National Clinical Guideline Centre

Draft for consultation

IV fluids in children

Intravenous fluid therapy in children and young people in hospital

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Appendix N

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Draft for consultation

Commissioned by the National Institute for Health and Care Excellence

Royal College of Physicians

The Royal College of Surgeons of England

RCGP Royal College of General Practitioners

Royal College of Nursing

NICE accredited www.nice.org.uk/accreditation

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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Appendix N: Research recommendations

N.1 Complications of IV fluid therapy

Research question: What is the incidence of complications during, and as a consequence of, IV fluid therapy in neonates, infants, children and young people?

Why this is important:

Every day, children and young people are prescribed IV fluid therapy for a variety of reasons. However, there is little evidence on IV fluids in children and young people, and the limited evidence available is of very poor quality.

Complications of IV fluid therapy can lead to mortality and significant morbidity for the patient. This, in turn, represents a cost burden for the NHS in terms of critical care admissions, prolonged inpatient stays or the potential need for long-term follow-up and care by medical and allied healthcare professionals.

Criteria for selecting high-priority research recommendations:

PICO question	What is the incidence of complications during, and as a consequence of, IV fluid therapy in neonates, infants, children and young people? This question should address: • Fluid prescribed, composition and rate • Frequency of complications • Electrolyte or glucose abnormalities • Hypovolaemia or overload
Importance to patients or the population	Currently, monitoring of IV fluid therapy is based on clinical experience and varies greatly between units and regions within the UK. Results from this research would guide how monitoring of IV fluids should be performed, in an attempt to prevent complications.
Relevance to NICE guidance	Complications arising from IV fluid therapy can lead to mortality and significant morbidity for the patient, which can have a significant burden upon the NHS, given the size of the population receiving IV fluids
Relevance to the NHS	Complications of IV fluids will have a significant cost to the NHS. These costs will be incurred from the treatment of complications, such as intensive care admission or prolonged hospital stay.
National priorities	No
Current evidence base	There were no high quality studies identified during development of the guideline which answered this question.
Equality	This research question has no particular equality issues. There are particular groups of children that could be stratified, for example, those with acute kidney injury, those undergoing chemotherapy, neonates and older children with complex neurodisabilities.
Study design	A prospective cohort study looking at the indication for fluid therapy (for example bolus or maintenance), fluid composition and rate and frequency of pre-agreed complications, (for example electrolyte or glucose abnormality). Further stratification should help to bring advice forward for specific sub-groups of patients.
Feasibility	Feasibility should not be a problem for this research. IV fluids are prescribed to children on a daily basis throughout the UK; it should be possible to engage with multiple centres to achieve appropriate numbers of patients.

Other comments	None
Importance	High: this research is essential to inform future updates of key recommendations in the guidelines

N.2 Fluid balance charts

Research question: For children receiving IV fluids, does the implementation of a standardised national fluid balance chart reduce the rate of complications arising as a result of prescription and / or administration errors?

Why this is important:

The National Confidential Enquiry into Perioperative Deaths 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 this. 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.

If using a standardised national fluid balance chart resulted in better fluid prescription and clinical outcomes in children and young people, this would have significant cost implications for the NHS.

Criteria for selecting high-priority research recommendations:

PICO question	For children receiving IV fluids, does the implementation of a standardised national fluid balance chart reduce the rate of complications arising as a result of prescription and/or administration errors?
Importance to patients or the population	Better fluid prescription and clinical outcomes in children
Relevance to NICE guidance	A positive result would inform a recommendation for using a standardised national fluid balance chart
Relevance to the NHS	There would be reduced variation in practice, better outcomes and improved cost effectiveness
National priorities	No
Current evidence base	There were no high quality studies identified during development of the guideline which answered this question
Equality	The research question has no particular equality issues
Study design	A prospective cohort study comparing children receiving IV fluids prescribed and documented on a standardised national fluid balance chart with non-standard 'local' fluid balance charts or a case control study comparing children receiving IV fluids prescribed and documented on a standardised national fluid balance chart with non-standard 'local' fluid balance charts. Outcomes should include complications of intravenous IV fluid therapy (hypovolaemia, hypervolaemia, electrolyte abnormalities, neurological complications and hypoglycaemia) and incidence of prescription errors.
Feasibility	The proposed research could be carried out in a realistic timescale and at an acceptable cost, without ethical or technical issues
Other comments	None
Importance	Medium: the research is relevant to the recommendations in the guideline, but the research recommendations are not key to future updates

N.3 Glucose concentration

Research question: What is the most appropriate glucose concentration in IV fluids for children of different ages?

Why this is important:

In recent years, the use of glucose-containing hypotonic IV fluids in children and young people has been questioned, because of the risk of hyponatraemia. Many children and young people are now prescribed non-glucose-containing isotonic IV fluids for maintenance. However, there are several groups of children and young people, in particular, neonates and some children in the peri-operative period (for example, those who underwent prolonged fasting preoperatively, and those who had central blocks during anaesthesia), who may benefit from glucose-containing IV solutions to prevent hypoglycaemia. A blanket prescription of 5 or 10% glucose solution for all may result in hyperglycaemia in some children and young people. However, the use of IV fluids containing lower concentrations of glucose may be sufficient to prevent hypoglycaemia and also avoid unnecessary hyperglycaemia. This may have a clinical application across all age groups, including neonates.

Criteria for selecting high-priority research recommendations:

PICO question	What is the optimum glucose concentration in IV fluids to maintain normoglycaemia in neonates, infants and children over the age of one year? The comparison should be between an isotonic solution containing no glucose and isotonic solutions containing 1%, 2.5%, 5% and 10 % glucose. Primary outcome measure would be blood sugar estimation at 1 hour, 4 hours, 8 hours and 24 hours after start of IV fluids therapy. Secondary outcome measure would be serum sodium at the same time intervals. Groups should be stratified into surgical and non-surgical children.
Importance to patients or the population	The delivery of an optimal concentration of glucose would avoid both hypo and hyperglycaemia and the consequent morbidities. If this concentration was lower than the standard 2.5%, 5% or 10% solutions seen widely in clinical practice then this would allow the use of a lower glucose concentration in an isotonic solution to wider groups of patients thus avoiding the risks of using hypotonic solutions for maintenance. Improved maintenance of normoglycaemia would reduce morbidity and improve quality of outcome.
Relevance to NICE guidance	This would provide evidence to allow the specific recommendation of a single glucose concentration specific to each age group. It may be possible to recommend an isotonic solution containing glucose for all patient groups.
Relevance to the NHS	Solutions containing a low concentration of glucose (1%) are not commercially available within the UK. Evidence to support their use rather than the traditional higher concentration solutions would facilitate the commissioning of production by NHS representatives to commercial organisations. The potential wide applicability of such a solution would allow competitive pricing for NHS procurement.
National priorities	Not identified within NSF or white paper
Current evidence base	The current evidence is limited and based on prospective observational studies for small specific groups, not prospective, randomised and across all age groups. Further research would help to identify at risk groups (from hypoglycaemia) and would facilitate the evidence-based prescription of appropriately formulated glucose containing solutions to all children who required it.
Equality	There are no specific equality or diversity issues
Study design	Prospective randomised control study, age groups specified, comparing an isotonic solution containing no glucose with isotonic solutions containing 1%, 2.5%, 5% and 10 % glucose. It may be clearer to have surgical and non-surgical children as two separate populations.

Feasibility	Technical issues re solution availability (see below). No ethical issues identified.
Other comments	Note limited UK commercial availability of isotonic solutions containing glucose. Appropriate solutions may need to be sourced from manufacturers in mainland Europe.
Importance	High: the research is essential to inform future updates of key recommendations in the guideline

N.4 Training and education of healthcare professionals

Research question: Does ensuring that all hospital healthcare professionals involved in prescribing and delivering IV fluids for children and young people are appropriately trained in the principles of fluid prescribing and IV fluid therapy-related complications lead to a reduction in IV fluid-related complications and associated healthcare costs?

Why this is important:

Assessing patients' IV fluid needs, as well as prescribing and delivering IV fluids, are essential daily tasks on most paediatric wards. These are complex responsibilities that entail careful clinical and assessment, good understanding of the physiology of fluid homeostasis both in health and disease, and appropriate supervision and training. There is currently no standard training provided for healthcare professionals working in the UK. Any teaching at both undergraduate and postgraduate level is currently delivered ad hoc, and in many cases may be limited. If fluid management in hospitalised children and young people is to improve, standardised training is likely to be needed. Any educational interventions made would need to be evaluated to assess whether practice had subsequently improved.

Criteria for selecting high-priority research recommendations:

PICO question	Does the introduction of systems that ensure all hospital healthcare professionals involved in prescribing and delivering IV fluid therapy for children are appropriately trained in the principles of fluid prescribing and IV fluid therapy-related complications lead to a reduction in IV fluid-related complications and associated healthcare costs?
Importance to patients or the population	IV fluid therapy is widely used in hospitalised children. Improved treatment has the potential to reduce complications and possibly the length of hospital stay.
Relevance to NICE guidance	It is recognised that the prescribing and monitoring of fluid therapy in children is often sub-optimal, and that this occasionally leads to patient harm. One potential solution to this problem is to improve the education and training provided to the healthcare professionals involved.
Relevance to the NHS	Inappropriate fluid therapy has the potential to increase cost to the NHS, partly as a result of litigation and partly through increasing the length of stay in hospital. Even if poor management of IV fluids does not increase length of stay or result in legal action, reporting and follow up of fluid-related incidents can be very time consuming. Appropriate education and training would, theoretically at least, reduce these costs by improving treatment standards.
National priorities	In 2007, the National Patient Safety Agency (NPSA) highlighted the risk of fatal hyponatraemia in children receiving IV fluids and required all NHS trusts in the UK to take steps to minimise the risk. One of the stipulated actions was to 'provide adequate training and supervision for all staff involved in the prescribing, administering and monitoring of intravenous infusions for children'.
Current evidence base	It is supposed that one of the key reasons why IV fluid therapy in children is sub-optimal is that healthcare professionals lack sufficient training and education in this area. There is however, little concrete evidence to support this view, and more critically it is not known whether the introduction of structured education and training would improve standards. Numerous studies have tried to

	determine the most successful educational approaches to improving general prescribing of medicines. This work may assist in the development of an educational programme specific to IV fluid management in children.
Equality	N/A
Study design	The study could be conducted in two parts: Development of a training package/programme, with appropriate formative and/or summative assessment. Research would focus on quantitatively identifying the specific learning needs, determining what is the optimal method of delivering training and evaluating the developed training materials. Quantitative evaluation of the impact of the training package on fluid management when compared to a 'control group' who do not receive the training. This could either be in the same institution(s) pre-implementation of the new training programme, or in other matched hospital settings.
Feasibility	Development of training packages/programmes can be very time-consuming and expensive, especially if the delivery is to be online/electronic. Any research grant application would need to reflect these development costs.
Other comments	N/A
Importance	Medium: the research is relevant to the recommendations in the guideline, but the research recommendations are not key to future updates