HYPONATREMIA (ADULT) – MANAGEMENT OF INCLUDING HYPERTONIC SALINE – ADMINISTRATION AND PRECAUTIONS

This LOP is developed to guide clinical practice at the Royal Hospital for Women. Individual patient circumstances may mean that practice diverges from this LOP.

1. AIM

- To guide clinicians in the recognition, differential diagnosis, classification, and appropriate management of woman with hyponatremia

2. PATIENT

- Any woman who has serum sodium (Na) result <135mmol/L (<130 mmol/L in pregnancy)

3. STAFF

- Medical, midwifery and nursing staff

4. EQUIPMENT

- Toilet specimen collector pan or indwelling catheter
- Intravenous (IV) cannula and insertion kit
- Intravenous infusion pump
- 21-gauge needle with vacutainer
- Blood tube - serum gel
- Urine specimen container
- Cardiotocograph monitor (CTG)

5. CLINICAL PRACTICE

- Identity woman with:
  - **Mild hyponatremia**: serum sodium 130-135mmol/L or if pregnant 130-132mmol/L (normal sodium in pregnancy is >132mmol/L)
  - **Moderate hyponatremia**: serum sodium 120-130 mmol/L with no cerebral symptoms
  - **Severe hyponatremia:** serum sodium < 120 mmol/L or with cerebral symptoms
- Take careful clinical and medication history
- Assess and document the woman's volume status by physical examination (skin turgor, evaluation of mucous membrane or review of fluid balance chart), and her neurological status using the Glasgow Coma Scale (GCS)
- Collect blood for measurement of serum osmolality (serum blood tube) and a spot urine for measurement of urine osmolality and urine sodium
- Identify and treat any potentially reversible underlying cause of hyponatremia as outlined in Table 1 in educational notes
- Discuss moderate and severe hyponatremia woman with obstetric medicine team
- **Be aware that acute symptomatic and/or severe hyponatremia is a medical emergency and take the following actions while undertaking the above assessments:**
  - Initiate Clinical Emergency Response System (CERS) – rapid response on 2222
  - Notify the anaesthetic team, obstetric physician on call +/- refer to Prince of Wales Hospital (POWH) intensive care unit (ICU) on-call team

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TREATMENT

General Principles

- Administer treatment dependent on the chronicity, the underlying cause, the clinical and biochemical severity, and the woman's co-morbidities. Harm often follows inappropriate or rapid treatment of hyponatremia in asymptomatic patients
- Assume hyponatremia is chronic, if in doubt
- Identify and treat any underlying cause in addition to direct treatment for hyponatremia
- Cease any drugs implicated in hyponatremia
- Instigate treatment strategies which are dependent on both volume status and severity
- **Consult obstetric medicine to determine recommendations for treatment** of moderate and severe hyponatremia (volume status or severity)
- **Be aware only acute (<48 hours), symptomatic hyponatremia should be reversed rapidly**

Recommendations for treatment by volume status

Hypovolaemic hyponatremia:

- Cease any drugs implicated as a cause of hypovolaemic hyponatremia before IV treatment begins
- Replace fluid volume, if volume depleted, for severe or chronic hyponatremia with:
  - 250mL boluses of 0.9% sodium chloride
  - frequent (2-4 hourly) assessment of sodium and water balance
- Avoid continuous infusion, since rapid correction can depress antidiuretic hormone (ADH) and lead to sudden massive diuresis and an overly rapid increase in sodium

Hypervolemic hyponatremia:

- Restrict fluids to a woman who is oedematous due to heart, liver, or kidney failure
- Consider using a loop diuretic as long as IV volume is not depleted further

Euvolemic hyponatremia:

- Evaluate treatment dependent on:
  - presence of central nervous system symptoms e.g. unconsciousness, seizure, drowsiness, headache
  - severity
  - rate of development
- Be aware 0.9% sodium chloride is generally not helpful in euvolemic hyponatremia and will usually worsen hyponatremia in SIADH. This is because the sodium will be lost in the urine whilst the water will be retained in proportion to the urine: plasma osmolality ratio

Recommendations for treatment by severity of hyponatremia

Mild hyponatremia (130-135mmol/L, pregnant 130-132mmol/L)

- Manage on ward
- Restrict fluid to 1000mL per 24 hours for the non-pregnant woman only with euvolemic or hypervolemic hyponatremia
- Monitor serum electrolytes, creatinine once daily
- Be aware of considerations in pregnancy (see below)

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Moderate hyponatremia (120-130mmol/L)

- Manage woman with moderate hyponatremia after discussion with obstetric medicine
- Manage on ward
- Restrict fluid to 800mL per 24 hours for woman with euvolemic or hypervolemic hyponatremia
- commence strict fluid
- Monitor serum electrolytes, creatinine twice daily
- Be aware more aggressive intervention to increase the serum sodium concentration above 120 mmol/L is generally not indicated

Severe hyponatremia

- Manage woman with severe hyponatremia after discussion with obstetric medicine or ICU
- Discuss treatment plans with the Acute Care Nurse in charge and the Access and Demand Manager/After Hours Nurse Manager (ADM/AHNM) as transfer to Acute Care Centre (ACC) or POWH ICU is mandatory for this woman
- Identify woman with acute, symptomatic and/or severe hyponatremia who may require treatment with 3% sodium chloride. If 3% sodium chloride (hypertonic saline) is to be given this **must occur in POWH ICU** (not ACC ward) as **rapid correction of hyponatremia may produce permanent central nervous system injury, due to osmotic demyelination and requires critical care monitoring.**
- **Manage severe hyponatremia in POWH ICU**
- Manage as outlined in appendix 1
- Document a detailed plan in the medical record
- Avoid complications related to rapid correction of serum sodium particularly osmotic demyelination, by aiming for a maximum rate of change in the serum sodium concentration of not more than 8-10 mmol/L in the first 24 hours and an additional 4-8 mmol/24 hours thereafter
- Review all existing medications and modify if required
- Commence fluid restriction (oral and intravenous), aiming for 500-800 mL per 24 hours
- Monitor the woman's fluid status, including urine output, until hyponatremia is corrected
- Monitor the woman's neurological status until hyponatremia is corrected
- Monitor serum electrolytes and creatinine twice daily until the hyponatremia has resolved

Administration of 3% Sodium Chloride for severe symptomatic hyponatremia

- Discuss with physician on call or ICU prior to administration *(this may only be commenced if transfer to ICU has been approved and planned, but there is a delay in transfer occurring*)
- Aim to acutely raise the serum sodium concentration by 4-6 mmol/L to prevent neurological damage secondary to brain herniation, swelling and cerebral ischaemia
- Commence cardiac monitoring, Heart Rate (HR), Blood Pressure (BP), Respiratory Rate (RR), oxygen saturations, neurological observations including GCS, and strict fluid balance
- Administer 3% sodium chloride (hypertonic saline) 150 mL IV over 20 minutes via infusion pump
- Recheck serum sodium every 2-4 hours depending on GCS and clinical status scores
- Repeat infusion as needed up to a maximum of 3 infusions in ICU only
- Cease 3% sodium chloride infusion when **either** of the following criteria are met:
  - symptoms improve
  - target increase in serum sodium has been achieved
- Continue ongoing care as per physician on call

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Considerations for Pregnancy (normal serum sodium 130-132mmol/L)

- Monitor fluid intake during labour as excessive oral fluid intake can cause hyponatremia.
- Encourage woman to drink to thirst only and NOT consume large volumes of water
- Commence Continuous Electronic Fetal Monitoring (CEFM) with CTG if hyponatremia diagnosed and woman is still pregnant
- Ensure cord blood gas is collected for pH and sodium level if hyponatremia is diagnosed during labour or birth
- Ensure neonatal sodium is collected if hyponatremia is diagnosed postnatally
- Notify pediatric team of maternal hyponatremia

6. DOCUMENTATION

- Medical Record

7. EDUCATIONAL NOTES

Table 1: Clinical classification of causes of hyponatremia

Volume status	Cause of low serum sodium concentration
Hypervolaemia ("wet")	• heart failure • liver cirrhosis • kidney failure • nephrotic syndrome
Euvolemia	• "Water toxicity": sodium loss with free water intake, including excess fluid intake during labour (oral and intravenous) • Syndrome of Inappropriate Antidiuretic Hormone Secretion (SIADH) • drug induced (e.g. carbamazepine, selective serotonin reuptake inhibitors (SSRIs), serotonin and noradrenaline reuptake inhibitors (SNRIs)) • cerebral or pulmonary pathology • malignancy associated SIADH • hypothyroidism • psychogenic polydipsia • pain • nausea • surgery and anaesthesia • adrenal insufficiency
Hypovolaemia ("dry")	• "Water toxicity": sodium loss with free water intake, including excess fluid intake during labour (oral and intravenous) • vomiting and/or diarrhoea • burns • thiazides and related diuretic drugs e.g. indapamide, hydrochlorothiazide, chlorthalidone • other sodium-wasting states • hypopituitarism
Others: ➢ pseudohyponatremia	• severe hypertriglyceridemia
➢ osmotic dilution	• hyperglycemia • mannitol or glycine administration (gynaecological and prostatic surgery)
➢ mechanism uncertain	• HIV

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Background:

- The normal range of the serum or plasma sodium concentration is 135 to 145 mmol/L. In pregnancy, the lower limit of normal is 130mmol/L
- Hyponatraemia is defined as a serum sodium (Na) concentration <135mmol/L non-pregnant, and <130 mmol/L in pregnancy. It is the most common disorder of body fluid and electrolyte balance encountered in clinical practice. It can lead to a wide spectrum of clinical symptoms, from subtle to severe or even life-threatening neurological changes, and is associated with increased mortality, morbidity and length of hospital stay in patients presenting with a range of conditions
- It is important to *monitor fluid intake during labour as excessive oral fluid intake can cause hyponatremia*. *Women should drink to thirst but not be actively encouraged to drink large volumes* of water. The National Institute for Health and Care Excellence (NICE) (2017) suggest isotonic drinks may be more beneficial than water in labour. Fluid balance monitoring is essential to avoid higher fluid volumes. This is particularly important if the woman is on IV oxytocin or requires fluid resuscitation, as large volumes of fluid intravenous and oral in labour, significantly increases the risk of hyponatraemia
- Hyponatraemia is NOT primarily a disorder of SODIUM but a disorder of water balance. Whether the patient is hypovolaemic or euvolemic, there is a relative excess of body water compared to total body sodium and potassium content. True hyponatraemia is always associated with either an appropriate or inappropriate activation of the hormone vasopressin (also called antidiuretic hormone)
- Symptoms range from nausea and malaise, with mild reduction in the serum Na, to lethargy, decreased level of consciousness, headache, and, if severe, seizures and coma
- Patients with chronic hyponatremia (i.e. known duration more than 48 hours) are particularly at risk. Additional factors that increase this risk include:
  - serum sodium concentration ≤105 mmol/L
  - hypokalaemia
  - alcoholism
  - malnutrition
  - advanced liver disease
- To avoid osmotic demyelination, the maximum rate of change in the serum sodium concentration in chronic hyponatraemia should be:
  - not more than 8-10 mmol/L in the first 24 hours
  - and an additional 8 mmol/24 hours thereafter
- To reduce the risk of overcorrection, the initial goal of therapy can be even lower: 4-8 mmol/L daily. For patients with the additional risk factors listed above, the goal should be 4-6 mmol/L daily
- This infusion should be given with critical care monitoring i.e. HR, BP, strict fluid balance and daily weights
- More rapid initial correction can be considered in patients with:
  - seizures or coma, regardless of whether the hyponatraemia is known to be chronic
  - self-induced acute water intoxication (e.g. psychiatric conditions, endurance exercise)
  - known hyponatraemia for less than 24 to 48 hours
  - intracranial pathology or increased intracranial pressure
- Often it is difficult to assess whether severe hyponatraemia is acute or chronic. Unless it is clearly acute, a slower rate of correction is essential. The volume of bolus sodium chloride and the patient's response must be considered when calculating the remaining volume and infusion rate in chronic hyponatraemia

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8. RELATED POLICIES / PROCEDURES / CLINICAL PRACTICE LOP

- Acute Care Centre - Admission Criteria, Process and Management, and Escalation
- Adult Urethral Catheterisation for the Acute Care Setting NSW Health GL2015_016
- Potassium – administration of oral or intravenous infusion
- Fetal Heart Rate Monitoring – Maternity – MoH GL2018/025
- Admission of Neonate to Newborn Care Centre
- Management of the Deteriorating Neonatal inpatient – SESLHDPR340
- Clinical Emergency Response System (CERS) – Management of the deteriorating patient
- Management of the Deteriorating Adult inpatient (excluding maternity) - SESLHDPR/697
- Management of the Deteriorating Maternity woman – SESLHDPR/705

9. RISK RATING

- High

10. NATIONAL STANDARD

- Standard 4 - Medication safety
- Standard 5 – Comprehensive care
- Standard 8 – Recognising and Responding to Clinical deterioration

11. REFERENCES

1. Spasovski G, Vanholder R, Allolio B, Annane D, Ball S, Bichet D, et al. Clinical practice guideline on diagnosis and treatment of hyponatraemia. European Journal of Endocrinology. 2014;170(3):G1-G47.
2. Moulds R, Black K, Clearihan L, Ebeling P, Frauman A, Greenberg P, et al. Endocrinology Expert Group. Therapeutic Guidelines: endocrinology. Version 5. 2014.
3. NICE, Clinical Guideline (CG190) Intrapartum care for health women and babies. Updated 2017.
4. Moen V, Brudin L, Rundgren M & Irestedt L, Hyponatraemia complicating labour – rare or unrecognised? A prospective observational study, BJOG, 2009, vol 116, issue 4, pp 552-561

REVISION & APPROVAL HISTORY
Reviewed and endorsed Maternity Services LOPs 26/10/21
Approved Quality & Patient Care Committee 7/7/16
Endorsed Therapeutic & Drug Utilisation Committee 18/12/16

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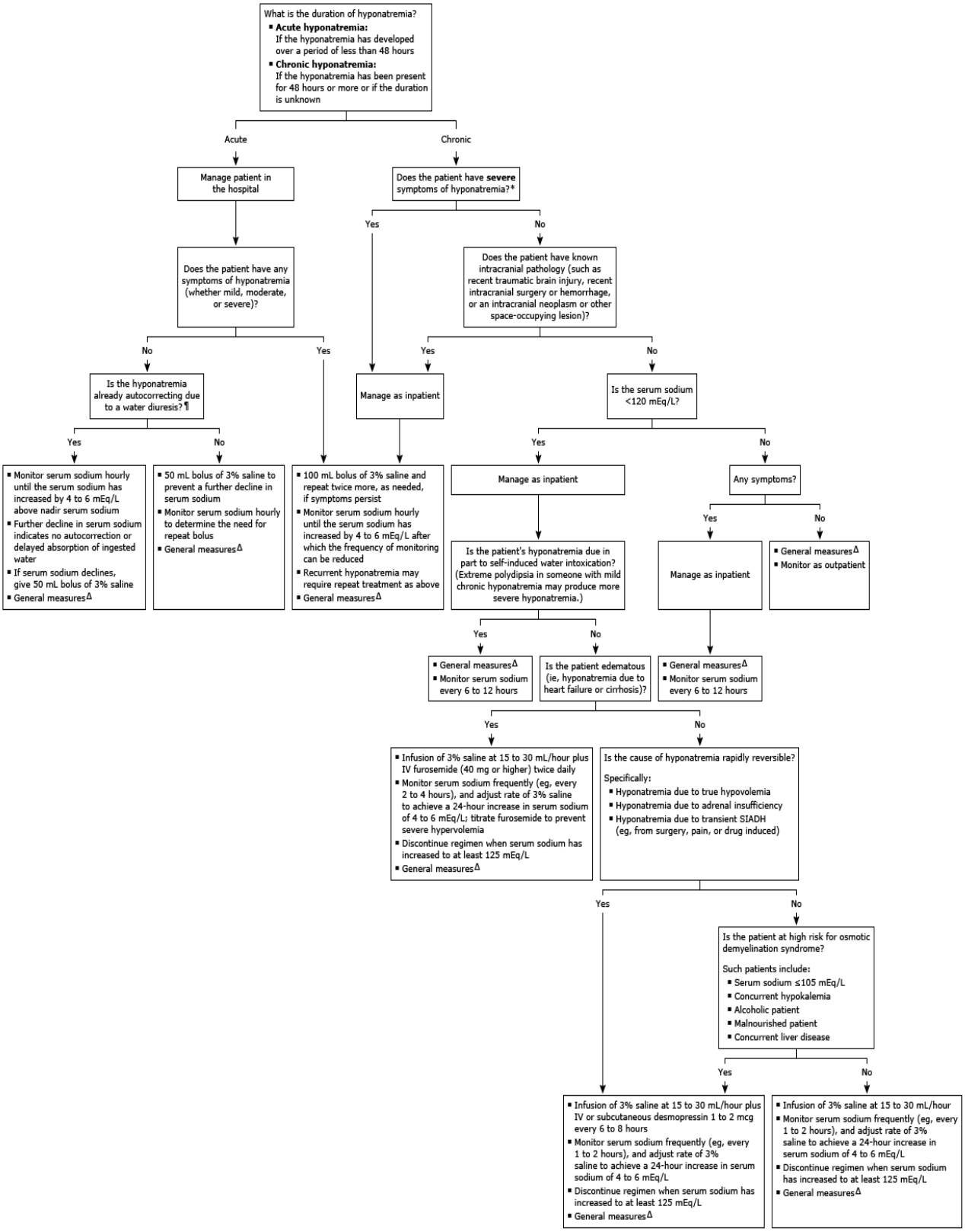
Appendix 1

Overview of the initial treatment of adults with moderate to severe hyponatremia (serum sodium <130 mEq/L)



IV: intravenous; SIADH: syndrome of inappropriate antidiuretic hormone secretion.

* Severe symptoms of hyponatremia include seizures, obtundation, coma, and respiratory arrest.

¶ Autocorrection of hyponatremia is present if the serum sodium is rising spontaneously without intervention or treatment. Autocorrection should be suspected, even before a spontaneous rise in serum sodium is noted, in the following hyponatremic patients: those with a rapidly reversible cause of hyponatremia who have a brisk urine output and those with a urine output that is increasing over time and a urine cation concentration (ie, the sum of the urine sodium and potassium concentration) that is lower than the serum sodium.

Δ General measures include the following:

- Identify and treat the underlying cause of hyponatremia.
- Identify drugs taken by the patient that could contribute to hyponatremia. Discontinue those drugs unless there is no reasonable substitute and stopping the medication would cause serious harm.
- Reduce intake of electrolyte-free water (impose fluid restriction, eliminate IV hypotonic fluids, increase dietary salt).
- Other therapies in patients with SIADH and chronic hyponatremia include loop diuretics, oral salt tablets, and urea. (Refer to UpToDate topics on treatment of hyponatremia and treatment of SIADH.)