National Clinical Guideline Centre

IV fluids in children

Intravenous fluid therapy in children and young people in hospital

Appendix A

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Commissioned by the National Institute for Health and Care Excellence

Royal College of Physicians

The Royal College of Surgeons of England

Royal College of General Practitioners

Royal College of Nursing

NICE accredited

Disclaimer
Healthcare professionals are expected to take NICE clinical guidelines fully into account when exercising their clinical judgement. However, the guidance does not override the responsibility of healthcare professionals to make decisions appropriate to the circumstances of each patient, in consultation with the patient and/or their guardian or carer.

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Contents

Appendices 5

Appendix A: Scope 5

Appendices

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FINAL SCOPE

NATIONAL INSTITUTE FOR HEALTH AND CLINICAL EXCELLENCE

SCOPE

1 Guideline title

Intravenous fluid therapy in children and young people in hospital

1.1 Short title

Intravenous fluid therapy in children and young people in hospital

2 The remit

The Department of Health has asked NICE: 'to develop a clinical guideline on intravenous fluid therapy in children and young people in hospital'.

3 Need for the guideline

3.1 Epidemiology

a) Correct fluid and electrolyte balance is essential to maintain normal physiological function. In hospital, some children may not be able to maintain their normal fluid requirements by eating and drinking normally and, as such, may have depleted fluid levels and/or an electrolyte deficit. These children may need intravenous fluid therapy to maintain or restore the correct fluid and electrolyte balance.

b) Children may also need intravenous 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 occur via the loss of blood, plasma and other fluids as a result of burns, diarrhoea, vomiting or leakage of fluid from the circulation into the

Intravenous fluid therapy in children in hospital (final scope) Page 1 of 11

interstitial space. In these situations, the aim is to replace any depleted fluids and restore electrolyte balance.

c) Other conditions, such as cardiac dysfunction, liver disease, inappropriate antidiuretic hormone secretion and nephrotic syndrome can result in fluid overload, that is, an excess of fluids in the body. In these situations, the aim is to rebalance and redistribute fluids and ensure the correct levels of electrolytes.

d) Whether intravenous fluid therapy is needed for fluid resuscitation, routine maintenance, replacement or redistribution, it is vital that the choice, volume and timing of intravenous fluids are all correct. Different types of fluids are appropriate for different situations, and include colloids, crystalloids and combinations of fluids. Errors (and a lack of knowledge) in prescribing or administering intravenous fluids can result in inadequate or excessive provision, leading to hypovolaemia and poor organ perfusion, or hypervolaemia, oedema and heart failure respectively. Furthermore, failing to correct imbalances in electrolytes can lead to disturbances in intracellular or extracellular electrolyte balance in children, particularly in those with reduced liver or kidney function. Failing to deliver adequate fluid replacement can therefore have a significant impact on morbidity and mortality.

e) Infants and children are usually prescribed intravenous fluids based on their body weight, however, using body surface area may be a more appropriate way of calculating optimum fluid requirements. Additionally, a National Patient Safety Agency (NPSA) alert has highlighted safety concerns in relation to the use of hypotonic intravenous 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 this electrolyte disturbance than are adults.

3.2 *Current practice*

a) Prescribers are not always aware of the most appropriate intravenous fluid therapies to use in specific circumstances and as such, the amount of fluid or electrolytes provided can be either too high or too low to restore and maintain fluid balance. Additionally, many healthcare professionals may be unaware of the specific physiology associated with many conditions in children. There is little formal training and education in intravenous fluid management to support correct prescribing.

b) There is a wide variation in the type of charts used to prescribe fluids and to record fluid and electrolyte status. Monitoring children is often challenging; it may be difficult to assess urine output accurately and,blood tests can be painful and distressing for the child, and difficult to repeat. As a result, assessment and monitoring is often suboptimal, with fluid and electrolyte status not being recorded accurately. Changes in patients' requirements may not be reassessed which can lead to the inappropriate prescribing of fluids. Clinical staff need to ensure that appropriate identification, treatment and monitoring of changes in fluid and electrolyte status is maintained and documented.

c) There is debate within current paediatric practice as to the most effective way to calculate routine maintenance requirements for infants and children, notably whether weight or body surface area is the more appropriate method.

d) Overall, there is a need for a standardised approach to the clinical assessment of patients' fluid and electrolyte status and the prescription of intravenous fluid therapy in the NHS. This guidance represents a major opportunity to improve patient safety for children receiving intravenous fluid therapy in hospital.

4 The guideline

The guideline development process is described in detail on the NICE website (see section 6, 'Further information').

This scope defines what the guideline will (and will not) examine, and what the guideline developers will consider. The scope is based on the referral from the Department of Health.

The areas that will be addressed by the guideline are described in the following sections.

4.1 Population

This guideline will include recommendations about general principles for managing intravenous fluids in babies born at term, children and young people, and applies to a range of conditions and different hospital settings. It will not include recommendations relating to specific conditions.

4.1.1 Groups that will be covered

a) Babies born at term, infants, children and people younger than 16 years.

b) Babies born prematurely who have a corrected age of term or more.

c) No patient subgroups have been identified as needing specific consideration.

4.1.2 Groups that will not be covered

a) Adults aged 16 years or older.

b) Babies born prematurely whose corrected age is less than term.

4.2 Setting

a) Hospitals in which NHS care is funded or commissioned.

4.3 Management

4.3.1 Key issues that will be covered

a) Assessment, monitoring and reassessment of fluid and electrolyte status:

- Clinical assessment and reassessment, including:
  - hypovolemia and dehydration
  - measuring and recording weight and surface area.
- Laboratory or point-of-contact assessment of, for example:
  - plasma or blood (sodium, potassium, chloride, urea, creatinine, pH, bicarbonate and glucose)
  - urine (sodium and potassium).

Principles and protocols including appropriate documentation for prescribing, recording and monitoring intravenous fluid therapy in children and young people.

b) Intravenous fluid therapy for fluid resuscitation:

- Types, volume and rates of fluids and electrolytes to restore fluid balance (resuscitation), including:
  - 0.9% sodium chloride
  - albumin
  - crystalloids
  - synthetic colloids
  - balanced crystalloids.

c) Intravenous fluid therapy for routine maintenance:

- Types, volume and rates of fluids and electrolytes to maintain fluid balance, including:
  - how to calculate fluid and electrolyte maintenance requirements
  - the type of fluid and/or electrolyte to offer, including:
    - 0.9% sodium chloride

- 0.45% sodium chloride
- balanced crystalloids
- other crystalloids
- 0.9% sodium chloride with additional electrolytes
- 0.45% sodium chloride with additional electrolytes
- 0.9% sodium chloride with glucose
- 0.45% sodium chloride with glucose
- balanced crystalloids with glucose.

d) Intravenous fluid therapy for replacement and redistribution:

- Types, volume and rates of intravenous fluid and electrolytes to address abnormal deficits or excesses, or to replace abnormal losses.

e) Management of hypernatraemia and hyponatraemia that develops during intravenous fluid administration.

f) Skills needed for adequate training and education of healthcare professionals.

4.3.2 Issues that will not be covered

a) Routes of administration.

b) How to deliver intravenous fluids, including the use of volumetric pumps

c) Use of blood and blood products, except albumin.

d) Prescribing and monitoring of electrolytes, minerals and trace elements other than sodium, potassium and chloride, unless their status directly influences sodium, potassium and chloride provision (for example, high calcium influencing renal water reabsorption, low magnesium preventing the correction of hypokalaemia).

e) Use of inotropes to support people with circulatory failure.

f) Invasive monitoring of fluid status (for example, in critical care or during surgical anaesthesia).

g) Parenteral nutrition beyond consideration of fluid and electrolyte content.

h) Labelling, preparation and storage of both standard and non-standard intravenous fluids.

i) Ethical issues related to intravenous fluid prescription at the end of life.

j) Patient and carer information needs specific to intravenous fluids.

4.4 Main outcomes

a) Mortality.

b) Length of stay in hospital.

c) Adverse events.

d) Quality of life.

4.5 Review questions

Review questions guide a systematic review of the literature. They address only the key clinical issues covered in the scope, and usually relate to interventions, diagnosis, prognosis, service delivery or patient experience. Please note that these review questions are draft versions and will be finalised with the Guideline Development Group.

4.5.1 Assessment, monitoring and reassessment

a) What are the most clinically and cost-effective clinical methods for assessing, monitoring and reassessing fluid intake and output to determine intravascular volume and hydration states?

b) How effective is measuring and recording body weight compared with measuring and recording body surface area to calculate intravenous fluid requirements?

c) What are the most clinically and cost-effective laboratory-based or point-of-contact methods for assessing, monitoring and reassessing fluid and electrolyte status?

d) What key components need to be documented to ensure safe prescribing and improved fluid balance recording?

4.5.2 Intravenous fluid therapy for fluid resuscitation

e) What is the most clinically and cost-effective rate of administration for intravenous fluid resuscitation?

f) What is the clinical and cost effectiveness of albumin compared with crystalloids?

g) What is the clinical and cost effectiveness of synthetic colloids compared with crystalloids?

h) What is the clinical and cost effectiveness of albumin compared with synthetic colloids?

i) What is the clinical and cost effectiveness of balanced crystalloids compared with 0.9% sodium chloride?

4.5.3 Intravenous fluid therapy for routine maintenance

j) What is the most clinically and cost-effective rate of administration for routine maintenance?

k) What is the clinical and cost effectiveness of 0.9% sodium chloride compared with 0.45% sodium chloride?

l) What is the clinical and cost effectiveness of 0.9% sodium chloride compared with balanced crystalloids?

m) What is the clinical and cost effectiveness of 0.45% sodium chloride compared with balanced crystalloids?

n) What is the clinical and cost effectiveness of adding glucose and/or electrolytes to crystalloids?

4.5.4 Intravenous fluid therapy for replacement and redistribution

o) What is the clinical and cost effectiveness of different rates of intravenous fluid administration to address abnormal deficits or excesses, or to replace abnormal losses?

p) What fluid types are the most clinically and cost effective to address abnormal deficits or excesses, or to replace abnormal losses?

4.5.5 Management of hypernatraemia and hyponatraemia

q) What are the most clinically and cost-effective methods to address hyponatraemia and hypernatraemia that develops during intravenous fluid administration?

4.5.6 Training and education

r) What skills are needed for the adequate training and education of healthcare professionals involved in prescribing and administering intravenous fluids?

4.6 Economic aspects

Developers will take into account both clinical and cost effectiveness when making recommendations involving a choice between alternative interventions. A review of the economic evidence will be conducted and analyses will be carried out as appropriate. The preferred unit of effectiveness is the quality-adjusted life year (QALY), and the costs considered will usually be only from an NHS and personal social services (PSS) perspective. Further detail on the methods can be found in The guidelines manual.

4.7 Status

4.7.1 Scope

This is the final scope.

4.7.2 Timing

The development of the guideline recommendations will begin in November 2013.

5 Related NICE guidance

5.1 Published guidance

- Acute kidney injury. NICE clinical guideline 169 (2013).
- Feverish illness in children. NICE clinical guideline 160 (2013).
- Neutropenic sepsis. NICE clinical guideline 151 (2012).
- Sedation in children and young people. NICE clinical guideline 112 (2010).
- Bacterial meningitis and meningococcal septicaemia. NICE clinical guideline 102 (2010).
- Diarrhoea and vomiting in children. NICE clinical guideline 84 (2009).
- Diabetes in pregnancy. NICE clinical guideline 63 (2008).
- Urinary tract infection in children. NICE clinical guideline 54 (2007).
- Type 1 diabetes. NICE clinical guideline 15 (2004).
- Pre-hospital initiation of fluid replacement therapy in trauma. NICE technology appraisal 74 (2004).

5.2 Guidance under development

NICE is currently developing the following related guidance (details available from the NICE website):

- Intravenous fluid therapy in adults in hospital. NICE clinical guideline. Publication expected December 2013.
- Bronchiolitis in children. NICE clinical guideline. Publication expected April 2015.
- Transfusion. NICE clinical guideline. Publication expected May 2015.
- Major trauma. NICE clinical guideline. Publication expected June 2015.
- Diabetes in children and young people. NICE clinical guideline. Publication expected August 2015

- Medicines optimisation. NICE clinical guideline. Publication date to be confirmed.

6 Further information

Information on the guideline development process is provided in the following documents, available from the NICE website:

- How NICE clinical guidelines are developed: an overview for stakeholders the public and the NHS: 5th edition
- The guidelines manual.

Information on the progress of the guideline will also be available from the NICE website.