2. Presentation time and date and whether patient received IV fluids
3. If received IV fluids, was there a measured patient weight
4. Type of IV fluids administered and total duration of all fluids.

5. Blood testing (including urea, sodium, potassium, chloride, and bicarbonate) if done with time and date up to a total of 5 days
6. IV fluids assessment, input measurement and output measurement on first and last day of intravenous treatment
7. Whether readmitted within 7 days of discharge.

Work plan

1. The data collection form was piloted and validated by the Multidisciplinary Project Group during July 2009.
2. To ensure standardisation of data collection, workshop/awareness sessions for staff in all five Trusts were completed between October and December 2009, this included the development of a frequently asked questions hand-out to address issues highlighted by audit staff within the individual Trusts (Appendix C).
3. Records for children aged greater than one month up until 15 years and 364 days admitted with the index conditions for the most recent 12-month period were reviewed. The time period chosen was 01 January to 31 December 2008 as this contained the most complete up to date records after the audit was commissioned.
4. All paediatric and medical in-patient units that care for these patients in NI were reviewed. This included the following units: Altnagelvin, Craigavon, Antrim, Causeway, Whiteabbey, Mater, Ulster, Daisy Hill, Erne, Belfast City, Royal Victoria and the Royal Belfast Hospital for sick children.
5. Data were collected between January 2010 and May 2010.
6. All data were entered using Microsoft Excel database.
7. Following full data collection, the analysis assessed frequencies of IV fluids use, laboratory monitoring and clinical outcomes.
8. Variances were analysed and assessed for targeted interventions.

Results

All children were audited with a diagnosis of Appendicitis or Bronchiolitis who were an age greater than one month up until 15 years and 364 days, in hospitals with a paediatric inpatient unit in Northern Ireland during the calendar year 2008. The total number of charts reviewed was 1236, 470 had Appendicitis and 766 had Bronchiolitis. Of all charts reviewed 578 (47%) received IV fluids.

Table 1 - Sample characteristics

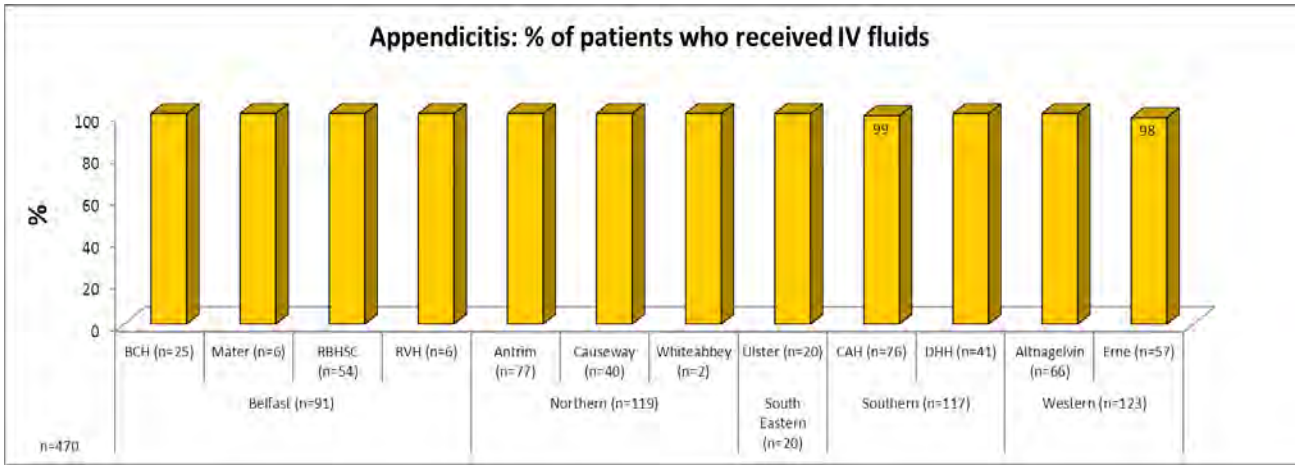
Clinical group	Appendicitis	Bronchiolitis
Total number	**N = 578**	
Number who received IV fluids (%)	468 (81%)	110 (19%)
Median age	12 years	3 months
Male Female	282 (60%) 186 (40%)	48 (44%) 62 (56%)
Length of stay in hospital (range)	1-22 days	0-22 days

These results reflect the known average age and sex of children affected by the two index conditions.

Appendicitis Group

Of the 470 children who were admitted with Appendicitis, 468 (99.6%) received fluids at some point in their hospitalisation. The breakdown of children on IV fluids by Trust is shown in Chart 1 below:

Chart 1 – Appendicitis % of Patients who Received IV fluids



Virtually all patients admitted with Appendicitis are prescribed IV fluids.

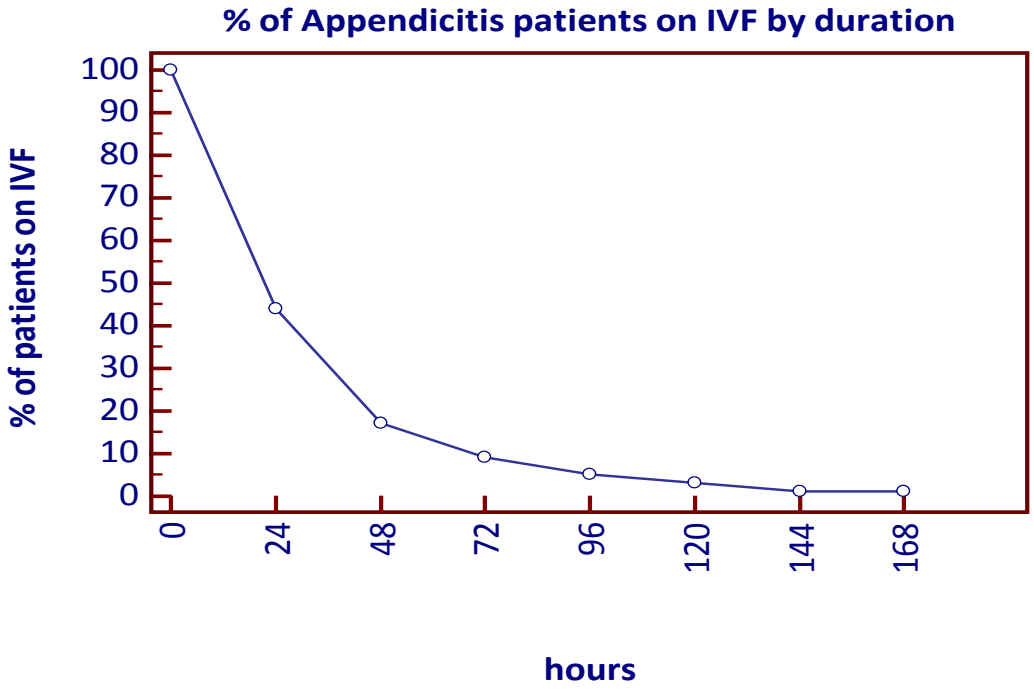
Table 2 - Duration of IV fluids (Appendicitis)

Please note this is only applicable to 429 patients with Appendicitis as 39 cases were unable to calculate a date or time.

Children spend a variable amount of time on fluids and the table below illustrates the range of time children are on fluids.

Hours on IV Fluids	Day	Initial number of patients on IV Fluids in this time band n=	Initial % on IV Fluids in this time band	Actual number of patients who stop IV Fluids in this time band
0-24	0	429	100	242
24-48	1	187	44	115
48-72	2	72	17	35
72-96	3	37	9	16
96-120	4	21	5	6
120-144	5	15	3	9
144-168	6	6	1	2
>168	7	4	1	4

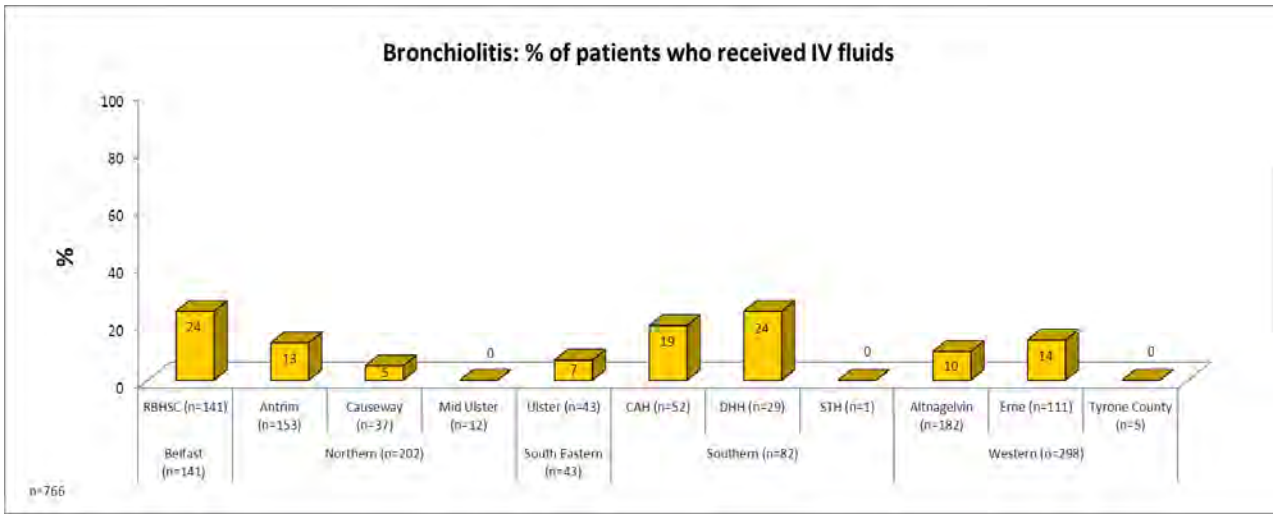
Chart 2 - % of Appendicitis Patients on IV Fluids by Duration



Bronchiolitis Group

Of the 766 children who were admitted with Bronchiolitis, 110 (14%) received IV fluids at some point in their hospitalisation. The breakdown of children on IV fluids by Trust as shown in Chart 3 below:

Chart 3 – Bronchiolitis: % of patients who received IV fluids



Whiteabbey, Mater and Belfast City hospitals had no patients with Bronchiolitis. For all other Trusts who were treating patients with bronchiolitis between 0 – 24% received IV Fluids. This reflects the case mix for each hospital, the clinical severity of the admitted patient and hospital policy for IV fluid prescribing.

Table 3 - Duration of IV fluids (Bronchiolitis)

Please note this is applicable to 97 patients with Bronchiolitis as in 13 cases we were unable to calculate a date or time.

Children spend a variable amount of time on fluids and the table below illustrates the range of time children are on fluids.

Hours on IV fluids	Day	Initial number of patients on IV fluids in this time band n=	Initial % on IV fluids in this time band	Actual number of patients who stop IV fluids in this time band
0-24	0	97	100	46
24-48	1	51	53	21
48-72	2	30	31	12
72-96	3	18	19	6
96-120	4	12	12	7
120-144	5	5	5	1
144->168	6	4	4	0
>168	7	4	4	4

Chart 4 - % of Bronchiolitis patients on IV fluids by duration

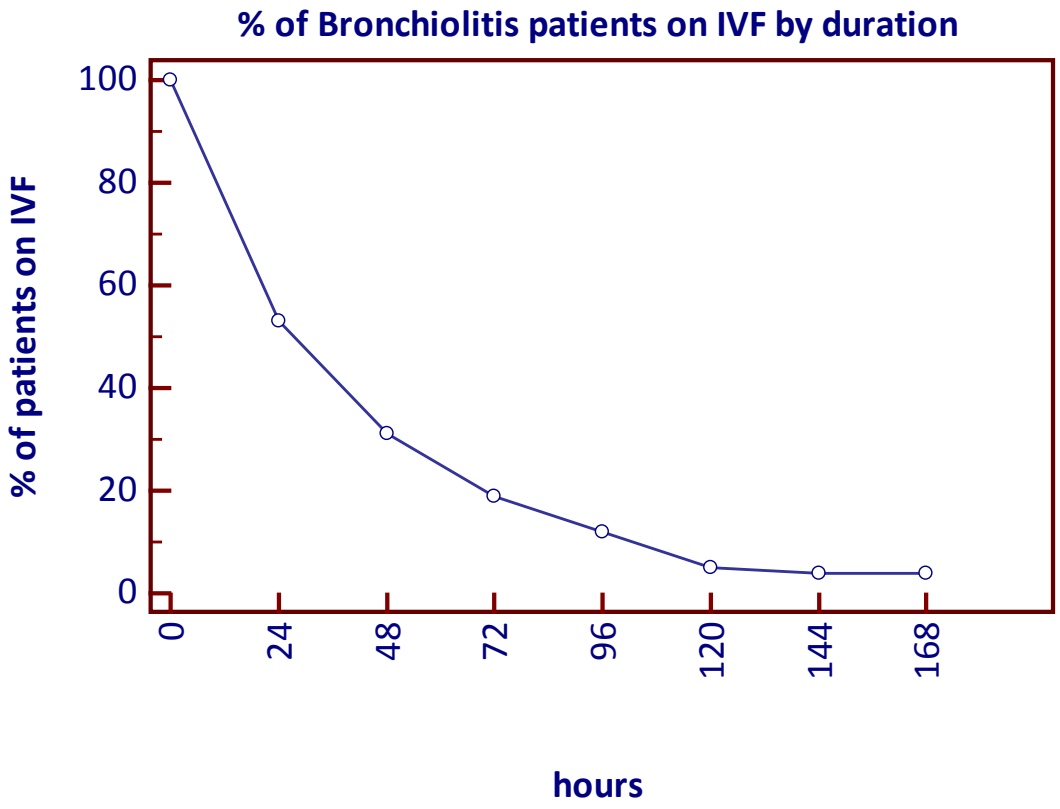


Table 4 - Characteristics of IV Fluids Prescribed

The NPSA guideline states that children at high risk of hyponatraemia (including peri/post-operative patients, Bronchiolitis) should *only* receive isotonic fluids such as sodium chloride 0.9% with glucose 5%, sodium chloride 0.9% and compound sodium lactate solution (Hartmann's solution/Ringer-Lactate solution)[9]. Therefore, all patients who were given non-isotonic solutions at any time during their admission were classified as inappropriate prescriptions.

Clinical group	Appendicitis	Bronchiolitis
Total number of IV fluids prescribed	**N = 578**	
Total number of IV fluids prescribed (%) by diagnosis	468 (81%)	110 (19%)
Total number of appropriate IV fluids prescribed (%)	397 (85%)	68 (62%)
Total number of inappropriate IV fluids prescribed at any time during their admission (%)	71 (15%)	42 (38%)

It is recognized that in some clinical circumstances, non-isotonic fluids may be appropriate but the limitations of data set precluded further assessment of this management. However, no patients who received inappropriate IV fluid prescriptions developed hyponatraemia.

Calculation of IV Fluids

Intravenous fluid prescribing is based on the clinical condition and calculated according to the weight of the child. Clinicians are required to note the reasons for prescribing the IV fluid as well as rate of infusion and time until the next assessment [9]. The following tables describe the frequencies of weight recorded.

Table 5 - Appendicitis – Is there evidence that the patient had a weight recorded?

Weight Recorded	(N=468)
Yes	429 (92%)
No	39 (8%)

Table 6 - Bronchiolitis – Is there evidence that the patient had a weight recorded?

Weight Recorded	(N=110)
Yes	107 (97%)
No	3 (3%)

Monitoring Outcomes

Following the initial prescription of the correct IV FLUIDS, all fluids need to be assessed regularly[9]. The IV fluid assessment was taken as documented evidence of the doctor's awareness of the on-going IV fluids at the time of review. This assessment is therefore a written judgement on the fluid balance from the above information and an action plan for the next time period. The following tables demonstrate the record of IV fluid assessment, inputs and outputs. The first and last days refer to the days on which IV fluids were commenced and discontinued (not the length of stay).

IV fluids, Input and Output Monitoring

Appendicitis (N=468)

Table 7 – IV Fluids Assessed

Day	IV fluids Assessed
First Day	440 (94%)
Last Day	437 (93%)

Table 8 – Input & Output Monitoring

	Input Totalled	Output Totalled
First Day	373 (80%)	122 (26%)
Last Day	338 (72%)	98 (21%)

Bronchiolitis (N=110)

Table 9 – IV fluids Assessed

Day	IV fluids Assessed
First Day	107 (97%)
Last Day	106 (96%)

Table 10 - Input & Output Monitoring

	Input Totalled	Output Totalled
First Day	95 (86%)	20 (18%)
Last Day	97 (88%)	18 (16%)

Blood testing

Plasma sodium, potassium, urea and/or creatinine should be measured on admission and at least once a day according to the regional paediatric parenteral fluid therapy guideline. In practical terms, this is accomplished initially when the intravenous cannula is sited and within the next 24 hours. More frequent measurements should be performed every four to six hours if an abnormal reading is found.

Routine blood testing

In order to assess this standard, a ratio was calculated using the number of blood tests divided by the duration of IV FLUIDS period. This provided an approximate estimate of the blood monitoring frequency in the average patient in each group. For example, for a patient that had 3 blood tests and had IV FLUIDS for a total of 68 hours (2.83 days) would have a ratio of 3/2.83 = 1.06 tests per 24 hours. An arbitrary minimal standard was set at 0.75 to reflect the realities of clinical blood testing. For example, if a patient had one blood test (with a normal result) and IV FLUIDS for a total of 32 hours (ratio = 0.75), this would be considered acceptable clinical practice.

It is understood that this ratio would underrepresent the sickest patients, given the need for multiple testing in a shorter time period. Also, as the audit only assessed up to 5 days of blood testing, it naturally excluded the sick long stay patient. The intention of this audit was to assess the basic standard of care for the average patient.

Appendicitis

Complete IV FLUIDS time data were available for 381 of the Appendicitis patients. Of this group, 359 (94%) patients had a blood testing ratio equal or greater than 0.75.

Bronchiolitis

Complete IV FLUIDS time data were available for 88 of the Bronchiolitis patients. Of this group, 82 (93%). patients had a blood testing ratio equal or greater than 0.75

Abnormal blood results

Appendicitis

For patients with Appendicitis, 29 (6%) had an initial low blood sodium (Na) result. For the patients with mild hyponatraemia (Na 131-134; n= 27), all but two had at least one additional blood tests with the final result in the normal range. Two however, had no further testing (initial Na: 132, 133). No clinical effects were noted. There were two patients with severe hyponatraemia (Na ≤ 130). One at 130 had two further tests and the result returned in the normal range. The other patient had an initial Na at 127 and required four further tests before the Na was in the normal range. This patient had a satisfactory clinical outcome.

For the 70 (15%) patients who received non-isotonic fluids, none developed hyponatraemia.

Bronchiolitis

For patients with Bronchiolitis, 8 (7%) had an initially abnormal blood Na result. Six patients had mild hyponatraemia (Na 131-134). Five of these patients had no further testing and one had one further test. Two patients had severe hyponatraemia (Na ≤ 130) and had at least three further tests until the Na returned to the normal range. Both patients recovered normally. No patients developed hyponatraemia after the initial test.

For the 42 (38%) patients who received non-isotonic fluids, none developed hyponatraemia. Only one individual had a low Na on the second sample but this had improved from his initial result.

Re-admission within 7 days of discharge

There were 27 (5%) patients re-admitted within 7 days of discharge. For patients with Appendicitis 24 (5%) were re-admitted within 7 days and for patients with Bronchiolitis 3 (3%) were re-admitted within 7 days of discharge.

Summary findings

Characteristics of the sample

There was a wide variation in the percentage of patients who received IV fluids for Bronchiolitis depending on the hospital. Part of this may be explained by differing case mix and severity.

Overall, only 14% of Bronchiolitis patients were prescribed IV fluids. Anecdotal experience would suggest that this number is dropping further with the more accepted use of nasogastric tube feeding as a method of hydration.

IV fluids Prescribed

Overall, 19% (15% of Appendicitis, 38% of Bronchiolitis) patients received hypotonic IV fluids (usually 0.45% N Saline/Glucose) at some point in the hospitalization. The clinical circumstances of the patients were not recorded which may limit the interpretation of this finding.

IV fluid Monitoring

1. Weights were recorded on 92% of the Appendicitis and 97% of the Bronchiolitis patients.

2. Assessment of IV fluids in the patient's chart was noted in 94% of Appendicitis charts on day 1 dropping to 93% on the last day of admission. Assessment of IV fluids in the patient's chart was noted in 97% of Bronchiolitis charts on day 1 dropping slightly to 96% on the last day of admission.

3. Daily IV fluid input was measured for 80% of the Appendicitis patients on day 1 dropping to 72% on the last day of fluid therapy. Daily IV fluid input was measured for 86% of the Bronchiolitis patients on day 1 to 88% on the last day of fluid therapy.

4. Daily output was measured in 26% of the Appendicitis patients on day 1 and in 21% on the last day of fluid therapy. Daily output was measured in 18% of the Bronchiolitis on day 1 and this dropped to 16% on the last day of fluid therapy. The assessment of urine output in ill children can be especially difficult and often there was only a record that the patient had passed urine but without the exact volume.

Blood Testing

1. Serum Na was measured by the accepted frequency in 94% of Appendicitis patients
2. Serum Na was measured by the accepted frequency in 93% of Bronchiolitis patients
3. 27 (6%) of Appendicitis patients had a mild hyponatraemia. The majority (25) of these patients had further testing with subsequent normal results. 2 patients had no subsequent testing with no clinical effects noted. 2 additional patients had severe hyponatraemia and had further blood testing until results returned to normal range.
4. 8 (7%) of Bronchiolitis patients had a serum Na outside the normal range. 2 patients had severe hyponatraemia and had further blood testing until results returned to normal range. 5 out of 6 patients with mild hyponatraemia had no further testing.

Table 11 - Standards table (based on the regional Paediatric fluid guideline)

	Standard Evidence of/that:	Compliance - Expected	Compliance - Actual	
			Appendicitis	Bronchiolitis
1	Documentation re evidence that the patient had a weight recorded	100%	92%	97%
2	Appropriate IV fluids administered	100%	85%	62%
3	Documentation re IV fluid assessment at (12/24 hrs) after commencement	100%	94%	97%
4	Inputs were totalled and recorded on 1st day of IV fluids	100%	80%	86%
5	Outputs were recorded on 1st day of IV fluids	100%	26%	18%
6	Inputs were totalled and recorded on last day of IV fluids	100%	72%	88%
7	Outputs were recorded on last day of IV fluids	100%	21%	16%
8	Documentation re IV fluid assessment on last day of IV fluids	100%	93%	96%
9	Daily blood testing (within acceptable range) while on IV fluids	100%	94%	93%

Summary

1. Further improvement is needed in all areas of IV fluids use in children
2. A detailed quality improvement program involving all levels of medical and nursing staff needs to address the barriers to 100% compliance in IV fluids standards
3. Strategies for improved performance need to be developed to enhance input and output recording, IV fluids calculation, blood testing and documentation
4. Further administrative barriers (such as restricting access to hypotonic IV fluids) could be developed to reduce incorrect IV fluid selection
5. Continuous auditing of various target groups with rapid feedback will aid in performance improvement
6. All of the above needs review and suggestions from the regional multidisciplinary group

Action Plan

1. A Paediatric IV fluid sheet should be developed for use in all hospital facilities that care for children:
    a. The IV fluid sheet should include space for weight, detailed calculation of fluids as well as input and output monitoring
    b. The IV fluid sheet should have space for blood results according to agreed time and frequency prescribed
    c. The IV fluid sheet should be considered to be similar to medication prescription and nursing staff should not commence IV fluid until all calculations and information are present
    d. The IV fluid sheet will have a separate area for emergency resuscitation
2. Once developed, the IV fluid sheet and educational package should be rolled out to all relevant hospital trusts including all medical and nursing staff that care for these children
3. After a suitable time period (ie one year) a random sample audit should be completed in each trust to ensure adherence to the guideline and IV fluid sheet

[GAIN Addendum: It is worthy of note that since the completion of this report that the above IV fluid sheet has been developed and is soon to be introduced].

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Regional Paediatric Fluid Audit Group

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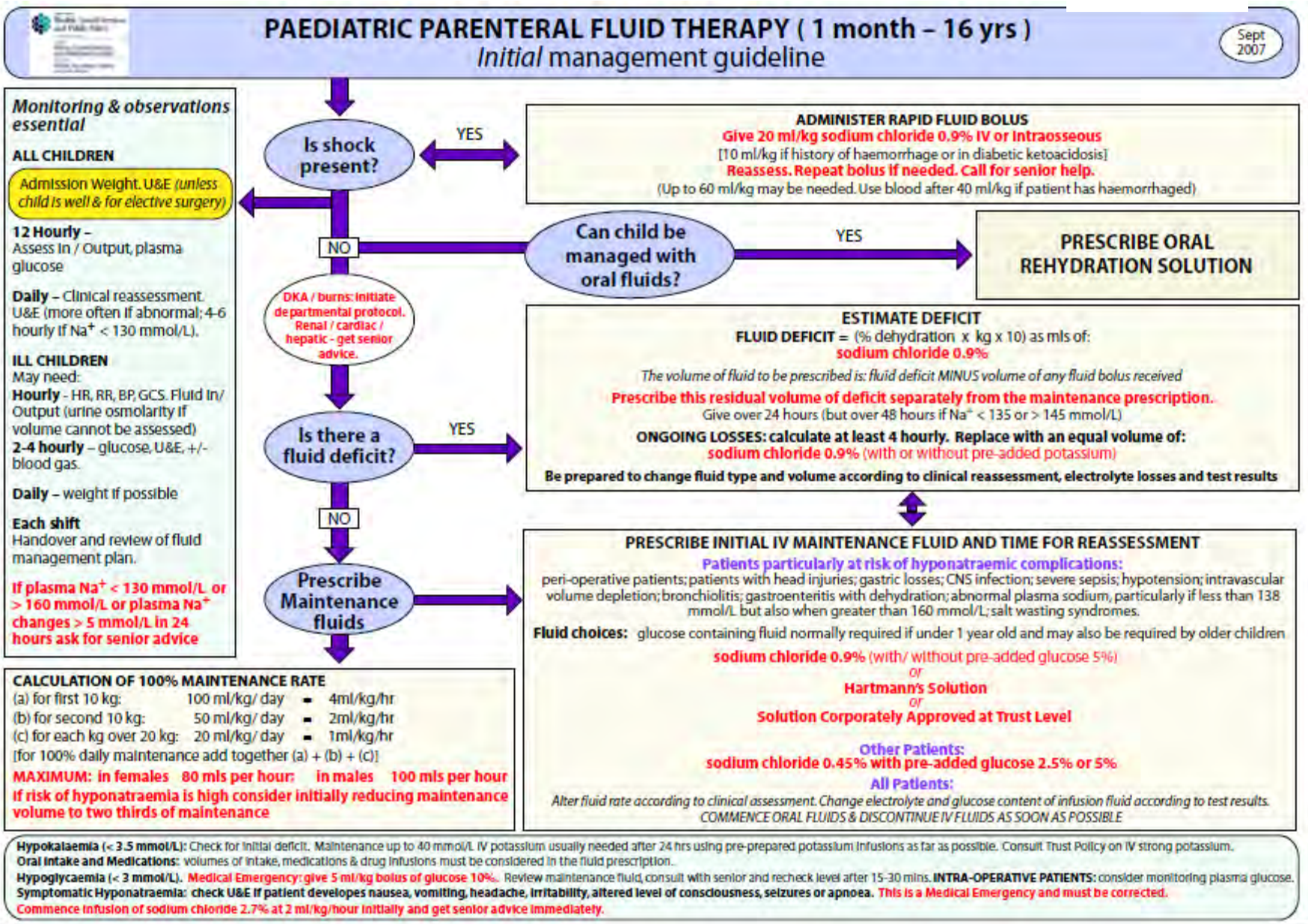
PAEDIATRIC PARENTERAL FLUID THERAPY (1 month – 16 yrs)
Initial management guideline
Sept 2007
Monitoring & observations essential
ALL CHILDREN
Admission Weight. U&E (unless child is well & for elective surgery)
12 Hourly – Assess In / Output, plasma glucose
Daily – Clinical reassessment. U&E (more often if abnormal; 4-6 hourly if Na+ < 130 mmol/L).
ILL CHILDREN
May need:
Hourly - HR, RR, BP, GCS. Fluid In/ Output (urine osmolarity if volume cannot be assessed)
2-4 hourly – glucose, U&E, +/- blood gas.
Daily – weight if possible
Each shift
Handover and review of fluid management plan.
If plasma Na+ < 130 mmol/L or > 160 mmol/L or plasma Na+ changes > 5 mmol/L in 24 hours ask for senior advice
Is shock present?
YES
ADMINISTER RAPID FLUID BOLUS
Give 20 ml/kg sodium chloride 0.9% IV or intraosseous
[10 ml/kg if history of haemorrhage or in diabetic ketoacidosis]
Reassess. Repeat bolus if needed. Call for senior help.
(Up to 60 ml/kg may be needed. Use blood after 40 ml/kg if patient has haemorrhaged)
NO
Can child be managed with oral fluids?
YES
PRESCRIBE ORAL REHYDRATION SOLUTION
DKA / burns: initiate departmental protocol. Renal / cardiac / hepatic - get senior advice.
Is there a fluid deficit?
YES
ESTIMATE DEFICIT
FLUID DEFICIT = (% dehydration x kg x 10) as mls of:
sodium chloride 0.9%
The volume of fluid to be prescribed is: fluid deficit MINUS volume of any fluid bolus received
Prescribe this residual volume of deficit separately from the maintenance prescription.
Give over 24 hours (but over 48 hours if Na+ < 135 or > 145 mmol/L)
ONGOING LOSSES: calculate at least 4 hourly. Replace with an equal volume of:
sodium chloride 0.9% (with or without pre-added potassium)
Be prepared to change fluid type and volume according to clinical reassessment, electrolyte losses and test results
NO
Prescribe Maintenance fluids
CALCULATION OF 100% MAINTENANCE RATE
(a) for first 10 kg: 100 ml/kg/ day = 4ml/kg/hr
(b) for second 10 kg: 50 ml/kg/ day = 2ml/kg/hr
(c) for each kg over 20 kg: 20 ml/kg/ day = 1ml/kg/hr
[for 100% daily maintenance add together (a) + (b) + (c)]
MAXIMUM: in females 80 mls per hour: in males 100 mls per hour
If risk of hyponatraemia is high consider initially reducing maintenance volume to two thirds of maintenance
PRESCRIBE INITIAL IV MAINTENANCE FLUID AND TIME FOR REASSESSMENT
Patients particularly at risk of hyponatraemic complications:
peri-operative patients; patients with head injuries; gastric losses; CNS infection; severe sepsis; hypotension; intravascular volume depletion; bronchiolitis; gastroenteritis with dehydration; abnormal plasma sodium, particularly if less than 138 mmol/L but also when greater than 160 mmol/L; salt wasting syndromes.
Fluid choices: glucose containing fluid normally required if under 1 year old and may also be required by older children
sodium chloride 0.9% (with/ without pre-added glucose 5%)
or
Hartmann's Solution
or
Solution Corporately Approved at Trust Level
Other Patients:
sodium chloride 0.45% with pre-added glucose 2.5% or 5%
All Patients:
Alter fluid rate according to clinical assessment. Change electrolyte and glucose content of infusion fluid according to test results.
COMMENCE ORAL FLUIDS & DISCONTINUE IV FLUIDS AS SOON AS POSSIBLE
Hypokalaemia (< 3.5 mmol/L): Check for initial deficit. Maintenance up to 40 mmol/L IV potassium usually needed after 24 hrs using pre-prepared potassium infusions as far as possible. Consult Trust Policy on IV strong potassium.
Oral intake and Medications: volumes of intake, medications & drug infusions must be considered in the fluid prescription.
Hypoglycaemia (< 3 mmol/L). Medical Emergency: give 5 ml/kg bolus of glucose 10%. Review maintenance fluid, consult with senior and recheck level after 15-30 mins. INTRA-OPERATIVE PATIENTS: consider monitoring plasma glucose.
Symptomatic Hyponatraemia: check U&E if patient develops nausea, vomiting, headache, irritability, altered level of consciousness, seizures or apnoea. This is a Medical Emergency and must be corrected.
Commence infusion of sodium chloride 2.7% at 2 ml/kg/hour initially and get senior advice immediately.

Audit of IV fluids of hospitalised children >1mth up to 15yrs 364dys
Audit time period...1/1/08 – 31/12/08

1. Hospital CAH☐ DHH☐ RVH☐ MATER ☐
ANTRIM☐ ALTNAGELVIN ☐ ULSTER☐
WHITEABBEY ☐ ERNE ☐ OTHER _____ *(SPECIFY)*

Patient ID _____
Age _____
Sex

2. Diagnosis: A ☐ B ☐
3. Other diagnosis as per discharge summary / letter: _____
4. Presentation: date ___/___/2008 5. Time (24 hr clock) ___:___
6. Discharge: date ___/___/2008 7. Time (24 hr clock) ___:___
8. LOS: _____ will be calculated automatically on spreadsheet
9. Did the patient get IVFs? Y☐ N☐
10. Is there evidence of a fluid calculation? Y☐ N☐
10a. If 'yes' where is it? _____

11. IVFs administered: ***(tick all that apply)***

Normal saline / sodium chloride 0.9%	
N saline / sodium chloride 0.9% + 5% glucose	
Sod chloride 0.45% with pre-added glucose 2.5% or 5%	
Hartmann's	
List any others used	

12. Patient's weight _____ kg or Not recorded ☐

	(a) 1st	(b) last
13. Level / rate		
14. Date	/ /2008	/ /2008
15. Time (24hr clock)	:	:

Investigations:

	Result 1 (a)	Date (b)	Time (c)	Result 2 (d)	Date2 (e)	Time2 (f)	Result 3 (g)	Date3 (h)	Time3 (i)	Result 4 (j)	Date4 (k)	Time4 (l)	Result 5 (m)	Date5 (n)	Time5 (o)
16. urea															
17. sodium															
18. potassium															
19. chloride															
20. HCO_3 check Abg / blood gases															
21. glucose															
Delete as appropriate:	pre / post IV fluids			pre / post IV fluids			pre / post IV fluids			pre / post IV fluids			pre / post IV fluids		

IV FLUIDS ASSESSMENT:

Day 1 (after starting IV fluids)

22. IVF assessed Y☐ N☐
(either **notes** or on **fluid prescription**)
23. Input totalled Y☐ N☐
24. Urine measured Y☐ N☐

Last day

25. IVF assessed Y☐ N☐
(either *{circle}* **notes** or on **fluid prescription**)
26. Input totalled Y☐ N☐
27. Urine measured Y☐ N☐

28. Readmitted within 7 days Y☐ N☐ If 'yes' why? _____

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Please record other comments overleaf & relate them to the appropriate question number.

Southern Health and Social Care Trust

IV Fluids in Hospitalised Children >1mth up to 15yrs 364dys

Admitted 1/1/08 – 31/12/08

Regional Audit 2009

Frequently Asked Questions

Q. How do I identify the patient sample?

A. For ease of reference I have included my business objects query.

Q. If a child aged 3 weeks is admitted but does not get fluids until they are 4 weeks old, are they included in the audit?

A. No. They must be at least 4 weeks old on admission.

Q. If a child is 15 on admission, but passes their 16th birthday before discharge, are they included in the audit?

A. Yes. Age on admission is the deciding factor.

Q. If on screening the patient, the recorded primary diagnosis is neither Appendicitis nor Bronchiolitis (e.g. may be recorded as "viral illness") is this patient included in the audit? (Ref Q2)

A. No. Primary diagnosis must be Appendicitis or Bronchiolitis. This may be a case of incorrect diagnostic coding.

Q. Is the presentation date the same as the admission date? (Ref Q4)

A. Not necessarily. If patient is admitted through Accident and Emergency, then the date and time of presentation at A&E should be recorded. If it is a direct admission (e.g. from GP straight to ward) then date and time of admission to the ward should be recorded.

(NB discharge time from the ward may not always be evident. If not recorded, but you know it is am or pm, record that instead.)

Q. Is there evidence of a fluid calculation? If 'yes', where is it recorded? (Ref Q10)

A. This relates to the calculation made using the child's weight to ascertain the prescription for IV fluids. Some hospitals have a special paediatric IV fluids calculation sheet. If a specialised fluid calculation sheet is in use, please enclose a blank copy for reference / information when you are submitting your dcfs.

Q. I cannot find any investigation results filed in the patient's notes. What should I do? (Ref Q16-21)

A. Check the labs system for any results you cannot find; it is also a good idea to check there also, in case investigations may have been undertaken in A&E the results of which may not always be filed in the patient's medical notes.

Also, if there is a 12hr gap or more in times of U&Es please check labs system.

Q. There are a lot more than 5 investigation results in the chart. Do I only need to record the first 5? (Ref Q16-21)

A. Please record results until the patient's sodium and / or urea levels are within the normal range. Continue on the back of the dcf if necessary, dating and timing each result as before.

This should correspond to the duration of IV fluids.

Q. What is acceptable as an assessment of IV fluids? (Ref Q22; 25)

A. There is a section on the daily fluid prescription sheet for 12 hr assessment which is signed off by a doctor. Ideally this is what we are looking for. If this is not completed, then look in the medical / clinical progress sheets or in the nursing notes / care pathway for reference to the fluids e.g. "fluids running as prescribed" or "eating and drinking well – fluids reduced" or "eating and drinking well – fluids discontinued".

If answering 'yes' – please record where you have found the assessment to be. Otherwise tick 'no'. Apply the same to question 25 for the last day of IV fluids.

Q. Does the input have to be totalled up at the bottom of the fluid prescription sheet?

A. Not necessarily. If there is a running total, that will suffice. (There is no need to check if the maths is correct.)

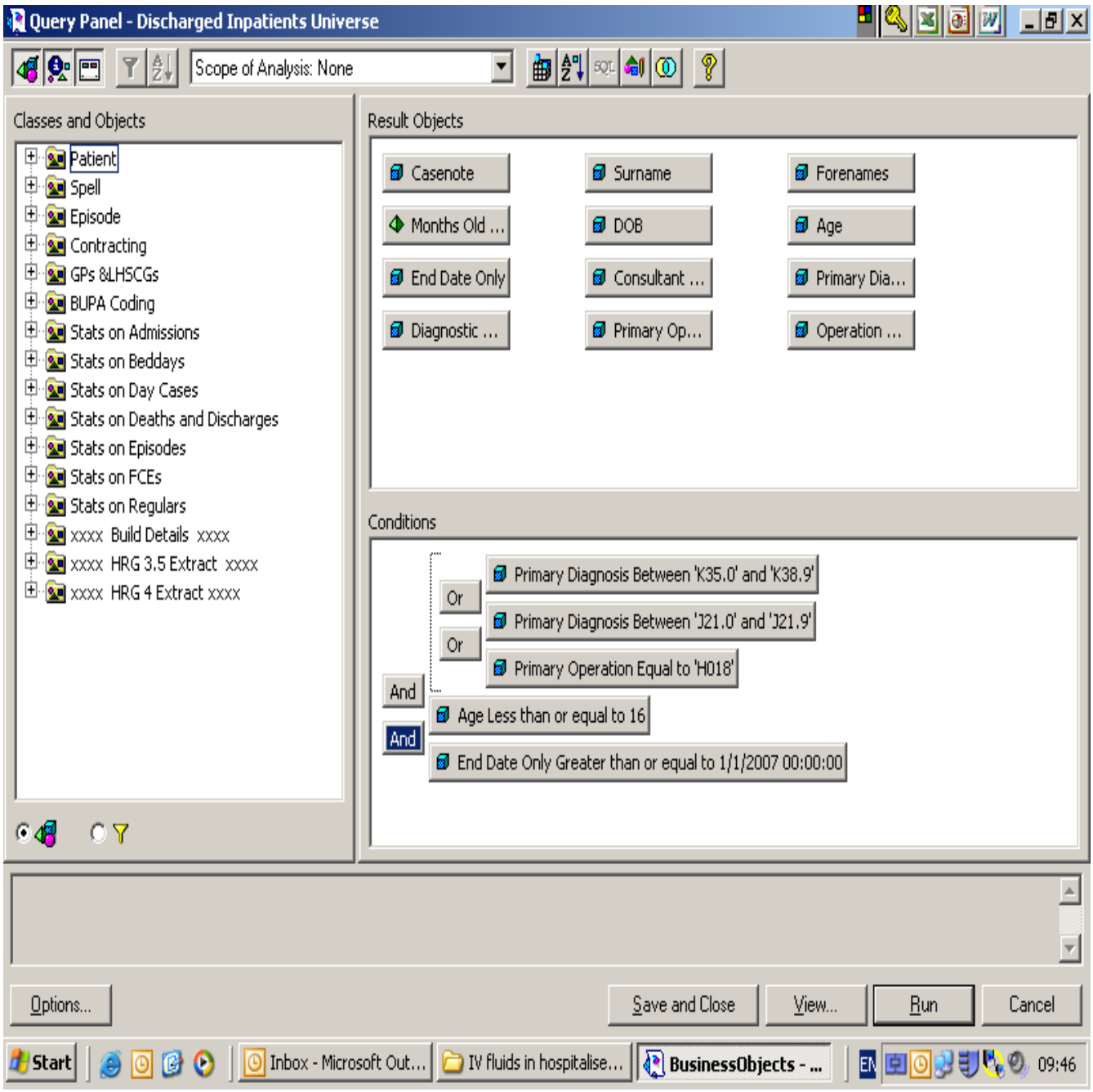
Q. Will 'PU' be sufficient to record that the urine is measured?

A. No. An amount must be recorded.

Q. The patient has been on IV fluids for less than 24 hours. How do I answer questions 25 – 27 in relation to the last day of IV fluids.

A. The answers will be duplicated for the last day, as the first and last are the same day in this case.

Business Objects Query:



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