NATIONAL INSTITUTE FOR HEALTH AND CARE EXCELLENCE

Health and social care directorate

Quality standards and indicators

Briefing paper

Quality standard topic: Intravenous fluid therapy in children and young people in hospital

Output: Prioritised quality improvement areas for development.

Date of Quality Standards Advisory Committee meeting: 17 February 2016

Contents

1 Introduction

This briefing paper presents a structured overview of potential quality improvement areas for intravenous (IV) fluids in children and young people in hospital. It provides the Committee with a basis for discussing and prioritising quality improvement areas for development into draft quality statements and measures for public consultation.

1.1 Structure

This briefing paper includes a brief description of the topic, a summary of each of the suggested quality improvement areas and supporting information.

If relevant, recommendations selected from the key development source below are included to help the Committee in considering potential statements and measures.

1.2 Development source

The key development source referenced in this briefing paper is:

Intravenous fluid therapy in children and young people in hospital. NICE guideline NG29 (2015). No review schedule presented.

2 Overview

2.1 Focus of quality standard

This quality standard will cover the management of intravenous (IV) fluids in children and young people up to age 16, including babies born at term and babies born prematurely who have a corrected age of term (40 weeks) or more. It covers IV fluids used for a range of conditions and in different hospital settings.

NICE quality standard QS66 for Intravenous fluid therapy in adults in hospital covers young people and adults aged 16 years and over.

2.2 Definition

Intravenous (IV) fluid therapy is a way of replacing fluids in the body by giving them straight into the bloodstream (intravenous means 'into a vein', and is often called a drip). IV fluid contains water, electrolytes (called salts) and glucose (a type of sugar). It is given to stop people becoming dehydrated, to treat people who are dehydrated, to make sure they have the right amount of fluid, salts and sugars in their blood that they need for normal health and to correct fluid and electrolyte imbalances.

Normally, children and young people get the fluid they need by drinking. Many children and young people admitted to hospital may be too ill to drink so may need

IV fluid therapy. Children and young people may need IV fluids to account for losses of red blood cells, plasma, water or electrolytes beyond the usual losses in urine, stools and sweat. These losses can come from burns, diarrhoea, vomiting or leakage of fluid into the interstitial space. In these cases the aim is to replace any depleted fluids and restore electrolyte balance. Conditions such as cardiac dysfunction, liver disease, inappropriate antidiuretic hormone secretion and nephrotic syndrome can result in an excess of fluids in the body, known as fluid overload. If this happens, the aim is to rebalance and redistribute fluids and ensure the correct levels of electrolytes.

Whatever IV fluid therapy is needed for it is vital that the correct composition, volume and timing of IV fluid therapy is used. Different types of IV fluids are appropriate for different situations. Errors in prescribing or administering IV fluids can result in inadequate or excessive provision, leading to hypovolaemia and poor organ perfusion, or hypervolaemia, oedema and heart failure. Failing to correct imbalances and deliver correct fluids can have a significant impact on morbidity and mortality.

2.3 Management

When administering IV fluids, the correct amount needs to be prescribed to meet the physiological needs of the child. As the size and weight of children varies, this needs to be taken into account in any system used in the calculation of the amount of fluids to be prescribed. It is very important to be able to keep a timely and accurate record of what type of fluid has been given and the type of fluid that has been lost, as well as any electrolytes lost in bodily fluids. Monitoring children and young people is often challenging: it may be difficult to assess urine output accurately, and blood tests can be painful, distressing and difficult to repeat. As a result, assessment and monitoring is often suboptimal, with fluid and electrolyte status not being evaluated adequately. This may lead to inappropriate IV fluid prescribing.

A National Patient Safety Agency alert[1] has highlighted safety concerns in relation to the use of hypotonic IV fluids in children, as these fluids are associated with the development of hyponatraemia. Children are more at risk of developing brain swelling and neurological complications as a consequence of hyponatraemia compared to adults. Children have died as a consequence of inappropriate hypotonic fluid therapy.

2.4 National Outcome Frameworks

Tables 1–2 show the outcomes, overarching indicators and improvement areas from the frameworks that the quality standard could contribute to achieving.

[1] National Patient Safety Agency (2007) Reducing the risk of hyponatraemia when administering intravenous infusions to children

Table 1 NHS Outcomes Framework 2015–16

Domain	Overarching indicators and improvement areas
1 Preventing people from dying prematurely	***Overarching indicators*** 1a Potential Years of Life Lost (PYLL) from causes considered amenable to healthcare ii Children and young people 1c Neonatal mortality and stillbirths ***Improvement areas*** **Reducing mortality in children** 1.6 i Infant mortality* ii Neonatal mortality and stillbirths
4 Ensuring that people have a positive experience of care	***Overarching indicators*** 4b Patient experience of hospital care ***Improvement areas*** **Improving hospitals' responsiveness to personal needs** 4.2 Responsiveness to inpatients' personal needs **Improving children and young people's experience of healthcare** *4.8 Children and young people's experience of inpatient services*
5 Treating and caring for people in a safe environment and protecting them from avoidable harm	***Overarching indicators*** *5a Deaths attributable to problems in healthcare* *5b Severe harm attributable to problems in healthcare* ***Improvement areas*** **Improving the culture of safety reporting** 5.6 Patient safety incidents reported
Alignment with Public Health Outcomes Framework * Indicator is shared Indicators in italics in development	

Table 2 Public health outcomes framework for England, 2013–2016

Domain	Objectives and indicators
4 Healthcare public health and preventing premature mortality	***Objective*** Reduced numbers of people living with preventable ill health and people dying prematurely, whilst reducing the gap between communities ***Indicators*** 4.1 Infant mortality* 4.3 Mortality rate from causes considered preventable**
Alignment with NHS Outcomes Framework * Indicator is shared ** Indicator is complementary	

3 Summary of suggestions

3.1 Responses

In total 4 stakeholders responded to the 2-week engagement exercise 15/12/15 – 8/1/16, 2 of which had no comments to make.

Stakeholders were asked to suggest up to 5 areas for quality improvement. Specialist committee members were also invited to provide suggestions. The responses have been merged and summarised in table 3 for further consideration by the Committee.

NHS England's patient safety division submitted comments during stakeholder engagement.

Full details of all the suggestions provided are given in appendix 4 for information.

Table 3 Summary of suggested quality improvement areas

Suggested area for improvement	Stakeholders
Assessment and monitoring • Assessment and documentation • Standardised fluid balance charts • Assessment before surgery	BHC, SCM
Type of fluids • Type of fluid for resuscitation and routine maintenance • Premixed solution	BHC, RCPCH, SCM
Hypernatraemia and Hyponatraemia	BHC, SCM
Governance • Accountability • Incident reporting	BHC, SCM
Additional areas • Audit tool	SCM
BHC, Baxter Healthcare Ltd NHSE, NHS England RCN, Royal College of Nursing RCPCH, Royal College of Paediatrics and Child Health SCM, Specialist Committee Member	

3.2 Identification of current practice evidence

Bibliographic databases were searched to identify examples of current practice in UK health and social care settings; 205 studies were identified for IV fluid therapy in children and young people in hospital. In addition, current practice examples were suggested by stakeholders at topic engagement (15 studies) and internally at project scoping (12 studies).

Of these studies, 4 were assessed as having potential relevance to this topic and the suggested areas for quality improvement identified by stakeholders (see appendix 2). A summary of relevant studies is included in the current practice sections for each suggested area of improvement.

4 Suggested improvement areas

4.1 Assessment and monitoring

4.1.1 Summary of suggestions

Assessment and documentation

Stakeholders suggested documented actual or estimated daily weight as this is the best indicator of the status of fluid balance as rapid changes in weight are due to changes in fluid status. Stakeholders also suggested carrying out urea estimations daily or more frequently if clinically indicated and this is an important was of monitoring the effects of IV fluids and helps guide further IV fluid prescribing.

Standardised fluid balance charts

Stakeholders suggested the use of a standardised fluid balance chart for assessing and monitoring children and young people receiving IV fluids. Currently there is no standardised chart used in the NHS therefore stakeholders reported there is wide variation between hospitals and between units in hospital in what is recorded and documented on a patients chart. This can make it difficult for clinicians to determine an accurate fluid balance for a patient when they are moved between units or hospitals.

Assessment before surgery

Stakeholders suggested routinely measuring electrolyte and blood glucose before surgery to help identify any imbalances to allow better peri-operative care and reduce side effects and complications.

4.1.2 Selected recommendations from development source

Table 4 below highlights recommendations that have been provisionally selected from the development source(s) that may support potential statement development. These are presented in full after table 4 to help inform the Committee's discussion.

Table 4 Specific areas for quality improvement

Suggested quality improvement area	Suggested source guidance recommendations
Assessment and documentation	NICE NG29 Recommendation 1.2.3 (KPI)
Standardised fluid balance charts	Not directly covered in NICE NG29 and no recommendations are presented

Assessment before surgery	NICE NG29 Recommendations 1.4.4 (KPI) and 1.4.5

Assessment and documentation

NICE NG29 Recommendation 1.2.3 (key priority for implementation)

In term neonates, children and young people who are receiving IV fluids, assess and document the following:

- Actual or estimated daily body weight. Record the weight from the current day, the previous day, and the difference between the two. If an estimate was used, the actual weight should be measured as soon as clinically possible.
- Fluid input, output and balance over the previous 24 hours.
- Any special instructions for prescribing, including relevant history.
- An assessment of the fluid status.
- The results of laboratory and point-of-care assessments, including:
    - full blood count
    - urea
    - creatinine
    - plasma electrolyte concentrations (including chloride, sodium and potassium; see recommendation 1.2.4)
    - blood glucose (see recommendation 1.2.5)
    - urinary electrolyte concentrations.
- Details of any ongoing losses (see recommendation 1.5.1 and the diagram of ongoing losses).
- Calculations of fluid needs for routine maintenance, replacement, redistribution and resuscitation.
- The fluid and electrolyte prescription (in ml per hour), with clear signatures, dates and times.
- Types and volumes of fluid input and output (urine, gastric and other), recorded hourly and with running totals.
- 12-hourly fluid balance subtotals.
- 24-hourly fluid balance totals.
- 12-hourly reassessments of:
    - the fluid prescription

- current hydration status
- whether oral fluids can be started
- urine and other outputs.

Assessment before surgery

NICE NG29 Recommendation 1.4.4 (key priority for implementation)

Measure plasma electrolyte concentrations and blood glucose when starting IV fluids for routine maintenance (except before most elective surgery), and at least every 24 hours thereafter.

NICE NG29 Recommendation 1.4.5

Be aware that plasma electrolyte concentrations and blood glucose are not routinely measured before elective surgery unless there is a need to do so, based on the child's medical condition or the type of surgery.

4.1.3 Current UK practice

Assessment and documentation

No current practice was identified relating to practice in England or Wales. A Northern Irish audit of parenteral fluid therapy for children and young people (2014)[2] examined 170 children with a wide range of clinical conditions aging from several months to 15 years of age. The audit found that all children had their weight recorded. In 95% of children this was a measured weight and in 5% it was estimated. The audit showed electrolyte and urea monitoring achieved high levels of appropriate sampling and result recording, at both the commencement of (92%) and throughout the IV infusion (94%). The audit also showed the 7% of children and young people had incomplete documentation in their fluid prescription.

Standardised fluid balance charts

No published studies on current practice were highlighted for this suggested area for quality improvement; this area is based on stakeholder's knowledge and experience.

Assessment before surgery

No published studies on current practice were highlighted for this suggested area for quality improvement; this area is based on stakeholder's knowledge and experience.

[2] Guidelines and Audit Implementation Network (2014) Audit of parenteral fluid therapy for children and young persons (aged over 4 weeks and under 16 years) Vol 1

4.2 Types of fluids

4.2.1 Summary of suggestions

Type of fluid for resuscitation and routine maintenance

Stakeholders highlighted the importance of identifying the correct IV fluid to be used for fluid resuscitation and maintenance. The types of fluid used can vary depending on the speciality and the fluid available which can cause confusion among professionals over what to prescribe in different circumstances.

Inappropriate fluid administration can cause harm for example serious neurological damage and death. Stakeholders stated that hypotonic IV fluids are still used in children in many hospitals in the UK when isotonic fluids have been shown to improve patient safety.

Premixed solutions

Stakeholders highlighted that there is some evidence that addition of solutes e.g. potassium, glucose, sodium bicarbonate to IV fluids at the point of contact rather than premixed solutions is associated with an increased incidence of patient safety incidents for example reducing the risk of potassium bolus due to incorrect mixing.

4.2.2 Selected recommendations from development source

Table 5 below highlights recommendations that have been provisionally selected from the development source(s) that may support potential statement development. These are presented in full after table 5 to help inform the Committee's discussion.

Table 5 Specific areas for quality improvement

Suggested quality improvement area	Selected source guidance recommendations
Type of fluid for resuscitation and routine maintenance	NICE NG29 Recommendations 1.3.1 (KPI) and 1.3.2 (KPI) NICE NG29 Recommendations 1.4.3 (KPI) and 1.4.7
Premixed solutions	Not directly covered in NICE NG29 and no recommendations are presented

Type of fluid for resuscitation and routine maintenance

NICE NG29 Recommendation 1.3.1 (key priority for implementation)

If children and young people need IV fluid resuscitation, use glucose-free crystalloids that contain sodium in the range 131–154 mmol/litre, with a bolus of 20 ml/kg over

less than 10 minutes. Take into account pre-existing conditions (for example, cardiac disease or kidney disease), as smaller fluid volumes may be needed.

NICE NG29 Recommendation 1.3.2 (key priority for implementation)

If term neonates need IV fluid resuscitation, use glucose-free crystalloids[3] that contain sodium in the range 131–154 mmol/litre, with a bolus of 10–20 ml/kg over less than 10 minutes.

NICE NG29 Recommendation 1.4.3 (key priority for implementation)

If children and young people need IV fluids for routine maintenance, initially use isotonic crystalloids that contain sodium in the range 131–154 mmol/litre.

NICE NG29 Recommendation 1.4.9

If term neonates need IV fluids for routine maintenance, initially use isotonic crystalloids that contain sodium in the range 131–154 mmol/litre with 5–10% glucose.

4.2.3 Current UK practice

Type of fluid for resuscitation and routine maintenance

In 2007 the National Patient Safety Agency issued a safety alert on reducing the risk of hyponatraemia when administering intravenous infusions to children. It stated that since 2000, there had been four child deaths (and one near miss) following neurological injury from hospital-acquired hyponatraemia reported in the UK. International literature cites more than 50 cases of serious injury or child death from the same cause, and associated with the administration of hypotonic infusions[3],[4].

In 2010 the National Confidential Enquiry into Patient Outcome and Death (NCEPOD)[5] report on parenteral nutrition showed that in neonates additional intravenous fluids is occasionally required. Of the 134 cases requiring additional fluids and based on the advisors opinion, 91.3% received the appropriate type of fluid and 91% received the appropriate volume.

[3] National Patient Safety Agency (2007) Reducing the risk of hyponatraemia when administering intravenous infusions to children

[4] MHRA (2012) Intravenous 0.18%saline/4% glucose solution ('hypotonic saline'): do not use in children except in specialist settings under expert supervision UK Public Assessment Report

[5] National Confidential Enquiry into Patient Outcome and Death (2010) A mixed bag: an enquiry into the care of hospital patients receiving parenteral nutrition

The Northern Irish audit of parenteral fluid therapy for children and young people (2014)[6] found that fluid prescription was appropriate for all fluids for 99.7% of completed daily fluid balance charts. The prescription and administration of fluids, particularly those deemed to be at risk of developing hyponatraemia was found to be appropriate and safe.

Premixed solutions

No published studies on current practice were highlighted for this suggested area for quality improvement; this area is based on stakeholder's knowledge and experience.

[6] Guidelines and Audit Implementation Network (2014) Audit of parenteral fluid therapy for children and young persons (aged over 4 weeks and under 16 years) Vol 1

4.3 Hypernatraemia and hyponatraemia

4.3.1 Summary of suggestions

Stakeholders highlight that hyponatraemia encephalopathy is a medical emergency and, if untreated, can cause permanent neurological damage or death. Many of the symptoms are non-specific therefore healthcare professionals require a heightened awareness of identifying them when they develop in children receiving intravenous fluids.

Stakeholders also highlighted that it is important to document that patients have been checked for hypernatraemia and hyponatraemia. This data can then be audited to demonstrate the number of patients checked at risk and complication rates to allow improvement to be made.

4.3.2 Selected recommendations from development source

Table 6 below highlights recommendations that have been provisionally selected from the development source(s) that may support potential statement development. These are presented in full after table 6 to help inform the Committee's discussion.

Table 6 Specific areas for quality improvement

Suggested quality improvement area	Selected source guidance recommendations
Hypernatraemia and hyponatraemia	**Managing hyponatraemia** NICE NG29 Recommendation 1.7.2 (KPI)

NICE NG29 Recommendation 1.7.2 (key priority for implementation)

Be aware that the following symptoms are associated with acute hyponatraemia during IV fluid therapy:

- Headache.
- Nausea and vomiting.
- Confusion and disorientation.
- Irritability.
- Lethargy.
- Reduced consciousness.
- Convulsions.
- Coma.
- Apnoea.

4.3.3 Current UK practice

Since 2000, there have been four child deaths (and one near miss) following neurological injury from hospital-acquired hyponatraemia reported in the UK. International literature cites more than 50 cases of serious injury or child death from the same cause, and associated with the administration of hypotonic infusions[7],[8].

[7] National Patient Safety Agency (2007) Reducing the risk of hyponatraemia when administering intravenous infusions to children

[8] MHRA (2012) Intravenous 0.18%saline/4% glucose solution ('hypotonic saline'): do not use in children except in specialist settings under expert supervision UK Public Assessment Report

4.4 Governance

4.4.1 Summary of suggestions

Accountability

Stakeholders highlighted the importance of clear responsibility and accountability for training, governance and education in conjunction with the adult IV fluid therapy lead.

Incident reporting

Stakeholders highlighted there is currently no consistency to error reporting leading to under-reporting of events. Adequate and consistent error reporting enables improvements to be made. IV fluid leads can review all critical incidents relating to fluid mismanagement to help refine training methods and identify possible improvements to internal processes.

4.4.2 Selected recommendations from development source

Table 7 below highlights recommendations that have been provisionally selected from the development source(s) that may support potential statement development. These are presented in full after table 7 to help inform the Committee's discussion.

Table 7 Specific areas for quality improvement

Suggested quality improvement area	Selected source guidance recommendations
Accountability	NICE NG29 Recommendation 1.8.1 (see NICE CG174 Recommendation 1.6.3)
Incident reporting	Not directly covered in NICE NG29 and no recommendations are presented

Accountability

NICE CG174 Recommendation 1.6.3

Hospitals should have an IV fluids lead, responsible for training, clinical governance, audit and review of IV fluid prescribing and patient outcomes.

4.4.3 Current UK practice

Accountability

No published studies on current practice were highlighted for this suggested area for quality improvement; this area is based on stakeholder's knowledge and experience.

Incident reporting

No published studies on current practice were highlighted for this suggested area for quality improvement; this area is based on stakeholder's knowledge and experience.

4.5 Additional areas

Summary of suggestions

The improvement areas below were suggested as part of the stakeholder engagement exercise. However they were felt to be either unsuitable for development as quality statements, outside the remit of this particular quality standard referral or require further discussion by the Committee to establish potential for statement development.

There will be an opportunity for the QSAC to discuss these areas at the end of the session on 17 February.

Audit tool

Stakeholders suggested that development of audit tools to evaluate prescribing practices could highlight compliance with safer intravenous prescribing and identify complications of intravenous prescribing.

Appendix 1: Key priorities for implementation (NG29)

Recommendations that are key priorities for implementation in the source guideline and that have been referred to in the main body of this report are highlighted in grey.

Assessment and monitoring

- In term neonates, children and young people who are receiving IV fluids, assess and document the following:
    - Actual or estimated daily body weight. Record the weight from the current day, the previous day, and the difference between the two. If an estimate was used, the actual weight should be measured as soon as clinically possible.
    - Fluid input, output and balance over the previous 24 hours.
    - Any special instructions for prescribing, including relevant history.
    - An assessment of the fluid status.
    - The results of laboratory and point-of-care assessments, including:
        - full blood count
        - urea
        - creatinine
        - plasma electrolyte concentrations (including chloride, sodium and potassium; see recommendation 1.2.4)
        - blood glucose (see recommendation 1.2.5)
        - urinary electrolyte concentrations.
    - Details of any ongoing losses (see recommendation 1.5.1 and the diagram of ongoing losses).
    - Calculations of fluid needs for routine maintenance, replacement, redistribution and resuscitation.
    - The fluid and electrolyte prescription (in ml per hour), with clear signatures, dates and times.
    - Types and volumes of fluid input and output (urine, gastric and other), recorded hourly and with running totals.
    - 12-hourly fluid balance subtotals.
    - 24-hourly fluid balance totals.
    - 12-hourly reassessments of:
        - the fluid prescription

- current hydration status
- whether oral fluids can be started
- urine and other outputs. [recommendation 1.2.3]

Fluid resuscitation

- If children and young people need IV fluid resuscitation, use glucose-free crystalloids[1] that contain sodium in the range 131–154 mmol/litre, with a bolus of 20 ml/kg over less than 10 minutes. Take into account pre-existing conditions (for example, cardiac disease or kidney disease), as smaller fluid volumes may be needed. [recommendation 1.3.1]
- If term neonates need IV fluid resuscitation, use glucose-free crystalloids[1] that contain sodium in the range 131–154 mmol/litre, with a bolus of 10–20 ml/kg over less than 10 minutes. [recommendation 1.3.2]

Routine maintenance

- If children and young people need IV fluids for routine maintenance, initially use isotonic crystalloids[2] that contain sodium in the range 131–154 mmol/litre. [recommendation 1.4.3]
- Measure plasma electrolyte concentrations and blood glucose when starting IV fluids for routine maintenance (except before most elective surgery), and at least every 24 hours thereafter. [recommendation 1.4.4]
- If there is a risk of water retention associated with non-osmotic antidiuretic hormone (ADH) secretion, consider either:
  - restricting fluids to 50–80% of routine maintenance needs **or**
  - reducing fluids, calculated on the basis of insensible losses within the range 300–400 ml/m^2/24 hours plus urinary output. [recommendation 1.4.9]

Replacement and redistribution

- Consider isotonic crystalloids[2] that contain sodium in the range 131–154 mmol/litre for redistribution. [recommendation 1.5.2]

Managing hyponatraemia that develops during intravenous fluid therapy

- If asymptomatic hyponatraemia develops in term neonates, children and young people, review the fluid status and take action as follows:

    - If a child is prescribed a hypotonic fluid, change to an isotonic fluid (for example, 0.9% sodium chloride).
    - Restrict maintenance IV fluids in children and young people who are hypervolaemic or at risk of hypervolaemia (for example, if there is a risk of increased ADH secretion) by either:
        - restricting maintenance fluids to 50–80% of routine maintenance needs **or**
        - reducing fluids, calculated on the basis of insensible losses within the range 300–400 ml/m^2/24 hours plus urinary output. [recommendation 1.7.1]
- Be aware that the following symptoms are associated with acute hyponatraemia during IV fluid therapy:
    - Headache.
    - Nausea and vomiting.
    - Confusion and disorientation.
    - Irritability.
    - Lethargy.
    - Reduced consciousness.
    - Convulsions.
    - Coma.
    - Apnoea. [recommendation 1.7.2]

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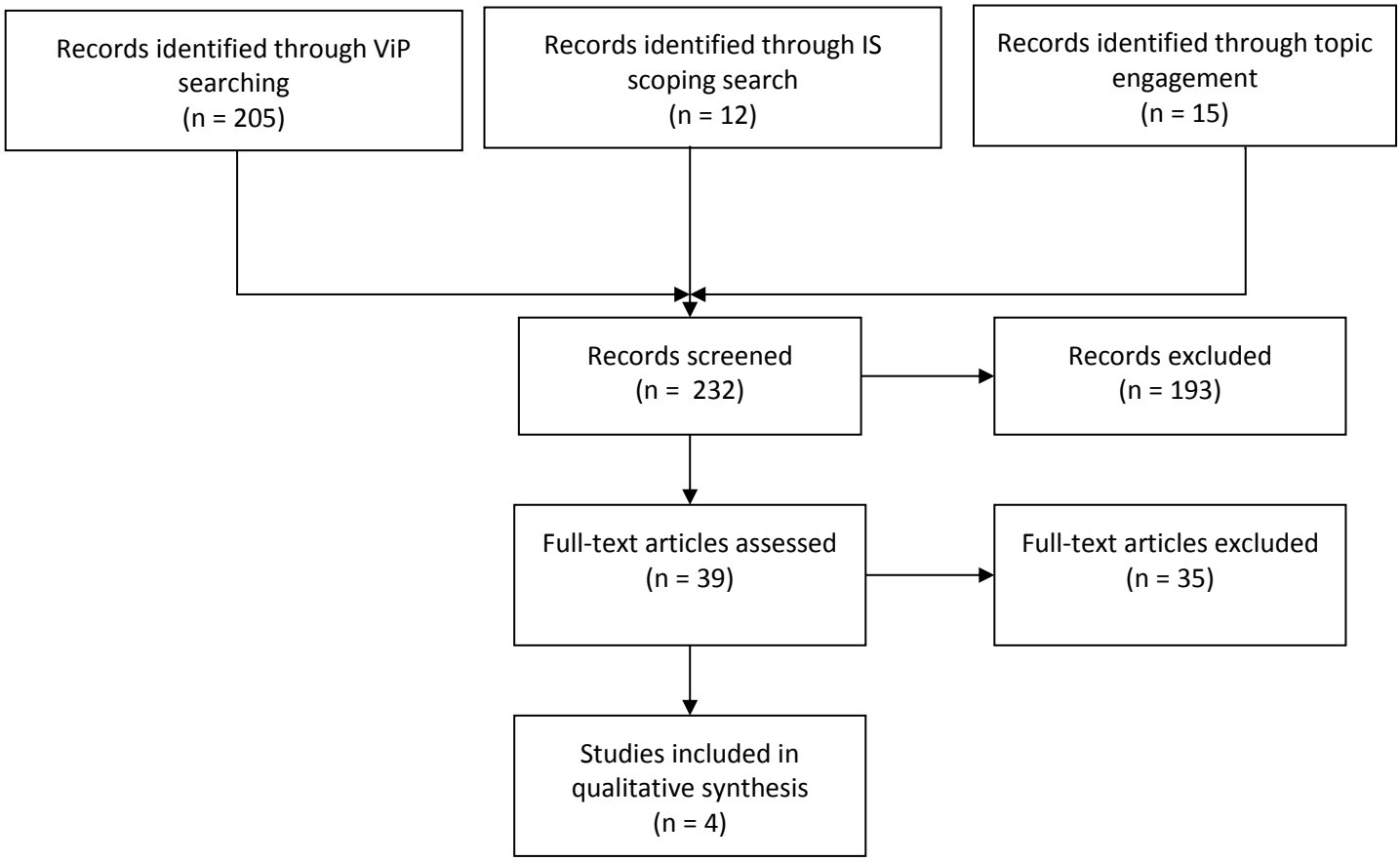
[1] At the time of publication (December 2015), some glucose-free crystalloids did not have a UK marketing authorisation for use in children and young people. The prescriber should follow relevant professional guidance, taking full responsibility for the decision. Informed consent should be obtained and documented. See the General Medical Council's Prescribing guidance: prescribing unlicensed medicines for further information.

[2] At the time of publication (December 2015), some isotonic crystalloids with 5–10% glucose did not have a UK marketing authorisation for use in children and young people. The prescriber should follow relevant professional guidance, taking full responsibility for the decision. Informed consent should be obtained and documented. See the General Medical Council's Prescribing guidance: prescribing unlicensed medicines for further information.

Appendix 2: Review flowchart



Appendix 3: Glossary

Children are aged 29 days to under 12 years

Crystalloid is a solution which is administered intravenously. Depending on their concentration, crystalloids can affect the distribution of water in the body. It is composed of electrolytes (e.g. sodium, potassium, calcium, chloride). Crystalloids can be divided into the following groups based on their concentration of electrolytes relative to that of body plasma: isotonic, hypertonic and hypotonic.

Fluid balance chart is a record of a patient's fluid intake, output and balance.

Fluid resuscitation is when a child or young person needs fluids to account for losses of red blood cells, plasma, water or electrolytes beyond the usual losses in urine, stools and sweat. These losses can come from burns, diarrhoea or vomiting. If this happens the aim is to replace any fluids and restore electrolyte balance.

Fluid Replacement and Redistribution is when a patient has an abnormal distribution of fluid in their body. The fluid is present but in the wrong place. Conditions such as cardiac dysfunction, liver disease, inappropriate antidiuretic hormone secretion and nephrotic syndrome can result in an excess of fluids in the body, known as fluid overload. It may also occur during sepsis, critical illness or after major surgery. If this happens, the aim is to rebalance and redistribute fluids and ensure the correct levels of electrolytes

Hypernatraemia is an increased sodium level in the blood (defined as plasma sodium greater than 145mmol/litre).

Hypertonic fluids are a solution with a higher concentration of electrolytes than body plasma. They draw water into the bloodstream to increase the blood volume.

Hyponatraemia is a decreased sodium level in the blood (defined as plasma sodium less than 135mmol/litre).

Hypotonic fluids are a solution with a lower concentration of electrolytes than body plasma. When a cell is immersed in a hypotonic solution, water will flow into the cell to balance the concentration of solutes. They typically have a concentration of 0.45% sodium chloride.

Isotonic fluids are a solution which has the same concentration of electrolytes as body plasma. They have a concentration of 0.9% sodium chloride.

Neonates are infants aged 28 days and under (born at term; or born prematurely who have a corrected age of term or more)

Young people are aged 12 to under 16 years

Appendix 4: Suggestions from stakeholder engagement exercise – registered stakeholders

ID	Stakeholder	Suggested key area for quality improvement	Why is this important?	Why is this a key area for quality improvement?	Supporting information
Assessment and monitoring – Assessment and documentation					
001	Baxter Healthcare Ltd.	Documented actual or estimated daily weight	Best indicator of the status of fluid balance. Rapid changes in weight are due to changes in fluid status.	Despite currently being routinely carried out, it may not necessarily be linked to the fluid chart.	NICE Clinical Guidelines CG174 "Clinical monitoring should include current status and trends in NEWS, Fluid balance charts and weight" – *although intended for adults is equally applicable to children and young people.*
002	SCM 2	Carry out urea and estimations daily or more frequently if clinically indicated.	This is an important way of monitoring the effects of iv fluids and helps guide further iv fluid prescribing.	This is a basic monitoring requirement that will improve patient safety.	This has been highlighted by others as an important monitoring requirement http://www.nrls.npsa.nhs.uk/resources/?entryid45=59809
Assessment and monitoring – Standardised fluid balance charts					
003	SCM 1	Adequate fluid balance chart for assessing and monitoring children receiving IV fluids	Precise measurement of fluid and electrolyte status is essential to ensure children are receiving the correct volume and type of fluid	The guideline specifies the minimum information needed on a fluid balance chart to ensure safe and correct administration of IV fluid. Currently there is no nationalised chart available.	Fluid balance charts vary widely from hospital to hospital and even from ward to ward. A standard chart would enable staff moving from area to area to know how to read and fill in the chart appropriately.
004	SCM 2	A standardised fluid balance and prescription chart for children to be used nationally	Currently there is no standard fluid balance and prescription chart in the NHS. In addition, there is variation in what is recorded and documented on a patient's chart between hospitals and between units within	The development of a chart that encompasses all of the aspects considered important in this NICE guideline relating to monitoring, prescribing and safely administering IV fluids would improve patient safety.	A unified chart has been developed in N Ireland and is currently being used in all hospitals where children are managed. An audit of this chart has recently been undertaken. http://www.gain-ni.org/images/Uploads/Audit/GAIN_

ID	Stakeholder	Suggested key area for quality improvement	Why is this important?	Why is this a key area for quality improvement?	Supporting information
			hospitals. This can make it difficult for clinicians to determine an accurate fluid balance for a patient when they are moving between hospitals and within hospital departments, and when there is more than 1 clinician involved in a patient's care.		VOLUME_1_Audit_of_Parenteral_Fluid_Therapy_for_Children_Young_Appendix_3_amended.pdf
005	SCM 3	Implementation of standardised fluid prescription and fluid balance charts in the UK	National Confidential Enquiries into Perioperative Deaths (NCEPOD) reports in 1999 and 2009 identified problems in fluid management in patients in the UK	A lack of consistency in prescribing and recording IV fluids may contribute to a high rate of complications. A lack of familiarity of 'mobile' medical and nursing staff with fluid balance charts in different hospital settings may further increase the likelihood of prescription and administration errors	Already available in the topic overview
Assessment and monitoring – Assessment before surgery					
006	Baxter Healthcare Ltd.	Routinely measure electrolyte and blood glucose before surgery	Not currently routinely performed for elective surgery.	Would help identify electrolyte imbalances prior to surgery to allow better peri-operative care and reduce side effects and complications.	Health Technology Assessment No.16:50 indicates these tests are low-cost as part of pre-operative work up. In adults targeted testing has probably led to a substantial resource saving but the high volume of all patients could be a burden on resources. NCEPOD Adding insult to injury 2009. All patients admitted as an emergency should have their

ID	Stakeholder	Suggested key area for quality improvement	Why is this important?	Why is this a key area for quality improvement?	Supporting information
					electrolytes checked routinely on admission and appropriately thereafter. This will prevent the insidious and unrecognised onset of AKI. *There are substantially lower paediatric, children and young adult patients requiring less resources for routine testing compared to the adult population. Undetected cardiac, renal or hepatic disorders may have a greater effect on these patients due to reduced metabolic compensatory mechanisms.*
Types of fluids - Type of fluid for resuscitation and routine maintenance					
007	Royal College of Paediatrics and Child Health	Key area for quality improvement 1	Physiologic saline should be use as standard maintenance fluid in acutely unwell children	It will decrease the mortality and morbidity associated with the use of hypotonic solutions	http://adc.bmj.com/content/early/2015/07/10/archdischild-2015-308858
008	SCM 1	Identifying what fluids to use for maintenance for different ages and conditions.	Apart from in resuscitation scenarios, the types of fluid prescribed for routine maintenance varies depending on the speciality and fluids available. This can cause confusion among professionals over what to prescribe in different circumstances.	It is important that clinicians are aware of the composition of the fluids they are prescribing and in what amounts in order to ensure safe prescribing and avoiding any electrolyte or glucose imbalances.	There is a wide range of fluids available to healthcare professionals which can be confusing, especially to doctors new to paediatrics. A table showing what fluids contain what is important to assist in safe prescribing of IV fluids.
009	SCM 2	The use of appropriate intravenous fluids for	Inappropriate fluid administration can cause harm, for example	Hypotonic intravenous fluids are still used in children in many	There are many publications in the literature highlighting harm caused

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		resuscitation and routine maintenance	serious neurological damage and death.	hospitals in the UK. Isotonic fluids have been shown to improve patient safety and this is highlighted in this NICE guideline.	by using hypotonic intravenous fluids in children.
Type of fluids- premixed solutions					
010	Baxter Healthcare Ltd.	Only administer pre-made potassium mixes unless not available in the dose required	In line with NPSA, eliminates risk of potassium bolus due to incorrect mixing.	Inclusion as a key area for quality improvement would help ensure compliance with NHS England Never Events 2015/16: Mis-selection of a strong potassium containing solution.	NPSA Alert 23 July 2002. "Commercially prepared ready to use diluted potassium solutions should be used wherever possible."
011	SCM 3	Prescription of IV fluids and electrolytes as premixed solutions	Medication and intravenous fluid prescribing and administration errors are a significant cause of patient safety incidents in the UK	There is some evidence (which I am not able to trace at the present time) that addition of eg, potassium, glucose, sodium bicarbonate to intravenous fluids at the point of contact, rather than in pre-mixed solutions is associated with an increased incident in patient safety incidents. Provision and administration of premixed solutions is a potential area for quality improvement that should be explored	*No additional information provided by stakeholder.*
Hypernatraemia and Hyponatraemia					
012	Baxter Healthcare Ltd.	Documented check and audit for hypo and hypernatraemia with a standard set of required documented information	Not currently routinely performed.	Audited data will demonstrate the number of patients checked at risk and complication rates and allow improvements to be implemented.	Paediatr Child Health 2013;18(2):102-104 Hospital acquired acute hyponatraemia is increasing recognised as a cause of morbidity and mortality in

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		which can be gradually introduced			children.
013	SCM 2	The recognition of the symptoms of acutely developing symptomatic hyponatraemic encephalopathy.	Hyponatraemic encephalopathy is a medical emergency and, if untreated, can cause permanent neurological damage or death.	Many of these symptoms are non-specific. Health care professional require a heightened awareness of identifying them when they develop in children receiving intravenous fluids.	Supported by many publications in the literature.
Training and education - Accountability					
014	Baxter Healthcare Ltd.	Clearer responsibility and accountability for training, governance and education in conjunction with adult lead	Training and education of IV fluid management is generally accepted as inadequate. Inadequate training and education leads to inadequate prescribing and administration which can lead to costly complications and increased length of stay.	Improved training and education will improve outcomes and reduce cost.	NCEPOD Extremes of age 1999. Training in fluid management, for medical and nursing staff, is required to increase awareness and spread good practice. Some doctors and nurses may lack awareness of the central role of good fluid management. Ann R Coll Surg Engl 2002;84:156-160 Consultant surgeons feel that the present practice in peri-operative fluid management is unsatisfactory. Higher standards with clinical governance and risk management may be achieved by focused practical training combined with formal written guidelines. Clinical Nutrition 2001;20(2):125-130 Inadequate knowledge and suboptimal prescribing of fluid and electrolyte is common.

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					Undergraduate and post graduate training in this basic patient management skill needs improvement, with particular emphasis on the practical aspects.
Training and education – Incidence reporting					
015	Baxter Healthcare Ltd.	Ensuring consistent incident and error reporting across all age groups	There is no current consistency to error reporting leading to under-reporting. Hospital IV fluid leads should review all critical incidents related to fluid mis-management to help refine training methods and identify possible improvements to internal processes. Without consistent reporting the true incidence of fluid mismanagement is not known. Without review of cases of IV fluid mismanagement no improvement in IV fluid therapy is possible.	Adequate and consistent error reporting enables route cause analysis and improvements to be implemented, enabling shared learning across the NRLS dataset.	NCEPOD Extremes of age 1999. When fluid imbalance was evident from review of the charts it often continued uncorrected. NICE Clinical Standards 66. By routinely reporting these events, even when well-managed, hospitals will increase learning, improving the likelihood of better patient outcomes. NICE Support for commissioning August 2014.
Additional areas					
016	SCM 2	Additional developmental areas of emergent practice: Development of audit tools to evaluate prescribing practices	Specific audit tools will highlight compliance with safer intravenous prescribing and identify complications of intravenous prescribing.	*No additional information provided by stakeholder.*	These are currently being developed in N Ireland
017	NHS England patient safety division	*No information provided by stakeholder.*	*No information provided by stakeholder.*	*No information provided by stakeholder.*	NHS England (Sep2015) National Safety Standards for Invasive Procedures (NatSSIPs)

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					NHS England (Sep2014) Patient safety alert – resources to support the prompt recognition of sepsis and the rapid initiation of treatment NHS England and Medicines and Healthcare products Regulatory Agency (MHRA) (Mar2014) Patient safety alert to improve reporting and learning of medication and medical devices incidents
018	Baxter Healthcare Ltd.	Training & education for anyone who is involved in prescribing and administration of intravenous fluids	Training and education of IV fluid management is generally accepted as inadequate. Inadequate training and education leads to inadequate prescribing and administration which can lead to costly complications and increased length of stay.	Improved training and education will improve outcomes and reduce cost.	NCEPOD An Acute Problem 2005. Training must be provided for junior doctors in the recognition of critical illness and the immediate management of fluid and oxygen therapy in these patients. NICE Clinical Standards No.66 Adults receiving intravenous fluid therapy in hospitals are cared for by healthcare professionals competent is assessing patient's fluid and electrolyte needs, prescribing and administering IV fluids, and monitoring patients response. *Although these recommendations are directed to adult patients, they are equally pertinent for paediatric and young patients.*
019	SCM 1	Training and education	Prescibers are not always aware	Failures in educating professionals	There is little formal training in IV

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		for prescribers of intravenous fluids for children.	of how to calculate how much fluid to prescribe in children which can result in under or over hydration or electrolyte imbalances. It is also important for nurses administering these fluids to know how to calculate infusion rates as they are the staff who will most likely be administering the fluid.	in this area could contribute to poor fluid balance chart documentation, incorrect volumes of fluid and types of fluid being prescribed and poor interpretation of any laboratory analysis.	management at present to support the correct and safe prescribing of intravenous fluids. This can contribute to prescribing and administration errors.
020	SCM 2	Ensure education and training for all healthcare professionals involved in prescribing and delivering IV fluid therapy for children and young people.	Accessible training and education for all health care professionals responsible for fluid management is important for patient safety and could reduce complication associated with iv fluid administration.	Formal training and education in IV fluid management in children will support best prescribing practices.	There is evidence to show that the prescription of intravenous fluid is performed poorly and that the knowledge base of those involved is often inadequate. http://www.bmj.com/content/342/bmj.d2741/rr/585271
021	NHS England	No Comments			
022	Royal College of Nursing	No Comments			