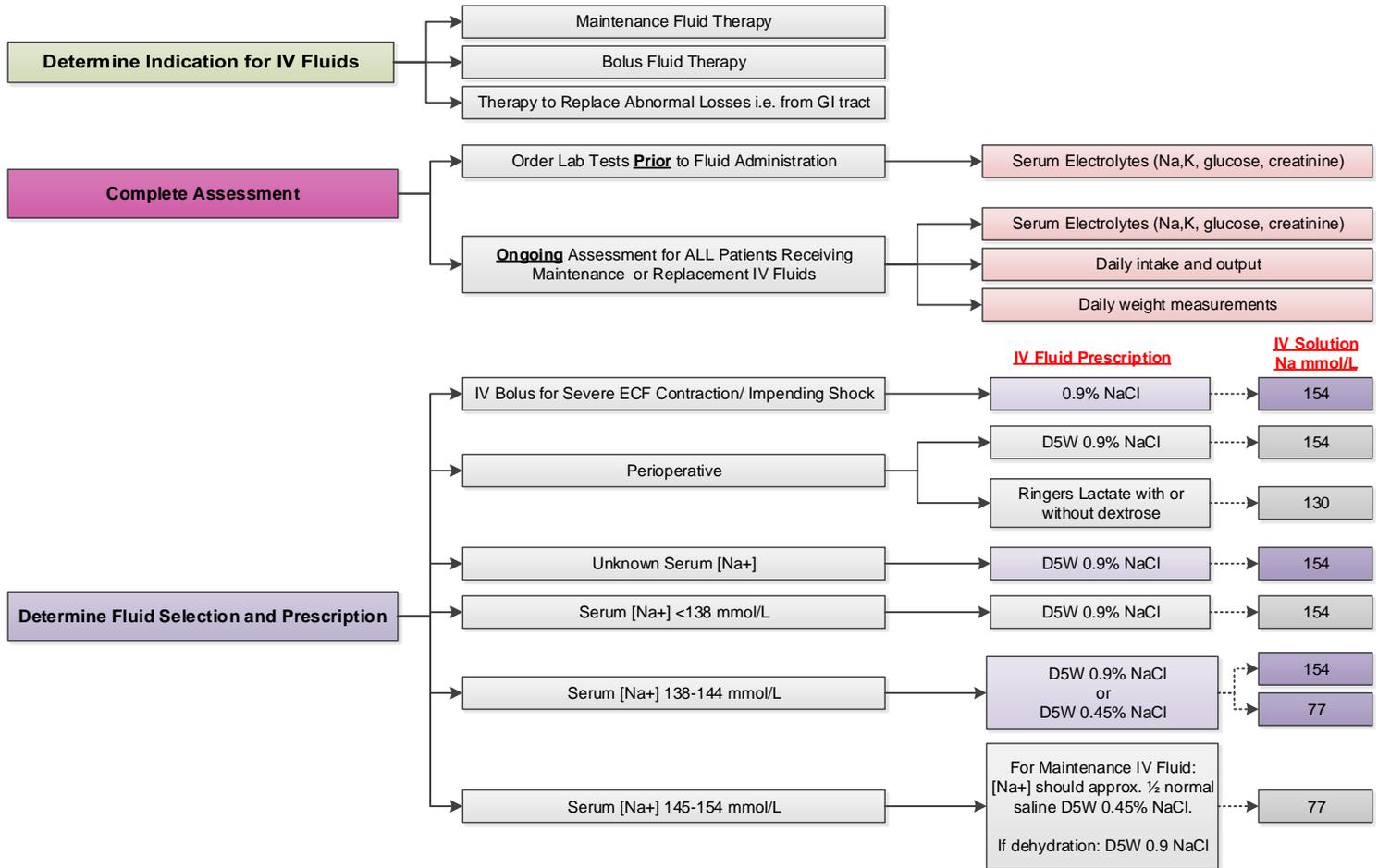


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<b>Fluid and Electrolyte Administration in Children</b>	

## IV Fluid Maintenance in Children: Assessment and Prescribing Recommendations



Potassium (KCl) may need to be added to IV Fluid prescription; maintenance requirement is approximately 20mEq/l but exact amount will depend on individual factors including serum K, serum Cr, and urine output.

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## Introduction

Salt and water homeostasis is frequently abnormal in hospitalized patients. Hyponatremia (Plasma Sodium (PNa) <135 mmol/l) is the most commonly occurring electrolyte abnormality. Hypernatremia can be caused either by water loss (GI tract or renal) or salt gain.

The purpose of this clinical practice guideline is to facilitate appropriate screening, prescription and monitoring of intravenous (IV) fluid and electrolyte administration in patients 1 month to 18 years of age admitted to SickKids or treated in the Emergency Department (ED).

## Target Patient Population:

- Children 1 month to 18 years;
- **Does not apply** to patients in the neonatal intensive care unit.

## Target Users:

- Physicians, nurses and paramedics.

## Definitions

- **Acute hyponatremia:** is defined as a rapid fall in serum sodium from a normal level to < 135 mmol/L within 48 hours. This can result in acute cerebral edema and brain stem herniation; and has been associated with the administration of intravenous (IV) hypotonic fluids in children, particularly in the perioperative period. These patients may retain free water due to non-physiological secretion of anti-diuretic hormone (ADH) stimulated by for example, pain, vomiting, anxiety, narcotics, anesthetic agents and positive pressure ventilation. The use of isotonic fluids, which contain no electrolyte free water, will reduce this risk but not eliminate it.

Definition	Serum [Na+] mmol/L
Normal/reference range	135 - 144
Acute Hyponatremia	Reduction in Na to <135 mmol/L in 48 hrs
Hypernatremia	>144

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## Recommendations

- This guideline should be followed when prescribing IV maintenance fluids; recommendations on the type of solution to be used for fluid bolus therapy are also included. IV fluids prescribed to replace losses from the GI tract and other extracellular fluid (ECF) compartments should be of the same electrolyte composition as the fluid that is being lost.

## Indications for prescribing IV fluids in pediatric patients

1. Maintenance fluid therapy to replace estimated normal physiologic urine output and insensible losses in patients with reduced or no oral intake.
2. Bolus fluid therapy to expand the circulating volume in children with hypovolemia or shock.
3. Replacement fluid therapy to replace abnormal losses from the GI tract and other body cavities.

## General principles

- Any hospitalized child requiring IV maintenance fluids should be considered at risk of non-physiological (inappropriate) ADH secretion. Groups particularly at risk identified in published studies include children undergoing surgery, in ICU and those with acute illnesses including meningitis, encephalitis, bronchiolitis and pneumonia. While most children will tolerate standard maintenance fluid requirements, some acutely ill children with increased ADH secretion may benefit from their maintenance fluids being restricted to two-thirds of the normal recommended volume. Some examples may include those groups mentioned above. Normal maintenance requirements should be in the form of isotonic saline.<sup>1,2</sup>
- Oral fluid intake must be included in the estimation of total fluid intake. Most oral fluids are very hypotonic i.e. much below the sodium concentration of recommended IV fluids. Both the volume and the concentration of sodium in IV and oral fluids are important contributors to the development of hyponatremia.
- Proprietary enteral fluid preparations and some standard parenteral nutrition (PN) solutions are low in sodium (<40mmol/L) and may be a substantial source of electrolyte free water. Despite this, patients on long term PN who are not acutely ill do not appear to have increased risk for the development of acute hyponatremia. Standard solutions containing higher amounts of sodium (>60mmol/L) are available to order as required. PN orders may also be customized, with varying sodium amounts based on the clinical needs of the patient.
- Infants and young children have limited glycogen stores. Therefore, saline solutions with added dextrose are required to prevent hypoglycemia and ketosis in those without a source of enteral glucose.<sup>3</sup> In some children, for

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example those on a ketogenic diet, the addition of dextrose may not be indicated (please discuss with specialist).

## Assessment

- Before starting IV fluids, baseline serum electrolytes and renal function (Na, K, glucose, urea, and creatinine) should be measured.<sup>1,2</sup> Patients undergoing day surgery where the IV is discontinued at the end of the case do not need their electrolytes measured.

## Prescription of IV fluid therapy

- Randomized controlled trials suggest that, compared with hypotonic saline, the use of isotonic saline for maintenance IV fluid requirements is less likely to result in hyponatremia and does not increase the risk of developing hypernatremia.<sup>3-14</sup>
- D5W.0.2% sodium chloride (NaCl), D5W or D10W all contain substantial amounts of electrolyte free water and must not be used as maintenance IV fluids.
  - 2/3 & 1/3 (0.3 NaCl with 3.3% dextrose) is no longer available in the hospital
  - Patients with a demonstrable free water deficit may require the administration of these types of hypotonic solutions. The use of these fluids is restricted to the PICU, CCU, NICU, and Nephrology services.
  - Consultation should be obtained from Nephrology if these solutions are being considered.
- Until serum electrolyte values are known, when starting IV maintenance fluids, D5W.0.9% NaCl is recommended.<sup>1,2</sup> *Solution should be adjusted when serum electrolyte results become available.*
- Serum sodium < 138 mmol/L → D5W. 0.9% NaCl, should be prescribed.<sup>1</sup>,
- Serum sodium 138-144 mmol/L → IV fluids should contain a minimum sodium concentration of 77mmol/L (D5W.0.9% NaCl or D5W.0.45% NaCl).<sup>1, 14</sup>
- Serum sodium 145-154 mmol/L → IV fluid sodium concentration should approximate one half normal saline (D5W.0.45% NaCl). If dehydration is present then D5W.0.9 NaCl may be more appropriate initially. When correcting hypernatraemia, ensure that the rate of fall of plasma sodium does not exceed 12 mmol/l in a 24-hour period.<sup>2</sup>
- If hypernatremia is due to salt gain → may receive hypotonic fluids such as D5W.0.2% NaCl

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- Patients with (PNa > 154 mmol/L) have either a water loss (dehydration) or salt gain (the use of solutions with a high sodium concentration).
- Infants and young children with severe hyponatremia due to dehydration (free water loss) are at risk for the development of cerebral edema with rapid rehydration when hypotonic saline is used.
- The water deficit should be replaced slowly, initially with isotonic saline (**Consult Nephrology**). Measure plasma electrolyte concentrations every 4–6 hours for the first 24 hours, and after this base the frequency of further plasma electrolyte measurements on the treatment response.<sup>2</sup>

### Postoperatively

- Dextrose should be added to maintenance fluids for children with no other source of glucose.<sup>3</sup>
- Isotonic fluids should be used in the perioperative period.<sup>5,11,12</sup>
- If a decision is made to use maintenance IV fluids without any glucose then frequent monitoring of the child's blood glucose is required to prevent hypoglycemia.
- Frequency of glucose monitoring will depend on the age/size/underlying diagnosis.
- In the absence of the need to continue with IV fluids for the replacement of ongoing losses, the IV should be discontinued or reduced to minimum and patients encouraged to take enteral fluids.

### Bolus therapy

- IV fluid boluses should be used in children with significant hypovolemia or impending shock and only in the form of isotonic saline (0.9% NaCl).<sup>1,2</sup>
- The injudicious use of IV bolus therapy may transiently over expand the ECF compartment and result in an increase in the renal sodium excretion, potentially increasing the risk for hyponatremia.

### Replacement therapy

- IV fluid therapy to replace losses from the GI tract should match the electrolyte composition of the lost fluid and usually be in the form of isotonic saline with KCl (0.9% NaCl plus KCl 20mEq/L).<sup>2</sup>

### Monitoring

- Patients receiving maintenance fluids by the IV route should have measurements of serum electrolytes and glucose regularly, approximately daily initially depending on exact circumstances.<sup>1</sup>
- All children receiving IV fluids must have an accurate intake and output record kept which is totaled and assessed at least every 12 hours; and when feasible, there is a daily weight measurement.

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- If a maintenance IV fluid that does not contain dextrose is used, then frequent monitoring of the child's blood glucose is required.

## Diagnosis and treatment of acute symptomatic hyponatremia

- **Acute symptomatic hyponatremia is a medical emergency and requires rapid and aggressive treatment to prevent the downward spiral of seizures, apnea and brain stem herniation, resulting from cerebral edema.**
- Diagnosis:
  - Common features of the onset of cerebral edema due to hyponatremia: lethargy, diminished level of consciousness, headache and vomiting.
  - Most cases in children have been reported when the PNa level has fallen from normal to <125 mmol/L within 48 hours, but can occur at higher levels.
  - Acute hyponatremia should be suspected when there are new seizures in patients receiving hypotonic IV fluids.
- Management:
  - Discontinue the IV fluid being administered and give 2-3 mL/kg of 3% NaCl.
  - Notify the critical care unit and Critical Care Response Team (CCRT).
  - Measure the serum electrolytes and correct the PNa to > 130 mmol/L acutely using 2 - 3 mL/kg of 3% saline (repeat if necessary) administered rapidly.

## Related Documents

- Friedman JN; CPS Acute Care Committee. Risk of acute hyponatremia in hospitalized children and youth receiving maintenance iv fluids. *Canadian Pediatric Society*. December 2018. <https://www.cps.ca/en/documents/position/acute-hyponatremia-in-hospitalized-children-and-youth>
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Reviewers were selected to reflect different backgrounds and perspectives. Their comments and suggestions were considered and the document amended accordingly.

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**Attachments:**

[IV fluid pathway 2019 update apr 23.pdf](#)