Intravenous fluid therapy in adults in hospital

NICE guideline

Draft for consultation, May 2013

This guideline contains recommendations about general principles for managing intravenous (IV) fluids, and applies to a range of conditions and different settings. It does not include recommendations relating to specific conditions.

If you wish to comment on this version of the guideline, please be aware that all the supporting information and evidence is contained in the full version.

Contents

Introduction

Many adult hospital inpatients need intravenous (IV) fluid therapy to prevent or correct problems with their fluid and/or electrolyte status. Deciding on the optimal amount and composition of IV fluids to be administered and the best rate at which to give them can be a difficult and complex task, and decisions must be based on careful assessment of the patient's individual needs.

Errors in prescribing IV fluids and electrolytes are particularly likely in emergency departments, acute admission units, and general medical and surgical wards because staff in these areas often have less relevant expertise than those in operating theatres and critical care units. Surveys have shown that many staff who prescribe IV fluids know neither the likely fluid and electrolyte needs of individual patients, nor the specific composition of the many choices of IV fluids available to them. Standards of recording and monitoring IV fluid and electrolyte therapy may also be poor in these settings. IV fluid management in hospital is often delegated to the most junior medical staff who frequently lack the relevant experience and may have received little or no specific training on the subject.

The National Confidential Enquiry into Perioperative Deaths report in 1999 highlighted that a significant number of hospitalised patients were dying as a result of infusion of too much or too little fluid. The report recommended that fluid prescribing should be given the same status as drug prescribing. Although mismanagement of fluid therapy is rarely reported as being responsible for patient harm, it is likely that as many as 1 in 5 patients on IV fluids and electrolytes suffer complications or morbidity due to their inappropriate administration.

There is also considerable debate about the best IV fluids to use (particularly for more seriously ill or injured patients), resulting in wide variation in clinical practice. Many reasons underlie the ongoing debate, but most revolve around difficulties in interpretation of both trial evidence and clinical experience, including the following factors:

- Many accepted practices of IV fluid prescribing were developed for historical reasons rather than through clinical trials.
- Trials cannot easily be included in meta-analyses because they examine varied outcome measures in heterogeneous groups, comparing not only different types of fluid with different electrolyte content, but also different volumes and rates of administration and, in some cases, the additional use of inotropes or vasopressors.
- Most trials have been undertaken in operating theatres and critical care units rather than admission units or general and elderly care settings.
- Trials claiming to examine best early therapy for resuscitation have actually evaluated therapy choices made after initial resuscitation with patients already in critical care or operating theatres.
- Many trials inferring best therapy for resuscitation after acute fluid loss have actually examined situations of hypovolaemia induced by anaesthesia.

There is a clear need for guidance on IV fluid therapy for general areas of hospital practice, covering both the prescription and monitoring of IV fluid and electrolyte therapy, and the training and educational needs of all hospital staff involved in IV fluid management.

The aim of this NICE guideline is to help prescribers understand the:

- physiological principles that underpin fluid prescribing
- pathophysiological changes that affect fluid balance in disease states
- indications for IV fluid therapy
- reasons for the choice of the various fluids available **and**
- principles of assessing fluid balance.

It is hoped that this guideline will lead to better fluid prescribing in hospitalised patients, reduce morbidity and mortality, and lead to better patient outcomes.

Strategies for further research into the subject have also been proposed.

The guideline will assume that prescribers will use a drug's summary of product characteristics to inform decisions made with individual patients.

Patient-centred care

This guideline offers best practice advice on the care of adults in hospital receiving intravenous fluid therapy.

Patients and healthcare professionals have rights and responsibilities as set out in the NHS Constitution for England – all NICE guidance is written to reflect these. Treatment and care should take into account individual needs and preferences. Patients should have the opportunity to make informed decisions about their care and treatment, in partnership with their healthcare professionals. If someone does not have the capacity to make decisions, healthcare professionals should follow the Department of Health's advice on consent, the code of practice that accompanies the Mental Capacity Act and the supplementary code of practice on deprivation of liberty safeguards. In Wales, healthcare professionals should follow advice on consent from the Welsh Government.

NICE has produced guidance on the components of good patient experience in adult NHS services. All healthcare professionals should follow the recommendations in Patient experience in adult NHS services.

Strength of recommendations

Some recommendations can be made with more certainty than others. The Guideline Development Group makes a recommendation based on the trade-off between the benefits and harms of an intervention, taking into account the quality of the underpinning evidence. For some interventions, the Guideline Development Group is confident that, given the information it has looked at, most patients would choose the intervention. The wording used in the recommendations in this guideline denotes the certainty with which the recommendation is made (the strength of the recommendation).

For all recommendations, NICE expects that there is discussion with the patient about the risks and benefits of the interventions, and their values and preferences. This discussion aims to help them to reach a fully informed decision (see also ‘Patient-centred care’).

Interventions that must (or must not) be used

We usually use ‘must’ or ‘must not’ only if there is a legal duty to apply the recommendation. Occasionally we use ‘must’ (or ‘must not’) if the consequences of not following the recommendation could be extremely serious or potentially life threatening.

Interventions that should (or should not) be used – a ‘strong’ recommendation

We use ‘offer’ (and similar words such as ‘refer’ or ‘advise’) when we are confident that, for the vast majority of patients, an intervention will do more good than harm, and be cost effective. We use similar forms of words (for example, ‘Do not offer…’) when we are confident that an intervention will not be of benefit for most patients.

Interventions that could be used

We use ‘consider’ when we are confident that an intervention will do more good than harm for most patients, and be cost effective, but other options may be similarly cost effective. The choice of intervention, and whether or not to

have the intervention at all, is more likely to depend on the patient's values and preferences than for a strong recommendation, and so the healthcare professional should spend more time considering and discussing the options with the patient.

Key priorities for implementation

The following recommendations have been identified as priorities for implementation.

Principles and protocols for intravenous fluid therapy

- When prescribing IV fluids, remember the 5 Rs: Resuscitation, Routine maintenance, Replacement, Redistribution and Reassessment. **[1.1.3]**

- Offer IV fluid therapy as part of a protocol (see Algorithms for IV fluid therapy):
  - Assess patients' fluid and electrolyte needs following Algorithm 1: Assessment.
  - If patients need IV fluids for resuscitation, follow Algorithm 2: Resuscitation.
  - If patients need IV fluids for routine maintenance, follow Algorithm 3: Routine maintenance.
  - If patients need IV fluids to address existing deficits or excesses, or ongoing abnormal losses, follow Algorithm 4: Replacement and redistribution. **[1.1.4]**

- Include the following information in IV fluid prescriptions:
  - The type of fluid to be administered.
  - The rate and volume of fluid to be administered.

  The IV fluid management plan should detail the fluid and electrolyte prescription over the next 24 hours. **[1.1.5]**

Assessment and monitoring

- Assess the patient's likely fluid and electrolyte needs from their history, clinical examination, clinical monitoring and laboratory investigations:
  - History should include any previous limited intake, the quantity and composition of abnormal losses (see Diagram of ongoing losses), and any comorbidities.

  - Clinical examination should include an assessment of the patient's fluid status, including:
    - pulse, blood pressure, capillary refill and jugular venous pressure
    - presence of pulmonary or peripheral oedema
    - presence of postural hypotension.
  - Clinical monitoring should include current status and trends in:
    - NEWS
    - fluid balance charts
    - weight.
  - Laboratory investigations should include current status and trends in:
    - full blood count
    - urea, creatinine and electrolytes. **[1.2.2]**

- All patients continuing to receive IV fluids need regular monitoring. This should initially include at least daily reassessments of clinical fluid status, laboratory values (urea, creatinine and electrolytes) and fluid balance charts, along with weight measurement twice weekly. Be aware that:
  - patients receiving IV fluid therapy to address replacement or redistribution problems may need more frequent monitoring
  - additional monitoring of urine sodium can help to identify whole-body sodium depletion in patients who have high-volume gastrointestinal losses, and may be useful in assessing sodium status in oedematous patients
  - patients on longer-term IV fluid therapy whose condition is stable may be monitored less frequently, although decisions to reduce monitoring frequency should be detailed in their IV fluid management plan. **[1.2.4]**

- Clear incidents of fluid mismanagement (for example, unnecessarily prolonged dehydration or inadvertent fluid overload due to IV fluid therapy) should be reported through standard critical incident reporting to encourage improved training and practice (see Consequences of fluid mismanagement to be reported as critical incidents). **[1.2.6]**

Resuscitation

- If patients need IV fluid resuscitation, use crystalloids that contain sodium in the range 130–154 mmol/l, with a bolus of 500 ml over less than 15 minutes. **[1.3.1]**

Routine maintenance

- If patients need IV fluids for routine maintenance alone, restrict the initial prescription to:
  - 25–30 ml/kg/day of water **and**
  - approximately 1 mmol/kg/day of potassium, sodium and chloride **and**
  - approximately 50–100 g/day of glucose to limit starvation ketosis. **[1.4.1]**

Training and education

- Hospitals should establish systems to ensure that all healthcare professionals involved in prescribing and delivering IV fluid therapy are trained on the principles covered in this guideline, and are then formally assessed and reassessed at regular intervals to demonstrate competence in:
  - understanding the physiology of fluid and electrolyte balance in patients with normal physiology and during illness
  - assessing patients' fluid and electrolyte needs (the 5 Rs: Resuscitation, Routine maintenance, Replacement, Redistribution and Reassessment)
  - assessing the risks, benefits and harms of IV fluids
  - prescribing and administering IV fluids
  - monitoring the patient response
  - evaluating and documenting changes **and**
  - taking appropriate action as required. **[1.6.1]**

- Hospitals should have an IV fluids lead, responsible for training, clinical governance, audit and review of IV fluid prescribing and patient outcomes. **[1.6.3]**

Recommendations

The following guidance is based on the best available evidence. The full guideline [hyperlink to be added for final publication] gives details of the methods and the evidence used to develop the guidance.

1.1 Principles and protocols for intravenous fluid therapy

1.1.1 The assessment and management of patients' fluid and electrolyte needs is fundamental to good patient care, and should be part of every ward review. Provide intravenous (IV) fluid therapy only for patients whose needs cannot be met by oral or enteral routes, and stop as soon as possible.

1.1.2 Skilled and competent healthcare professionals should prescribe and administer IV fluids, and assess and monitor patients receiving IV fluids.

1.1.3 When prescribing IV fluids, remember the 5 Rs: Resuscitation, Routine maintenance, Replacement, Redistribution and Reassessment.

1.1.4 Offer IV fluid therapy as part of a protocol (see Algorithms for IV fluid therapy):

- Assess patients' fluid and electrolyte needs following Algorithm 1: Assessment.
- If patients need IV fluids for resuscitation, follow Algorithm 2: Resuscitation.
- If patients need IV fluids for routine maintenance, follow Algorithm 3: Routine maintenance.
- If patients need IV fluids to address existing deficits or excesses, or ongoing abnormal losses, follow Algorithm 4: Replacement and redistribution.

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Algorithms for IV fluid therapy

Algorithm 1: Assessment

Does the patient need fluid resuscitation?
Assess volume status taking into account clinical examination, trends and context. Possible indicators include: systolic BP <100mmHg; heart rate >90bpm; capillary refill >2s or peripheries cold to touch; respiratory rate >20 breaths per min; NEWS ≥5; 45° passive leg raising test positive.

Yes → **Algorithm 2: Resuscitation**

No → **Can the patient meet their fluid and/or electrolyte needs orally or enterally?**

Yes → **Ensure nutrition and fluid needs are met.** Also see 'Nutrition support in adults' (NICE clinical guideline 32).

No → **Assess the patient's likely fluid and electrolyte needs**
- History: previous limited intake, abnormal losses, comorbidities.
- Clinical examination: pulse, BP, capillary refill, JVP, oedema (peripheral/pulmonary), postural hypotension.
- Clinical monitoring: NEWS, fluid balance charts, weight.
- Laboratory assessments: FBC, urea, creatinine and electrolytes.

Does the patient have complex fluid or electrolyte replacement or abnormal distribution issues?
Look for existing deficits or excesses, ongoing losses, abnormal distribution or other complex issues.

Yes → **Algorithm 4: Replacement and Redistribution**

No → **Algorithm 3: Routine Maintenance**

Give maintenance IV fluids
Normal daily fluid and electrolyte requirements:
- 25–30 ml/kg/d water
- 1 mmol/kg/day sodium, potassium, chloride
- 50–100 g/day glucose (e.g. glucose 5% contains 5 g/100ml).

Reassess and monitor the patient
Stop IV fluids when no longer needed.
Nasogastric fluids or enteral feeding are preferable when maintenance needs are more than 3 days.

Algorithm 2: Resuscitation

Initiate treatment
- Give high-flow oxygen.
- Secure large bore IV access.
- Identify cause of deficit and respond.

Give a fluid bolus of 500 ml of crystalloid

Reassess the patient using the ABCDE approach (Airway, Breathing, Circulation, Disability, Exposure)
Does the patient still need fluid resuscitation?

Yes → >2000 ml given?
- Yes → **Seek expert help urgently**
- No → **Give a further fluid bolus of 250–500 ml of crystalloid** → Reassess the patient using the ABCDE approach (Airway, Breathing, Circulation, Disability, Exposure) Does the patient still need fluid resuscitation?

No → **Does the patient have signs of shock?**
- Yes → **Seek expert help urgently**
- No → **Assess the patient's likely fluid and electrolyte needs**

Algorithm 4: Replacement and Redistribution

Are there existing fluid and/or electrolyte deficits or excesses?
Check for:
- dehydration
- fluid overload
- hyper/hypokalaemia.

Yes → **Estimate deficits or excesses and add to or subtract from normal daily maintenance requirements**

No → **Are there any ongoing abnormal fluid or electrolyte losses?**

Yes → **Check for:**
- vomiting and nasogastric tube loss
- biliary drainage loss
- high/low volume ileal stoma loss
- diarrhoea/excess colostomy loss
- ongoing blood loss, e.g. melena
- sweating/fever/dehydration
- pancreatic/jejunal fistula/stoma loss
- urinary loss, e.g. post AKI polyuria.

Prescribe for routine maintenance requirement plus additional fluid and electrolyte supplements to replace the 'measured' abnormal 'ongoing' losses.

Monitor and reassess fluid and biochemical status by clinical and laboratory monitoring.

No → **Are there other complex issues?**
Check if allowance required for:
- gross oedema
- severe sepsis
- hyper/hyponatraemia
- renal, liver and/or cardiac impairment.

Yes → **Seek expert help promptly**

1.1.5 Include the following information in IV fluid prescriptions:

- The type of fluid to be administered.
- The rate and volume of fluid to be administered.

The IV fluid management plan should detail the fluid and electrolyte prescription over the next 24 hours.

1.1.6 When prescribing IV fluids and electrolytes, take into account all other sources of fluid and electrolyte intake, including any oral or enteral intake, and intake from drugs, IV nutrition, blood and blood products.

1.1.7 Patients have a valuable contribution to make to their fluid balance. If a patient needs IV fluids, explain the decision, and discuss the signs and symptoms they need to look out for if their fluid balance needs adjusting. Provide written information (for example, NICE's Information for the public [hyperlink to be added for final publication]), and involve the patient's family members or carers (as appropriate).

1.2 Assessment and monitoring

Initial assessment

1.2.1 Assess whether the patient is hypovolaemic and needs IV fluid resuscitation. Indicators of urgent resuscitation include:

- systolic blood pressure is less than 100 mmHg
- heart rate is more than 90 beats per minute
- capillary refill time is more than 2 seconds or peripheries are cold to touch
- respiratory rate is more than 20 breaths per minute
- National Early Warning Score (NEWS) is 5 or more
- passive leg raising test is positive.

1.2.2 Assess the patient's likely fluid and electrolyte needs from their history, clinical examination, clinical monitoring and laboratory investigations:

- History should include any previous limited intake, the quantity and composition of abnormal losses (see Diagram of ongoing losses), and any comorbidities.
- Clinical examination should include an assessment of the patient's fluid status, including:
  - pulse, blood pressure, capillary refill and jugular venous pressure
  - presence of pulmonary or peripheral oedema
  - presence of postural hypotension.
- Clinical monitoring should include current status and trends in:
  - NEWS
  - fluid balance charts
  - weight.
- Laboratory investigations should include current status and trends in:
  - full blood count
  - urea, creatinine and electrolytes.

Reassessment

1.2.3 If patients are receiving IV fluids for resuscitation, reassess the patient using the ABCDE approach (Airway, Breathing, Circulation, Disability, Exposure), monitor their respiratory rate, pulse, blood pressure and perfusion continuously, and measure their venous lactate levels and/or arterial pH and base excess according to guidance on advanced life support (Resuscitation Council [UK], 2011).

1.2.4 All patients continuing to receive IV fluids need regular monitoring. This should initially include at least daily reassessments of clinical fluid status, laboratory values (urea, creatinine and electrolytes)

and fluid balance charts, along with weight measurement twice weekly. Be aware that:

- patients receiving IV fluid therapy to address replacement or redistribution problems may need more frequent monitoring
- additional monitoring of urine sodium can help to identify whole-body sodium depletion in patients who have high-volume gastrointestinal losses, and may be useful in assessing sodium status in oedematous patients
- patients on longer-term IV fluid therapy whose condition is stable may be monitored less frequently, although decisions to reduce monitoring frequency should be detailed in their IV fluid management plan.

1.2.5 If patients have received IV fluids containing chloride concentrations greater than 120 mmol/l (for example, sodium chloride 0.9%), monitor their serum chloride concentration daily. If patients develop hyperchloraemia or acidaemia, reassess their IV fluid prescription and assess their acid–base status. Consider less frequent monitoring for patients who are stable.

1.2.6 Clear incidents of fluid mismanagement (for example, unnecessarily prolonged dehydration or inadvertent fluid overload due to IV fluid therapy) should be reported through standard critical incident reporting to encourage improved training and practice (see Consequences of fluid mismanagement to be reported as critical incidents).

1.2.7 If patients are transferred to a different location, reassess their fluid status and IV fluid management plan.

1.3 Resuscitation

1.3.1 If patients need IV fluid resuscitation, use crystalloids that contain sodium in the range 130–154 mmol/l, with a bolus of 500 ml over less than 15 minutes.

1.3.2 Do not use tetrastarch for resuscitation, unless as part of a clinical trial.

1.3.3 Consider human albumin solution 4–5% only for resuscitation in patients with severe sepsis.

1.4 Routine maintenance

1.4.1 If patients need IV fluids for routine maintenance alone, restrict the initial prescription to:

- 25–30 ml/kg/day of water **and**
- approximately 1 mmol/kg/day of potassium, sodium and chloride **and**
- approximately 50–100 g/day of glucose to limit starvation ketosis.

1.4.2 For patients who are obese, adjust the IV fluid prescription to their ideal body weight. Use lower range volumes per kg (patients rarely need more than a total of 3 litres of fluid per day) and seek expert help if their BMI is more than 40 kg/m^2.

1.4.3 Do not exceed 30 ml/kg/day for routine fluid maintenance, and consider prescribing less fluid (for example, 25 ml/kg/day fluid) for patients who:

- are older or frail
- have renal impairment or cardiac failure.

1.4.4 When prescribing for routine maintenance alone, consider using 25–30 ml/kg/day sodium chloride 0.18% in 4% glucose with 27 mmol/l potassium on day 1 (there are other regimens to achieve this). Prescribing more than 2.5 litres per day increases the risk of hyponatraemia. Further prescriptions should be guided by monitoring.

1.4.5 Consider delivering IV fluids for routine maintenance during daytime hours, if possible.

1.5 Replacement and redistribution

1.5.1 Adjust the IV prescription (add to or subtract from maintenance needs) to account for existing fluid and/or electrolyte deficits or excesses, ongoing losses (see Diagram of ongoing losses) or abnormal distribution.

1.5.2 Seek expert help if patients have a complex fluid and/or electrolyte redistribution issue or imbalance, or significant comorbidity, for example:

- gross oedema
- severe sepsis
- hyponatraemia or hypernatraemia
- renal, liver and/or cardiac impairment.

1.6 Training and education

1.6.1 Hospitals should establish systems to ensure that all healthcare professionals involved in prescribing and delivering IV fluid therapy are trained on the principles covered in this guideline, and are then formally assessed and reassessed at regular intervals to demonstrate competence in:

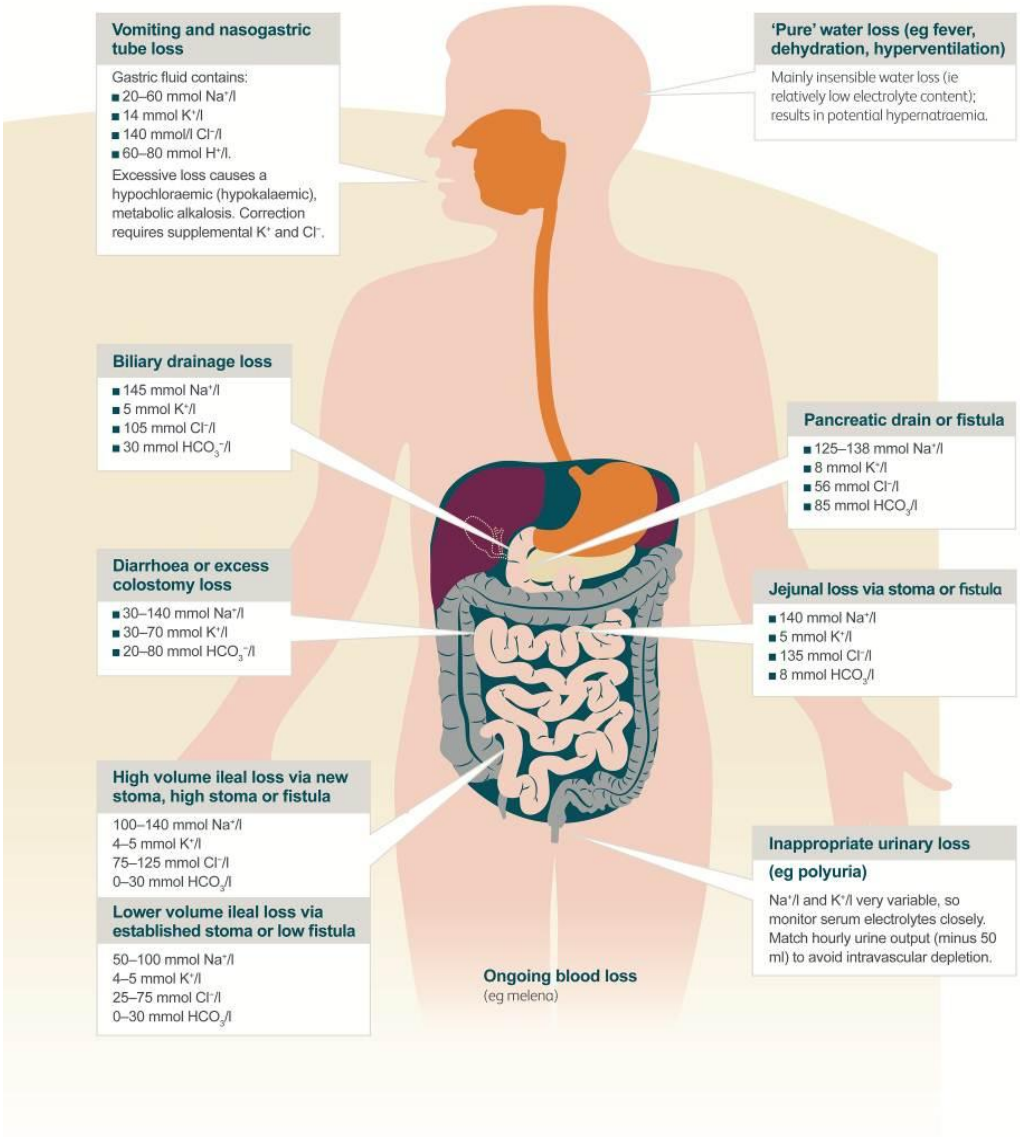
- understanding the physiology of fluid and electrolyte balance in patients with normal physiology and during illness
- assessing patients' fluid and electrolyte needs (the 5 Rs: Resuscitation, Routine maintenance, Replacement, Redistribution and Reassessment)
- assessing the risks, benefits and harms of IV fluids
- prescribing and administering IV fluids
- monitoring the patient response
- evaluating and documenting changes **and**
- taking appropriate action as required.

1.6.2 Healthcare professionals should receive training and education about, and be competent in, recognising, assessing and preventing consequences of mismanaged IV fluid therapy, including:

- pulmonary oedema
- peripheral oedema
- volume depletion and shock.

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.

Diagram of ongoing losses



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Consequences of fluid mismanagement to be reported as critical incidents

Consequence of fluid mismanagement	Identifying features	Time frame of identification

Dehydration	• Patient's fluid needs not met by oral or enteral intake **and**
	  ○ Features of dehydration on clinical examination
	  ○ Low urine output or concentrated urine
	  ○ Biochemical indicators, such as more than 50% increase in urea or creatinine with no other identifiable cause
		Before and during IV fluid therapy

Pulmonary oedema (breathlessness during infusion)	• No other obvious cause identified (for example, pneumonia, pulmonary embolus or asthma) • Features of pulmonary oedema on clinical examination • Features of pulmonary oedema on X-ray	During IV fluid therapy or within 6 hours of stopping IV fluids
Hyponatraemia	• Serum sodium less than 130 mmol • No other likely cause of hyponatraemia identified	During IV fluid therapy or within 24 hours of stopping IV fluids
Hypernatraemia	• Serum sodium 155 mmol/l or more • Baseline sodium normal or low • IV fluid regimen included 0.9% sodium chloride • No other likely cause of hypernatraemia identified	During IV fluid therapy or within 24 hours of stopping IV fluids
Peripheral oedema	• Pitting oedema in extremities and/or lumbar sacral area • No other obvious cause identified (for example, nephrotic syndrome or known cardiac failure)	During IV fluid therapy or within 24 hours of stopping IV fluids
Hyperkalaemia	• Serum potassium more than 5.5 mmol	During IV fluid therapy or within 24 hours of stopping IV fluids
Hypokalaemia	• Serum potassium less than 3.0 likely to be due to infusion of fluids without adequate potassium provision • No other obvious cause (for example, potassium-wasting diuretics, re-feeding syndrome)	During IV fluid therapy or within 24 hours of stopping IV fluids

2 Research recommendations

The Guideline Development Group has made the following recommendations for research, based on its review of evidence, to improve NICE guidance and patient care in the future. The Guideline Development Group's full set of research recommendations is detailed in the full guideline.

2.1 Assessment and monitoring

What is the incidence of complications during, and as a consequence of, IV fluid therapy?

Why this is important

This is almost certainly under-reported in the ward setting with significant implications for patients, predominantly morbidity through to mortality. It is probable that complications of fluid therapy are frequent and may be associated with increased clinical needs, such as critical care and, on occasion, may necessitate resuscitation. Lack of a set of clearly defined features of the complications of fluid mismanagement compounds the problem. It is important to define these features and then undertake an observational study in a hospital setting to determine the epidemiology of these complications. Such a study would highlight the prevalence of fluid related complications and inform the development of preventive measures.

2.2 IV fluid therapy for resuscitation

Are balanced solutions superior to sodium chloride 0.9% for the resuscitation of patients with acute shock?

Why this is important

Physiological studies, large cohort studies and small randomised studies have shown that balanced crystalloids may be superior to sodium chloride 0.9% for the treatment of surgical patients. However, the quality of the evidence is poor. These studies have shown that, when compared with sodium chloride 0.9%, there is less disturbance in acid–base balance (hyperchloraemic

acidosis), acute kidney injury, the need for renal replacement therapy, blood loss and overall complication rates with balanced crystalloids. However, large randomised trials have shown that crystalloids are superior to colloids for resuscitation. In these studies colloids were given for prolonged periods of time and the groups of patients included were heterogenous. The proposed trial will help validate whether the data gathered from physiological studies and cohort studies that compared sodium chloride 0.9% with balanced crystalloids translate into relevant clinical benefit in patients needing acute fluid resuscitation, and will be a valuable guide to clinical practice.

Are balanced crystalloids superior to a combination of a balanced crystalloid and a gelatin suspended in a balanced solution for the resuscitation of patients with acute shock?

Why this is important

Recent large randomised controlled trials suggest that crystalloids (sodium chloride 0.9% or balanced solutions) are superior to 6% hydroxyethyl starch for resuscitation. Mortality and complication rates, especially renal complications, may be increased with 6% hydroxyethyl starch. However, there is a lack of good-quality evidence on the use of gelatin for resuscitation. Some randomised controlled trials have shown that when colloids are used for resuscitation, volumes of fluid required may be less than with crystalloids. It must be remembered that colloids cannot be used exclusively for resuscitation and that some free water must be provided, and there are limited data on the use of gelatins for resuscitation. The proposed trial will help inform whether a combination of gelatin and crystalloid is superior to crystalloid alone for the resuscitation of patients with acute shock.

2.3 IV fluid therapy for routine maintenance

Does a higher sodium content IV fluid regimen for maintenance reduce the risk of developing hyponatraemia and volume depletion without increasing the risk of volume overload in hospitalised adults?

Why this is important

Patients who cannot meet their daily needs of fluids and electrolytes through oral or enteral routes but are otherwise euvolaemic often need IV fluid therapy for maintenance. The most common complications of this therapy are hyponatraemia (if excessive IV water is administered), volume overload (if excessive sodium and water are administered) and volume depletion and/or acute kidney injury (if inadequate sodium and water are administered). There are no published trials considering what the optimal IV fluid regimen for maintenance is.

A randomised controlled trial is needed to compare IV fluid maintenance regimens with different sodium concentrations (for example, comparison between sodium chloride 0.18% in glucose 4% and sodium chloride 0.45% in glucose 4% solutions) in terms of the above detailed complication rates, cost and other clinical outcomes (for example, length of stay). The patient group will be heterogeneous, and analysis should consider both 'medical' and 'surgical' patients.

2.4 Training and education

Does the introduction of hospital systems that ensure:

- all hospital healthcare professionals involved in prescribing and delivering IV fluid therapy are appropriately trained in the principles of fluid prescribing; and
- all IV fluid therapy-related complications are reported;

lead to a reduction in IV fluid-related complications and associated healthcare costs?

Why this is important

Despite the fact that assessment of a patient's IV fluid needs and prescription of an appropriate IV fluid regimen can be complex, the job is often delegated to healthcare professionals with limited experience and little or no relevant training. Errors in prescribing IV fluids and electrolytes are thought to be common and associated with unnecessary morbidity, mortality and increased

healthcare costs. The problems are most likely to occur in emergency departments, acute admission units and medical and surgical wards rather than operating theatres and critical care units, since the staff in more general hospital areas have less relevant expertise, and standards of recording and monitoring of IV fluid and electrolyte therapy can be poor. In addition, the consequences of IV fluid mismanagement are not widely reported. It would be useful to undertake this study to evaluate and audit the effects of introducing training and governance initiatives in the NHS.

3 Other information

3.1 Scope and how this guideline was developed

NICE guidelines are developed in accordance with a scope that defines what the guideline will and will not cover.

How this guideline was developed

NICE commissioned the National Clinical Guideline Centre to develop this guideline. The Centre established a Guideline Development Group (see section 4), which reviewed the evidence and developed the recommendations.

The methods and processes for developing NICE clinical guidelines are described in The guidelines manual.

3.2 Related NICE guidance

Details are correct at the time of consultation on the guideline (May 2013). Further information is available on the NICE website.

Published

General

- Patient experience in adult NHS services. NICE clinical guidance 138 (2012).

- Medicines adherence. NICE clinical guidance 76 (2009).

Condition-specific

- Prevention and control of healthcare associated infections. NICE public health guidance 36 (2011).
- Delirium. NICE clinical guideline 103 (2010).
- Chronic kidney disease. NICE clinical guideline 73 (2008). This guidance is currently being updated.
- Acutely ill patients in hospital. NICE clinical guideline 50 (2007).
- Nutrition support in adults. NICE clinical guideline 32 (2006).
- Obesity. NICE clinical guideline 43 (2006)
- Type 1 diabetes. NICE clinical guideline 15 (2004).
- Pre-hospital initiation of fluid replacement therapy in trauma. NICE technology appraisal guidance 74 (2004).

Under development

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

- Acute kidney injury. NICE clinical guideline. Publication expected August 2013.

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