

## Diabetes Insipidus (DI) Post-operative Neurosurgical Management

Cem Demirci, MD

Emily Germain-Lee, MD

David Hersh, MD

Jonathan Martin, MD

Elliot Melendez, MD



# What is a Clinical Pathway?

---



An evidence-based guideline that decreases unnecessary variation, and therefore promotes safe, effective, and consistent patient care.

# Background

---

- Diabetes insipidus (DI) refers to the passage of large volumes of dilute urine and may result from decreased secretion of antidiuretic hormone (ADH) by the posterior pituitary gland.
- Patients undergoing surgery in the sellar or parasellar region are at risk for postoperative DI, which may be transient, triphasic [DI > SIADH > DI], or permanent.
- Patients without an intact thirst mechanism (adipsic central DI) are a particular challenge, as they may not drink enough to replace their urine losses, resulting in severe hypernatremia.

# Why is the DI Pathway Necessary?

---



- Uncontrolled hypernatremia has adverse effects, including an increased risk of neurological sequela and venothromboembolism
- Provider variability and inconsistent care delivery/monitoring are barriers to establish diagnosis and deliver timely and effective care in the absence of a standardized protocol

# Objectives of the DI Pathway

---



- Standardize the management of postoperative patients at risk for developing DI
  - Initial PICU monitoring for development of DI
  - Initial PICU management if DI develops
  - Standardized clearance for patient's transfer to med/surg floors
- Standardize the management of post-operative patients with confirmed DI in the PICU and on the floors
  - Minimize fluctuations in sodium level and volume status
  - Expedite the development of an outpatient plan in order to facilitate a safe discharge to home

# Pathway Overview

- This is the Diabetes Insipidus (DI) Post-operative Neurosurgical Management Clinical Pathway.
- There are 3 portions of the pathway:
  - 1) PICU Post-operative Monitoring for DI
  - 2) PICU Management of DI
  - 3) Med/Surg Management of DI
- We will be reviewing each component in the following slides.

Page 1

**CLINICAL PATHWAY:**  
Diabetes Insipidus (DI) - Post-operative Neurosurgical Management  
PICU Post-operative Monitoring for DI

Page 2

**CLINICAL PATHWAY:**  
Diabetes Insipidus (DI) - Post-operative Neurosurgical Management  
PICU Management of DI

Page 3

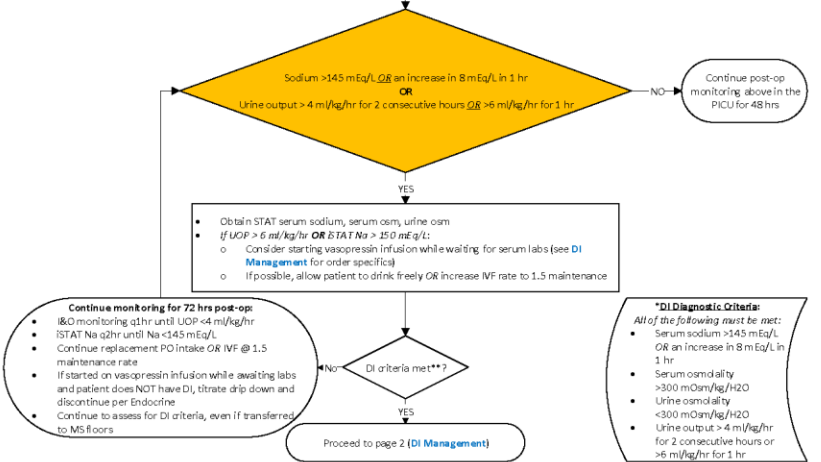
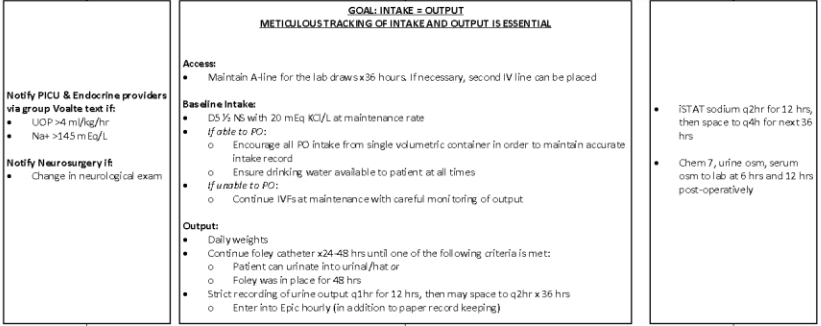
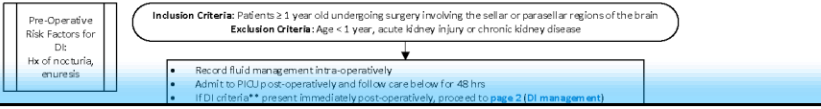
**CLINICAL PATHWAY:**  
Diabetes Insipidus (DI) - Post-operative Neurosurgical Management  
Med/Surg Management of DI

# PICU Post-Operative Monitoring for DI

Because any surgical procedure that involves the sellar or parasellar regions of the brain can increase the risk of DI development, any child that is  $\geq 1$  year of age that has such a procedure will be monitored for the development of DI post-operatively.

Of note, those with any acute kidney injury or chronic kidney disease are excluded from the pathway.

**Inclusion Criteria:** Patients  $\geq 1$  year old undergoing surgery involving the sellar or parasellar regions of the brain  
**Exclusion Criteria:** Age  $< 1$  year, acute kidney injury or chronic kidney disease



Continue monitoring for 72 hrs post-op:  
 • I&O monitoring q1hr until UOP  $< 4$  m/kg/hr  
 • STAT Na q2hr until Na  $< 145$  mEq/L  
 • Continue replacement PO intake OR IVF @ 1.5 maintenance rate  
 • If started on vasopressin infusion while awaiting labs and patient does NOT have DI, titrate drip down and discontinue per Endocrine  
 • Continue to assess for DI criteria, even if transferred to MS floors

**\*DI Diagnostic Criteria:**  
 All of the following must be met:  
 • Serum sodium  $> 145$  mEq/L OR an increase in 8 mEq/L in 1 hr  
 • Serum osmolality  $> 300$  mOsm/kg H<sub>2</sub>O  
 • Urine osmolality  $< 300$  mOsm/kg H<sub>2</sub>O  
 • Urine output  $> 4$  m/kg/hr for 2 consecutive hours or  $> 6$  m/kg/hr for 1 hr

NEXT PAGE

CONTACTS: CEM DEMIRCI, MD | EMILY GERMAIN-LEE, MD | DAVID HERSH, MD  
 JONATHAN MARTIN, MD | ELLIOT MELENDEZ, MD  
 LAST UPDATED: 10.11.21



# PICU Post-Operative Monitoring for DI

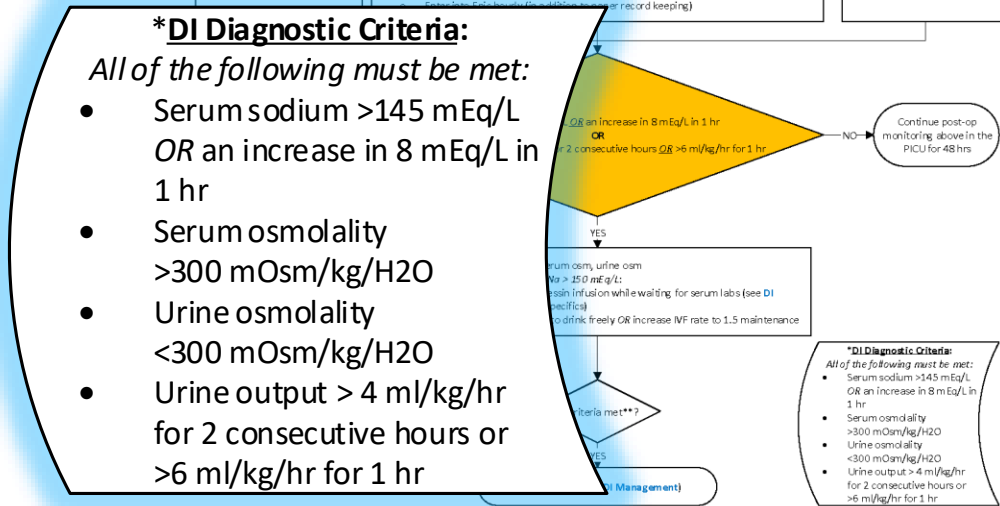
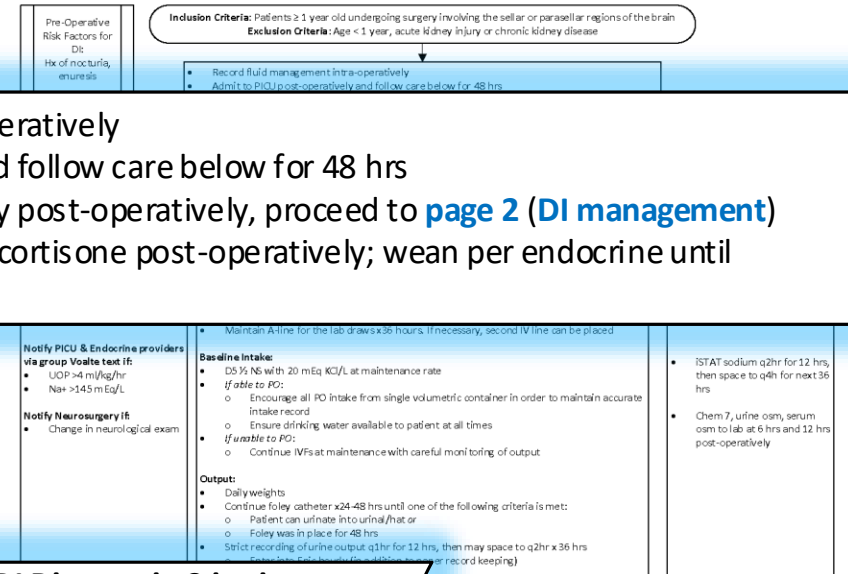
All patients with sellar/parasellar surgery will be admitted to the PICU for monitoring of DI development.

If DI is noted immediately post-op, DI management should be followed.

DI criteria are noted here.

Note that all of the criteria must be met, which includes serum sodium, serum osmolality, urine osmolality, and urine output. These parameters will be assessed frequently.

- Record fluid management intra-operatively
- Admit to PICU post-operatively and follow care below for 48 hrs
- If DI criteria\*\* present immediately post-operatively, proceed to [page 2 \(DI management\)](#)
- Neurosurgery to stress dose hydrocortisone post-operatively; wean per endocrine until cosyntropin stim test performed



NEXT PAGE



# PICU Post-Operative Monitoring for DI

**CLINICAL PATHWAY:**  
**Diabetes Insipidus (DI) - Post-operative Neurosurgical Management**  
PICU Post-operative Monitoring for DI

THIS PATHWAY  
SERVES AS A GUIDE  
AND DOES NOT  
REPLACE CLINICAL  
JUDGMENT.

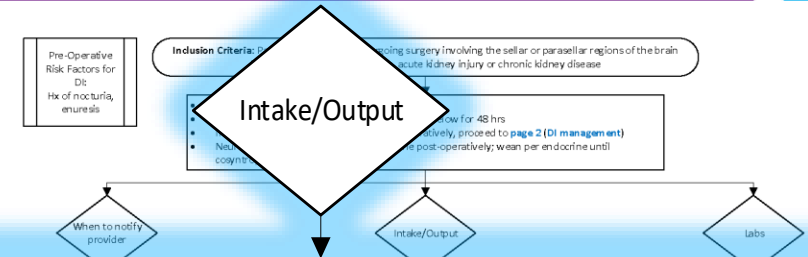
The most important aspect of DI is to ensure intake = output. Meticulous tracking of I&Os is essential.

## Intake:

- All should be started on maintenance IVF.
- In order to maintain accurate intake, PO from one container is encouraged, and patient should have water available at all times.

## Output:

- Foley catheter is maintained for 24-48 hours until the patient can urinate or the foley has been in for 48 hours.
- Strict recording of output is needed every 1 hour for 12 hours, and then every 2 hours for 36 hours thereafter.



**GOAL: INTAKE = OUTPUT**

**METICULOUS TRACKING OF INTAKE AND OUTPUT IS ESSENTIAL**

### Access:

- Maintain A-line for the lab draws x36 hours. If necessary, second IV line can be placed

### Baseline Intake:

- D5 ½ NS with 20 mEq KCl/L at maintenance rate
- *If able to PO:*
  - Encourage all PO intake from single volumetric container in order to maintain accurate intake record
  - Ensure drinking water available to patient at all times
- *If unable to PO:*
  - Continue IVFs at maintenance with careful monitoring of output

### Output:

- Daily weights
- Continue foley catheter x24-48 hrs until one of the following criteria is met:
  - Patient can urinate into urinal/hat *or*
  - Foley was in place for 48 hrs
- Strict recording of urine output q1hr for 12 hrs, then may space to q2hr x 36 hrs
  - Enter into Epic hourly (in addition to paper record keeping)

CONTACTS: CEM DEMIRCI, MD | EMILY GERMAIN-LEE, MD | DAVID HERSH, MD  
JONATHAN MARTIN, MD | ELLIOT MELENDEZ, MD  
LAST UPDATED: 10.11.21

©2019 Connecticut Children's Medical Center. All rights reserved.

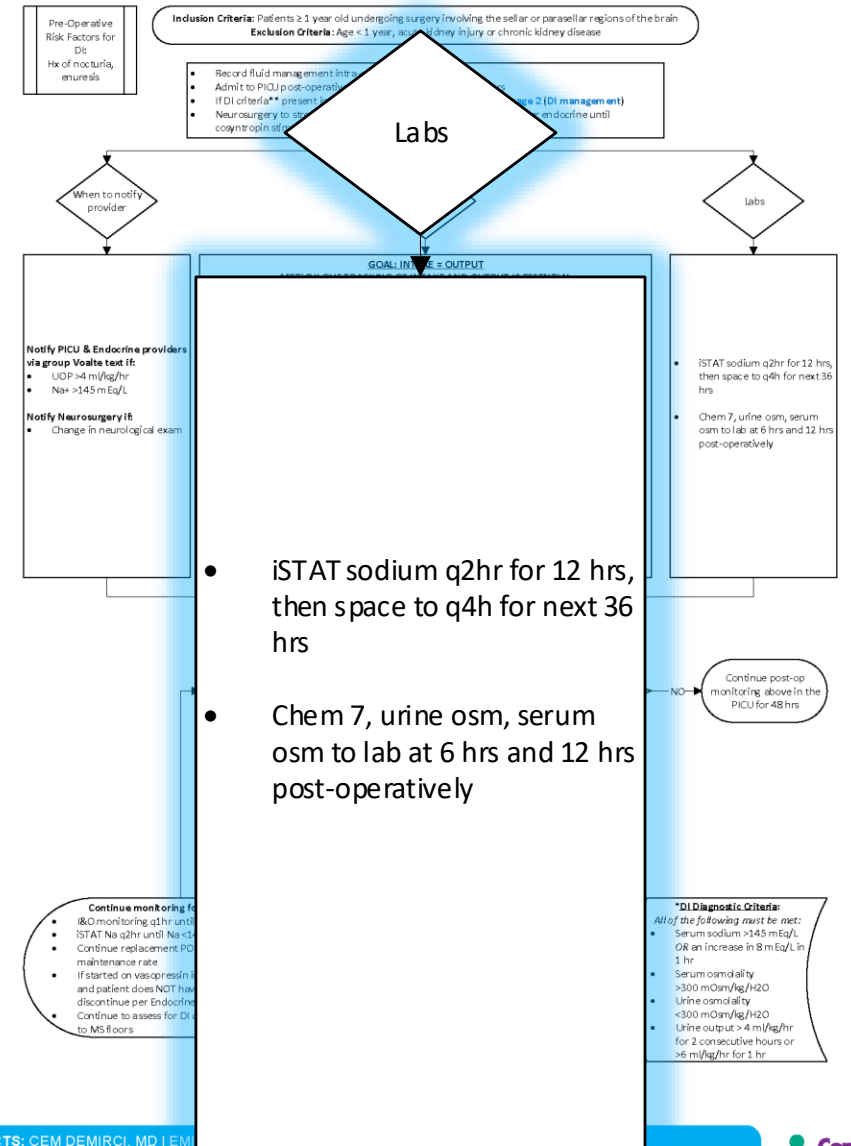
# PICU Post-Operative Monitoring for DI

## CLINICAL PATHWAY: Diabetes Insipidus (DI) - Post-operative Neurosurgical Management PICU Post-operative Monitoring for DI

THIS PATHWAY  
SERVES AS A GUIDE  
AND DOES NOT  
REPLACE CLINICAL  
JUDGMENT.

Laboratory monitoring is also essential to ensure that DI has not developed.

Recommendations are listed here.



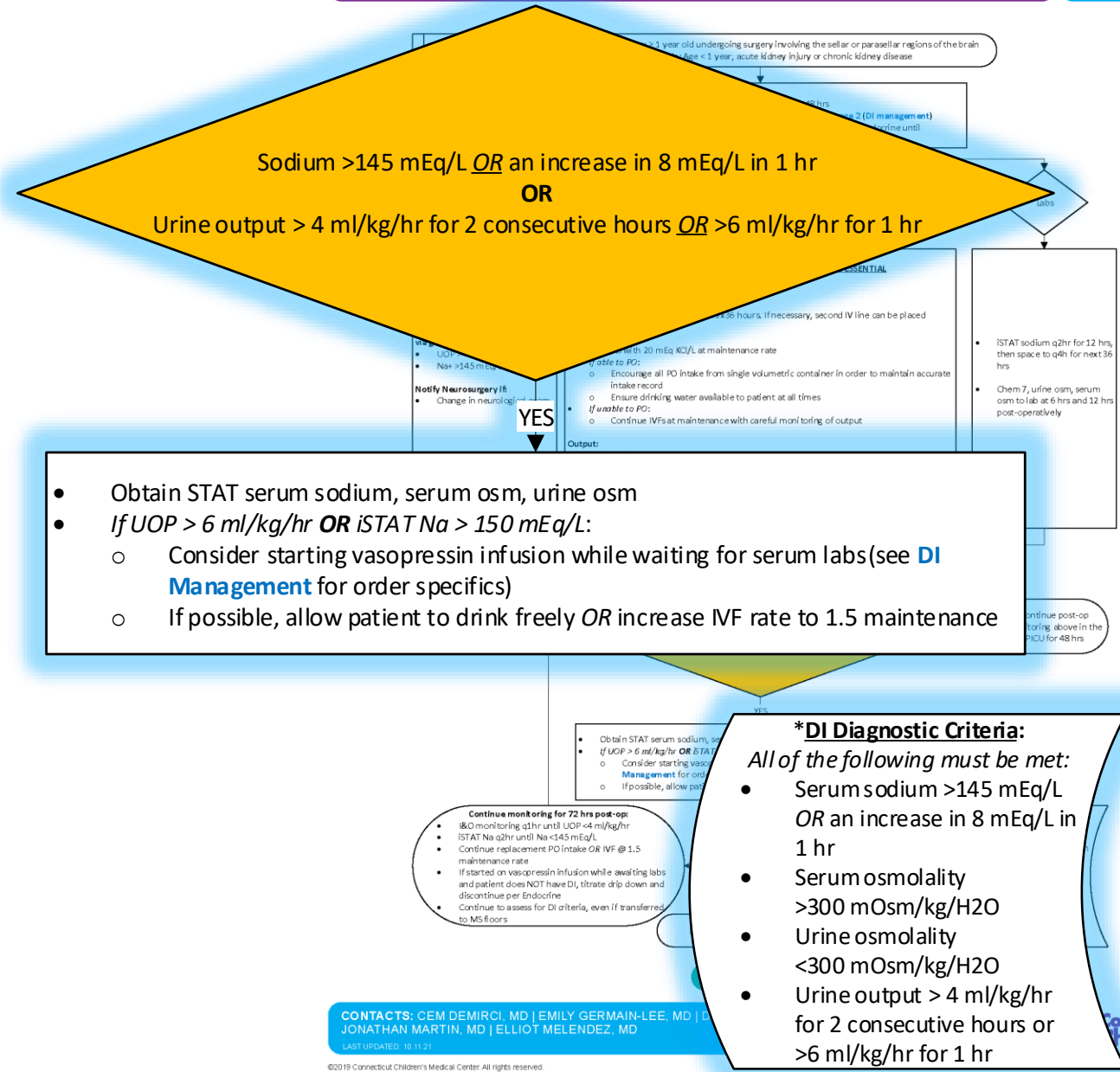
CONTACTS: CEM DEMIRCI, MD | EM  
JONATHAN MARTIN, MD | ELLIOT MELENDEZ, MD  
LAST UPDATED: 10.11.21

©2019 Connecticut Children's Medical Center. All rights reserved.



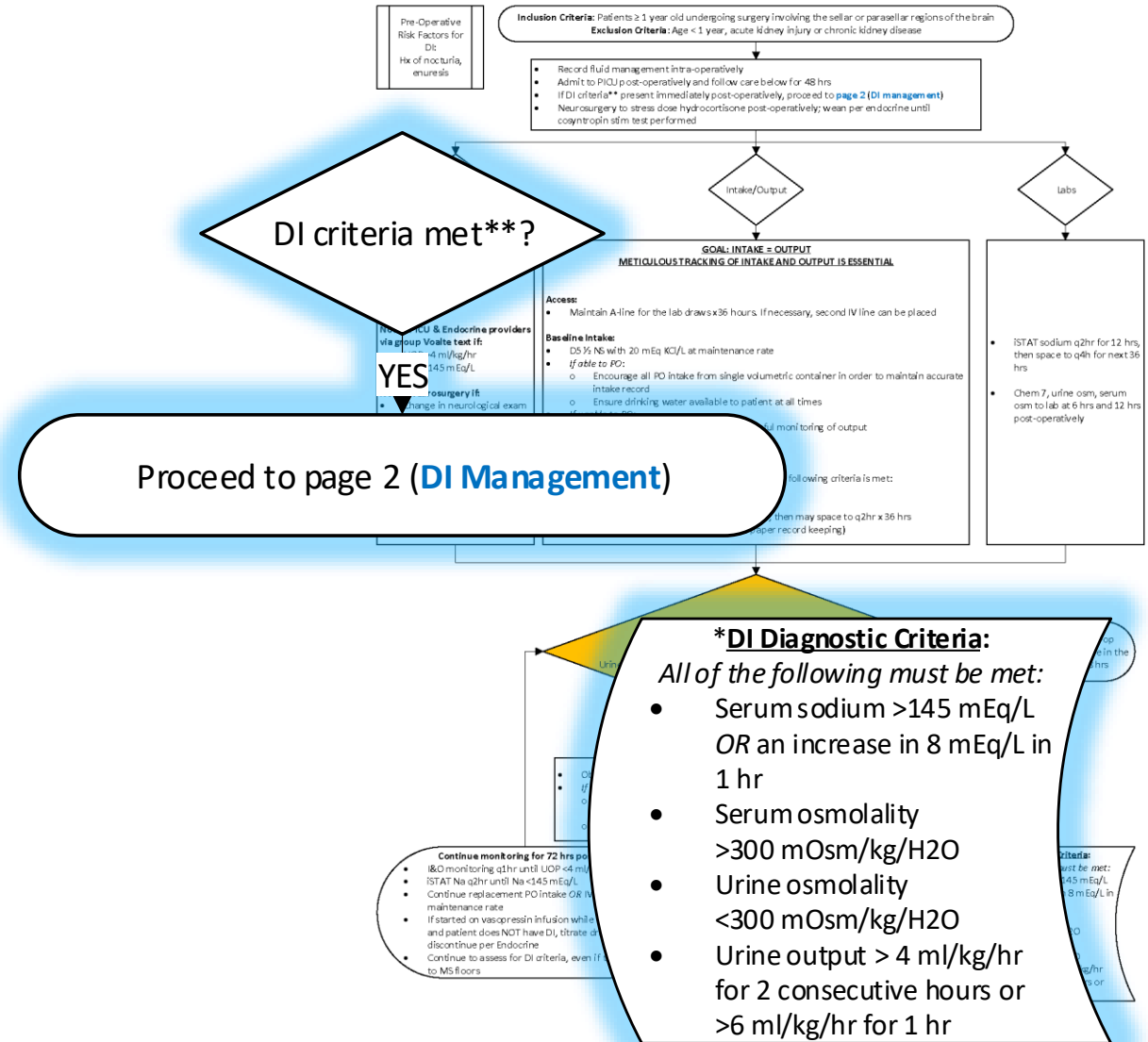
# PICU Post-Operative Monitoring for DI

- If sodium is  $>145$  mEq/L (or an increase by 8 mEq/L in 1 hr) OR there is urine output that is  $>4$  ml/kg/hr for 2 consecutive hours (or  $>6$  ml/kg/hr for 1 hr), you MUST obtain stat labs to evaluate if DI is present.
- If UOP or Na is concerning, you can consider starting vasopressin right away while waiting for the other confirmatory labs.
- While waiting, it is advisable to increase IVF to 1.5 M to help combat losses, or allow the patient to drink freely.



# PICU Post-Operative Monitoring for DI

• If DI criteria is met after those STAT labs are obtained, then you will proceed to DI management on page 2.



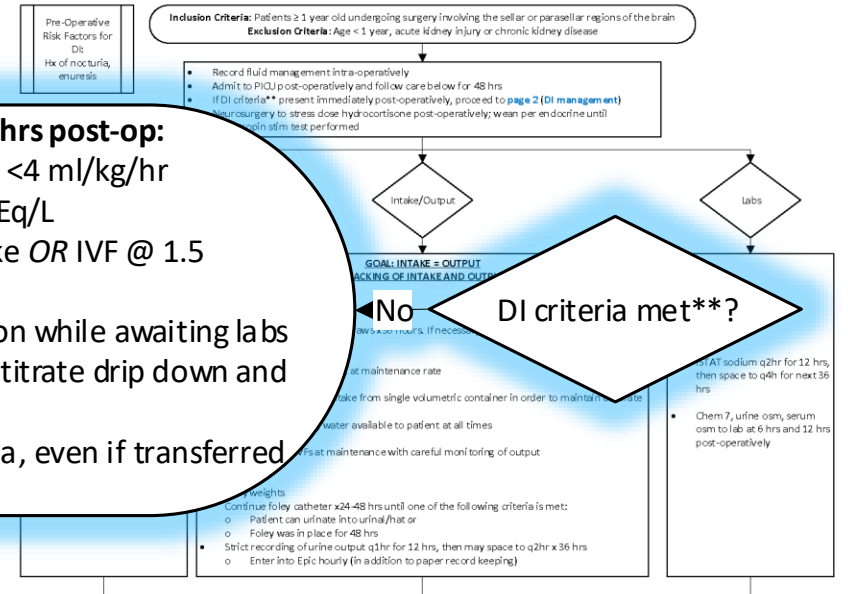
# PICU Post-Operative Monitoring for DI

## If DI criteria is not met:

- Continue closer monitoring until patient is more stable
- Increase input by increasing IVF to 1.5 maintenance or replace PO to meet UOP
- Titrate vasopressin if it was started
- Continue to closely monitor for DI as previously reviewed

## Continue monitoring for 72 hrs post-op:

- I&O monitoring q1hr until UOP <4 ml/kg/hr
- iSTAT Na q2hr until Na <145 mEq/L
- Continue replacement PO intake OR IVF @ 1.5 maintenance rate
- If started on vasopressin infusion while awaiting labs and patient does NOT have DI, titrate drip down and discontinue per Endocrine
- Continue to assess for DI criteria, even if transferred to MS floors



## \*DI Diagnostic Criteria:

All of the following must be met:

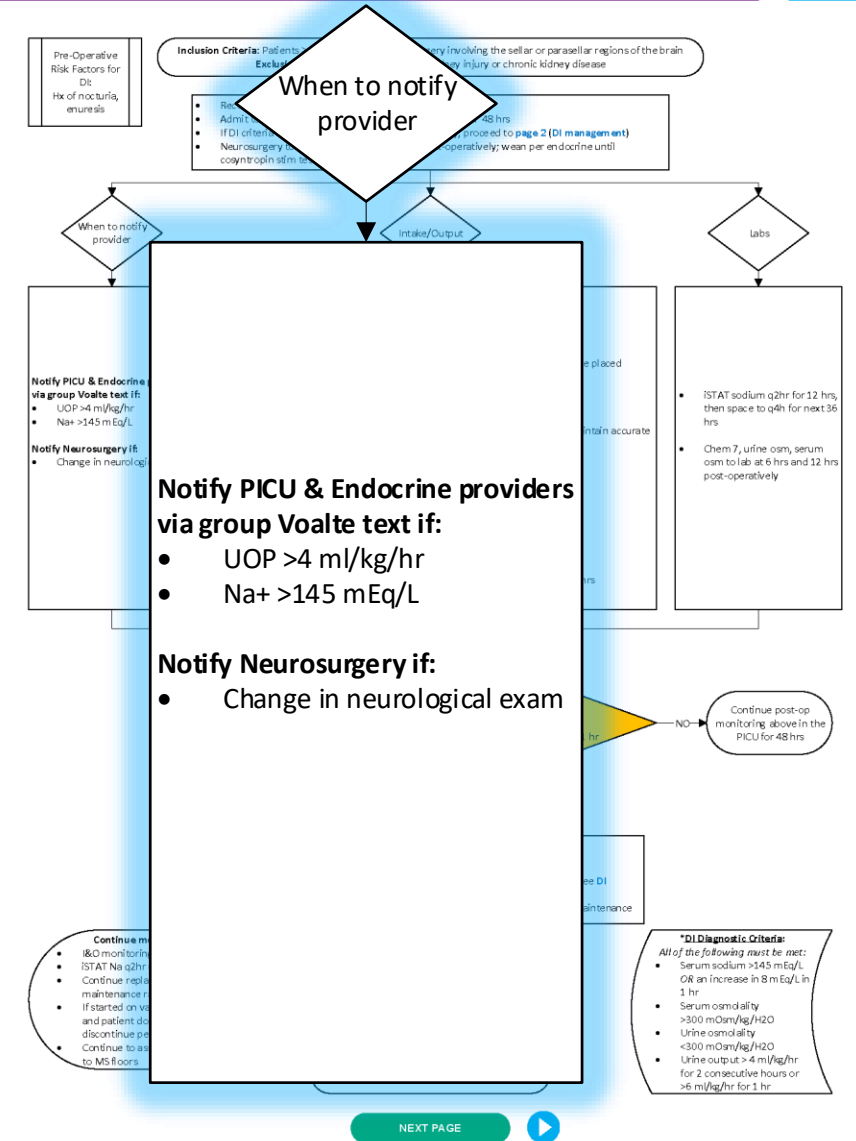
- Serum sodium >145 mEq/L OR an increase in 8 mEq/L in 1 hr
- Serum osmolality >300 mOsm/kg/H<sub>2</sub>O
- Urine osmolality <300 mOsm/kg/H<sub>2</sub>O
- Urine output > 4 ml/kg/hr for 2 consecutive hours or >6 ml/kg/hr for 1 hr

# PICU Post-Operative Monitoring for DI

## CLINICAL PATHWAY: Diabetes Insipidus (DI) - Post-operative Neurosurgical Management PICU Post-operative Monitoring for DI

THIS PATHWAY  
SERVES AS A GUIDE  
AND DOES NOT  
REPLACE CLINICAL  
JUDGMENT.

- Note that PICU/Endocrine providers should be notified immediately if UOP >4 ml/kg/hr or sodium is >145 mEq/L. This is to allow for immediate intervention and closer monitoring.
- Neurosurgery should be notified if there is any change in neurological examination.



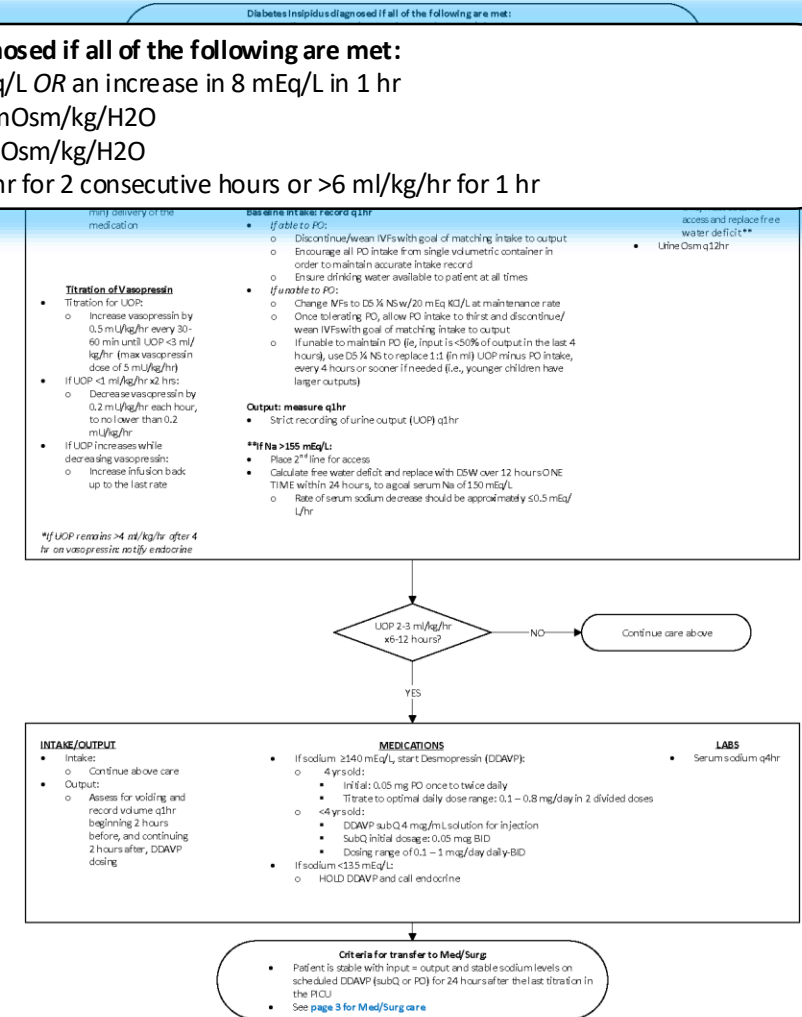
CONTACTS: CEM DEMIRCI, MD | EMILY GERMAIN-LEE, MD | DAVID HERSH, MD  
JONATHAN MARTIN, MD | ELLIOT MELENDEZ, MD  
LAST UPDATED: 10.11.21

©2019 Connecticut Children's Medical Center. All rights reserved.

# PICU Management of DI

- If DI criteria is met, follow the 2nd page of the algorithm for PICU management of DI
- Diagnostic criteria are listed here. Remember that all criteria must be met.

- Diabetes Insipidus diagnosed if all of the following are met:**
- Serum sodium >145 mEq/L **OR** an increase in 8 mEq/L in 1 hr
  - Serum osmolality >300 mOsm/kg/H<sub>2</sub>O
  - Urine osmolality <300 mOsm/kg/H<sub>2</sub>O
  - Urine output > 4 ml/kg/hr for 2 consecutive hours or >6 ml/kg/hr for 1 hr



RETURN TO THE BEGINNING

# PICU Management of DI

- Part of the initial management of DI is vasopressin.
- One role of vasopressin is to stimulate arginine vasopressin receptors (aka, antidiuretic hormone, or ADH).
- This results in decreased urine output and increased osmolality.
- Vasopressin is titrated based on UOP.
- If UOP stays >4 ml/kg/hr despite 4 hrs of vasopressin therapy, endocrine should be notified.

## CLINICAL PATHWAY: Diabetes Insipidus (DI) - Post-operative Neurosurgical Management PICU Management of DI

THIS PATHWAY  
SERVES AS A GUIDE  
AND DOES NOT  
REPLACE CLINICAL  
JUDGMENT.

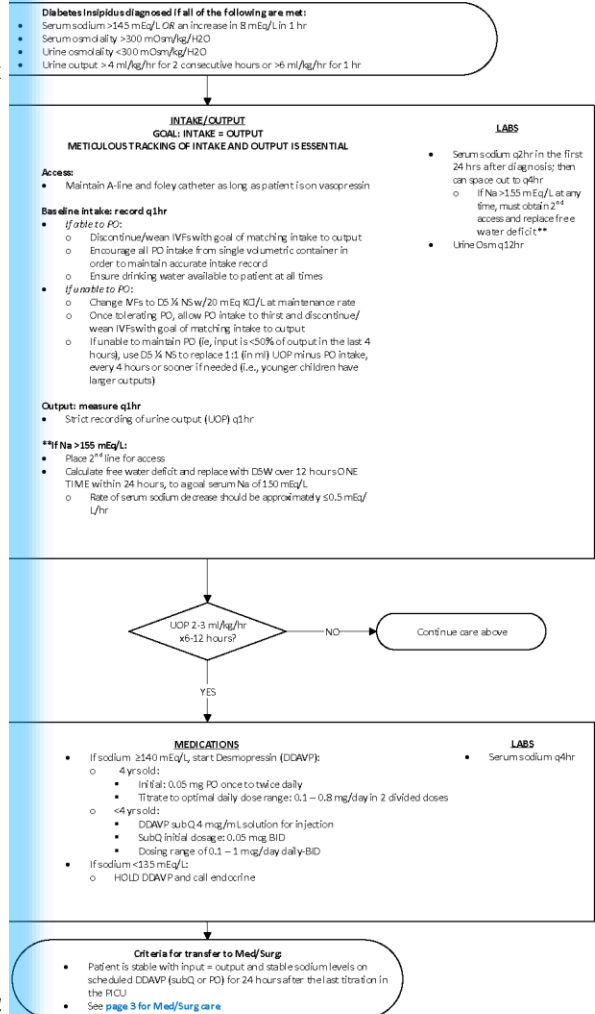
### MEDICATION

- Order STAT Vasopressin IV infusion at 0.5 mU/kg/hr (max vasopressin dose of 5 mU/kg/hr)
  - Call pharmacy in order to ensure timely (<30 min) delivery of the medication

### Titration of Vasopressin

- Titration for UOP:
  - Increase vasopressin by 0.5 mU/kg/hr every 30-60 min until UOP <3 ml/kg/hr (max vasopressin dose of 5 mU/kg/hr)
- If UOP <1 ml/kg/hr x2 hrs:
  - Decrease vasopressin by 0.2 mU/kg/hr each hour, to no lower than 0.2 mU/kg/hr
- If UOP increases while decreasing vasopressin:
  - Increase infusion back up to the last rate

*\*If UOP remains >4 ml/kg/hr after 4 hr on vasopressin: notify endocrine*



RETURN TO THE BEGINNING

CONTACTS: CEM DEMIRCI, MD | EMILY GERMAIN-LEE, MD | DAVID HERSH, MD

JONATHAN MARTIN, MD | ELLIOT MELENDEZ, MD

LAST UPDATED: 10.11.21

©2019 Connecticut Children's Medical Center. All rights reserved.



# PICU Management of DI

- Again, meticulous tracking of intake and output is essential.
- The goal would be to ensure that intake = output. Careful monitoring is necessary, especially while on vasopressin.
- While the patient is on vasopressin, an A line and Foley should be maintained.
- If the patient's sodium reaches over 155 mEq/L:
  - A 2<sup>nd</sup> line should be placed to allow additional fluids
  - Free water deficit should be replaced with D5W once to get to a goal of serum Na 150 mEq/L

## INTAKE/OUTPUT GOAL: INTAKE = OUTPUT METICULOUS TRACKING OF INTAKE AND OUTPUT IS ESSENTIAL

### Access:

- Maintain A-line and foley catheter as long as patient is on vasopressin

### Baseline intake: record q1hr

- *If able to PO:*
  - Discontinue/wean IVFs with goal of matching intake to output
  - Encourage all PO intake from single volumetric container in order to maintain accurate intake record
  - Ensure drinking water available to patient at all times
- *If unable to PO:*
  - Change IVFs to D5 ¼ NS w/20 mEq KCl/L at maintenance rate
  - Once tolerating PO, allow PO intake to thirst and discontinue/wean IVFs with goal of matching intake to output
  - If unable to maintain PO (ie, input is <50% of output in the last 4 hours), use D5 ¼ NS to replace 1:1 (in ml) UOP minus PO intake, every 4 hours or sooner if needed (i.e., younger children have larger outputs)

### Output: measure q1hr

- Strict recording of urine output (UOP) q1hr

### \*\*If Na >155 mEq/L:

- Place 2<sup>nd</sup> line for access
- Calculate free water deficit and replace with D5W over 12 hours ONE TIME within 24 hours, to a goal serum Na of 150 mEq/L
  - Rate of serum sodium decrease should be approximately  $\leq 0.5$  mEq/L/hr

LABS  
m sodium q2hr in the first  
hrs after diagnosis; then  
space out to q4hr  
If Na >155 mEq/L at any  
time, must obtain 2<sup>nd</sup>  
access and replace free  
water deficit\*\*  
\*Qsm q12hr

re above

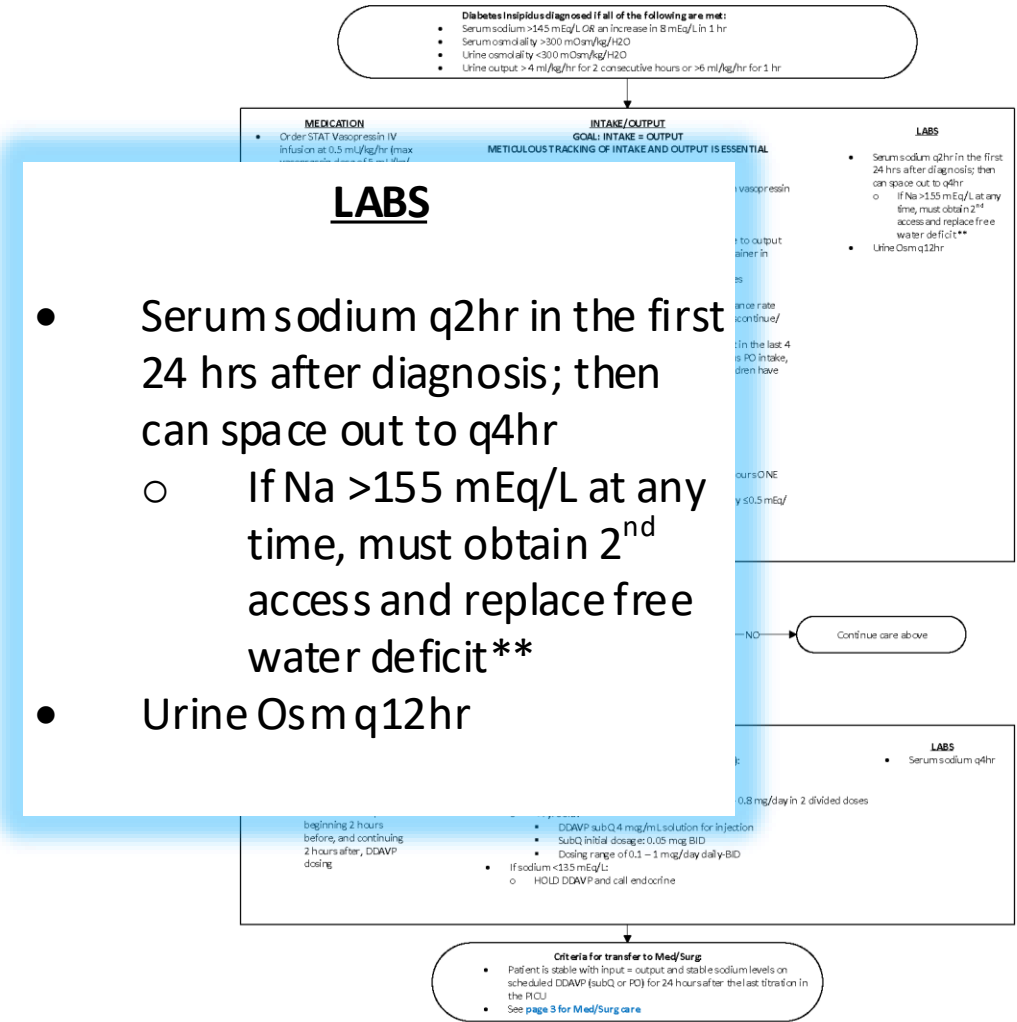
LABS  
Serum sodium q4hr

# PICU Management of DI

- Labs are directed at closely monitoring serum sodium and urine osmolality
- Remember, if sodium becomes >155 mEq/L at any time, obtain a 2<sup>nd</sup> line to replace the free water deficit

## CLINICAL PATHWAY: Diabetes Insipidus (DI) - Post-operative Neurosurgical Management PICU Management of DI

THIS PATHWAY  
SERVES AS A GUIDE  
AND DOES NOT  
REPLACE CLINICAL  
JUDGMENT.



CONTACTS: CEM DEMIRCI, MD | EMILY GERMAIN-LEE, MD | DAVID HERSH, MD  
JONATHAN MARTIN, MD | ELLIOT MELENDEZ, MD

LAST UPDATED: 10.11.21  
©2019 Connecticut Children's Medical Center. All rights reserved.

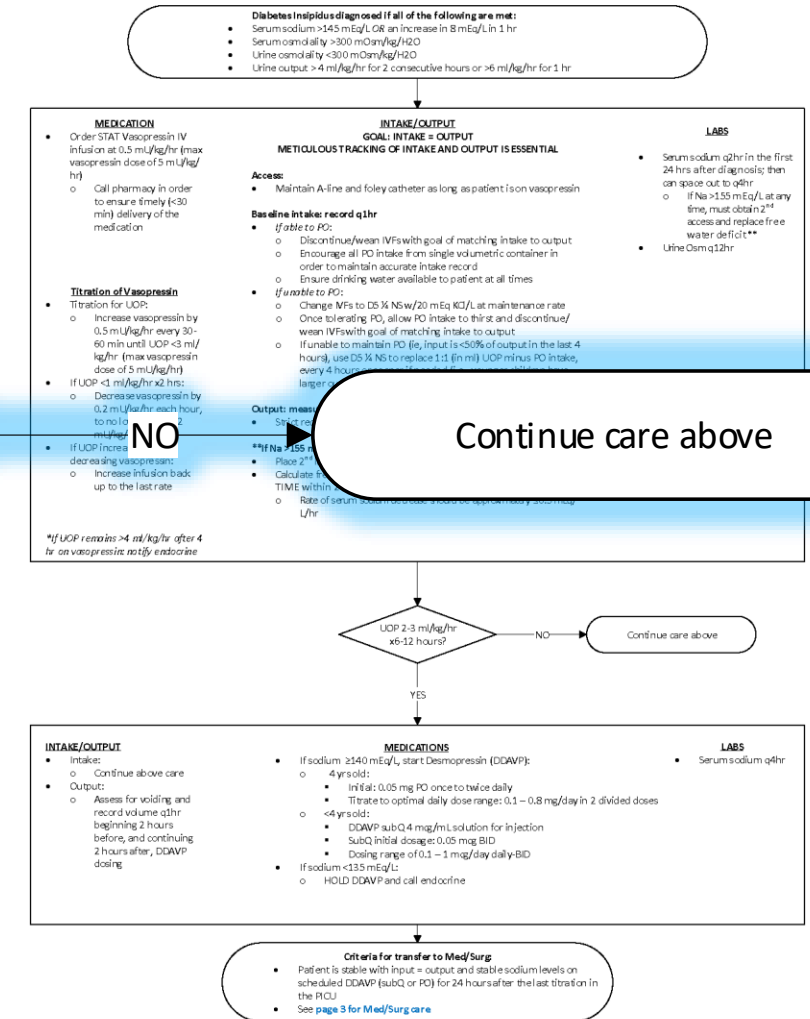
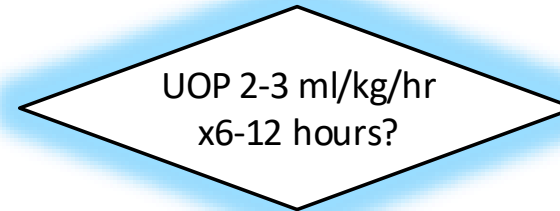


# PICU Management of DI

## CLINICAL PATHWAY: Diabetes Insipidus (DI) - Post-operative Neurosurgical Management PICU Management of DI

THIS PATHWAY  
SERVES AS A GUIDE  
AND DOES NOT  
REPLACE CLINICAL  
JUDGMENT.

- If UOP has not stabilized to 2-3 ml/kg/hr for 6-12 hours, then the care outlined in previous slides should continue.



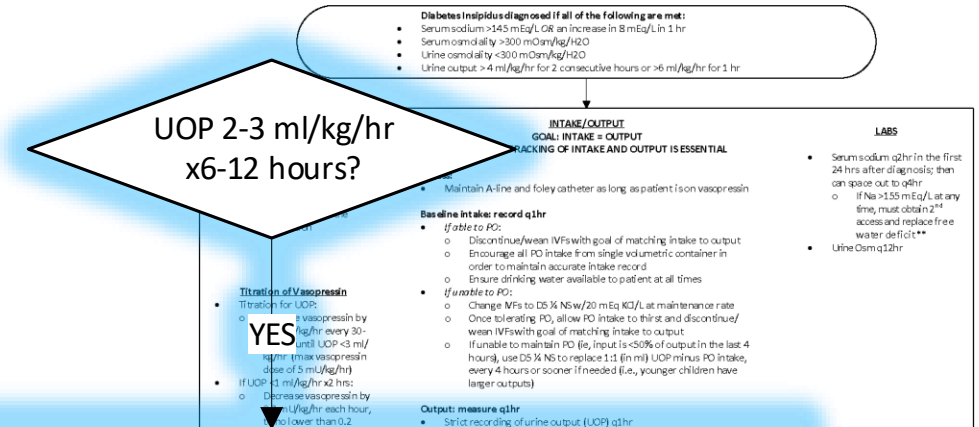
RETURN TO THE BEGINNING

CONTACTS: CEM DEMIRCI, MD | EMILY GERMAIN-LEE, MD | DAVID HERSH, MD  
JONATHAN MARTIN, MD | ELLIOT MELENDEZ, MD

LAST UPDATED: 10/11/21

©2019 Connecticut Children's Medical Center. All rights reserved.

# PICU Management of DI



If UOP has reached 2-3 ml/kg/hr for 6-12 hours:

- DDAVP may be started depending on sodium levels.

## MEDICATIONS

- If sodium  $\geq 140$  mEq/L, start Desmopressin (DDAVP):
  - $\geq 4$  yrs old:
    - Initial: 0.05 mg PO once to twice daily
    - Titrate to optimal daily dose range: 0.1 – 0.8 mg/day in 2 divided doses
  - <4 yrs old:
    - DDAVP subQ
    - SubQ initial dosage: 0.05 mcg BID
    - Dosing range of 0.1 – 1 mcg/day daily-BID
- If sodium <135 mEq/L:
  - HOLD DDAVP and call endocrine

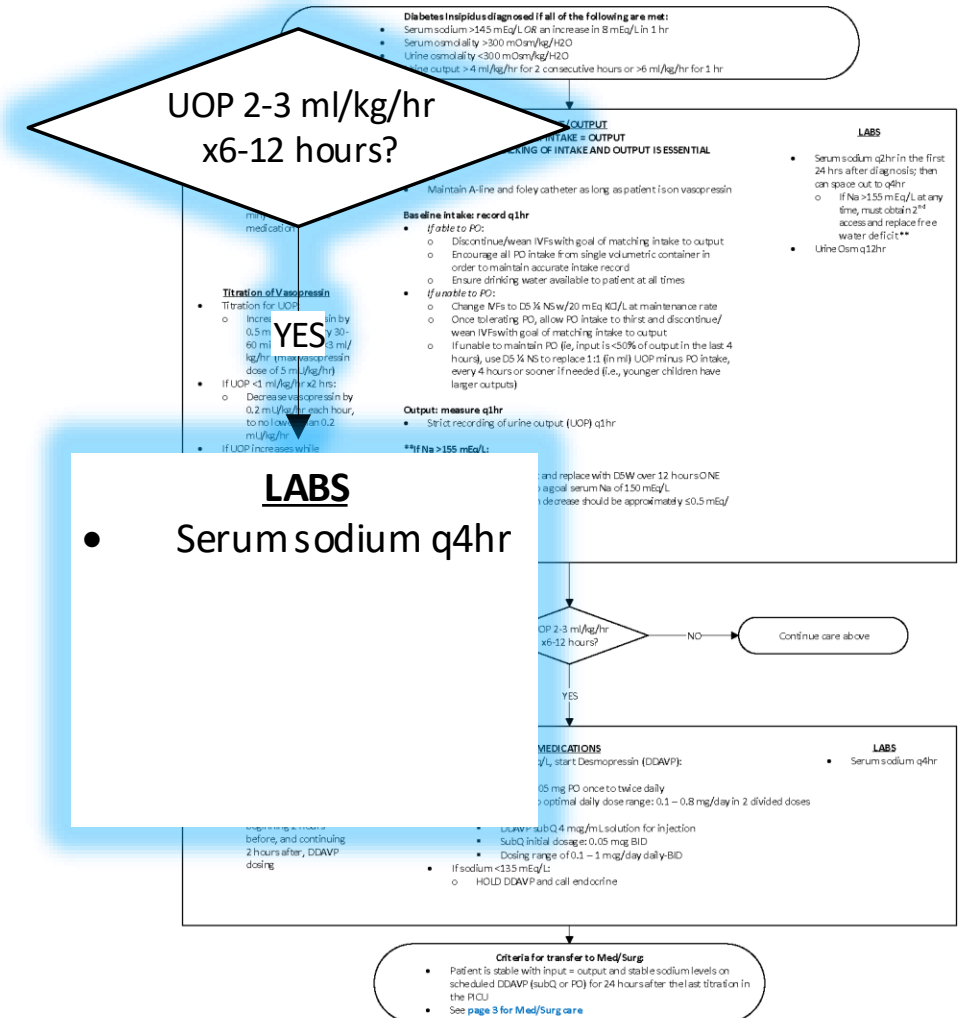
# PICU Management of DI

## CLINICAL PATHWAY: Diabetes Insipidus (DI) - Post-operative Neurosurgical Management PICU Management of DI

THIS PATHWAY  
SERVES AS A GUIDE  
AND DOES NOT  
REPLACE CLINICAL  
JUDGMENT.

If UOP has reached 2-3 ml/kg/hr for 6-12 hours:

- Serum sodium monitoring can be spaced to every 4 hours if not already done



CONTACTS: CEM DEMIRCI, MD | EMILY GERMAIN-LEE, MD | DAVID HERSH, MD

JONATHAN MARTIN, MD | ELLIOT MELENDEZ, MD

LAST UPDATED: 10.11.21

©2019 Connecticut Children's Medical Center. All rights reserved.

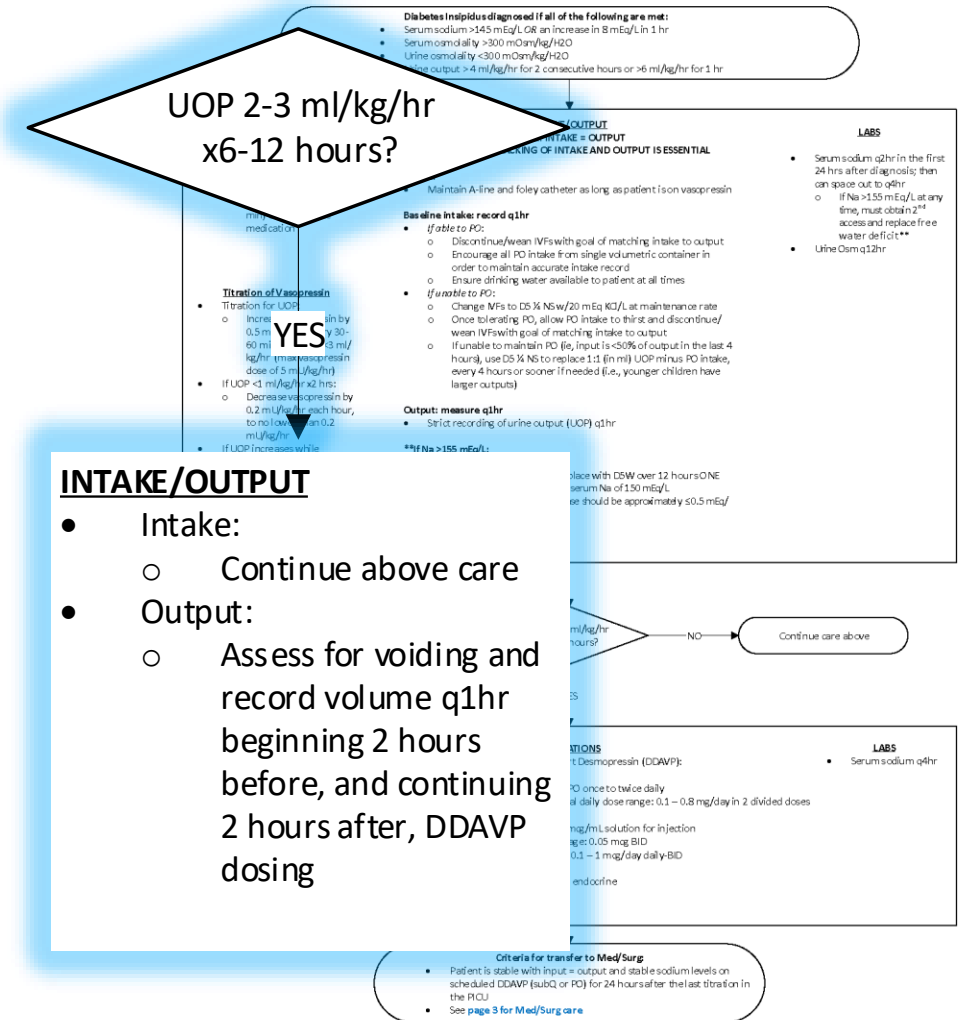
# PICU Management of DI

## CLINICAL PATHWAY: Diabetes Insipidus (DI) - Post-operative Neurosurgical Management PICU Management of DI

THIS PATHWAY  
SERVES AS A GUIDE  
AND DOES NOT  
REPLACE CLINICAL  
JUDGMENT.

### If UOP has reached 2-3 ml/kg/hr for 6-12 hours:

- Close monitoring of Intake and Output should continue
- Output assessment is important around DDAVP dosing



RETURN TO THE BEGINNING

CONTACTS: CEM DEMIRCI, MD | EMILY GERMAIN-LEE, MD | DAVID HERSH, MD

JONATHAN MARTIN, MD | ELLIOT MELENDEZ, MD

LAST UPDATED: 10.11.21

©2019 Connecticut Children's Medical Center. All rights reserved.

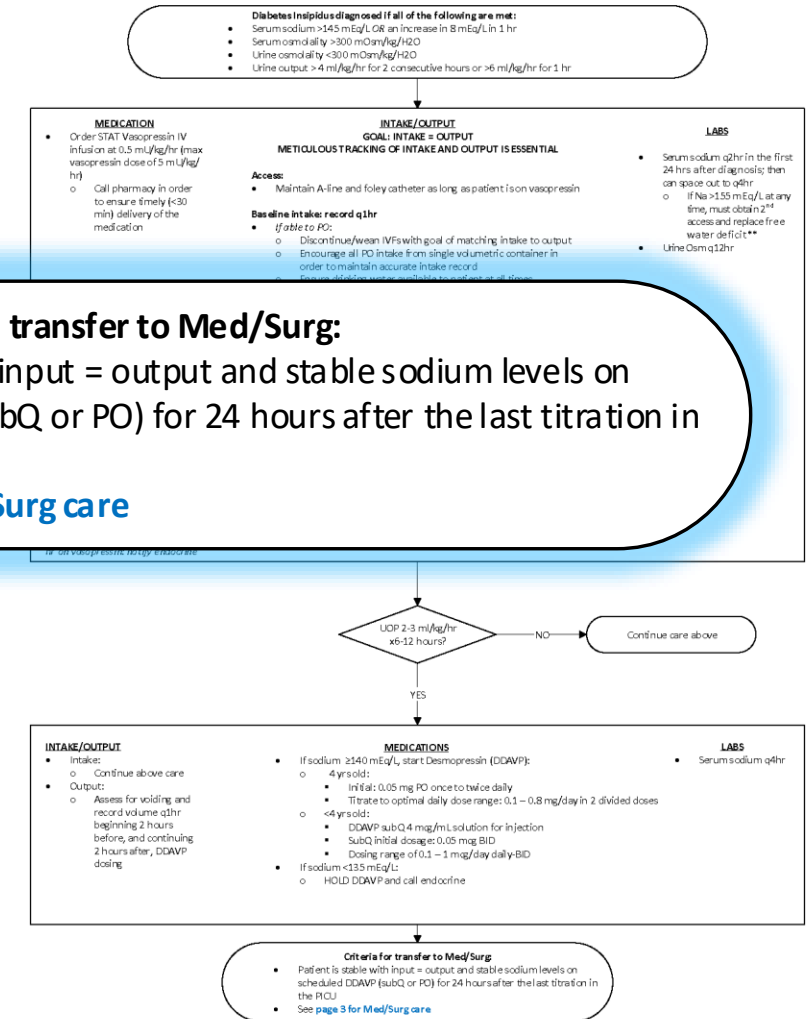
# PICU Management of DI

## CLINICAL PATHWAY: Diabetes Insipidus (DI) - Post-operative Neurosurgical Management PICU Management of DI

THIS PATHWAY  
SERVES AS A GUIDE  
AND DOES NOT  
REPLACE CLINICAL  
JUDGMENT.

- After DDAVP is titrated and the patient remains on scheduled doses for 24 hours, transfer to med/surg can be considered if intake = output and sodium levels are stable.

- Criteria for transfer to Med/Surg:**
- Patient is stable with input = output and stable sodium levels on scheduled DDAVP (subQ or PO) for 24 hours after the last titration in the PICU
  - See [page 3 for Med/Surg care](#)



RETURN TO THE BEGINNING

CONTACTS: CEM DEMIRCI, MD | EMILY GERMAIN-LEE, MD | DAVID HERSH, MD

JONATHAN MARTIN, MD | ELLIOT MELENDEZ, MD

LAST UPDATED: 10.11.21

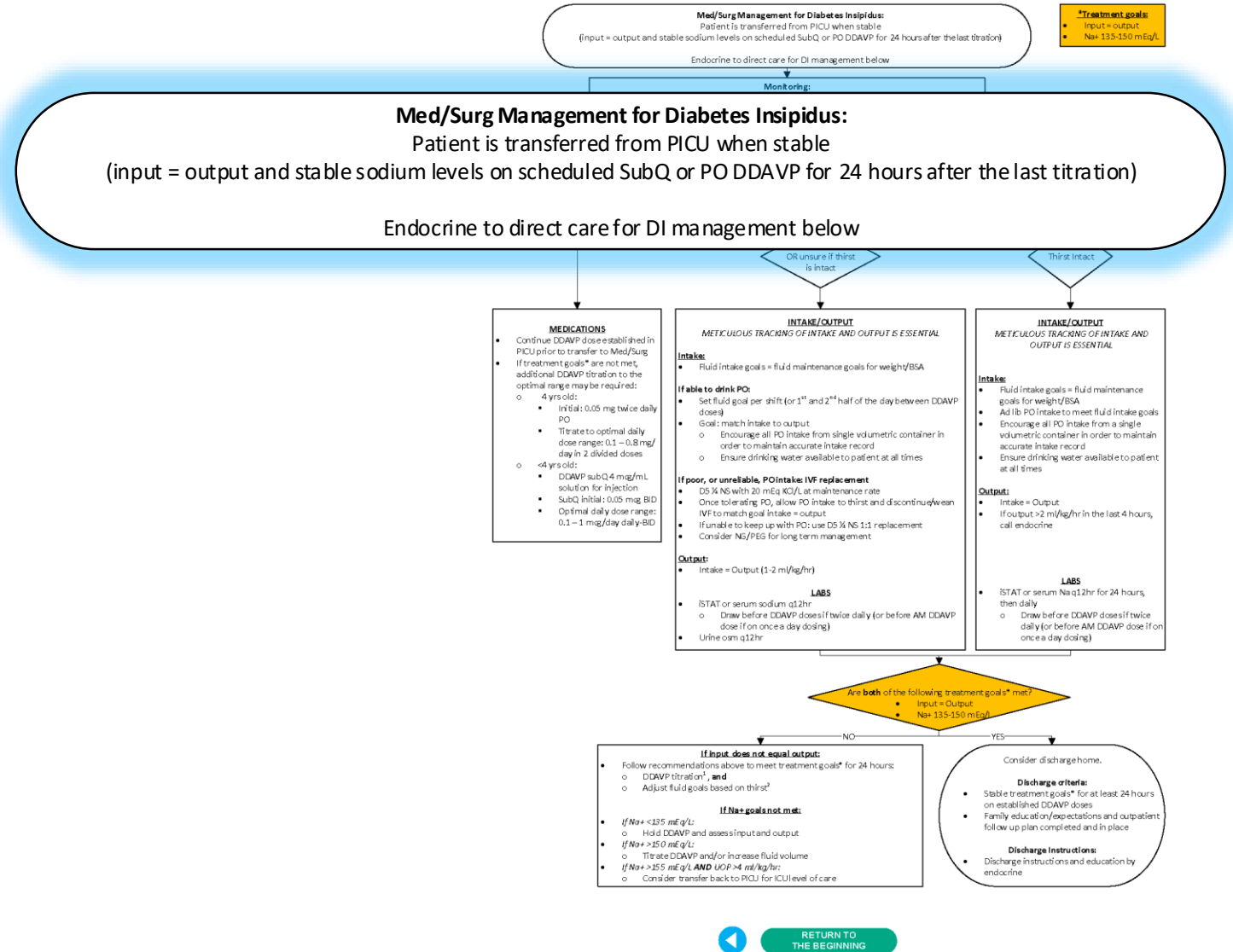
©2019 Connecticut Children's Medical Center. All rights reserved.

# Med/Surg Management of DI

- Once criteria to transfer out of the PICU to the med/surg floors is met, follow page 3 of the pathway: Med/Surg Management of DI
- Endocrinology will direct the care for DI management.

## CLINICAL PATHWAY: Diabetes Insipidus (DI) - Post-operative Neurosurgical Management Med/Surg Management of DI

THIS PATHWAY  
SERVES AS A GUIDE  
AND DOES NOT  
REPLACE CLINICAL  
JUDGMENT.



CONTACTS: CEM DEMIRCI, MD | EMILY GERMAIN-LEE, MD | DAVID HERSH, MD  
JONATHAN MARTIN, MD | ELLIOT MELENDEZ, MD

LAST UPDATED: 10.11.21  
©2019 Connecticut Children's Medical Center. All rights reserved.





# Med/Surg Management of DI

- Meticulous I&O tracking is essential. On the med/surg floors, this is done every 4 hours in conjunction with vitals. If more frequent monitoring is required, then consider transferring back to the PICU for closer monitoring.
- Labs are dependent upon thirst mechanism.

**Med/Surg Management for Diabetes Insipidus:**  
Patient is transferred from PICU when stable  
(input = output and stable sodium levels on scheduled SubQ or PO DDAVP for 24 hours after the last titration)  
Endocrine to direct care for DI management below

**\*Treatment goals:**

- Input = output
- Na+ 135-150 mEq/L

Monitoring:

## Monitoring:

- Meticulous tracking of intake and output q4hr is essential
- Vitals q4hr
- Labs q12hr and are dependent upon thirst<sup>2</sup> (see below)

*If more frequent monitoring of vital signs and I&Os are required, consider transfer back to PICU.*

MEDICATIONS	METICULOUS TRACKING OF INTAKE AND OUTPUT IS ESSENTIAL	METICULOUS TRACKING OF INTAKE AND OUTPUT IS ESSENTIAL
<ul style="list-style-type: none"> <li>Continue DDAVP dose established in PICU prior to transfer to Med/Surg</li> <li>If treatment goals* are not met, additional DDAVP titration to the optimal range may be required:                             <ul style="list-style-type: none"> <li>4 yrs old:                                     <ul style="list-style-type: none"> <li>Initial: 0.05 mg twice daily PO</li> <li>Titrate to optimal daily dose range: 0.1 – 0.8 mg/day in 2 divided doses</li> </ul> </li> <li>&lt;4 yrs old:                                     <ul style="list-style-type: none"> <li>DDAVP subQ 4 mg/mL solution for injection</li> <li>SubQ Initial: 0.05 mg BID</li> <li>Optimal daily dose range: 0.1 – 1 mg/day daily BID</li> </ul> </li> </ul> </li> </ul>	<p><b>Intake:</b></p> <ul style="list-style-type: none"> <li>Fluid intake goals = fluid maintenance goals for weight/BSA</li> </ul> <p><b>If able to drink PO:</b></p> <ul style="list-style-type: none"> <li>Set fluid goal per shift (or 1<sup>st</sup> and 2<sup>nd</sup> half of the day between DDAVP doses)</li> <li>Goal: match intake to output                             <ul style="list-style-type: none"> <li>Encourage all PO intake from single volumetric container in order to maintain accurate intake record</li> <li>Ensure drinking water available to patient at all times</li> </ul> </li> </ul> <p><b>If poor, or unreliable, PO intake: IVF replacement</b></p> <ul style="list-style-type: none"> <li>D5 ½ NS with 20 mEq KCl/L at maintenance rate</li> <li>Once tolerating PO, allow PO intake to thirst and discontinue IVF to match goal intake = output</li> <li>If unable to keep up with PO: use D5 ½ NS 1:1 replacement</li> <li>Consider NS/PEG for long term management</li> </ul> <p><b>Output:</b></p> <ul style="list-style-type: none"> <li>Intake = Output (1-2 ml/kg/hr)</li> </ul> <p><b>LABS</b></p> <ul style="list-style-type: none"> <li>ISTAT or serum sodium q12hr                             <ul style="list-style-type: none"> <li>Draw before DDAVP doses if twice daily (or before AM DDAVP dose if on once a day dosing)</li> </ul> </li> <li>Urine osm q12hr</li> </ul>	<p><b>Intake:</b></p> <ul style="list-style-type: none"> <li>Fluid intake goals = fluid maintenance goals for weight/BSA</li> <li>Ad lib PO intake to meet fluid intake goals</li> <li>Encourage all PO intake from a single volumetric container in order to maintain accurate intake record</li> <li>Ensure drinking water available to patient at all times</li> </ul> <p><b>Output:</b></p> <ul style="list-style-type: none"> <li>Intake = Output</li> <li>If output &gt;2 ml/kg/hr in the last 4 hours, call endocrine</li> </ul> <p><b>LABS</b></p> <ul style="list-style-type: none"> <li>ISTAT or serum Na q12hr for 24 hours, then daily                             <ul style="list-style-type: none"> <li>Draw before DDAVP doses if twice daily (or before AM DDAVP dose if on once a day dosing)</li> </ul> </li> </ul>

Are both of the following treatment goals\* met?

- Input = Output
- Na+ 135-150 mEq/L

**If input does not equal output:**

- Follow recommendations above to meet treatment goals\* for 24 hours:
  - DDAVP titration<sup>2</sup>, and
  - Adjust fluid goals based on thirst<sup>2</sup>
- If Na+ goals not met:**
  - If Na+ <135 mEq/L:
    - Hold DDAVP and assess input and output
  - If Na+ >150 mEq/L:
    - Titrate DDAVP and/or increase fluid volume
  - If Na+ >155 mEq/L AND UOFR >4 ml/kg/hr:
    - Consider transfer back to PICU for ICU level of care

Consider discharge home.

**Discharge criteria:**

- Stable treatment goals\* for at least 24 hours on established DDAVP doses
- Family education on expectations and outpatient follow up plan completed and in place

**Discharge instructions:**

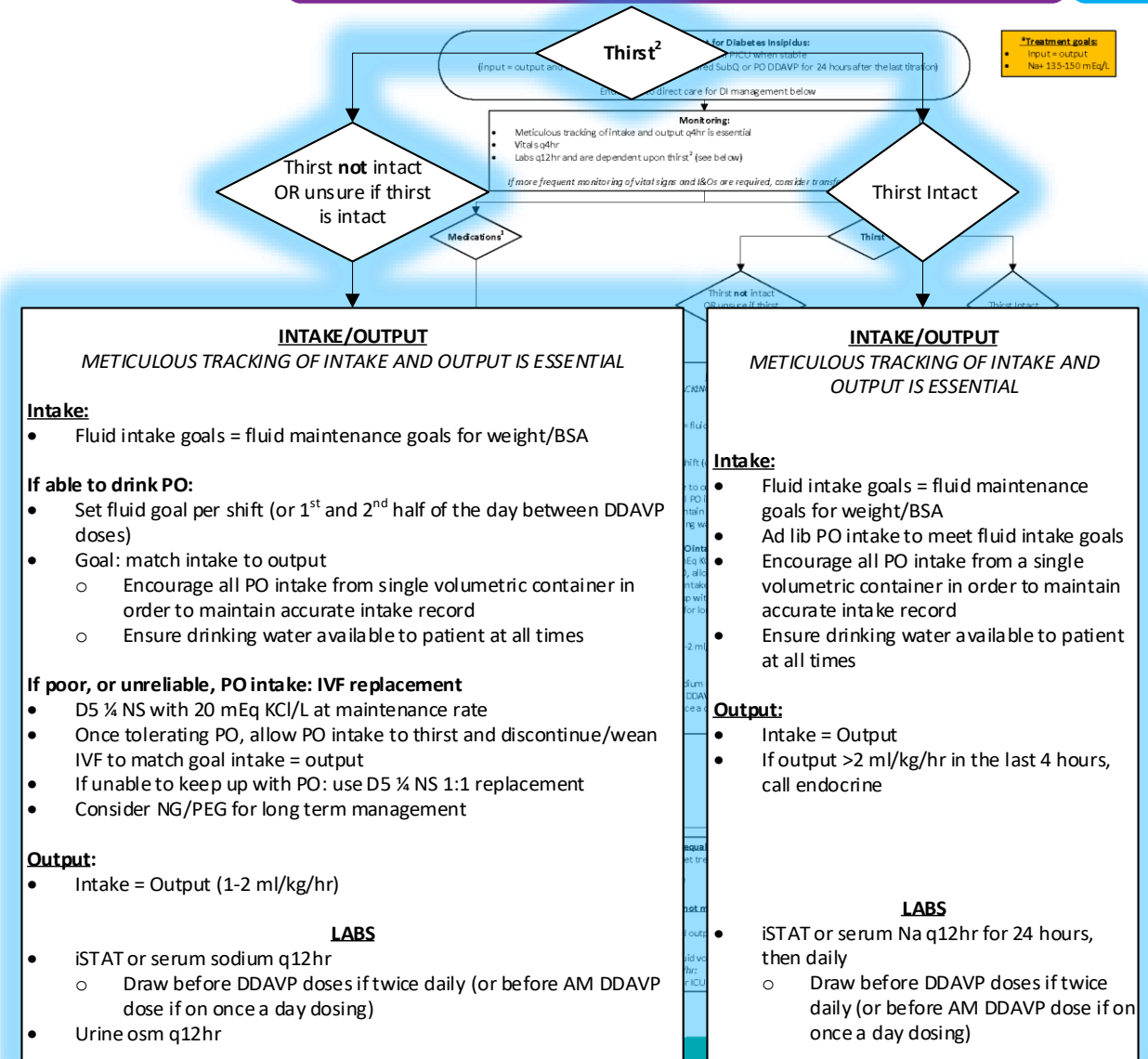
- Discharge instructions and education by endocrine



RETURN TO THE BEGINNING

# Med/Surg Management of DI

- Recommendations for I&Os and labs depend on if thirst mechanisms are intact.
- Both require:
  - Meticulous tracking of I&Os
  - Fluid intake goals to equal fluid maintenance goals for weight/BSA
  - Intake = output

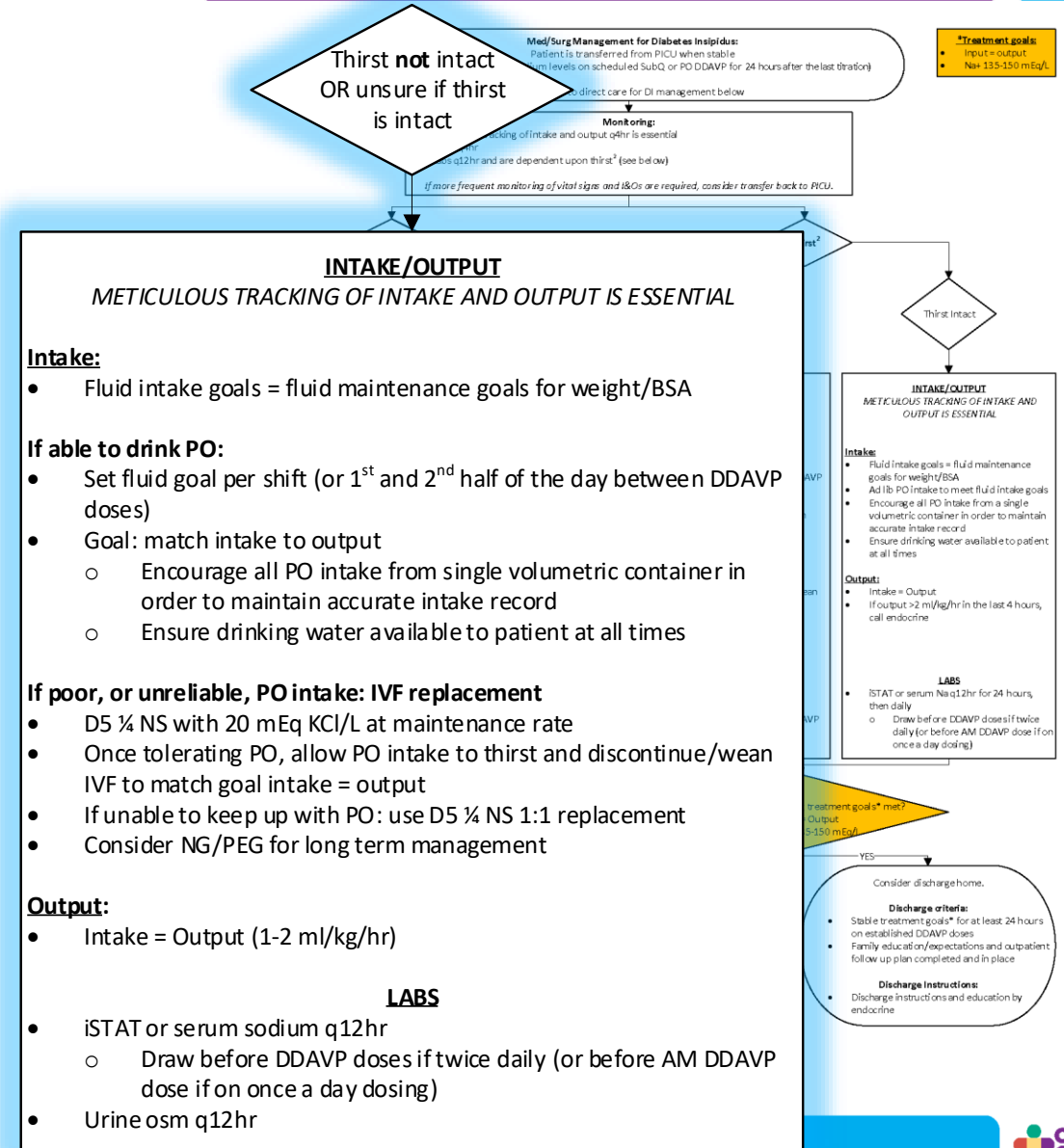


# Med/Surg Management of DI

## If thirst is not intact (or if there is uncertainty):

### Intake:

- Should have fluid goals set and encourage all intake from one container for accurate measurements if patient is able to PO
- If PO intake is poor:
  - Start maintenance IVF
  - May need to replace 1:1
  - Consider using a NG/PEG for long term management

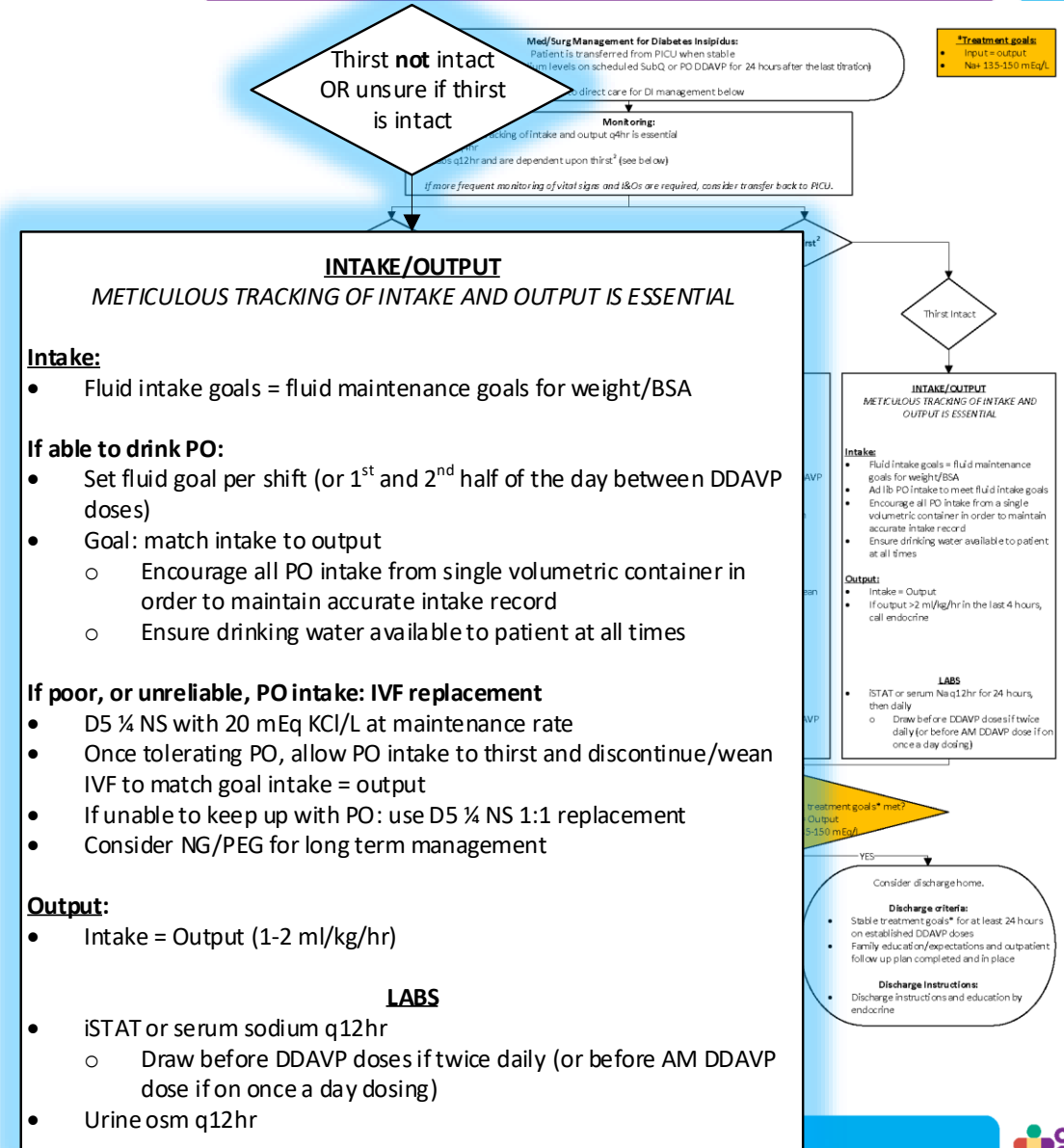


# Med/Surg Management of DI

## If thirst is not intact (or if there is uncertainty):

### Labs:

- Sodium should be measured every 12 hours and drawn before DDAVP doses.
- Urine osm should also be monitored



# Med/Surg Management of DI

## If thirst is intact

### Intake:

- PO should be ad lib and monitored from one container

### Output:

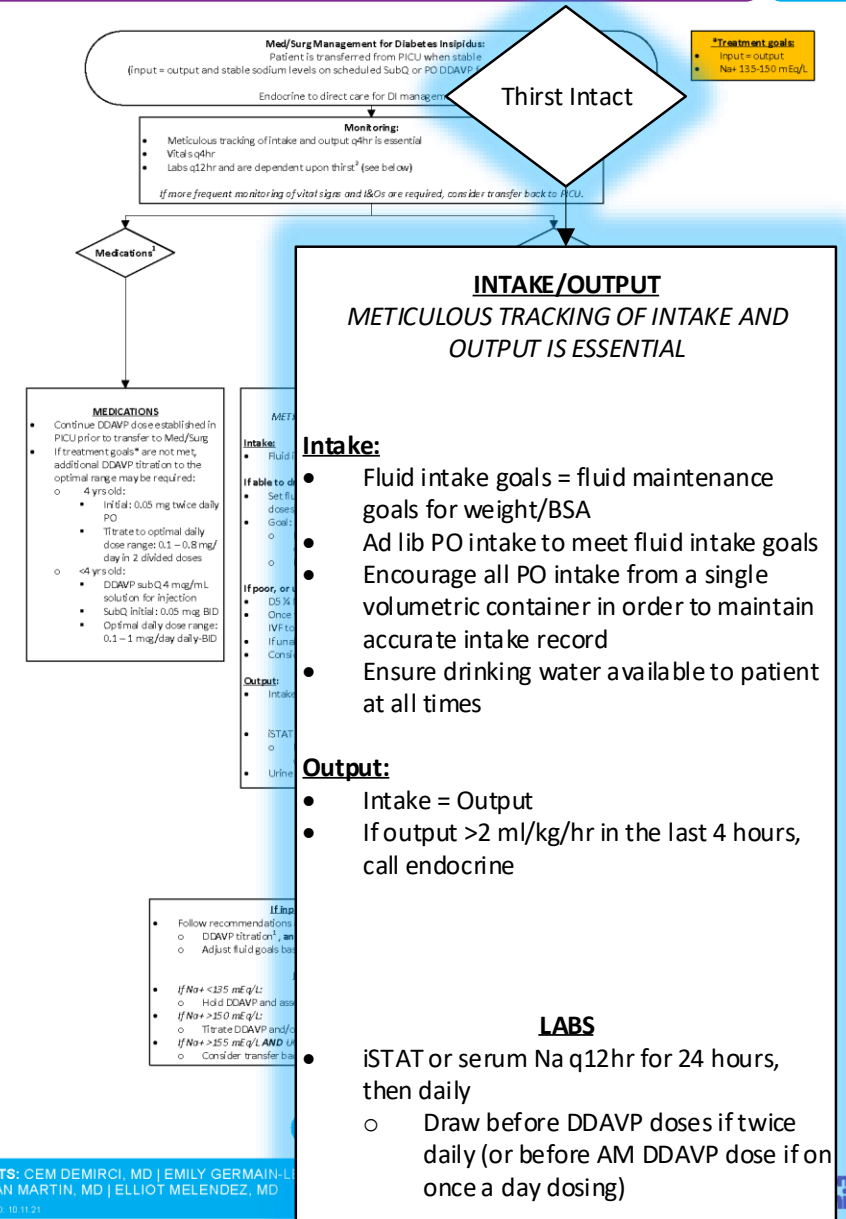
- Closely monitor output and call endocrine if output exceeds 2 ml/kg/hr in the last 4 hours

### Labs:

- Only sodium will be monitored

## CLINICAL PATHWAY: Diabetes Insipidus (DI) - Post-operative Neurosurgical Management Med/Surg Management of DI

THIS PATHWAY  
SERVES AS A GUIDE  
AND DOES NOT  
REPLACE CLINICAL  
JUDGMENT.



CONTACTS: CEM DEMIRCI, MD | EMILY GERMAIN, MD  
JONATHAN MARTIN, MD | ELLIOT MELENDEZ, MD  
LAST UPDATED: 10.11.21

©2019 Connecticut Children's Medical Center. All rights reserved.

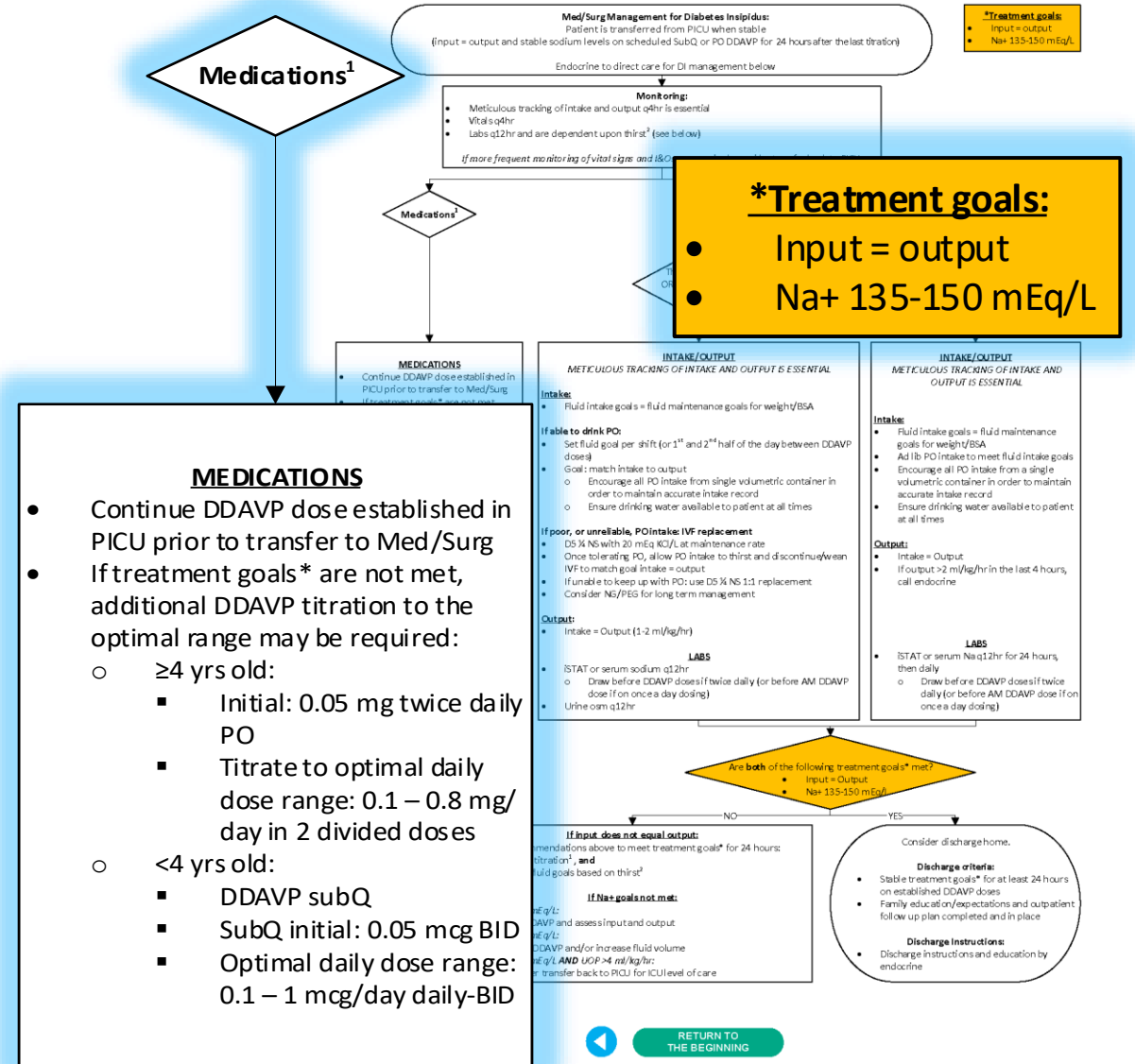
connecticut  
children's

# Med/Surg Management of DI

- All patients will continue their scheduled DDAVP dose that was established in the PICU.
- Treatment goals are outlined in the yellow box. DDAVP may need to be further titrated to reach these optimal ranges.

## CLINICAL PATHWAY: Diabetes Insipidus (DI) - Post-operative Neurosurgical Management Med/Surg Management of DI

THIS PATHWAY  
SERVES AS A GUIDE  
AND DOES NOT  
REPLACE CLINICAL  
JUDGMENT.



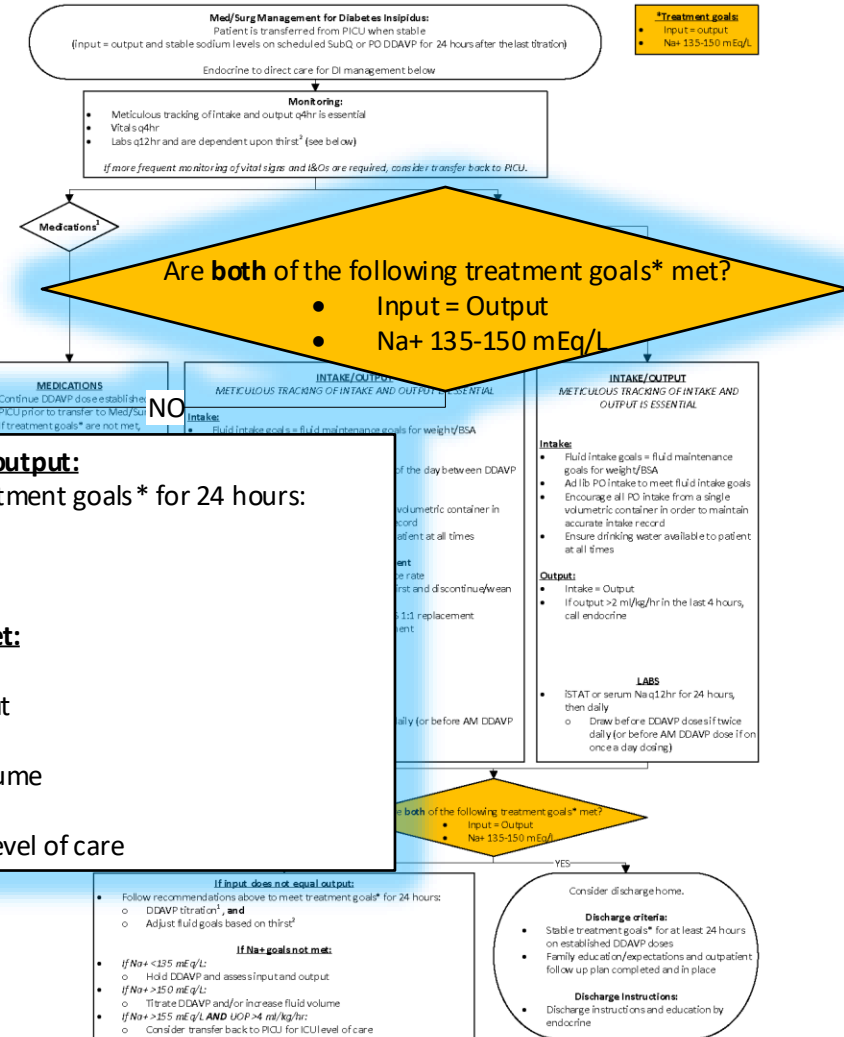
CONTACTS: CEM DEMIRCI, MD | EMILY GERMAIN-LEE, MD | DAVID HERSH, MD  
JONATHAN MARTIN, MD | ELLIOT MELENDEZ, MD

LAST UPDATED: 10/11/21

©2019 Connecticut Children's Medical Center. All rights reserved.

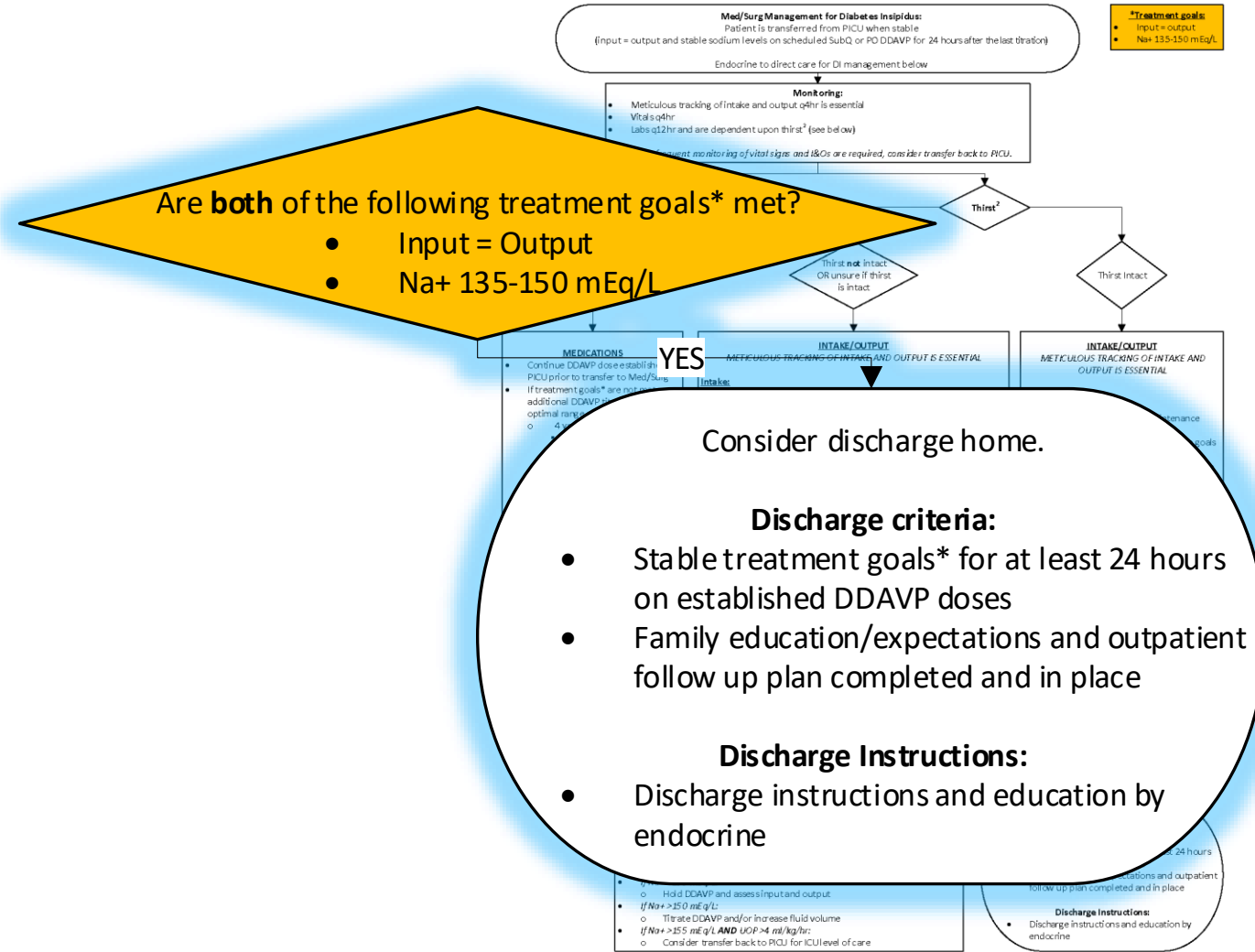
# Med/Surg Management of DI

- Remember that treatment goals are input=output and sodium levels within 135-150 mEq/L
- If input does not equal output, consider DDAVP titration and adjusting fluid goals.
- If sodium goals are not met, guidelines for DDAVP and/or input adjustments are listed.
- If there is concern concerning Na of >155 mEq/L and UOP >4 ml/kg/hr, consider transfer back to the PICU.



# Med/Surg Management of DI

- If treatment goals are met for both input=output and Na 135-150 mEq/L while on established DDAVP for at least 24 hours, then patient can be considered for discharge.
- Discharge education and instructions will be provided by endocrinology.



RETURN TO THE BEGINNING



# Review of Key Points

---



- Central DI can develop post-operatively after a neurosurgical procedure following sellar and parasellar regions
- DI diagnosis depends on serum sodium, serum osmolality, urine osmolality and urine output measures
- The main goal is for the patient to maintain intake = output, thus careful monitoring of I&Os are essential
- A second goal is to achieve desirable sodium levels. Frequency of monitoring depends on the clinical situation.

# Use of Order Set

---



- An associated order set in Care Navigator is undergoing completion. We will make an announcement when it is available.

# Quality Metrics

---



- Quality metrics are under development.

# Pathway Contacts

---



- Cem Demirci, MD
  - Division of Endocrinology
- Emily Germain-Lee, MD
  - Division of Endocrinology
- David Hersh, MD
  - Division of Neurosurgery
- Jonathan Martin, MD
  - Division of Neurosurgery
- Elliot Melendez, MD
  - Division of Critical Care

# References

- Christ-Crain M, Biche DG, Fenske WK, et al. Diabetes insipidus. *Nat Rev Dis Primers*. 2019 Aug;5(1): 54.
- Di Iorgi N, Napoli F, Allegri AE, et al. Diabetes Insipidus – Diagnosis and Management. *Horm Res Paediatr*. 2012;77(2):69-84.
- Melmed S, Koenig R, Rosen C, Auchus R, Goldfine A. Williams Textbook of Endocrinology. 14th ed. Elsevier; c2019. 1792 p.
- Pratheesh R, Swallow DM, Rajaratnam S, et al. Incidence, predictors and early post-operative course of diabetes insipidus in paediatric craniopharygioma: a comparison with adults. *Childs Nerv Syst*. 2013 Jun;29(6):941–9.
- Sperling M, et al. Sperling Pediatric Endocrinology. 5th ed. Elsevier; c2020. 1072 p.

# Thank You!



---

## About Connecticut Children's Pathways Program

Clinical pathways guide the management of patients to optimize consistent use of evidence-based practice. Clinical pathways have been shown to improve guideline adherence and quality outcomes, while decreasing length of stay and cost. Here at Connecticut Children's, our Clinical Pathways Program aims to deliver evidence-based, high value care to the greatest number of children in a diversity of patient settings.

These pathways serve as a guide for providers and do not replace clinical judgment.