



GUIDELINES AND AUDIT
IMPLEMENTATION NETWORK

Regional audit of the 5 Health and Social Care Trusts

Specialty/Service of audit: Paediatric

Audit of Parenteral Fluid Therapy for Children and Young Persons
(aged over 4 weeks & under 16 years)

AUDIT REPORT VOLUME 1

Audit report

Volume 1	Audit Methodology, Discussion and Recommendations
Volume 2	Audit Findings (Data tables and audit proformas)

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Audit Report Volume 1

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Executive Summary

This audit was undertaken to ascertain the safety of the prescription and administration, recording and monitoring of intravenous (IV) fluids to children aged over 4 weeks and under 16 years.

The audit examined 170 children with a wide range of clinical conditions, most of which categorised the child to be at high risk of hyponatraemia. The majority were emergency presentations, cared for in both medical and surgical environments, and covered the full range of ages from several months to 15 years of age. A small number of children were cared for in adult wards and were examined separately.

Examination of the documentation for prescription and administration of IV fluids revealed that the correct age specific charts were always used and all children had a weight recorded. All charts had the patient's name, 98% had a second key identifier of either date of birth or hospital number and 97% achieved the gold standard of all three identifiers. A key finding is that the prescription of fluid type, particularly to those deemed to be at particular risk of developing hyponatraemia, was always found to be appropriate. The care that young people received appeared to be independent of where they received their care.

Examination of the recording and monitoring of IV fluids, particularly the practice of cumulative totalling of fluids to monitor fluid balance revealed 76% had their 24 hour periods fluid input totalled and 65% had fluid output totalled. Only 43% had a calculation of the overall balance performed. This has been highlighted in the recommendations as requiring action.

Electrolyte and Urea (E&U) monitoring was examined carefully and generally revealed high levels of appropriate sampling and result recording, at both the commencement of (92%) and throughout the IV infusion (94%). There were also high levels (95%) of appropriate frequency and timing of sampling when there was evidence of hyponatraemia.

Glucose monitoring did not attain the high levels reached with electrolyte monitoring, with only 62% of expected recordings being found within the notes. With the perceived increased risk of hypoglycaemia following the removal of sodium chloride 0.18% with 4% glucose solution, this would need attention. In addition, when severe hypoglycaemia was identified in 6% of cases there was no documentation of any treatment in over one third of these patients. This has been highlighted in the recommendations as requiring action. 12 hour reassessments of the clinical course were performed in 92% of cases.

It is reassuring that 100% compliance was achieved in the prescription of safe and appropriate types of fluid. Additional safety in the management of intravenous fluids comes from appropriate and timely monitoring, the clear recording of results and prompt intervention when necessary. The audit found that performance in these areas rated from moderate to very good but that all can be further improved. A view was taken that for many of these performance criteria, the aim must be for 100% compliance. Therefore, despite

evidence of high degrees of performance, the recommendations do reflect further work is needed to attain complete compliance with standards and absolute perfection.

The recommendations contained within this report, combined with both the Action Plan and the proposed Paediatric IV Fluid Audit Improvement Tool, provide a framework for Trusts on how to do this.

GAIN would like to express its deep gratitude to the Project Team, the Trust Clinical Audit Managers and all medical, nursing and clinical audit staff across all Trusts for their support and help in completing this audit in such an effective and timely manner.

A handwritten signature in black ink, reading 'Tom Trinick'. The signature is written in a cursive style with a large 'T' and a long horizontal stroke.

Dr T Trinick
GAIN (Chair GAIN Strategic Committee)

Primary recommendations

- 1*. Health and Social Care Trusts (HSCTs) must ensure that **patients are identified** on fluid balance charts, using at least their name, date of birth and hospital identification number.
- 6*. HSCTs must ensure that **cumulative totalling** of fluid input and output, with the calculation of a 24 hour balance figure, is performed daily.
- 9*. **Blood glucose monitoring** must be performed on all children as recommended in the Paediatric Wallchart**.
- 10*. Confirmed **hypoglycaemia** must be treated and a record made of the treatment.

Further recommendations

- 2*. Every child on intravenous fluids should have a DFBC, preferably a single daily chart which moves with them on their patient's journey. All fluids administered must be both prescribed and their administration recorded on the DFBCs.
- 3*. Fluid calculations for bolus, maintenance, deficit and on-going loss replacement must be made and documented, preferably on the DFBC and with a coded indication for the fluid administration.
- 4*. HSCTs should use Oral Rehydration Solutions whenever possible when treating dehydration deficits by the gastric route.
- 7*. An Electrolyte and Urea (E&U) must be taken for every 24 hour period while receiving IV fluids, including the last day of an infusion – as per Paediatric Wallchart.
- 8*. E&U monitoring must be more frequent if there is hyponatraemia and if the child is ill – as per Paediatric Wallchart.
- 11*. HSCTs must enforce the practice of 12 hourly reassessments when children are receiving IV fluids.

Areas of good practice

- 5*. HSCTs should continue to adhere to the recommendations of the latest Paediatric Wallchart, especially regarding the prescription of IV fluids to those deemed to be at particular risk of developing hyponatraemia.

12. Young people being cared for in an adult ward appear to have received the same standard of care as children being cared for in paediatric wards.
13. The prescription and administration of fluids, including those deemed to be at particular risk of developing hyponatraemia, was found to be appropriate and safe.

** Paediatric Wallchart = Parenteral Fluid Therapy for Children and Young Persons [aged over 4 weeks and under 16 years] Initial management guideline June 2013.

Action Plan

GAIN should:

- Publish this report and seek widespread circulation to all staff involved in administering IV fluids in children.
- Make widely available a short educational presentation of the key findings of this audit.
- Produce a modified and simplified Paediatric IV Fluid Audit Improvement Tool (PIVFAIT)* based on the lessons learned from this audit, for internal use in all clinical areas where this age group is treated.
- Provide HSCTs with guidance and advice where necessary on the correct use of the PIVFAIT.
- Review the PIVFAIT over time and modify it as additional lessons are learned.
- Highlight to the HSCTs, items that were agreed by the clinical experts to be acceptable as standards but which are not yet enshrined in HSCT policy documentation.

HSCTs should:

- Promote the presentation of the key findings of this audit to all relevant staff and ensure the recommendations are implemented.
- Ensure that there is a continuing training programme to ensure staff are trained and up to date in all aspects of fluid therapy.
- Regularly audit practice using the PIVFAIT; forward results to GAIN as requested.

*Paediatric IV Fluid Audit Improvement Tool (PIVFAIT) – monthly audit of

1. Patient identification.
2. Patient weight.
3. Daily fluid balance chart calculation guidance completed.
4. Electrolyte monitoring.
5. Glucose monitoring.
6. Cumulative input and output totalling and Fluid balance.
7. 12 hour reassessment.

Introduction

The development of fluid-induced hyponatraemia has become a well-recognised clinical phenomenon, especially in children where it can occur in the previously well child or in those with a mild illness. Strategies, outlined in DHSSPSNI circulars, to reduce the risk and provide early warning of its development have been established. These include,

- National Patient Safety Agency, [NPSA alert 22](#),
- [DHSSPSNI circular HSC \(SQS\) 20/2007](#) and its [addendum](#),

which have resulted in,

- dramatically reducing the use of hypotonic solutions,
- increasing the frequency of monitoring,
- ensuring widespread training and educational programmes to highlight this issue.

In a local context, action has taken the form of,

- continuously developing guidelines in the form of wallcharts,
- development of regional adult and paediatric fluid balance charts,
- frequent auditing of our processes and performance against these strategies.

Background

In 2007, the DHSSPSNI issued guidance regarding fluid use in children in the form of a wall chart (Parenteral Fluid Therapy for Children & Young Persons [aged over 4 weeks & under 16 years] initial management guideline – September 2007).

In 2008, GAIN funded an audit on intravenous (IV) fluid use in children hospitalised for appendicitis or bronchiolitis. The original Wallchart was subsequently amended in February 2010 and in December 2011 the Chief Medical Officer (CMO) commissioned GAIN to undertake a “snapshot” audit of compliance with the standards as set out in this Wallchart.

This 2012 audit had some helpful additional features but it highlighted the need to,

- include careful definitions to clarify and reduce ambiguity,
- ensure sample size takes into account the small proportion staying on IV fluids for more than 24 hours,
- exclude those children being admitted for elective surgery and those only receiving fluids while in the operating theatre,
- consider amending the Regional Parenteral Fluid Therapy Wallchart to take account of recording of all glucose monitoring, including point of care technology, and

- perform a full regional audit within one year of the recommended change to the Wallchart guidance.

Following further modification of the Paediatric Wallchart in June 2013, this group began the development of the next cycle of regional audit on this topic, ensuring that lessons are learned from issues identified from the 2008 and 2011 audits. The goal is to show an up-to-date (spring 2014), accurate snapshot of the care of children receiving IV fluids in Northern Ireland.

In the intervening period, further necessary modifications to the [Paediatric Wallchart](#) have been made resulting in a May 2014 version; the resultant modifications to the standards did not affect the relevance of this particular audit but could not be tested on this occasion.

Aim

The overall purpose is to provide an up to date 2014 position on the current practice of paediatric fluid prescription and therapy in Northern Ireland.

This audit is designed to examine whether the administration of IV Fluids to children and young people (aged over 4 weeks and under 16 years) is safe and meets quality standards. It is also designed to ensure collection of data from young people being cared for while in wards primarily used by adult patients.

Objectives

1. To audit the prescription of IV Fluids
2. To audit the administration of IV Fluids
3. To audit the recording of IV Fluids
4. To audit the monitoring of IV Fluids

Standards

The audit measures against minimum standards of practice adopted from aspects of the,

- DHSSPS Parenteral Fluid Therapy for Children & Young Persons (aged over 4 weeks & under 16 years) Initial management guideline of the June 2013 Wallchart (bearing in mind that modification to the Wallchart was anticipated);

- Regulation and Quality Improvement Authority (RQIA) Independent review – reducing the risk of hyponatraemia when administering intravenous infusions to children (2010); and
- NPSA Patient Safety Alert 22 (2007).

Project Steering Group

The Steering Group for the audit represented GAIN, DHSSPSNI Standards and Guidelines Quality Unit, Audit and Governance from the HSCTs, Consultant Anaesthetist from each HSCT, Consultant Paediatrician/Paediatric Lead from each HSCT, Paediatric Nursing (each HSCT invited), DHSSPS Nursing, Midwifery and Allied Health Professional Directorate, and RQIA.

Methodology

This regional audit adopted retrospective data collection from clinical records of patients who were identified as receiving intravenous fluids during the study period.

Sample

- All inpatient paediatric (>4 weeks and <16 years) patients who were receiving intravenous fluids at some point during the study period and do not meet the exclusion criteria.
- Study period **00:01 24th March 2014 to 23:59 27th April 2014.**
- HSCT Wards kept a daily record of the patient case note numbers included in the audit and informed the HSCT Audit & Governance Departments.

Exclusion criteria

- The audit excluded children treated with IV fluid for the following conditions:
 - Diabetic ketoacidosis (DKA);
 - Burns;
 - Renal, Liver, Cardiac - use own specialist charts;
 - Any child on a fluid protocol (for example, for chemotherapy);
 - Children treated in Intensive Care (ICU);
 - Elective patients receiving IV Fluid for less than 4 hours;
 - Theatre IV Fluid prescription and administration;

- Maternity unit admission;
- Children under 4 weeks old or 16 years and over

Audit tool

- The audit proforma was agreed by the GAIN IV Fluids Audit Steering Group.
- Pilot undertaken during data collector training session with each HSCT asked to provide 2 sets of case notes.

Data collection

- Each HSCT nominated staff to be data collectors for the audit. Data was collected by HSCT Audit staff with the support of nominated clinical expert members.
- On agreement of audit proforma, GAIN hosted a training day for the data collectors.
- Data collection carried out during April 2014 and all completed audit proformas delivered to GAIN by Friday 9th May 2014.
- HSCTs nominees assisted with data cleansing process and validation.

Clinical expert audit review

Clinical experts were used throughout the audit to provide interpretation and comment on the clinical relevance of data that was variant (details in Volume 2).

Data analysis

- GAIN and Project Team carried out initial data analysis and prepared report.
- Members of IV Fluids Audit Steering Group provided further data analysis.

Report Presentation

The audit generated a large amount of data and the audit reporting has been divided into two volumes:

- Volume 1: Audit Methodology, Discussion and Recommendations.
- Volume 2: Audit Findings (Data tables and audit proformas).

All table and figure identification numbers are as given in Volume 2 and the same numbers are used throughout both documents.

List of Tables (referred to in Volume 1)

Table 60	Diagnosis spread of sample
Table 18	Number of hours of episode that was not recorded on Prescription Chart
Table 61	Type of IV Fluids Administered
Table 27	HSCTs where U&E result not available within 4 hours of commencing IV fluids
Table 73	HSCTs where there was no evidence of a 12 hour medical reassessment

List of Figures (referred to in Volume 1)

Figure 1	Baseline Proforma returns per HSCT
Figure 4	Daily Proforma returns per HSCT
Figure 2	Age band spread of sample
Figure 3	Duration of IV Fluids

HSCT identification anonymised

Health and Social Care Trust	Code
BHSCT	
NHSCT	
SEHSCT	
SHSCT	
WHSCT	

Each HSCT is identified with a letter throughout volumes 1&2 of this report.

Each HSCT will be given their individual coded letter and the overall code is available to the Project Team and the members of the DHSSPSNI who commissioned the audit.

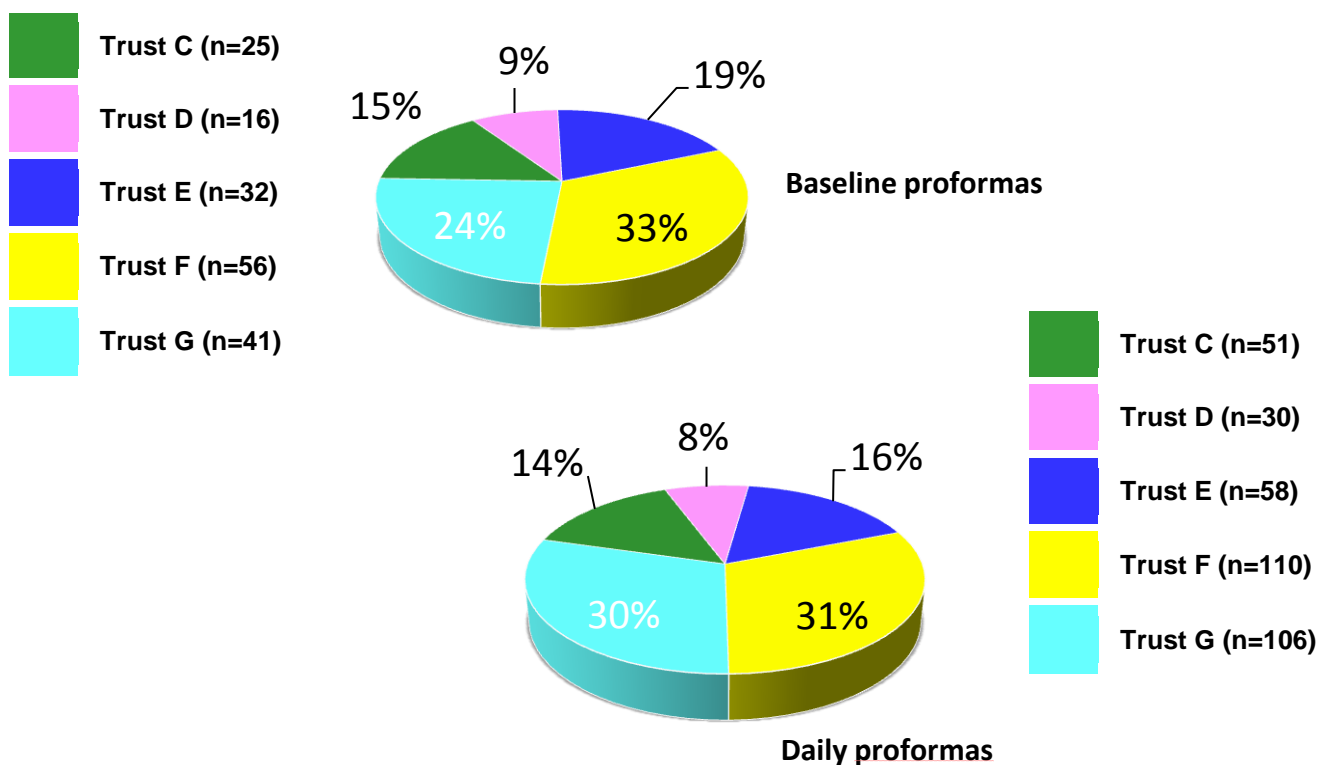
The demographics of the audit sample are examined first, followed by the audit objectives displayed in three sections: the prescription & administration; recording and monitoring of intravenous fluids.

Demographics

A baseline proforma was completed for each of 170 children identified to be on intravenous fluids during the audit period and from them, a total of 355 completed DFBCs were audited. Two additional DFBCs were missing; meaning the total number of DFBCs should have been 357. The charts below indicate a good spread of cases collected from across the 5 HSCTs for entry into the audit.

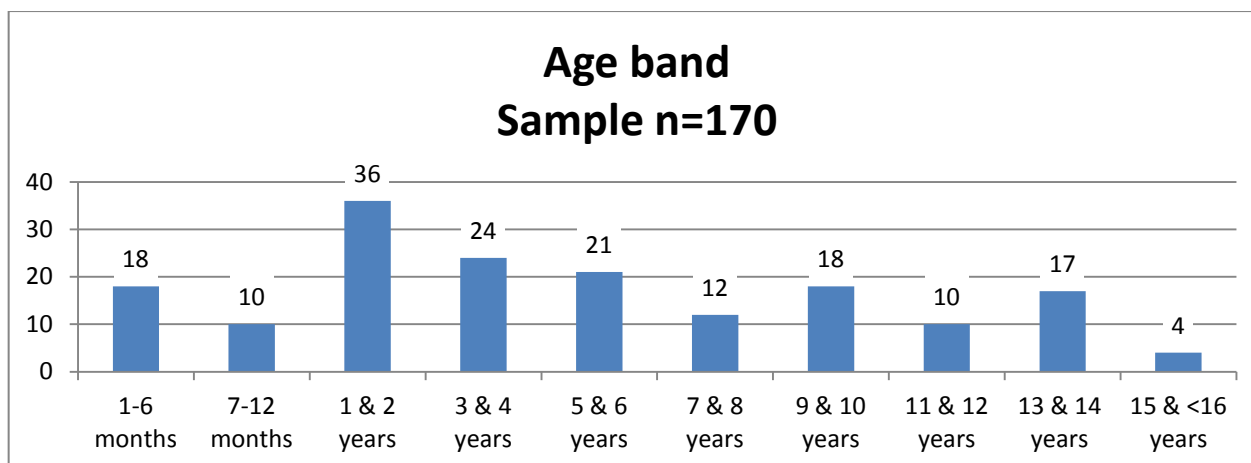
Baseline and Daily proformas: (Volume 2: Table 1, 33)

There were 170 Baseline and 355 DFBCs proforma returns from the 5 HSCTs.



Sex & Age

The gender breakdown of the sample was Male 49% : Female 51%. The age range is displayed in Figure 2. The gender and age data indicate a satisfactory range was captured for the study.



Diagnosis

The diagnosis data of the 170 patients in this audit is summarised below in Table 60. This indicates, as expected, a wide range of diagnoses which are representative of the broad scope of patients presenting at hospital.

Diagnosis	Number	Risk of Hyponatraemic complications
<i>Medical</i>		
Gastroenteritis, Vomiting	47	High
Bronchiolitis, Chest infection, Pneumonia, Asthma	13	High
Scarlet fever, other fevers, infections, Sepsis	13	High
Tonsillitis	11	High
Viral illness	7	High
Abdominal Pain	6	Low
Tonsillectomy	5	High
UTI	6	High
<i>Surgical</i>		
Appendicitis, Appendicectomy	22	High
Surgical abdomen, postop abdominal surgery	12	High
Pyloric stenosis	5	High
Orthopaedic Surgery, fractures – postoperative	7	High
Seizures, Neurosurgical	5	High
Trauma - minor	3	Low
Testicular	3	High
Miscellaneous	5	Low
Regional Total	170	156 High / 14 Low

A judgement was taken by clinical experts concerning which of these diagnoses could be considered high risk for developing hyponatraemia; the high figure of 92% (156/170) lends justification to the use of IV fluids.

Admission setting: (Volume 2: Table 4, 35)

As expected, the majority of the patients studied were children treated in a paediatric setting. 162 children had a total of 345/355 DFBCs completed in a paediatric setting; equivalent to 97% of all DFBCs completed. The admission setting of the DFBCs were distributed between Medical (52%), Surgical (31%) and the other 14% were in other paediatric wards including the emergency department. The remaining 10 DFBC (3%) related to 8 young people who were treated on an adult ward.

Young people being cared for in an adult ward: (Volume 2: Tables 5-7)

Young people being cared for in an adult environment can occur because there is insufficient paediatric bed availability but also because an adult ward may be where the specialist expertise lies and therefore is the safest option. Nevertheless, it can present challenges to the child, their families and those caring for them.

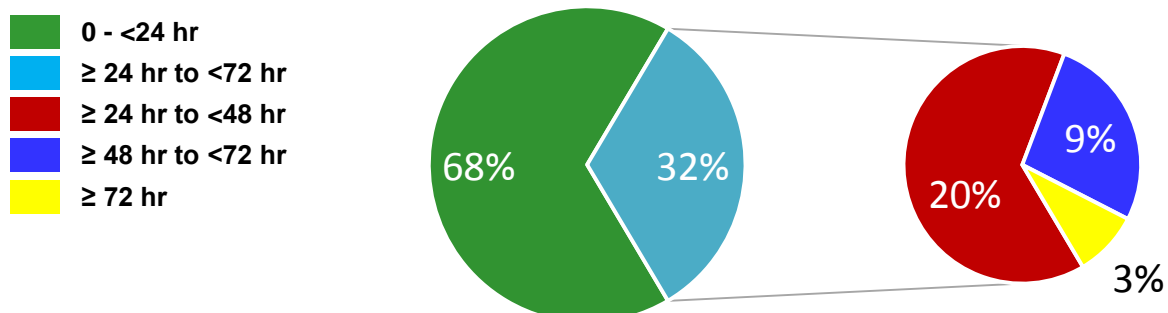
The details regarding the care provided to those 8 young people are summarised in Volume 2: Tables 5-7. Examination of their baseline and DFBC proformas did not reveal significant differences between these young people and those cared for in a paediatric environment, indicating they received the same standard of care as other children.

Type of Admission

Most of the children & young people in the audit sample were treated as emergencies (156/170 emergency admissions, 8/170 elective admissions & 6/170 transfers from another hospital, of which at least two were emergency admissions).

Duration of IV Fluid treatment: (Volume 2: Table 9)

Approximately two thirds of the children had intravenous fluids for less than 24 hours; further details of the remaining third are given in Figure 3 below.



Prescription and administration of IV Fluids

Age appropriate chart: (Volume 2: Table 36)

All children had the correct appropriate age specific chart used to prescribe and record their IV fluids.

Clear identification of patient: (Volume 2: Tables 37-40)

Administration of intravenous fluid therapy demands timely and correct labelling and patient identification on the fluid balance chart.

97% of children had the minimum of 3 key patient identification indices on all their DFBCs. Every chart had a name, 12/355 did not have a date of birth and 10/355 did not have a hospital number.

Recommendation 1

HSCTs must ensure that patients are identified on fluid balance charts using at least their name, date of birth and hospital identification number.

Recording of weight: (Volume 2: Tables 23-25)

All the children had their weight recorded. In 95% of children this was a measured weight and in 5% an estimate was used. At the time of the audit, not all HSCTs fluid balance charts had a prompt for date of weighing to be recorded. In 95% of cases on charts where the date was prompted, the weight was dated. In those where the date was not prompted, the data collector referred to the clinical record to confirm that the date had been recorded.

Completion of DFBCs and Prescription Charts: (Volume 2: Tables 16-22)

345 DFBCs (97%) had the prescription area fully completed for their episode of care. 2 DFBCs were missing and in the other 10 there was an average of 2.3 hours per DFBC considered to be incomplete (Table 18).

Table 18: Number of hours of episode not recorded on Prescription Chart.

Children	Trust	Details
3	C	Periods missing: Appropriate fluids administered. <ul style="list-style-type: none"> • 1 for 5 hours (out of 6 hours 20 minutes duration of IV Fluids, Emergency, in theatre) • 1 for 4 hours, • 1 chart missing
0	D	
1	E	<ul style="list-style-type: none"> • 1 chart missing
5	F	Emergency admissions, Appropriate fluids administered. Periods missing: <ul style="list-style-type: none"> • 2 for 1 hour • 3 for 2 hours
3	G	Periods missing: Appropriate fluids administered. <ul style="list-style-type: none"> • 2 for 1 hour • 1 for 4 hours

Conclusion:

Overall the audit revealed 7% of children & young people (12/170) had incomplete documentation in their fluid prescription. Before concluding that administration of fluids proceeded without prescription, these were examined by clinical experts. The variances included short time gaps, 11/12 were emergency admissions with the likelihood that the prescription was on a secondary record that was not reviewed by the auditor e.g. anaesthetic chart from theatre.

Recommendation 2

Every child on intravenous fluids should have a DFBC, preferably a single daily chart which moves with them on their patient's journey. All fluids administered must be both prescribed and their administration recorded on the DFBCs.

Indication for fluid Prescription (Volume 2: Tables 41-42)

In December 2013, NICE in their [clinical guideline CG174](#) (for adults) recommended that the 5 Rs: Resuscitation, Routine maintenance, Replacement, Redistribution and Reassessment are remembered when IV fluids are prescribed. This 2014 audit evaluated the practice of identifying, on the fluid prescription chart, the indications for fluid administration – whether as a bolus, for maintenance, to correct a deficit or cover ongoing losses. Even though using a coded indicator has only recently become accepted as good

practice and before updated guidance was released, data was collected to judge the current state of this practice. 78% of DFBCs had an indication of why a fluid was being given; maintenance being the commonest reason identified.

Fluid Bolus (Volume 2: Tables 43-47)

45 of the 355 DFBCs had evidence of a fluid bolus and in 91% of these, this was indicated on the prescription chart.

Only 49% (22/45 cases) had evidence of a bolus calculation on the DFBC or in the clinical record. The 23 cases that had no evidence of calculation were examined by a clinical expert and the bolus volume range was always considered to be appropriate (Table 45).

Maintenance (Volume 2: Tables 48-52)

352 of the 355 DFBCs had evidence of a maintenance fluid and in 92% of these, this was indicated on the prescription chart.

In 91% cases (322/352) there was evidence of a maintenance calculation on the DFBC or in the clinical record and in a further 6 cases (1.7%) there was evidence of a calculation on a previous chart. 18 of the 24 cases that had no evidence of calculation were examined by a clinical expert and in all cases the maintenance prescription, rate of administration and the type of fluid was found to be appropriate.

Deficit (Volume 2: Tables 53-56)

13 of the 355 DFBCs had evidence of a fluid deficit and in 7 of these, this was indicated on the prescription chart.

69% (9/13 cases) had evidence of a fluid deficit calculation on the DFBC or in the clinical record. The 4/13 cases (all from Trust F) that had no evidence of calculation were examined by a clinical expert and all were treated appropriately.

For these 13 patients, the auditors examined whether they received an oral replacement fluid other than ORS* or medications, during this period of IV deficit replacement. Of the three who did, all received fruit juice.

*ORS = proprietary Oral Rehydration Solution, e.g. Dioralyte, Dioralyte Relief, Electrolade.

On-going losses (Volume 2: Tables 57 - 59)

38 of the 355 DFBCs had evidence of on-going fluid losses and in 95% of these this was indicated on the prescription chart.

76% (29/38 cases) had evidence of an on-going fluid losses calculation on the DFBC or in the clinical record. The 9/38 cases that had no evidence of calculation were examined by a clinical expert and all were found to have an appropriate prescription.

Conclusion

Despite not being an overt standard, providing the indication for the prescription of a particular fluid is already a wide spread practice.

Recommendation

3. Fluid calculations for bolus, maintenance, deficit and on-going loss replacement must be made and documented, preferably on the DFBC and with a coded indication for the fluid administration.
4. HSCTs should use Oral Rehydration Solutions whenever possible when treating dehydration deficits by the gastric route.

Particular Risk of Hyponatraemia

The full range of diagnoses from the 170 patients are given in Table 60 and shows 156/170 patients (92%) had a diagnosis, that when mapped to those on the Paediatric Wallchart 2013, were judged to be at high risk of developing hyponatraemia. They were therefore deserving of particular scrutiny of their fluid prescription and administration.

Consequently, all the DFBC data was audited for the types of fluid prescribed. The audit sample shows that 355 had at least one type of IV fluid recorded, 65/355 had at least two types of fluids recorded and 5/355 had three types of fluids recorded.

Table 61: Type of IV Fluids Administered

Type of fluid	1 st type of fluid	2 nd type of fluid	3 rd type of fluid
Sodium chloride 0.9% Sodium chloride 0.9% + 5% glucose Hartmann's solution Hartmann's solution + 3% glucose	334	42	1
Other fluid	21	23	4
Regional total	355	65	5

The 377 occasions of fluid prescription (334+42+1) that directly reflected the named fluids in the Paediatric Wallchart fluid guidance were deemed to be appropriate. Examination by

clinical experts of the 48 occasions when 'Other' fluids were prescribed (21+23+4) confirmed that 47 also adhered to this guidance. The commonest reason for the fluid being described as 'Other' was because of the addition of potassium. Another reason was the use of an alternative fluid regimen for treating infants with pyloric stenosis. The 1 remaining DFBC was one which a clinical expert deemed borderline appropriate; an infant just outside the neonatal age group had the fluid type changed to a hypotonic one (an approved Paediatric Wallchart fluid) after receipt of satisfactory E&U results.

Conclusion

Fluid prescription was therefore found to be appropriate for all fluids for 354/355 DFBCs (99.7%). The prescription and administration of fluids, particularly of those deemed to be at risk of developing hyponatraemia, was found to be appropriate and safe.

Recommendation 5

HSCTs should continue to adhere to the recommendations of the latest Paediatric Fluid Wallchart, especially regarding the prescription of IV fluids to those deemed to be at particular risk of developing hyponatraemia.

Recording of IV Fluids

351 of 357 (98%) of all DFBCs had the recording of the fluid administration fully completed. In the 6 charts that were incomplete, 2 patients had a DFBC missing, presumed to have been misfiled and 4 patients had incomplete recording ranging from 1 – 5 hours.

Cumulative Totalling: (Volume 2: Tables 76-80)

Particular attention for this audit was paid to examining the practice of cumulative totalling of fluid. For each DFBC, this requires the measurement of fluid intake and then the calculation of a cumulative fluid total for at least a 12 hour period and if possible the full 24 hour period. This process is repeated for fluid output and then the calculation of an overall 24 hour fluid balance – the difference between the input and output. All of this ensures that accurate input and output measurement has taken place; its importance coming from the information it can provide regarding hypovolaemia or fluid overload and early warning of these states.

63% of DFBCs (224/354) had their 12 hour input fluid totalled and 76% of DFBCs (188/246) that could have had a 24 hour period totalled, had that performed.

The equivalent figures for fluid output was 40% (142/353) for the 12 hour period and 65% (160/247) for those that could have a 24 hour total calculated (108 not on fluids for that period).

43% (147/341) of the DFBC charts had a 24 hour daily fluid balance calculated.

Recommendation 6

HSCTs must ensure that cumulative totalling of fluid input and output, with the calculation of a 24 hour balance figure, is performed daily.

Monitoring of IV Fluids

Electrolyte monitoring (Volume 2: Tables 26-32, 62-71)

It is considered reasonable to expect that an electrolyte and urea (E&U) result should be available within 4 hours of commencing IV fluids to aid prescription and monitor progress. This is desirable especially if the child is ill and/or has evidence of hyponatraemia. One child did not require an E&U and of the other 169 children, 155 (92%) met this 4 hour target. Of the 14 that did not meet it, examination reveals one patient had a test 16 hours after commencing IV fluids and this result was slightly hyponatraemic. A test the next day was normal.

Table 27: HSCTs where U&E result not available within 4 hours of commencing IV fluids

E&U result not available within 4 hours of commencing fluids	HSCT	Details (n=14)
1	C	Normal result; E&U was taken during first DFBC
1	D	Normal result within 4.5 hours
2	E	Normal results; E&U was taken during first DFBC
7	F	Normal results; E&U was taken during first DFBC
3	G	1 abnormal (Na 133) result within 16 hours during first DFBC 1 normal result by second DFBC 1 no record on the laboratory system

There should be regular E&U monitoring during the course of an intravenous infusion to obtain early warning of electrolyte disturbances. Of the 355 DFBCs, 27 had had the fluids discontinued and required no further testing. Of the remaining 328 DFBCs, 309 (94%) had

an E&U test taken as recommended. Examination of the 19 DFBCs where an E&U was not taken, revealed that a further 16 were on the last day of their IV infusion. The 3 cases (0.9%) of DFBCs associated with on-going IV fluids were peri-operative patients who were in the higher risk group of developing hyponatraemia; who should have had better monitoring.

There should be a record of an E&U test, ideally on the fluid chart or in the clinical record. Where a test was performed, 95% (293/309 of DFBC with E&U test taken) were found to be so recorded, with the remaining 5% available on the laboratory system.

It is particularly important that where there is laboratory evidence of hyponatraemia, further more frequent testing is undertaken. Of the 309 DFBCs with E&U testing, 16% (50 tests) had a serum sodium outside the reference interval (<135 mmol/L to >145mmol/L). This reinforces the need to be diligent with regard to electrolyte monitoring. Of those 50, 84% had a follow up test. The remaining 8 cases were examined by a clinical expert; 6 were deemed not to require a repeat E&U leaving 2 cases where testing should have been done.

A more detailed audit was undertaken where there was evidence of a serum sodium of <130 mmol/L at any time. Out of the 309 DFBCs with E&U testing there were 6 episodes with a low sodium level and 4 of the 6 had a follow-up E&U within a further 4-6 hours. This left 2 cases with less than optimal monitoring, although they had testing performed within 11 and 17 hours respectively.

Recommendations

7. An Electrolyte and Urea (E&U) must be taken for every 24 hour period while receiving IV fluids, including the last day of an infusion – as per Paediatric Wallchart.
8. E&U monitoring must be more frequent if there is hyponatraemia and if the child is ill – as per Paediatric Wallchart.

Glucose monitoring (Volume 2: Tables 81-84)

Blood glucose must be monitored every 12 hours; auditing revealed this was complied with in 62% of the DFBCs (218/353 monitored + 2/355 not applicable). Of these, 6% (13/218)

had a blood glucose of <3 mmol/L; 8 received treatment for this hypoglycaemia. Of the 8 DFBC with treatment for hypoglycaemia, 6 received 2-4 ml/kg of 10% glucose and 2 oral glucose. In 5 children, no record could be found documenting the treatment of their hypoglycaemia.

Recommendations

9. Blood glucose monitoring must be performed on all children as recommended in the Parenteral Wallchart.

10. Confirmed hypoglycaemia must be treated and a record made of the treatment.

12 hour reassessment (Volume 2: Tables 72-75)

Children receiving intravenous fluids should have 12 hourly assessments of their clinical state. Audit of this feature indicated that 23/355 were deemed not to require it as their admission was less than 12 hours. Of those applicable, 326/332 (98%) had evidence of such assessments. The remaining 6 charts were from 5 patients, involving 2 of the Trusts.

Table 73: HSCTs where there was no evidence of a 12 hour medical reassessment.

DFBC	HSCT	Details (n=6)
0	C	
0	D	
4	E	3 of 4 patients received 12 hour medical reassessment on another DFBC
0	F	
2	G	2 DFBC applied to one patient.

Details of the 5 children are given in Volume 2 Tables 73-75. One child was 8 years old and the rest less than two years with one being an infant with pyloric stenosis. All were judged to be at high risk of hyponatraemia with all 5 receiving appropriate IV fluid management.

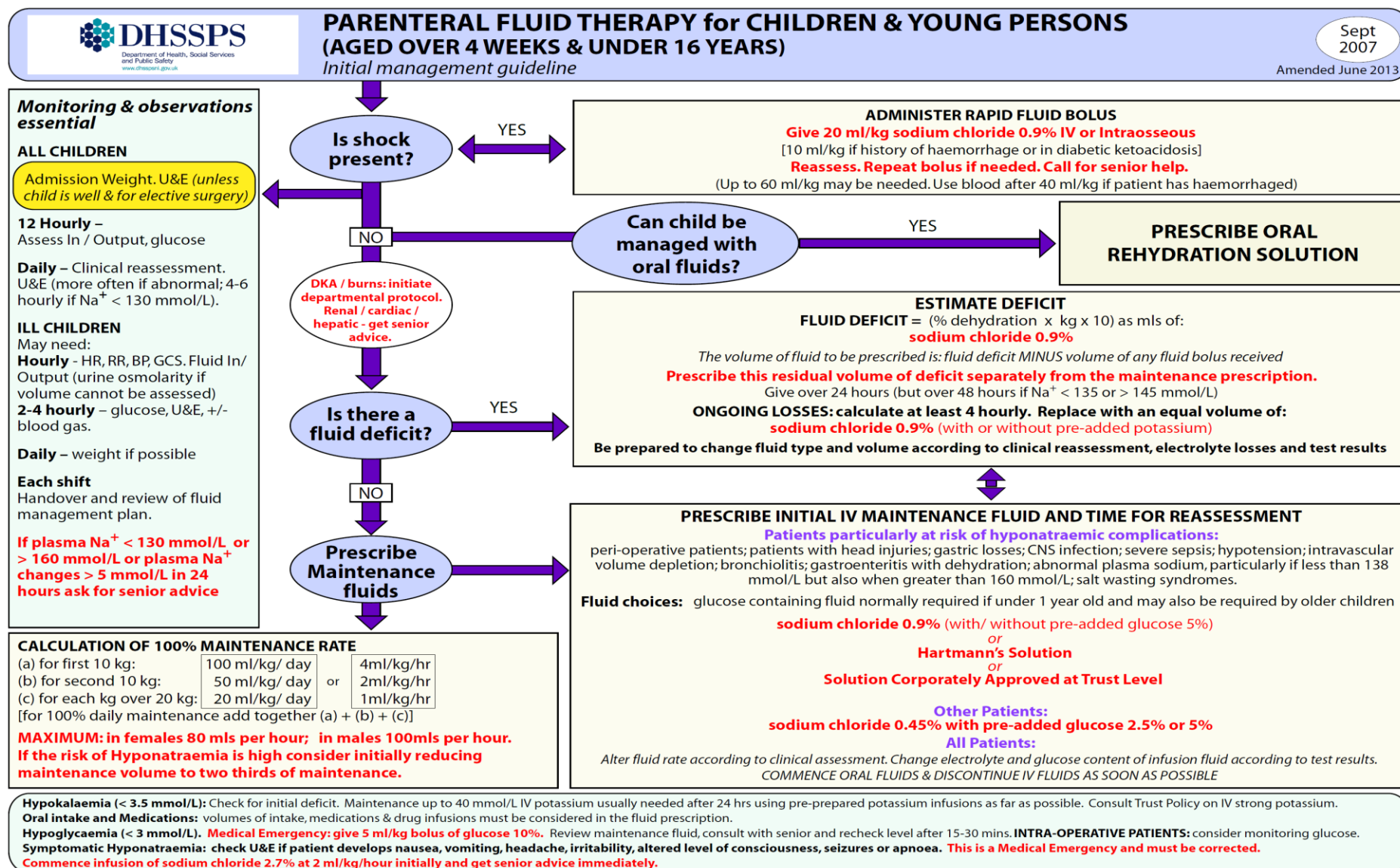
Recommendations

11. HSCTs must enforce the practice of 12 hourly reassessments when children are receiving IV fluids.

Limitations of the audit

1. Case note unavailability interfered with sequential case note auditing in some Trusts.
2. If there was doubt about the risk categorisation of a clinical condition – the child was allocated to the group considered to be at high risk of hyponatraemia to err on the side of caution. The audit may therefore have overestimated the proportion of children in the higher risk group.
3. Prescribed bags of intravenous fluids may run across successive daily fluid balance sheets and consequently prescriptions can erroneously appear to be missing from the beginning of some fluid balance sheets while staff wait for a bag from the previous sheet to finish.
4. There were no definitive published standards for some of the criteria audited against (e.g. 4 hour timing of E&U when fluids are commenced) and a consensus standard of clinical best practice by experts was agreed. The lack of this precise guidance can be the cause of any variance detected by the audit.
5. Some children were in theatre during the audited episode and there was a likely interruption in their ward fluid balance record when theatre recording systems/charts take over. This would lead to an audit return of incomplete data on the daily fluid balance chart.
6. There was not a standardised daily fluid balance chart in use across Northern Ireland at the time of the audit. Variations in the information prompted by the different fluid balance charts in use may bias the performance of some of the results between Trusts
7. Glucose testing is generally a bedside point of care test and results are not retrospectively computer traceable as in a laboratory based test. If it is not documented into a record once performed, or if recorded in an undiscovered document, its frequency of testing will be underestimated. This could be the cause of any variance detected by the audit.
8. It is recognised that the standards are derived from guidelines while in some cases sound clinical treatment involves a skilled interpretation of a wide variety of complex interacting variables existing at the time of decision making. This may not be apparent to an auditor some weeks or months later during a retrospective case note audit.

Appendix 1: Parenteral Fluid Therapy for Children & Young Persons (aged over 4 weeks & under 16 years) Initial management guideline (June 2013)



Appendix 2: Data fields – used for measuring practice against the standards included in the Wallchart and providing core information

Baseline proforma:

Question		Measures Standard or Core information	Standard Source	Standard text
No.	Topic			
1	HSCT	Core information		
2	Audit coding	Core information		
3	Audit coding	Core information		
4	Sex & Age	Core information		
5	Admission date & time	Core information		
6	Setting	Core information		
7	Type of admission	Core information		
8	Date & time infusion commenced	Core information		
9	Date & time infusion discontinued	Core information		
10	Number of DFBC for episode	Core information		
11	Hourly completion of fluid balance within the FBC	Measures Standard	DHSSPS (2013)	All children who have IV fluids must have them recorded on a daily fluid balance chart for the duration that they are on IV fluids.
12	Daily completion of the Prescription of fluids	Measures Standard	DHSSPS (2013)	All children who have IV fluids must have them recorded on a daily fluid balance chart for the duration that they are on IV fluids.
13	Recording weight	Measure Standard	DHSSPS (2013)	All children – admission weight Ill children – daily weight if possible
14	U&E result availability	Measures Standard	DHSSPS (2013)	All children – Admission U&E (unless child is well & for elective surgery) All children – Daily U&E

Daily proforma:

Question		Measures Standard or Core information	Standard Source	Standard text
No.	Topic			
1	Day of DFBC	Core information		
2	Age appropriate chart	Measures Standard	RQIA (2010)	Recommendation 5: Independent hospitals should introduce the use of paediatric prescription and fluid balance charts in line with clinical good practice when administering intravenous fluids to children.
3	Setting	Core information		
4	Clear identification of patient	Measures Standard	HSCT Policy	GAIN audit accepted as a clear identification of patient as recording a minimum of the 3 patient identifiers: name; date of birth (age); HSC/Medical Record Number.
5	Bolus admin.; indication; calculation	Core information		
6	Maintenance admin.; indication; calculation	Core information		
7	Deficit fluid; indication; calculation	Core information		
8	On-going losses fluid; indication; calculation	Core information		
9	Diagnosis	Core information	DHSSPS (2013)	
10	Type of IV Fluid prescribed	Measures Standard	DHSSPS (2013)	Fluids should be appropriate as per Wallchart depending on risk category.
11	U&E taken on day of DFBC	Measures Standard	DHSSPS (2013)	All children – Daily U&E
12	Primary location U&E results recorded	Core information		
13	Normal / Abnormal Sodium result	Measures Standard	DHSSPS (2013)	Frequency of U&E check required daily for all children (Required more often if abnormal)
14	Repeat test for Abnormal results	Measures Standard	DHSSPS (2013)	
15	12 hour medical reassessment	Measures Standard	DHSSPS (2013)	All children – 12 hourly Assess
16	U&E result Na <130 mmol/L	Measures Standard	DHSSPS (2013)	All children –U&E 4-6 hourly if Na ⁺ <130mmol/L
17	Fluids total Intake recording	Measures Standard	DHSSPS (2013)	12 Hourly – Assess Input

18	Fluids total Output recording	Measures Standard	DHSSPS (2013)	12 Hourly – Assess Output
19	24 hour Fluid Balance (ml) recording	Measures Standard	DHSSPS (2013)	Each shift – Handover and review of fluid management plan
20	Laboratory glucose/BM monitoring	Measures Standard	DHSSPS (2013)	12 Hourly – Assess glucose
21	Episodes of Laboratory glucose/BM <3	Measures Standard	DHSSPS (2013)	12 Hourly – Assess glucose
22	Treatment for Hypoglycaemia	Measures Standard	DHSSPS (2013)	Appropriate treatment for Hypoglycaemia (<3 mmol/L)
23	Optional notes for Data Collector	Core information		
24	Optional notes for Clinical Expert	Core information		

Appendix 3: Members of the Audit Steering Group

Forename	Surname	Job Title	Organisation
Tom	Trinick (Dr)	Chair GAIN Strategic Committee	GAIN
Nicola	Porter	GAIN Manager	GAIN
Dalrene	Masson	Regional Clinical Audit Facilitator	GAIN
Julian	Johnston (Dr)	Assistant Medical Director	BHSCT
Karen	Campbell	Principal Officer, Standards and Guidelines Quality	DHSSPS
Jennifer	Lamont	Deputy Principal	DHSSPS
David	Stewart (Dr)	Director	RQIA
Damien	Carson (Dr)	Consultant Anaesthetist	SEHSCT
Peter	Crean (Dr)	Consultant Anaesthetist	BHSCT
Patrick	Stewart (Dr)	Consultant Anaesthetist	WHSCT
Chris	Clarke (Dr)	Consultant Anaesthetist	SHSCT
Jarlath	McAloon* (Dr)	Consultant Paediatrician	NHSCT
Mike	Shields (Prof)	Consultant Paediatrician	BHSCT
Shilpa	Shah (Dr)	Consultant Paediatrician	SHSCT
Mary	McKenna	Head of Acute & Community Paediatrics	WHSCT
Sheila	McGovern* (Dr)	Associate Specialist Paediatrics	SEHSCT
Zoe	Boreland	Nursing Officer	DHSSPS
Rosie	Kelly*	Paediatric Nursing	SEHSCT
Bernie	McGibbon	Paediatric Nursing members were identified in all HSCTs however only these staff were able to contribute to meetings of the Audit Steering Group.	SHSCT
Anne	McMullan*		SHSCT
Linda	Kelly	Assistant Director of Nursing, Safe and Effective Care	SEHSCT
Christine	Murphy	Governance Manager	BHSCT
Anne	Quinn	Effectiveness & Evaluation Manager	SHSCT
Fintan	McErlean	Clinical Audit Manager	BHSCT
Raymond	Haffey	Clinical Audit Manager	SHSCT

*** Clinical Expert Group**

Sam	Lamont*	Consultant Anaesthetist	BHSCT
Gerry	Mackin*	Consultant Paediatrician	WHSCT
Damien	Armstrong*	Consultant Paediatrician	WHSCT

Appendix 4: Abbreviation Glossary

CMO	Chief Medical Officer
DFBC	Daily Fluid Balance Chart
DHSSPSNI	Department of Health, Social Services and Public Safety Northern Ireland
E&U / U&E	Electrolyte and Urea
GAIN	Guideline and Audit Implementation Network
HSCTs	Health and Social Care Trusts
IV	Intravenous
NPSA	National Patient Safety Agency
Paediatric Wallchart	Parenteral Fluid Therapy for Children and Young Persons (aged over 4 weeks and under 16 years) Initial management guideline June 2013
PIVFAIT	Paediatric IV Fluid Audit Improvement Tool
RQIA	Regulation and Quality Improvement Authority