Creighton UNIVERSITY

Implementation of Urine Sodium Monitoring in Preterm Infants

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Learning Objectives

- Understand why premature infants are deficient in sodium
- Understand how sodium impacts the growth of premature infants
- Realize the long-term effects of blood draws on infants
- Understand how utilizing urine sodium levels to guide sodium supplementation affects the number of blood draws and growth of premature infants

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Financial Disclosure

- I have no financial interest or conflicts of interest with the material presented in this presentation

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Introduction

- Urine sodium monitoring to guide sodium supplementation
  - ELBW (≤ 1,000 grams)
  - < 30 weeks' gestation
- Prematurity correlates with impaired kidney function and increased sodium loss
- Sodium deficiency impairs nutrition and weight gain
- Current practice utilizes serum sodium monitoring

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Nutrition

- Goal = simulate same rate of growth infant would experience in-utero
- Many advances in current practice
- Up to 40% of ELBW infants experience growth failure[1]
- Vermont Oxford Network (2022)[2]:
  - 52% of infants with BW 500-1500 grams have a discharge weight < 10th percentile
  - 15% of these infants have a discharge weight < 3rd percentile

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Sodium Deficiency

- Contributes to poor nutrition and growth
- Preterm infants have immature kidneys that cannot regulate sodium homeostasis
- ELBW infants have high fractional excretion rate of sodium for the first 10-14 days of life[3]
- Serum sodium levels may not be the best way to monitor total body sodium content
  - Serum sodium levels reflect total body water content

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Current Practice

- Supplementation based on serum sodium levels
  - May not be the best way to monitor total body sodium content
    - More reflective of total body water content
  - Recent literature suggests using urine sodium levels to guide supplementation
- Increases the number of blood draws
  - Poor motor and cognitive effects
  - Increases anxiety
  - Increases blood loss

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Significance

- According to WHO, 13.4 million premature infants in 2020[4]
- Cost of prematurity is $25 billion each year in the U.S.[5]
- In Nebraska (2022)[6]:
  - 11.3% of infants were premature
  - 7.9% were considered low birthweight
  - 1.5% born at less than 32 weeks' gestation
- According to AAP, 50% of preterm infants experience growth failure[3]
- AAP recommends 3-5 mEq/kg/day sodium[7]
  - Feeds provide 1.7-2.2 mEq/kg/day[3]
  - Additional supplementation is needed

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Clinical Problem

- Sodium supplementation is essential in premature infants
  - Improves nutrition and growth
  - Decreases adverse outcomes
- Current practice involves utilizing serum sodium levels
  - Results in an increased number of blood draws and blood loss
  - Serum levels may not be best indicator of sodium balance

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Review of the Literature

- **Sodium Supplementation Optimizes Growth**
  - Improves weight gain[8,9]
  - No complications or adverse outcomes[8,9]
- **Use of Urine Sodium to Guide Sodium Supplementation**
  - University of Iowa created algorithm for urine sodium monitoring[7]
    - Improved postnatal weight gain[7]
  - Higher urine sodium levels associated with improved growth and weight gain in post-operative surgical infants[10]

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Review of the Literature

- **Decreasing Blood Draws in the NICU**
  - Increased number of invasive procedures correlates with lower IQ and long-term brain abnormalities
  - Two studies implemented protocols that decreased the number of painful procedures[12,13]
    - Demonstrates that decreasing painful procedures is a priority

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Lewin's Theory of Planned Change[14]

Unfreeze	*Change*	*Refreeze*
• Recognize the need for change • Determine what changes will be made • Replace old behaviors and attitudes	• Plan the change • Implement the change • Help nurses and providers navigate the change	• Changes are reinforced and sustained • Becomes the "new normal"

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Purpose & Aims

Purpose: Decrease the number of blood draws in ELBW infants and infants < 30-weeks' gestation that are associated with sodium supplementation monitoring over a two-month period.

1. *Developed a protocol based on urine sodium values to guide sodium supplementation.*
2. *Implemented urine sodium monitoring to guide sodium supplementation at Bergan Mercy Hospital in Omaha, NE over a two-month period.*
3. *Evaluated the effectiveness of urine sodium monitoring in decreasing the number of blood draws in infant's receiving sodium supplementation.*
4. *Evaluated the growth chart of infants whose sodium supplementation was based on urine sodium monitoring.*

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Methods

Bergan Mercy Hospital

- Omaha, NE
- Level III NICU
- 38 beds

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Methods

- Identify appropriate infants
  - ELBW (≤ 1,000 grams)
  - < 30 weeks' gestation
  - *Exclusion criteria: cardiac disease, renal disease, chronic diuretic use*
- Begin screening at ~ 2 weeks of age
- Collection
  - Place gauze in infant's diaper
  - Use a syringe to draw up urine from soaked gauze
- Continue monitoring every 2 weeks until 34 weeks CGA

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Methods

- If urine sodium is **below** threshold
  - Start supplementation at 4 mEq/kg/day
  - Increase by 2 mEq/kg/day every 2 weeks if urine sodium continues to be below goal
- If urine sodium is **above** threshold
  - Decrease supplementation by 1 mEq/kg/day
- Wean or stop supplementation at 36 weeks CGA

Reference Urine Sodium Levels

	2 weeks	4 weeks	6 weeks	8 weeks	10 weeks	12 weeks
< 26 weeks	50	40	40	40	40	30
26 to < 30 weeks	40	40	40	30	30	30
> 30 weeks	40	30	30	30	30	30

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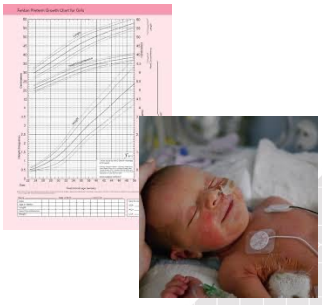
Methods

- Evaluation
  - Number of blood draws over two-month period
  - Growth curve will be monitored



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Findings

Demographics

	Number of Infants	Mean GA	Percent Male	Mean Birthweight (grams)	Mean BW Percentile
2023	2	27 2/7	50	1070	66
2024	4	28 5/7	75	1326	71
		p = 0.38	*p = 0.63*	*p = 0.38*	*p = 0.86*

- *T-test shows no significant differences between two groups*
- *2023: excluded 1 infant (transfer to a different facility)*
- *2024: excluded 4 infants (2 sepsis evaluations, 1 long-term ventilation, 1 transfer to a different facility)*

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Findings

Discharge Weight and Serum Blood Draw Results					
	Mean Discharge Weight (grams)	Mean Discharge Weight Percentile	Mean Number Serum Draws	Mean Number Urine Sodiums	Mean Number of Blood Draws Saved
2023	2741	24	5.5	N/A	N/A
2024	2943	30	4	3.25	2.25
	p = 0.65	*p = 0.80*	*p = 0.47*		

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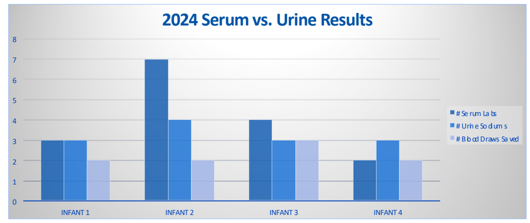
Findings



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Strengths and Limitations

- ***Strengths***
  - Provider buy-in
- ***Limitations***
  - Small participant sizes in both 2023 and 2024
  - Urine sodiums were double checked with serum, especially in the beginning
  - Infants need to be followed longer than 8 weeks

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