NICE National Institute for Health and Care Excellence

NICE guideline

Intravenous fluid therapy in over 16s in hospital

Clinical guideline

Published: 10 December 2013
nice.org.uk/guidance/cg174

Contents

This guideline is the basis of QS66.

Introduction

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.

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 rather than 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 fluid resuscitation have actually evaluated therapy choices made after initial fluid resuscitation, with patients already in critical care or operating theatres.
- Many trials inferring best therapy for fluid 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.

In developing the guideline, it was necessary to limit the scope by excluding patient groups with more specialised fluid prescribing needs. It is important to emphasise that the recommendations do not apply to patients under 16 years, pregnant women, and those with severe liver or renal disease, diabetes or burns. They also do not apply to patients needing inotropes and those on intensive monitoring, and so they have less relevance to intensive care settings and patients during surgical anaesthesia. Patients with traumatic brain injury (including patients needing neurosurgery) are also excluded. The scope of the guideline does not cover the practical aspects of administration (as opposed to the prescription) of IV fluids.

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 people over 16 years who are 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. Healthcare professionals should follow the Department of Health's advice on consent. If someone does not have capacity to make decisions, healthcare professionals should follow 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.

Key priorities for implementation

The following recommendations have been identified as priorities for implementation. The full list of recommendations is in section 1.

Principles and protocols for intravenous fluid therapy

- When prescribing IV fluids, remember the 5 Rs: Resuscitation, Routine maintenance, Replacement, Redistribution and Reassessment.
- 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 fluid resuscitation, follow Algorithm 2: Fluid 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, ongoing abnormal losses or abnormal fluid distribution, follow Algorithm 4: Replacement and redistribution.
- Patients should have an IV fluid management plan, which should include details of:
  - the fluid and electrolyte prescription over the next 24 hours
  - the assessment and monitoring plan.

    Initially, the IV fluid management plan should be reviewed by an expert daily. IV fluid management plans for patients on longer-term IV fluid therapy whose condition is stable may be reviewed less frequently.

Assessment and monitoring

- Assess the patient's likely fluid and electrolyte needs from their history, clinical examination, current medications, clinical monitoring and laboratory investigations:
  - History should include any previous limited intake, thirst, the quantity and composition of abnormal losses (see Diagram of ongoing losses), and any comorbidities, including patients who are malnourished and at risk of refeeding syndrome (see Nutrition support in adults [NICE clinical guideline 32]).

  - 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:
    - National Early Warning Score (NEWS)
    - fluid balance charts
    - weight.
  - Laboratory investigations should include current status and trends in:
    - full blood count
    - urea, creatinine and electrolytes.

- 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 urinary sodium may be helpful in patients with high-volume gastrointestinal losses. (Reduced urinary sodium excretion [less than 30 mmol/l] may indicate total body sodium depletion even if plasma sodium levels are normal. Urinary sodium may also indicate the cause of hyponatraemia, and guide the achievement of a negative sodium balance in patients with oedema. However, urinary sodium values may be misleading in the presence of renal impairment or diuretic therapy.)
  - 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.

- 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).

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. (For more information, see the Composition of commonly used crystalloids table.)

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. (This quantity will not address patients' nutritional needs; see Nutrition support in adults [NICE clinical guideline 32].)

For more information see IV fluid prescription for routine maintenance over a 24-hour period.

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.

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

1 Recommendations

The following guidance is based on the best available evidence. The full guideline gives details of the methods and the evidence used to develop the guidance.

Terms used in this guideline

In this guideline, the term 'expert' refers to a healthcare professional who has core competencies to diagnose and manage acute illness. These competencies can be delivered by a variety of models at a local level, such as a critical care outreach team, a hospital-at-night team or a specialist trainee in an acute medical or surgical specialty. For more information, see Acutely ill patients in hospital (NICE clinical guideline 50).

> The wording used in the recommendations in this guideline (for example, words such as 'offer' and 'consider') denotes the certainty with which the recommendation is made (the strength of the recommendation). See About this guideline for details.

1.1 Principles and protocols for intravenous fluid therapy

The assessment and management of patients' fluid and electrolyte needs is fundamental to good patient care.

1.1.1 Assess and manage patients' fluid and electrolyte needs as 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 (see recommendations 1.6.1–1.6.3).

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

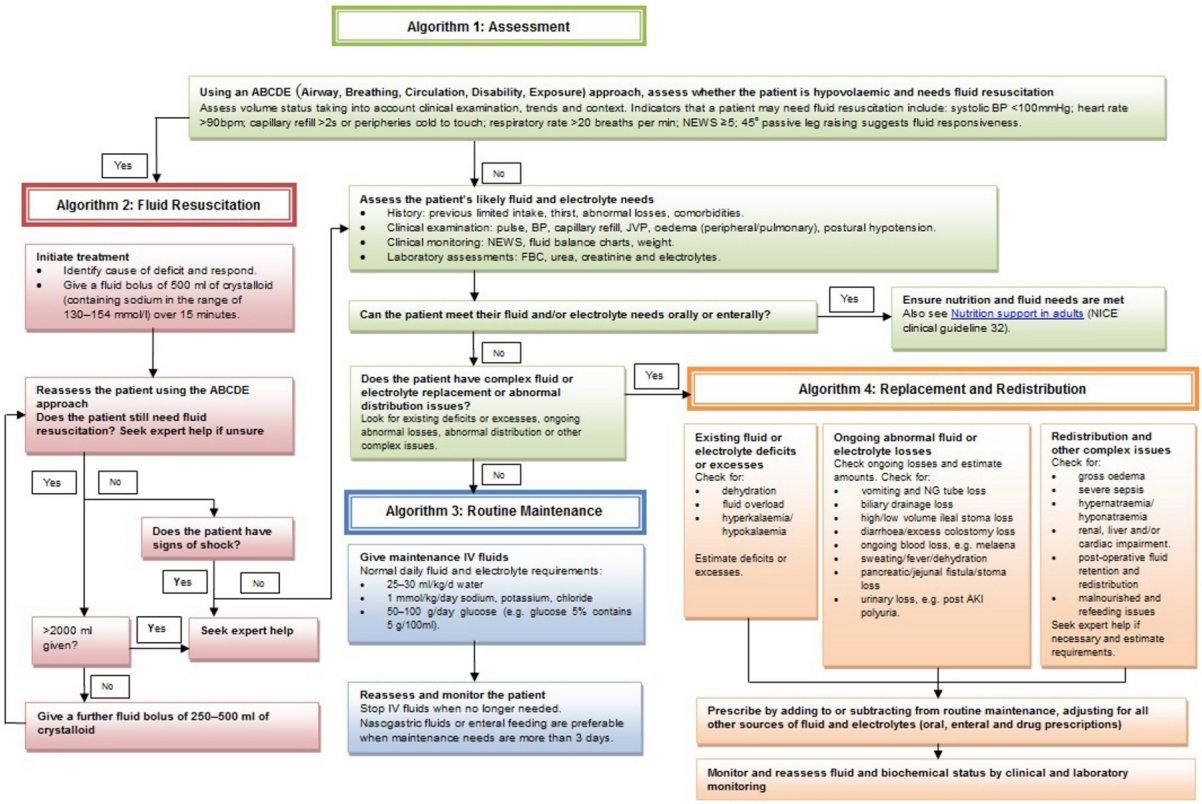
1.1.4 Offer IV fluid therapy as part of a protocol (see Algorithms for IV fluid therapy):

- Assess patients' fluid and electrolyte needs following Algorithm 1: Assessment.
- If patients need IV fluids for fluid resuscitation, follow Algorithm 2: Fluid 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, ongoing abnormal losses or abnormal fluid distribution, follow Algorithm 4: Replacement and redistribution.

Algorithms for IV fluid therapy

Download the PDF here.



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.

1.1.6 Patients should have an IV fluid management plan, which should include details of:

- the fluid and electrolyte prescription over the next 24 hours

- the assessment and monitoring plan.

  Initially, the IV fluid management plan should be reviewed by an expert daily. IV fluid management plans for patients on longer-term IV fluid therapy whose condition is stable may be reviewed less frequently.

1.1.7 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.

1.1.8 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. If possible or when asked, provide written information (for example, NICE's Information for the public), 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. Indicators that a patient may need urgent fluid 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 suggests fluid responsiveness[1].

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

- History should include any previous limited intake, thirst, the quantity and composition of abnormal losses (see Diagram of ongoing losses), and any

comorbidities, including patients who are malnourished and at risk of refeeding syndrome (see Nutrition support in adults [NICE clinical guideline 32]).

- 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 urinary sodium may be helpful in patients with high-volume gastrointestinal losses. (Reduced urinary sodium excretion [less than 30 mmol/l] may indicate total body sodium depletion even if plasma sodium levels are normal. Urinary sodium may also indicate the cause of hyponatraemia, and guide the achievement of a negative sodium balance in patients with oedema. However, urinary sodium values may be misleading in the presence of renal impairment or diuretic therapy.)

- 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 on arrival in the new setting.

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. (For more information, see the Composition of commonly used crystalloids table.)

1.3.2 Do not use tetrastarch for fluid resuscitation.

1.3.3 Consider human albumin solution 4–5% for fluid resuscitation only 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. (This quantity will not address patients' nutritional needs; see Nutrition support in adults [NICE clinical guideline 32].)

  For more information see IV fluid prescription for routine maintenance over a 24-hour period.

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 Consider prescribing less fluid (for example, 20–25 ml/kg/day fluid) for patients who:

- are older or frail
- have renal impairment or cardiac failure
- are malnourished and at risk of refeeding syndrome (see Nutrition support in adults [NICE clinical guideline 32]).

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. These are initial prescriptions and further prescriptions should be guided by monitoring.

1.4.5 Consider delivering IV fluids for routine maintenance during daytime hours to promote sleep and wellbeing.

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
- post-operative fluid retention and redistribution
- malnourished and refeeding issues (see Nutrition support in adults [NICE clinical guideline 32]).

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.

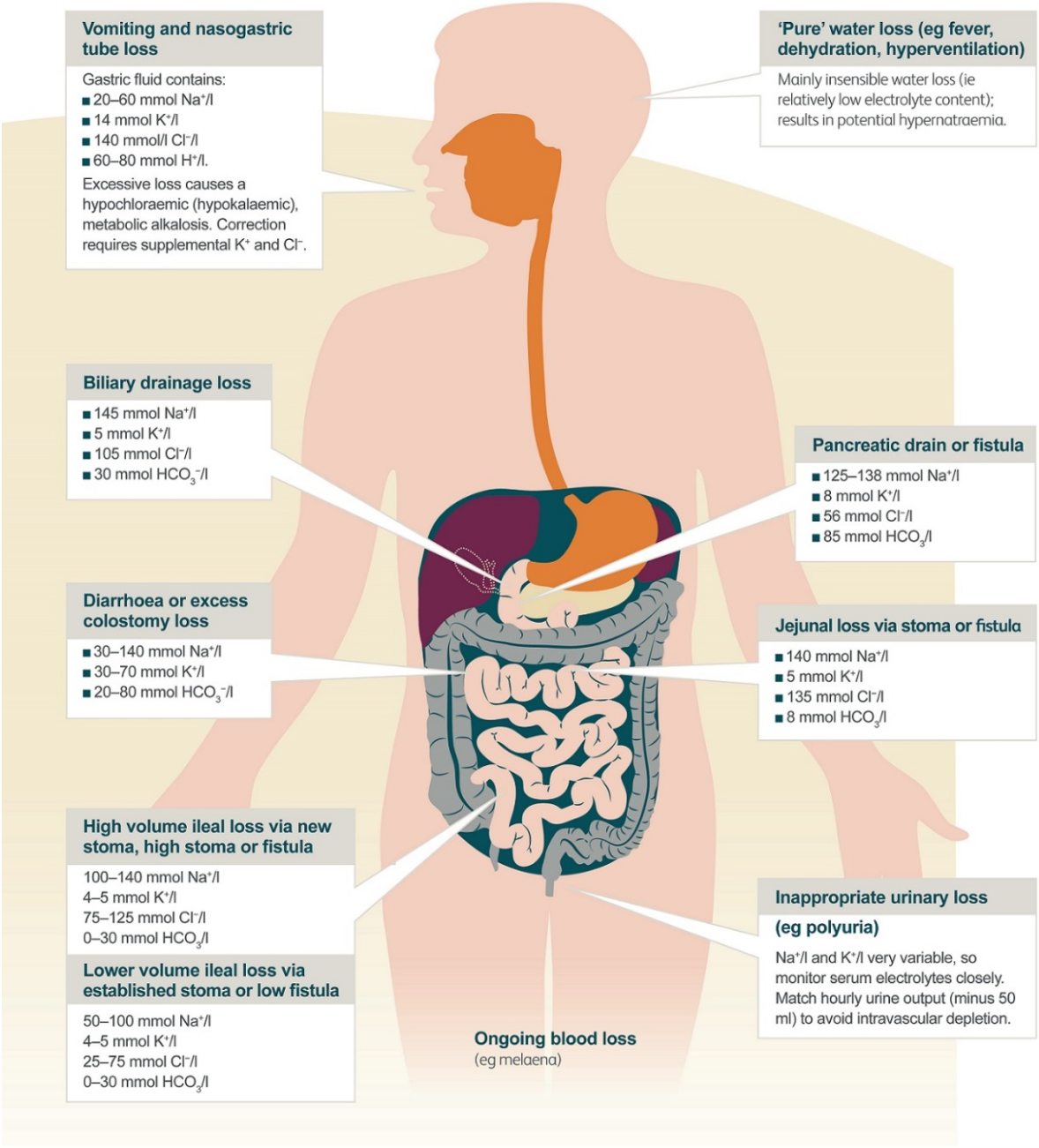
1.6.2 Healthcare professionals should receive training and education about, and be competent in, recognising, assessing and preventing consequences of mismanaged IV fluid therapy, including:

- 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

Download the PDF here.



Source: Copyright – National Clinical Guideline Centre

Consequences of fluid mismanagement to be reported as critical incidents

Consequence of fluid mismanagement	Identifying features	Time frame of identification

Hypovolaemia	• Patient's fluid needs not met by oral, enteral or IV 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/l • 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/l • No other obvious cause identified	During IV fluid therapy or within 24 hours of stopping IV fluids
Hypokalaemia	• Serum potassium less than 3.0 mmol/l likely to be due to infusion of fluids without adequate potassium provision • No other obvious cause (for example, potassium-wasting diuretics, refeeding syndrome)	During IV fluid therapy or within 24 hours of stopping IV fluids

Source: This table was drafted based on the consensus decision of the members of the Guideline Development Group.

IV fluid prescription (by body weight) for routine maintenance over a 24-hour period

Body weight	Water	Sodium, chloride, potassium	Body weight	Water	Sodium, chloride, potassium
kg	25–30 ml/ kg/day	approx. 1 mmol/kg/ day of each	kg	25–30ml/ kg/day	approx. 1 mmol/kg/ day of each
40	1000–1200	40	71	1775–2130	71
41	1025–1230	41	72	1800–2160	72
42	1050–1260	42	73	1825–2190	73
43	1075–1290	43	74	1850–2220	74
44	1100–1320	44	75	1875–2250	75
45	1125–1350	45	76	1900–2280	76
46	1150–1380	46	77	1925–2310	77
47	1175–1410	47	78	1950–2340	78
48	1200–1440	48	79	1975–2370	79
49	1225–1470	49	80	2000–2400	80
50	1250–1500	50	81	2025–2430	81

51	1275–1530	51	82	2050–2460	82
52	1300–1560	52	83	2075–2490	83
53	1325–1590	53	84	2100–2520	84
54	1350–1620	54	85	2125–2550	85
55	1375–1650	55	86	2150–2580	86
56	1400–1680	56	87	2175–2610	87
57	1425–1710	57	88	2200–2640	88
58	1450–1740	58	89	2225–2670	89
59	1475–1770	59	90	2250–2700	90
60	1500–1800	60	91	2275–2730	91
61	1525–1830	61	92	2300–2760	92
62	1550–1860	62	93	2325–2790	93
63	1575–1890	63	94	2350–2820	94
64	1600–1920	64	95	2375–2850	95
65	1625–1950	65	96	2400–2880	96
66	1650–1980	66	97	2425–2910	97
67	1675–2010	67	98	2450–2940	98
68	1700–2040	68	99	2475–2970	99
69	1725–2070	69	100	2500–3000	100
70	1750–2100	70	>100	2500–3000	100
Add 50–100 grams/day glucose (e.g. glucose 5% contains 5g/100ml). For special considerations refer to the recommendations for routine maintenance.					

Source: This table was drafted based on the consensus decision of the members of the Guideline Development Group.

[1] Passive leg raising is a bedside method to assess fluid responsiveness in a patient. It is best undertaken with the patient initially semi-recumbent and then tilting the entire bed through 45°.

Alternatively it can be done by lying the patient flat and passively raising their legs to greater than 45°. If, at 30–90 seconds, the patient shows signs of haemodynamic improvement, it indicates that volume replacement may be required. If the condition of the patient deteriorates, in particular breathlessness, it indicates that the patient may be fluid overloaded.

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 fluid 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 fluid resuscitation

Are balanced solutions superior to sodium chloride 0.9% for the fluid resuscitation of patients with acute hypovolaemic 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 fluid 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.

2.3 IV fluid therapy for fluid resuscitation

Are balanced crystalloids superior to a combination of a balanced crystalloid and a gelatin suspended in a balanced solution for the fluid resuscitation of patients with acute hypovolaemic 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 fluid 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 fluid resuscitation. Some randomised controlled trials have shown that when colloids are used for fluid resuscitation, volumes of fluid required may be less than with crystalloids. It must be remembered that colloids cannot be used exclusively for fluid resuscitation and that some free water must be provided, and there are limited data on the use of gelatins for fluid resuscitation. The proposed trial will help inform whether a combination of gelatin and crystalloid is superior to crystalloid alone for the fluid resuscitation of patients with acute hypovolaemic shock.

2.4 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.

2.5 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 publication of the guideline (December 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

- Acute kidney injury. NICE clinical guideline 169 (2013).
- Prevention and control of healthcare-associated infections. NICE public health quality improvement guide 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).

- Obesity. NICE clinical guideline 43 (2006).
- Nutrition support in adults. NICE clinical guideline 32 (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):

- Transfusion. NICE clinical guideline. Publication expected May 2015.
- Major trauma: assessment and management of major trauma. NICE clinical guideline. Publication expected June 2015.
- Type 1 diabetes (update). NICE clinical guideline. Publication expected August 2015.
- Intravenous fluid therapy in children. NICE clinical guideline. Publication expected November 2015.

4 The Guideline Development Group, National Collaborating Centre and NICE project team

4.1 Guideline Development Group (GDG)

Michael Stroud
Chair, Consultant in Gastroenterology and General (internal) Medicine, Southampton University Hospitals NHS Trust

Reem Al-Jayyousi
Consultant Nephrologist, Leicester General Hospital

Paul Cook
Consultant in Chemical Pathology, Southampton University Hospitals NHS Trust

Richard Leach
Consultant Physician in Respiratory and Critical Care, Guy's and St Thomas' Hospital Foundation Trust, London

Dileep Lobo
Professor of Gastrointestinal Surgery, Nottingham University Hospital

Tom McLoughlin-Yip
Patient and carer member

Michael Mythen (GDG member until October 2012)
Professor of Anaesthetics and Critical Care, University College London

Patrick Nee
Consultant in Emergency Medicine and Critical Care Medicine, Whiston Hospital, Prescot, Merseyside

Jerry Nolan (GDG member from October 2012)
Consultant in Intensive Care and Anaesthetics, Royal United Hospital NHS Trust, Bath

Fleur North
Patient and carer member

Katie Scales
Consultant Nurse Critical Care (Outreach), Imperial College Healthcare NHS Trust, London

Rebecca Sherratt
Advanced Nurse Practitioner, Sheffield Teaching Hospitals Trust

Neil Soni
Consultant in Intensive Care and Anaesthetics, Chelsea and Westminster Hospital, London

Mark Tomlin
Consultant Pharmacist in Critical Care, Southampton General Hospital

4.2 Expert advisers to the group

Andrew Lewington (GDG member from Acute kidney injury guideline)
Consultant Renal Physician/Clinical Sub Dean, Leeds Teaching Hospitals

Michael Mythen (from October 2012)
Professor of Anaesthetics and Critical Care, University College London

4.3 National Clinical Guideline Centre

Joanna Ashe
Senior Information Scientist

Ian Bullock
Guideline Lead – Chief Operating Officer

Smita Padhi
Senior Research Fellow/Project Manager

David Wonderling
Health Economics Lead

Varo Kirthi
Co-opted Technical Team Member

Lilian Li
Health Economist (from July 2011 to February 2013)

Nina Balachander
Senior Research Fellow (from March 2013 to April 2013)

Serena Carville
Senior Research Fellow/Project Manager (from February 2013 to March 2013)

Lee Yee Chong
Senior Research Fellow (from July 2011 to December 2012)

Jennifer Layden
Senior Project Manager (from July 2011 to July 2012)

Julie Neilson
Senior Research Fellow/Project Manager (from December 2010 to July 2011)

Sara Buckner
Research Fellow (from July 2011 to April 2012)

Susan Latchem
Guideline Lead – Operations Director (from December 2010 to November 2011)

4.4 NICE project team

Sharon Summers-Ma
Associate Director

Mark Baker
Clinical Adviser

Clifford Middleton
Guideline Commissioning Manager (until May 2013)

Claire Ruiz
Guideline Commissioning Manager (from May 2013)

Elaine Clydesdale
Guideline Coordinator

Steven Barnes
Technical Lead

Jasdeep Hayre
Health Economist

Sarah Palombella
Senior Medical Editor

About this guideline

NICE clinical guidelines are recommendations about the treatment and care of people with specific diseases and conditions in the NHS in England and Wales.

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

This guideline was developed by the National Clinical Guideline Centre, which is based at the Royal College of Physicians. The Centre worked with a Guideline Development Group, comprising healthcare professionals (including consultants, GPs and nurses), patients and carers, and technical staff, which reviewed the evidence and drafted the recommendations. The recommendations were finalised after public consultation.

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

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.

Other versions of this guideline

The full guideline intravenous fluid therapy in adults in hospital, contains details of the methods and evidence used to develop the guideline. It is published by the Internal Clinical Guidelines Programme.

The recommendations from this guideline have been incorporated into a NICE pathway.

We have produced information for the public about this guideline.

Implementation

Implementation tools and resources to help you put the guideline into practice are also available.

Your responsibility

This guidance represents the view of NICE, which was arrived at after careful consideration of the evidence available. Healthcare professionals are expected to take it fully into account when exercising their clinical judgement. However, the guidance does not override the individual responsibility of healthcare professionals to make decisions appropriate to the circumstances of the individual patient, in consultation with the patient and/or guardian or carer, and informed by the summaries of product characteristics of any drugs.

Implementation of this guidance is the responsibility of local commissioners and/or providers. Commissioners and providers are reminded that it is their responsibility to implement the guidance, in their local context, in light of their duties to have due regard to the need to eliminate unlawful discrimination, advance equality of opportunity and foster good relations. Nothing in this guidance should be interpreted in a way that would be inconsistent with compliance with those duties.

Changes after publication

October 2015: Minor maintenance.

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ISBN: 978-1-4731-0375-7

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