Maintenance IV Fluid Management v 2.0: Initiation

Approval & Citation | Summary of Version Changes | Explanation of Evidence Ratings

PHASE I: Initiation

Inclusion Criteria
Euvolemic requiring maintenance IV fluids

Exclusion Criteria
Hypovolemia or fluid overload, critically ill, diabetic (type I or 2), on parenteral nutrition or ketogenic diet, serum sodium ≥150 mEq/L or ≤130 mEq/L, age <4 weeks corrected chronological age

On the following services: nephrology, neurosurgery, cardiology, biochemical genetics, oncology or solid organ/stem cell transplant

Factors to consider in determining adequate enteral fluid intake:
- Mental status at baseline
- Clinically stable or improving
- Demonstrated ability to take enteral fluids with subsequent urine output
- Presence of bowel sounds/ return of bowel function
- Well-controlled pain and nausea

Patient euvolemic? (not hypovolemic or fluid overloaded)

NO → **Off Pathway**

YES

Patient able to take adequate fluids enterally?

NO → **Off Pathway**

YES

Major non-osmotic risk factors for increased ADH secretion:
- Uncontrolled pain
- Uncontrolled nausea/ vomiting
- Recent surgery
- Acute CNS disorders
- Acute pulmonary diseases, particularly pneumonia

Patient without increased ADH secretion risk factors:
- Use ½ normal saline
- Add 5% dextrose if patient has limited or no nutritional intake
- Add 20 mEq/L potassium chloride, unless contraindicated

! Do not use ¼ NS for maintenance fluids

Patient with increased ADH secretion risk factors:
- Use normal saline
- Add 5% dextrose if patient has limited or no nutritional intake
- Add 20 mEq/L potassium chloride, unless contraindicated

! Do not use maintenance fluids at rates above calculated maintenance

Hourly Maintenance Rate Calculation:
- Use Dose Calc Weight (or Ideal Body Weight if patient is obese)
- 1st 1-10 kg = 4 mL/kg/hour, next 11-20 kg = 2 mL/kg/hour and next >20 kg = 1 mL/kg/hour, to a max of 100 mL/hr

! Patients with signs of SIADH need fluid restriction

Last Updated: Jan 2016
Next Expected Revision: June 2020

Maintenance IV Fluid Management v2.0: Monitoring

Approval & Citation | Summary of Version Changes | Explanation of Evidence Ratings

PHASE II: Monitoring

Inclusion Criteria
Euvolemic requiring maintenance IV fluids

Exclusion Criteria
Hypovolemia or fluid overload, critically ill, diabetic (type I or 2), on parenteral nutrition or ketogenic diet, serum sodium ≥150 mEq/L or ≤130 mEq/L, age <4 weeks corrected chronological age

On the following services: nephrology, neurosurgery, cardiology, biochemical genetics, oncology or solid organ/stem cell transplant

Factors to consider in determining adequate enteral fluid intake:
- Mental status at baseline
- Clinically stable or improving
- Demonstrated ability to take enteral fluids with subsequent urine output
- Presence of bowel sounds/ return of bowel function
- Well-controlled pain and nausea

Patient euvolemic? (not hypovolemic or fluid overloaded)
- NO → **Off Pathway**
- YES ↓

Patient able to take adequate fluids enterally?
- YES → **Discontinue IV fluids**
- NO ↓

For all maintenance IV fluids, monitor:
- Strict intake and output with particular attention to on-going losses
- Daily weight
- Signs/symptoms of fluid retention at least daily

! Do not use maintenance fluids to replace ongoing losses

For ISOTONIC fluids, monitor:
- Serum sodium at ~24 hours post-initiation for patients continuing to receive >75% of their maintenance need via IV fluid
- Subsequent serum sodium only as needed

For HYPOTONIC fluids, monitor:
- Serum sodium at ~24 hours post-initiation for patients continuing to receive >75% of their maintenance need via IV fluid
- Subsequent serum sodium daily until IV fluid constitutes ≤75% of maintenance

Patient able to take adequate fluids enterally?
- NO → return to "For all maintenance IV fluids, monitor:"
- YES → **Discontinue IV fluids**

! Attention to weight fluctuations +/- 3%

Patient receiving maintenance IV fluids for >96 hours as primary source of hydration/nutrition?
- YES → Consider alternative source of hydration/nutrition (e.g. NG, PPN/TPN)

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For questions concerning this pathway, contact: maintenanceivfluids@seattlechildrens.org

Last Updated: Jan 2016
Next Expected Revision: June 2020

Indications for Maintenance IV Fluids

Maintenance IV fluids are appropriate for euvolemic medical and surgical patients who cannot take adequate enteral fluids.

- Before starting maintenance IV fluids, consider:
  - Need for fluid resuscitation
  - Need for fluid restriction
- Consider alternative routes:
  - Before starting maintenance IV fluids
  - For patients receiving maintenance IV fluids for >96 hours as their primary source of hydration and/or nutrition

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Defining Adequate Enteral Intake

This is a *clinical* determination made for each patient and may include some or all of the following factors:

- Mental status returned to baseline
- Clinically stable or improving
- Demonstrated ability to take enteral fluids with subsequent urine output
- Presence of bowel sounds/return of bowel function
- Well-controlled pain and nausea

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Defining Maintenance

- “Maintenance” = volume of fluid required to meet daily metabolic needs, such as normal water and electrolyte losses, and maintain homeostasis.
- During acute illness, “maintenance” rates often do not reflect the true water and electrolyte needs of the patient due to increased losses due to factors such as:
  - Fever
  - Emesis
  - Diarrhea
  - Tachypnea

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Incorrect Use of Maintenance IV Fluids

Do not use maintenance IV fluids...

- To replace abnormal or ongoing fluid losses including:
  - Bleeding
  - Surgical drain output
  - Emesis
  - Diarrhea
- To replete intravascular volume or for volume resuscitation

Calculate maintenance fluids and ongoing losses separately.

Do not adjust the calculated maintenance rate to account for ongoing losses.

Level of evidence: Expert Opinion

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Choosing Maintenance IV Fluid

- There is not a single best IV fluid choice for all patients.
- Based on the individual patient, determine the following:
  - Fluid composition
    - Dextrose content
    - Potassium content
    - Saline content
  - Fluid rate

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Dextrose Content

- Add dextrose if the patient has limited or no nutritional intake.
- 5% dextrose is appropriate for most patients included in this pathway.
- Enteral nutrition is preferred to IV whenever feasible.

[Level of evidence: Expert Opinion]

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Potassium Content

- Include potassium in maintenance IV fluids, unless contraindicated.
- 20 mEq/L KCl is appropriate for most patients included in this pathway.
- Consider contraindications to potassium addition, such as impaired ability to clear potassium and/or hyperkalemia that may be associated with:
  - Renal insufficiency/failure
  - Systemic acidosis
  - Use of potassium-sparing diuretics
  - Adrenal insufficiency
  - Severe tissue damage such as burns

[Level of evidence: Expert Opinion]

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Saline Content

- For patients at risk for increased ADH secretion, use normal saline (0.9% NS = 154 mEq/L NaCl).
- For patients not at risk for increased ADH secretion, use ½ normal saline (0.45% NS = 77 mEq/L NaCl).
- Do not use less than ½ NS (e.g., ¼ NS) for maintenance fluid in any age group on this pathway.

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Saline Content

- *In several RCTs and meta-analyses of RCTs, hypotonic IV maintenance fluids have been shown to significantly increase the risk of hyponatremia and severe hyponatremia compared to isotonic IV maintenance fluids. This is thought to be due to non-osmotic stimuli for ADH secretion that are present in many hospitalized patients [Level of evidence: ✪✪✪O (Choong 2006; Foster 2014; McNab 2014; Neville 2006; Neville 2010; Wang 2014)].*
- *Current evidence argues against an increased risk of hypernatremia in patients who receive isotonic fluids, however most RCTs and meta-analyses have not specifically addressed other potential adverse effects of isotonic fluids (e.g. hypertension, edema, hyperchloremia). For this reason, the committee elected to focus the use of isotonic fluids on patients at highest risk for hyponatremia and to recommend against the use of the most hypotonic IV fluids (i.e. ¼ NS) [Level of evidence: Expert Opinion].*

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Risk Factors for Increased ADH Secretion

- Anti-diuretic hormone (ADH) is released by the pituitary gland in response to increased plasma osmolality and decreased circulating volume.
- ADH promotes water absorption in the distal nephron collecting ducts.
- ADH is also released in response to acute illness, stress, pain and other *non-osmotic* triggers. In these situations, non-osmotic ADH secretion may lead to excess water retention and hyponatremia.

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Risk Factors for Increased ADH Secretion

Common non-osmotic stimuli for ADH secretion include:

- Uncontrolled pain
- Uncontrolled nausea/vomiting
- Recent surgery
- Acute central nervous system disorders
- Acute pulmonary diseases, particularly pneumonia

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Rate

Maintenance rate is determined by the patient's dose calc weight in kilograms

- "4-2-1" rule for hourly rate:
  - First 1-10 kg = 4 mL/kg/hour
  - Next 11-20 kg = 2 mL/kg/hour
  - Next >20 kg = 1 mL/kg/hour
- For larger patients, maximum rate: 100 mL/hr

Do not use maintenance IV fluids at rates above calculated maintenance.
Do not adjust the calculated maintenance rate to account for ongoing losses.

[Level of evidence: Expert Opinion]

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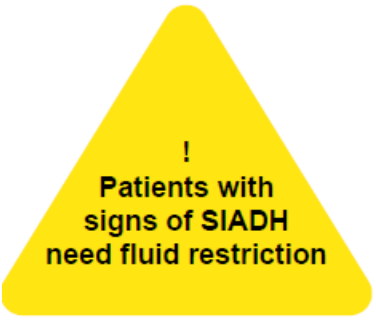
Rate in SIADH

- Syndrome of Inappropriate ADH Secretion (SIADH) occurs when ADH secretion persists despite normal or robust fluid status
- Signs:
  - Hyponatremia and hypo-osmolality
  - High urine sodium and osmolality
  - Absence of clinical signs of hypovolemia
  - Weight may be normal or increased
- Patients with SIADH require fluid restriction.



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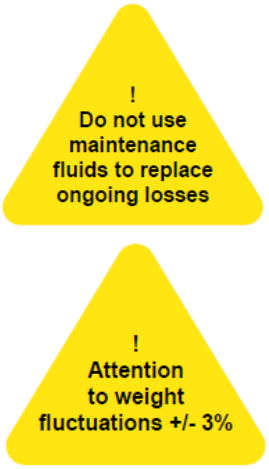
Monitoring Patients on Maintenance IV Fluids

For all patients receiving maintenance IV fluids, monitor:

- Strict intake and output with particular attention to on-going losses
- Daily weight
  - An accurate weight is the best marker of fluid status
  - Unexpected fluctuations in weight, when accurate, should prompt closer evaluation for dehydration or fluid overload
- Signs/symptoms of fluid retention at least daily
  - Peripheral edema (periorbital, presacral, scrotal or distal extremity edema) or pulmonary edema
  - Elevated blood pressures
  - Increased weight



[Level of evidence: Expert Opinion]

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Lab Monitoring

For ISOTONIC fluids, monitor:

- Serum sodium at ~24 hours post-initiation for patients continuing to receive >75% of their maintenance need via IV fluid
- Subsequent serum sodium only as needed

For HYPOTONIC fluids, monitor:

- Serum sodium at ~24 hours post-initiation for patients continuing to receive >75% of their maintenance need via IV fluid
- Subsequent serum sodium daily until IV fluid constitutes ≤75% of maintenance

Monitoring serum sodium whenever hypotonic fluids are administered is warranted because hypotonic fluids are significantly more likely than isotonic fluids to exacerbate or cause hyponatremia, particularly in pediatric patients with non-osmotic stimuli for ADH secretion. One RCT demonstrated that prolonged (>4 hours) use of hypotonic IV fluids was associated with a decline in serum sodium, whereas isotonic fluids were not and that there were no cases of hypernatremia. [Level of Evidence: ✪✪○○ (Neville 2006, Wang 2014)]. Another RCT showed that patients receiving isotonic IV fluids had some risk for early hyponatremia, but little risk beyond 24 hours on IV fluids, whereas the risk of hyponatremia for patients on hypotonic fluids persisted throughout the study period [Level of evidence: ✪✪✪○ (McNab 2014)].

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Discontinuing Maintenance IV Fluids

- For patients who can take adequate hydration enterally, discontinue IV fluids.
  - This includes patients who can be hydrated via non-oral enteral routes including nasogastric, gastrostomy tube, etc.
- Consider alternative regimens for patients receiving maintenance IV fluids as their primary source of hydration/nutrition for more than 96 hours.
  - Such regimens include partial or total parenteral nutrition for patients who cannot tolerate enteral routes.

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Maintenance IV Fluid Management Citation

Approved by the CSW Maintenance IV Fluid Management Team for June 24, 2015 Go-live.

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Retrieval Website: http://www.seattlechildrens.org/pdf/maintenance-iv-fluid-management-pathway.pdf

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Evidence Ratings

This pathway was developed through local consensus based on published evidence and expert opinion as part of Clinical Standard Work at Seattle Children's. Pathway teams include representatives from Medical, Subspecialty, and/or Surgical Services, Nursing, Pharmacy, Clinical Effectiveness, and other services as appropriate.

When possible, we used the GRADE method of rating evidence quality. Evidence is first assessed as to whether it is from randomized trial or cohort studies. The rating is then adjusted in the following manner (from: Guyatt G et al. J Clin Epidemiol. 2011;4:383-94.):

Quality ratings are *downgraded* if studies:

- Have serious limitations
- Have inconsistent results
- If evidence does not directly address clinical questions
- If estimates are imprecise OR
- If it is felt that there is substantial publication bias

Quality ratings are *upgraded* if it is felt that:

- The effect size is large
- If studies are designed in a way that confounding would likely underreport the magnitude of the effect OR
- If a dose-response gradient is evident

Guideline – Recommendation is from a published guideline that used methodology deemed acceptable by the team.

Expert Opinion – Our expert opinion is based on available evidence that does not meet GRADE criteria (for example, case-control studies).

Quality of Evidence:

✪✪✪✪ High quality
✪✪✪○ Moderate quality
✪✪○○ Low quality
✪○○○ Very low quality
Guideline
Expert Opinion

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Summary of Version Changes

- **Version 1 (6/24/2015):** Go live
- **Version 2 (1/27/2016):** Updated exclusion criteria.

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Medical Disclaimer

Medicine is an ever-changing science. As new research and clinical experience broaden our knowledge, changes in treatment and drug therapy are required.

The authors have checked with sources believed to be reliable in their efforts to provide information that is complete and generally in accord with the standards accepted at the time of publication.

However, in view of the possibility of human error or changes in medical sciences, neither the authors nor Seattle Children's Healthcare System nor any other party who has been involved in the preparation or publication of this work warrants that the information contained herein is in every respect accurate or complete, and they are not responsible for any errors or omissions or for the results obtained from the use of such information.

Readers should confirm the information contained herein with other sources and are encouraged to consult with their health care provider before making any health care decision.

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Bibliography

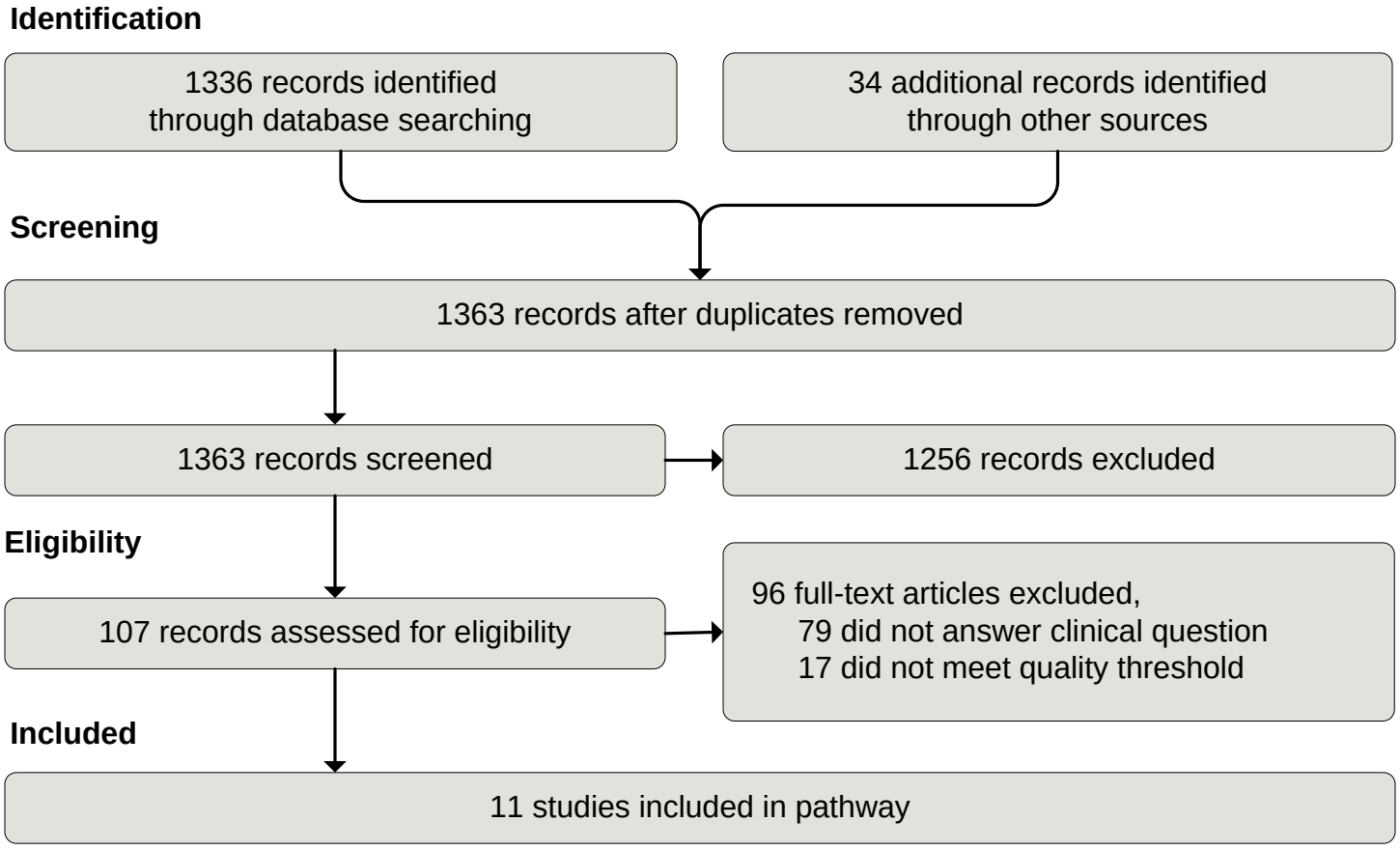
Literature Search Strategy

Search Methods, Maintenance IV Fluid Management, Clinical Standard Work

Studies were identified by searching electronic databases using search strategies developed and executed by a medical librarian, Susan Klawansky. Searches were performed in March 2014 in the following databases: on the Ovid platform – Medline (2004 to date), Cochrane Database of Systematic Reviews (2005 to date); elsewhere – Embase (2004 to date), CINAHL (2004 to date), National Guideline Clearinghouse, TRIP (2004 to date) and Cincinnati Children's Evidence-Based Care Guidelines. Retrieval was limited to humans (any age) and English language. In Medline, Embase and CINAHL, appropriate Medical Subject Headings (MeSH), Emtree and CINAHL subject headings were used respectively, along with text words, and the search strategy was adapted for other databases as appropriate. Concepts searched were fluid therapy, hypertonic solutions, hypotonic solutions, isotonic solutions, water-electrolyte imbalance, water-electrolyte balance, dehydration, hyperkalemia, hypokalemia, hypernatremia, hyponatremia, intravenous infusions, osmolar concentation, salinity. All retrieval was further limited to certain evidence categories, such as relevant publication types, index terms for study types and other similar limits. Additional articles were identified by team members and added to results.

Susan Klawansky, MLS, AHIP

February 10, 2015



Flow diagram adapted from Moher D et al. BMJ 2009;339:bmj.b2535

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